The relationship between the ESG scores and firm performance in Europe: the moderating role of R&D investment and board characteristics

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Abstract

This study analyzes the relationship between environmental, social and governance (ESG) scores and firm performance. It also analyzes the effect of R&D investments (research and development), board size and female representation on board on the relationship between environmental pillar score and firm performance. Hence, this paper aims to answer the following research questions: How does ESG pillar scores affect firm performance? How does R&D investment affect firm performance and how does it impact the relationship between environmental pillar score and firm performance? How do board size and female on board serve as moderators for the relationship between environmental pillar scores on company performance in European firms? In order to answer these questions, this paper analyzes a sample collected from the Thomson–Eikon database from 2013 until 2019. The sample included 673 public and private firms in Europe region. The finding of this study shows that the social pillar score positively influences a firm's profitability and market value. However, it reveals a negative impact of the governance score on firm performance and of the environmental score on market value. Regarding R&D investment, the study suggests a negative impact on European firms’ performance, although it does not significantly moderate the relationship between environmental performance and firm performance. Additionally, the study highlights a negative moderating effect of board size on the relationship between environmental performance and firm profitability. However, the presence of female representation on the board contributes positively to this relationship between environmental score and firm’s market value.

JEL Classification: C01, G31, G56, M14

Keywords: Firm Performance, ESG pillar scores, Research & Development Investment, Board size, Female Representation on Board, Panel Data Fixed Effect
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Introduction

This paper aims to examine the relationship between ESG pillar scores, research & development investment, and firm performance in Europe, with the moderating role of research and development investment and board characteristic including board size and female representation on board. The global investment landscape has experienced significant growth in responsible investments, leading to the emergence of a multitrillion dollar market in developed countries (Renneboog, Horst & Zhang, 2007). Over time, there has been a gradual shift from ethical investments to socially responsible or responsible investments (SRI or RI), and subsequently to environmental, social, and governance (ESG) investing. This transition reflects a change in the underlying motivation for these investments, moving from purely philanthropic intentions to recognizing their material impact (Nermend & Tarczyński, 2019). Consequently, a crucial question arises regarding whether ESG scores reflect the financial and market value enhancement of European firms.

In recent years, corporate managers have placed more importance on non-financial activities, particularly those related to environmental, social, and governance (ESG) issues. According to the 2016 UN Global Compact-Accenture CEO study, over 1,000 CEOs from around the world stated that they feel personally responsible for ensuring their company has a purpose and contributes to society. This suggests a growing awareness and recognition among corporate leaders about the importance of ESG issues. According to the 2018 Global Sustainable Investment Report, assets invested using ESG criteria totaled $30.7 trillion globally; sustainable investments in Europe account for 48.8% of all total managed assets (USSIF, 2019). The growing focus on ESG factors can be attributed to several reasons. Academically, the impact of ESG on corporate financial performance remains a topic of relevance due to the absence of a consensus regarding its effect. Despite varying empirical findings, investors are increasingly favoring assets with ESG considerations. This is driven by factors like evolving regulations, reputation risk management, and the fiduciary duty of institutional investors.

Because of the importance of ESG aspects to investors, ESG ratings were introduced as a tool to quantify corporate social performance (CSP), by evaluating the performance of companies in their environmental, social, or corporate governance pillar. Companies that engage in environmental pollution or have unethical treatment of employees may face financial penalties or negative reactions from consumers, which could lead to losses and make them unappealing to investors (Costa Campi et al., 2017). In recent times, an increasing number of companies have come to realize that incorporating ESG factors can provide a competitive edge, enhance operational efficiency, and establish a positive
reputation. These effects are evident from various studies conducted by researchers such as Alsayegh et al. (2020), Aouadi and Marsat (2018), Buallay (2019), and Filbeck et al. (2019).

The need for action to enhance the environmental performance of nations worldwide and the widespread concern over climate-related issues has increased and to limit climate change issues, it is important that CO2 emissions be reduced. Thus, environmental R&D and innovation are crucial in addressing this problem by improving environmental performance in this regard (European Commission, 2014). Much research primarily examined R&D investment in OECD member nations. The United States (Le et al., 2006), the United Kingdom (Toivanen et al., 2002), and Japan (David et al., 2008) are the countries receiving the most focus in the research. Literature on R&D investments in the (continental) European nations is scarce, apart from the study by Hall & Oriani (2006), which centered on businesses from Germany, France, and Italy.

Research and development (R&D) investment holds a critical role in the growth initiatives of a firm, as highlighted in studies by Ketata et al. (2015), Lee & Min (2015), and Parthasarthy & Hammond (2002). It is widely acknowledged as one of the most crucial factors for promoting economic growth and enhancing the value of businesses, as noted by Chan et al. (1990) and Ghisetti & Pontoni (2015). The primary objective of R&D investment is to generate innovation that contributes to increased sales for the company. This innovation is often realized through the development of new products, which enables the company to stay competitive and capitalize on market opportunities. Some studies have explored the relationship between R&D investments and sustainability practices. For instance, Arora & Cason (1996) present empirical evidence demonstrating that a firm’s R&D expenditure positively impacts its environmental management efforts.

Furthermore, Chakrabarty & Wang (2012) investigate a similar issue but focus specifically on multinational corporations (MNCs). Using longitudinal panel data spanning from 1989 to 2009, their study provides evidence that MNCs with higher R&D investments are more likely to adopt superior sustainability practices. More recently, Jiang et al. (2014) find that higher R&D intensity is associated with a significant reduction in industrial soot emissions among Chinese manufacturing firms. Therefore, the inclusion of R&D as a moderator in this study is driven by two primary factors. Firstly, previous studies have demonstrated the significance of R&D in enhancing firm performance, as highlighted earlier. Secondly, given the increasing importance of addressing climate change and improving environmental performance, R&D plays a vital role in driving such enhancements. Consequently, due to the limited research and gap in the European region in exploring the potential of R&D as a moderator
in strengthening the relationship between the environmental pillar score and firm performance, it becomes important to investigate this aspect further.

According to Klein's (1998) proposition, as a firm becomes increasingly reliant on the external environment for resources, the advisory requirements of the CEO likewise expand. In this context, board size assumes significance as it determines the availability of diverse perspectives and expertise necessary to address the CEO’s evolving needs in navigating the complex external landscape. By accommodating a larger number of directors, the board can enhance its ability to provide valuable guidance and insights to support the CEO in effectively managing the firm's resource dependencies and adapting to changes in the external environment. Therefore, by expanding the board size, the organization establishes a stronger connection with its external environment and ensures the availability of vital resources.

Additionally, considering the regulations and growing significance of women in the corporate sphere, there is a need for further investigation into the influence of female representation on boards. The inclusion of women on the board, according to academics, would improve the firm's governance by bringing different views, talents, and capacities to board meetings (Jamali et al., 2007). Going by this, this paper finds it likely that board size and female representation on board can play a role in enhancing the relationship between environmental performance and firm performance. Larger boards and woman representation bring diversity in culture and education and can also provide the management with different preceptive regarding the environmental-firm performance. Thus, this study aims to add to the previous and current literature in filling the gap by using board size to moderate the relationship between environmental performance and firm environmental performance. Based on the previous information, this paper aims to answer the following research questions:

How does ESG pillar scores affect firm performance? How does R&D investment affect firm performance and how does it impact the relationship between the environmental pillar score and firm performance?

How do board size and female on board serve as moderators for the relationship between the environmental pillar score on company performance in European firms?

Answering these research questions will make three contributions to the literature. First, it adds to the literature on the effect of ESG pillar scores on firm performance by researching public and private firms in all Europe. Second, it will add to the knowledge about the effect of R&D investment on the relationship between environmental score and firm performance in European firms. Third, it will take in account the effect of board size and female representation in the board on the relationship between Environmental score and firm performance. In this thesis I will start with a theoretical background by
discussing the main concepts of this study: ESG-firm performance and ESG rating. Then I will illustrate the developing hypothesis of this thesis by discussing the relationship between ESG pillar scores and firm performance. Then I will continue with why R&D is a suitable moderating variable as well as board size and female on board and which factors, I will use control variables to control for firm performance. The methodology for this thesis will encompass several components, beginning with data collection and descriptions, followed by data analysis. Subsequently, the results and discussion will be presented, leading to the conclusion that summarizes the paper’s findings and highlights its limitations, implications, and suggestions for future research.
Literature review

Theoretical background

Numerous studies have explored the impact of ESG on firm value, aiming to determine whether such factors influence the value of a company. However, despite the abundance of research conducted in this area, a consensus regarding the relationship between ESG and firm value has not been reached. Consequently, theories describing the link between ESG and corporate financial performance exhibit significant variability. The traditional neoclassical perspective suggests that incorporating socially responsible aspects into a firm's operations incurs additional costs (Palmer et al., 1995). In a competitive market, these extra costs can diminish the company's profits (Baumol, 1991), and in the long term, higher costs can affect the competitiveness of a firm, ultimately impacting its cash flows. Such a reduction in profits and revenues contradicts the well-established shareholder theory proposed by Friedman (1970), as according to Friedman, a firm's sole social responsibility is to maximize shareholder value.

Following the traditional perspective of business, the primary purpose of corporations was believed to be the maximization of shareholder value (Friedman, 1970). Within this framework, any allocation of resources towards social objectives was seen as utilizing the shareholders' money and diminishing their financial returns. Consequently, such practices were deemed professionally unacceptable. In contrast to the traditional shareholder approach, the stakeholder approach to management has gained significant recognition as an alternative perspective. According to this model, corporations should consider the interests and demands of various groups, known as stakeholders, who can impact or can be impacted by the company (Freeman, 1984; Mitchell et al., 1997). In this framework, firms are not solely focused on creating value for shareholders. Instead, they are expected to address environmental and social responsibilities that contribute to their long-term sustainability in the marketplace (Kiel & Nicholson, 2003).

The ESG principle is a comprehensive framework that includes environmental, social, and governance factors. These factors, as defined by the European Banking Authority (EBA), refer to matters that can
impact the financial performance or solvency of entities, sovereigns, or individuals (EBA Report, 2021). ESG serves as an investment concept aimed at achieving sustainable and coordinated development, taking into account economic, environmental, social, and governance benefits. It represents a holistic and practical strategy for governance. Consequently, ESG has become a widely adopted standard and approach utilized by investors to evaluate corporate behavior and assess potential future financial performance.

In recent years, ESG practices have increased dramatically and many investors measure firm sustainability by measuring its ESG performance. Therefore, it’s important to investigate ESG practices and its effect on firm performance. To grasp the concept of sustainable finance, it is crucial to understand what an environmental, social and governance (ESG) score is, as a proxy for corporate social responsibility (CSP), and how it should be evaluated for the user. Therefore, it is necessary to identify the goal of sustainable financing. Most social responsibility (SR) investors are unable to analyze a company’s sustainability by themselves, and hence rely significantly on the ESG scores provided by sustainability rating organizations that have established themselves in the market as intermediaries. Sustainability rating firms collect data from the public as well as directly from businesses in order to establish ESG ratings using detailed and sophisticated techniques.

The Environmental factor of ESG performance is often associated with sustainability, and it encompasses several key categories in Thomson Reuters’ rating methodology. These categories include resource use, emissions, and innovation. Resource use assessment focuses on a company’s ability to minimize energy, material, and water usage while implementing eco-efficient solutions through supply chain management. Emissions evaluation examines a company’s commitment and effectiveness in reducing emissions throughout production and operational processes. And innovation is evaluated by considering a company’s capacity to develop environmentally friendly products, technologies, and processes that reduce environmental costs for customers (Thomson Reuters, 2017).

The operations of a business can significantly influence individuals in various ways. The Social factor of ESG performance assesses how companies impact their diverse stakeholders from a social standpoint.

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1 For the full table of the ESG factors and its definitions by the EBA, see Appendix 1.
UN Global Compact defines social sustainability as the process of recognizing and effectively managing the effects that companies have on people globally. The Social factor of ESG in Thomson Reuters scoring methodology encompasses several key categories, including Product responsibility, Workforce, Human rights, and Community (Thomson Reuters, 2017).

Corporate governance refers to the framework and guidelines that companies establish to govern their management and direction. The Governance factor of ESG encompasses various elements such as CSR strategy, corruption, tax strategy, and wages. Thomson Reuters has further categorized Governance into three main areas: Shareholder, CSR strategy, and Management. The Management category assesses the company’s commitment to adopting and adhering to governance principles that promote best practices. The Shareholder category examines how the company treats its shareholders equitably and whether it utilizes anti-takeover measures. In evaluating the CSR strategy category, Thomson Reuters examines how well companies communicate their strategy for integrating financial, environmental, and social considerations into their daily decision-making processes (Thomson Reuters, 2017).

The information used by rating agencies is mostly derived from reports published by businesses. Non-financial reporting is still in its infancy, whereas financial reporting has attained standardized forms on a worldwide scale. This exposes the credibility of the ESG data provided by corporations to various degrees, which may eventually affect the validity of ESG scores. Certainly, the scores will be noisy if the data of the rating agencies obtain from the firms is even slightly noisy (Del Giudice & Rigamonti, 2020). However, PRI (n.d., a) suggests that investors should consider ESG investing even if their primary concern is financial returns. Ignoring ESG factors means disregarding potential risks and opportunities that could impact clients’ financial returns negatively or positively. Therefore, incorporating ESG considerations is essential to fully assess and mitigate risks while also maximizing potential returns for investors. This is a reason why ESG rating became very important and why various agencies, including Thomson Reuters, assess ESG performance and convert it into an ESG rating. This rating serves as a valuable indicator for investors, providing insights into a company’s sustainability practices. According to Unruh et al. (2016), investors recognize a significant correlation between corporate sustainability performance and financial performance. As a result, they are increasingly relying on data such as ESG ratings when making investment decisions, more so than ever before.
Developing hypotheses

ESG pillar scores and firm performance

The ESG performance of a company is evaluated based on its performance across the sub-factors of environmental, social, and governance performance. Examining the impact of each individual sub-factor of ESG performance on corporate financial performance has been a subject of interest in the literature. The lack of consensus in the findings of literature makes it an important area of study to examine the relationship between each sub-factor of ESG and its impact on firm performance. Some previous studies examined the relationships between ESG scores and firm performance, for example the research conducted by Bahadori et al. (2021) found that companies with higher ESG scores tend to achieve higher levels of profitability. Another study carried out on Indian firms demonstrates a positive relationship between ESG performance and firm performance, particularly in relation to the social and governance pillar (Maji & Lohia, 2022). Furthermore, Kalia & Aggarawal (2023) investigated the relationship between ESG performance and firm performance in the healthcare industry and they have found that in developed economies, the implementation of ESG activities has a positive impact on companies. However, they found that in developing economies this relationship tends to be negative or not statistically significant.

The relationship between environmental pillar score and firm performance

The literature has extensively examined the influence of environmental performance on firm value, with significant discussions dating back to the 1980s. McGuire et al. (1988) were among the early researchers who conducted empirical studies and presented several theoretical arguments concerning the relationship between environmental and firm performance. They introduced three theoretical concepts that propose distinct relationships. Firstly, they suggest a trade-off between environmental and economic performance, indicating that firms focusing on improving environmental performance may experience economic disadvantages. This theoretical explanation aligns with the neoclassical theory mentioned earlier. Secondly, they argue that the costs associated with enhancing corporate environmental performance are relatively modest and can yield additional managerial benefits, such as enhanced morale and increased productivity. The theory presented aligns with the findings of Porter and van der Linde (1995), who challenge the conventional perspective by suggesting that environmental regulations do not necessarily impose significant costs on firms. According to their viewpoint, well-managed environmental regulations can stimulate innovation, which can compensate for the initial compliance costs. Thirdly, McGuire et al. (1988) propose that the expenses incurred for improving environmental performance can be offset by reducing other costs or by generating increased revenues.
Many event studies focus on assessing abnormal returns associated with events related to environmental performance. Hamilton (1995) presents evidence suggesting that the release of pollution data by the EPA leads to negative abnormal returns for publicly traded companies listed on the New York and American Stock Exchanges. The underlying theoretical explanation is that analysts’ estimates are influenced by various types of environmental costs. Hamilton finds that investors in companies with high pollution levels experience negative abnormal returns, with an average loss of $4.1 million on the day the pollution data is made public. Expanding on this finding, Klassen & McLaughlin (1996) reveal that stocks exhibit an asymmetric response to environmental news. They observe that the increase in stock price resulting from positive environmental information is less pronounced compared to the decrease in price when a company faces negative environmental news.

Dowell et al. (2000) conducted a long-term regression analysis and discovered evidence supporting a positive relationship between environmental performance and firm value. Their study, based on data from 98 listed mining and manufacturing firms spanning the period of 1994 to 1997, revealed that companies with a higher market value tended to exhibit better environmental performance. Additionally, the research indicated that this relationship has strengthened in recent years.

In contrast, Daszyńska-Zygadło (2016) found a negative relationship between environmental performance and firm performance. By examining 10 global industry classification sectors, the study demonstrated a statistically significant negative relationship in eight sectors. These findings align with the arguments put forth by Derwall et al. (2005) and Semenova & Hassel (2008), who suggest that achieving positive effects in environmentally sensitive sectors is more challenging due to higher costs associated with environmental performance. Limited research has been conducted on the relationship between environmental performance and corporate financial performance specifically for European firms, in comparison to studies focusing on US companies. To fill this gap, Elsayed and Paton (2005) undertook a regression analysis using panel data from 227 UK-based firms spanning the years 1994 to 2000. The evaluation of environmental performance was based on the community and environmental scores. The results indicate a positive association between environmental performance and firm performance; however, this relationship did not reach statistical significance. Given the limited amount of research conducted specifically on European firms, there is an opportunity to further investigate the relationship between environmental performance and firm performance in this region. Despite the mixed findings from existing studies, there is an expectation of a positive association between environmental performance and firm performance among European companies.
The relationship between social pillar score and firm performance

As previously discussed, the stakeholder theory emphasizes that businesses have responsibilities not only towards shareholders but also towards a wide range of stakeholders including creditors, employees, customers, and debtors. According to this theory, meeting the demands of stakeholders not only gains support from internal and external groups but also contributes to long-term performance improvement. In line with this perspective, prior research demonstrates that companies adopting a sustainable and stakeholder-oriented approach tend to experience benefits such as enhanced firm performance (Nekhili et al., 2017; Li et al., 2018), development of competitive advantages (Bernardi & Stark, 2018), and various other direct and indirect advantages (Hamman et al., 2010). The aligned actions with the long-term goals of stakeholders not only increases their satisfaction but also secures valuable support and resources, ultimately contributing to the enhancement of firm value (Jones, 1995; Aboud & Diab, 2018). According to the studies conducted by Bhaskaran et al. (2020) and Ting et al. (2020), it was discovered that the social initiatives undertaken by a company prove to be beneficial in generating value for both the organization and society.

A considerable amount of literature investigates whether human resource management has an impact on corporate financial performance within the social factor. Among these studies, a consensus has been reached that organizational human resources policies can make a direct and economically meaningful positive contribution to corporate financial performance (Huselid, 1995). In a study of 405 publicly traded firms in North America, Molina & Ortega (2003) examine the relationship between training and development expenses and firm performance. They discover a positive correlation, suggesting that investing in training and development can enhance firm performance. Based on the widely accepted positive relationships identified between social performance and corporate financial performance, it is anticipated that there is a positive association between a firm's corporate social performance and its financial performance in European firms as well.

The relationship between governance pillar score and firm performance

According to Clark et al. (2015), companies with inadequate corporate governance strategies tend to have lower valuations and poorer firm performance. In a study by Daszyńska-Żygadło (2016), the importance of corporate governance mechanisms was examined across different sectors. The results indicated a positive and statistically significant association between corporate governance and firm performance in the material, industrial, and finance sectors. Specifically, financial firms appeared to benefit the most from effective corporate governance, possibly due to their heightened vulnerability to reputation risks associated with poor governance practices. Conversely, a negative and statistically significant relationship was observed for companies in the consumer discretionary sector.
Furthermore, in their studies, Brown and Caylor (2006a, 2006b) utilized Instructional Shareholder Services (ISS) to create a governance score. They observed that firms with lower governance scores exhibited higher return on equity, higher profit margins, and higher firm valuations. Larcker et al. (2007) employed a principal components analysis to establish 14 governance factors, and their findings indicated a relationship between these factors and future operating performance as well as stock returns. However, they found weak results when examining abnormal accruals and accounting restatements. Moreover, MacAvoy and Millstein (1999) examined the impact of board independence and found that a board with independent members is more likely to make decisions that prioritize the interests of shareholders. Additionally, the findings of Bahadori et al. (2021) indicate that organizations that have stronger governance practices may not necessarily experience increased profitability or operational efficiency.

Based on the above mentioned studies on the relationship between the ESG pillar scores and firm performance, this paper’s hypotheses will be the following:

**H1:** There is a statistically significant positive relationship between the environmental pillar score and firm performance.

**H2:** There is a statistically significant positive relationship between the social pillar score and firm performance.

**H3:** There is a statistically significant positive relationship between the governance pillar score and firm performance.

**R&D investment and its moderating effect**

According to the European Commission (2014), increasing the level of ambition in setting goals requires the expansion and enhancement of existing R&D and innovation initiatives. As a result, Research and Development investments (R&D) have been the subject of several studies. For example, due to the potential misassessment of risks, long-term abnormal stock returns can be susceptible to inaccuracies. To mitigate this issue, Eberhart et al. (2004) employed Fama and French’s (1993) three-factor model to measure risks in their study conducted in the United States. Their research consistently demonstrates significant positive long-term operating performance, which implies that investments in R&D yield favorable returns. Ehie & Olibe (2010) have looked at the connection between R&D and market value, their finding suggests that offering strong information and insights and inspiring changes to current procedures can boost firm’s productivity and cut expenses.
Despite the potential benefits of R&D investments, it is important to acknowledge that they are not always immediately profitable and involve various risks. The benefits of R&D investments can take several years, and there is no guarantee of success or successful commercialization. Mansfield and Wagner (1975) highlight the variability in the probability of commercial success for R&D projects, further emphasizing the inherent risks involved in R&D investments. Chen et al. (2019) & Xu et al. (2019) conducted studies to explore the relationship between R&D intensity and financial firm performance. They found that initially there was a negative association between R&D and current financial firm performance, which is also supported by the previous findings of Lieberman & Montgomery (1988). However, after implementing a lag, a positive relationship emerged. This suggests that the positive effects of R&D investments on firm performance may take some time to materialize.

Additionally, Paula and Silva (2018) found that a two-year lag may not be sufficient to observe the positive impact of R&D investments. Vithessonthi and Racela (2016) conducted a study focusing on listed firms in the United States. They discovered that R&D intensity has a negative and significant association with return on assets (ROA), implying that a higher level of R&D investment can be linked to lower firm performance. Moreover, in accordance with the findings of Coşkun, as described by Bouaziz (2016), it has been observed that an increase in R&D expenses can have a positive influence on a company’s performance. However, it is important to note that beyond a certain threshold of expenditure, this favorable effect may be reversed or even negatively altered.

A body of theoretical literature within the field of sustainability research suggests that proactive environmental policies, including R&D investment, can create a mutually beneficial situation by improving a firm’s financial and environmental performance. Esty & Porter (1998) argue that firms can achieve better financial performance by being early adopters of environmentally friendly products and services. Hart (1997) suggests that managers often underestimate the economic returns derived from environmental investments, as these activities can yield unforeseen financial benefits. Similarly, King & Lenox (2002) propose that R&D investments lead to improved productivity and reduced environmental costs. And McWilliams & Siegel (2001) also highlight that incurring costs in environmental activities positively impacts a firm’s reputation among stakeholders, thereby increasing the firm’s overall value. Consequently, firms that take proactive measures towards environmental sustainability may experience simultaneous financial and environmental gains from their investments in environmentally friendly initiatives. A noteworthy study conducted by Grisales et al. (2020) investigated the moderating role of R&D investment in the relationship between green innovation and firm performance. The findings of this study indicated that R&D investment positively moderates this relationship.
Building upon the previous discussions by considering the positive impact of R&D investment on firm performance, this thesis will analyze how R&D investment impacts the firm performance. In addition, based on the evidence illustrated regarding the impact of R&D investment on firm performance as well as its effect on enhancing the firm environmental activities, the objective of this thesis is to explore the role of R&D in moderating the relationship between environmental score and firm performance. Hence, the following hypotheses are formulated:

**H4:** R&D investment has a significant positive impact on firm performance.

**H5:** R&D investment has a positive moderating effect on the relationship between environmental pillar score and firm performance.

**Board size and female on board as moderators**

Previous research has examined the impact of board size on firm performance, investigating whether larger boards have a positive or negative effect. Larmou and Vafeas (2009) conducted a study that found a positive association between larger board sizes and shareholder value, indicating that larger boards contribute to firm performance. Similarly, Singh and Harianto (1989) and Adam and Mehran (2003) also found evidence supporting the idea of larger boards being beneficial. Furthermore, according to De Villiers et al. (2011), a larger board has the potential to foster more extensive involvement with stakeholders such as customers, suppliers, and local communities. This can be accomplished by incorporating board members who possess diverse backgrounds and expertise. In contrast, Yermack (1995) conducted a study that revealed a negative relationship between board size and corporate financial performance. These findings suggested that smaller boards operate more efficiently, leading to higher market value. This negative relationship was also observed in a study by Guest (2009), which analyzed 2,746 listed UK firms from 1981 to 2002. The study found that increasing the size of a six-person board by one member led to a decrease in Tobin’s q, indicating a negative impact on firm performance.

The drawbacks associated with large boards are rooted in the notion that activities such as communication, coordination, and decision-making become more challenging and resource-intensive within larger groups compared to smaller ones. This is confirmed by a study by Jensen (1993), who found that maintaining smaller board sizes can enhance their effectiveness, as larger boards tend to be less functional and more susceptible to CEO control. Similarly, Lipton & Lorsch (1992) suggest that boards with more than ten members face challenges in facilitating open expression of ideas and opinions. In addition, Boone et al. (2007) suggest that larger boards may encounter slower decision-
making processes due to the heightened complexity and the requirement for extensive discussions. This shows that existing literature presents varying findings regarding the relationship between board size and firm performance. Some studies, such as those conducted by Yermack (1996) and Eisenberg et al. (1998), support the effectiveness of small boards. However, certain studies, including those by Hermelin & Weisbach (1991) and Bhagat & Black (1999), do not provide substantial support for the association between board composition and firm performance.

In regard to environmental sustainability, the board of directors has a significant role in shaping corporate environmental policies and guiding a company's strategic actions related to environmental management (Walls et al., 2011; Walls et al., 2012). Certain studies indicate that both board size and independence have a notable influence on firms' environmental corporate social responsibility (CSR) ratings (Walls et al., 2012) as well as litigation risk. A larger board can be advantageous in this context, as it allows for the inclusion of more directors who possess a genuine concern for environmental issues and possess expertise in environmental protection. These directors are well-positioned to promote their interest in sustainable development, facilitate access to relevant resources, and encourage the corporate board to enhance environmental sustainability performance (Jizi, 2017).

More consensuses can be found regarding the effect of women on the board of directors on firm performance. The findings of Daily et al. (1999) and Jurkus et al. (2011) support the agency theory, which suggests that investors have a positive perception of including female board members due to the belief that it enhances board control. A study by Mattis (2000) reveals that 86% of CEOs consider female representation on boards as highly important for their organizations. Smith et al. (2006) revealed a significant positive influence of women on the board of directors on firm performance. Likewise, Bonn (2004) established a positive relationship between the ratio of women directors and firm performance. And according to Brindelli et al. (2018), women are more likely to have received a socially focused education which would make them more receptive to business awareness programs and environmental efforts. Thus, having women on a company's board should result in greater social and environmental investments because they have more competence in this field (Cucari, 2017). Recent studies have explored the impact of gender diversity in the board of directors on corporate financial performance. However, the findings from these studies are inconsistent, with the majority of cases indicating neither a positive nor a negative effect when specifically examining European firms (Marinova et al., 2010).

Previous research examining the relationship between corporate environmental performance and gender diversity on boards, has produced mixed findings due to variations in proxies for environmental performance, countries, time periods, and research methods. Theoretical and empirical perspectives
suggest that women may excel in decision-making regarding environmental issues to mitigate legal risks (Cumming et al., 2015). Post et al. (2011) observed a positive correlation between higher environmental strength scores and gender-diverse boards with three or more female directors. However, their study focused on a limited sample of 78 firms from the electronics and chemical industries in either 2006 or 2007. More broadly, Walls et al. (2012) explored the relationship between corporate governance, including gender diversity, and environmental performance in 313 industrial sector firms (excluding service firms) for the period 1997-2005. They found a slight association between a higher presence of women on the board and fewer environmental concerns, but no significant association with environmental strengths. And in another study by Glass et al. (2016), a sample of 473 Fortune 500 firms spanning a 10-year period from 2001 to 2010 was utilized to investigate the relationship between gender diversity and environmental performance. The findings revealed a nuanced relationship, where interconnected women directors were associated with environmental strengths but had no impact on environmental concerns.

Previous studies have employed board size and gender diversity on boards as moderators. For example, Zheng and Tsai (2019) used board size as a moderator to investigate its influence on the relationship between unrelated diversification and the performance of Chinese tourism firms. Similarly, Rossi et al. (2021) examined the moderating role of board size in the link between corporate social responsibility (CSR) practices and financial performance. In another study, Shakil (2021) employed gender diversity as a moderator to analyze its effect on the relationship between environmental, social, and governance (ESG) practices and financial risk in the oil and gas industry. Additionally, Brinette et al. (2023) explored the moderating impact of gender diversity on the association between ESG controversies and firm value.

Consequently, based on the existing empirical evidence and the potential of utilizing board characteristics as moderators, board size and female representation on boards can be employed as moderators that can impact environmental, social, and governance practices (ESG) by enhancing the decision-making process. A larger board size and increased gender diversity can enhance this process by introducing novel ideas and offering diverse perspectives, particularly in the context of environmental practices. This makes it interesting to analyze their effects on the relationship between environmental performance and firm performance. Therefore, the following hypotheses are developed:

**H6: Board size has a positive moderating effect on the relationship between environmental pillar score and firm performance.**
**H7:** Female presentation on board has a positive moderating effect on the relationship between environmental pillar score and firm performance.

Based on the literature review and the hypotheses, the following model is formulated:

*Fig. 1. Hypotheses model*
Data & Methodology

Data collection and descriptions
The study sample is collected from the Thomson–Eikon database, with data ranging from 2013 to 2019. The sample included public and private firms in the European region. In order to download the data, one filter was added, making sure that the environmental pillar score is greater than zero. The initial sample size was 903. However, due to missing data in some variables, especially the research and development variable (R&D) and after dropping the outliers, the final sample size is 673 firms. The variables descriptions are presented in the table in Appendix 2.

Dependent variables
In this research, firm performance (FP) serves as the dependent variable, and it is evaluated through two indicators. The first indicator is the return on assets (ROA), which is a commonly employed accounting metric used as a proxy for FP. ROA is determined by dividing the net income of the company by its total assets. This measure is widely used to gauge the efficiency of management in generating profits from the firm's assets. Previous studies by Aguilera-Caracuel & Ortiz-de-Mandojana (2013) & Xie et al. (2019) have also recognized the significance of ROA in assessing firm performance.

To strengthen the reliability of the findings obtained, using the first measure (ROA) as a proxy for firm performance, this study also incorporates Tobin's Q as a second measure. This serves as a robustness check (Daines, 2001). As explained by Daines, James Tobin, a Nobel Prize-winning economist, states that the concept of the "Q" ratio. It represents the market value of a company relative to the cost of replacing its assets. The Q ratio has been widely used to explore the connection between management ownership and the value of businesses. In this study, Tobin's Q is calculated by dividing the market capitalization of the firm by its total assets (Daines, 2001).

Independent variables
Refinitiv ESG pillar scores assess a company's ESG performance in environmental, social, and governance areas. These scores use a percentile rank system, represented as percentages and letter grades (D- to A+). They are compared to the country of incorporation for governance and the Thomson Reuters Business Classifications (TRBC) for ESG. Environmental and social category weights differ by industry, while governance weights are consistent. Pillar scores are calculated by combining three to four category ratings, with environmental and social scores combined to form the overall pillar score. Normalized pillar weights range from 0 to 100%.
The measurement of R&D investment in a company, according to De Marchi's study (2012), is expressed as the annual R&D investment percentage relative to the company's annual revenue. The reason for not directly using the firm's R&D expenditure as a measure of R&D investment, is that this value consistently shows a strong association with the size of the firm (Tsai et al., 2011).

**Moderating variables**

This research explores the potential moderating influence of R&D investment and board characteristics, specifically board size and female representation, on the relationship between the Environmental score pillar and firm performance (FP). The data for analysis in this study was acquired from the Thomson Reuters (Eikon) database.

R&D is considered as a component of green innovation (Refinitiv 2022) and the reason for incorporating it as a moderator in this study is the existing gap in the literature regarding the use of this variable to moderate the relationship between the environmental pillar score and firm performance. Thus, this study builds upon previous research that has employed R&D as a moderating factor in the context of green innovation (Grisales et al., 2020) as existing literature reviews have shown that only a limited number of studies have examined the influence of R&D investment on firm performance, and even fewer have explored its impact on a firm's environmental performance. Hence, this thesis aims to bridge this gap by analyzing the relationship between R&D investment and the connection between firm performance and environmental practices.

Board size is used as the total number of directors on the board as described in Eikon and used by Cheng et al. (2008) and Kim (2005). But to achieve a more suitable distribution of the variable, the natural logarithm is employed to transform the number of directors (Elsayed, 2009). Female on board represents the percentage of women serving on a firm's board, as defined by Refinitiv Eikon DataStream. Previous studies, such as those conducted by Galbreath (2018), Shakil et al. (2020) and Brinette et al. (2023), have also utilized the percentage of women on a firm board as a proxy to assess board gender diversity. This thesis seeks to address a research gap by investigating the correlation between board size and the presence of women on corporate boards. While previous literature reviews have explored their influence on firm performance, there has been limited examination of their impact on a company's environmental performance. Therefore, this study aims to bridge this gap by analyzing the relationship between board size, the inclusion of women on boards, and the connection between firm performance and environmental practices.
Control variables

Previous empirical studies highlight the significance of controlling specific variables when investigating the relationship between ESG factors and firm performance. In order to account for the firms' capital structures, financial leverage is included as a control variable as also done by Liu & Zhang, (2017). It is anticipated that financial leverage will have a negative impact on firm performance, as it can limit managerial options and restrict access to new business opportunities (Platonova et al., 2018). Firm size is another control variable in this study (Waddock and Graves, 1997; Aras et al., 2010; Byun and Oh, 2018). Larger firms generally demonstrate better performance compared to smaller firms, often due to improved operational efficiencies such as lower costs and greater purchasing power (Yoon & Chung, 2018).

Table 1 provides descriptive statistics for the variables used in the models. The ESG pillar scores are above the average. The social pillar score has the highest mean of 60.85663, ranging from 1.162281 to 98.20207, indicating that European firms have higher scores on average for the social pillar compared to the other two pillars. The environmental pillar score shows the highest variability among the ESG pillar scores, with a standard deviation of 23.9873, while the governance pillar score has the lowest variability with a standard deviation of 21.45337.

R&D has a mean of 0.0151692, ranging from 0 to 0.6354175, suggesting that research and development density in European firms is relatively low. This finding aligns with previous studies by Jin et al. (2018), Teng & Yi (2017), Xin et al. (2019) and Xu & Liu (2021). The mean of ROA indicates that corporate profitability in Europe is slightly higher than the average. However, Tobin's q suggests that the firms are valued less than the cost of their assets. F-board (female representation on board) stands out with the highest central tendency, as indicated by its mean. Furthermore, the variable E_score (environmental score) demonstrates the highest variability, as indicated by its standard deviation.
Table 1. Data descriptive statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
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<td>.0457896</td>
<td>.0783754</td>
<td>-1.363094</td>
<td>.5009191</td>
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<tr>
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<td>.7858958</td>
<td>1.274525</td>
<td>.0004584</td>
<td>14.52283</td>
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<td>S_score</td>
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<td>63.67411</td>
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<td>1.162281</td>
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</tr>
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<td>G_score</td>
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<td>54.40444</td>
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<tr>
<td>RD</td>
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<td>0</td>
<td>.0440727</td>
<td>0</td>
<td>.6354175</td>
</tr>
<tr>
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<td>10</td>
<td>3.815255</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>F_board</td>
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<td>.2307692</td>
<td>.1330647</td>
<td>0</td>
<td>.6666667</td>
</tr>
<tr>
<td>Firm_size</td>
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<td>22.66769</td>
<td>22.6168</td>
<td>1.507368</td>
<td>15.97953</td>
<td>27.70355</td>
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<tr>
<td>lev</td>
<td>4,661</td>
<td>.847181</td>
<td>.5797049</td>
<td>2.715974</td>
<td>-45.71429</td>
<td>81.46429</td>
</tr>
</tbody>
</table>
Data Analysis & research design

The panel data regression analysis was conducted in three main regression models and three robustness regression models, to test the relationship between independent variables and dependent variables. The dependent variable in the main regressions is Return on Assets (ROA), while Tobin’s Q is the dependent variable in the robustness regressions. In all six models, the ESG pillar scores were included as independent variables.

In the first and fourth models, RD (research and development) and its moderating effect were added as independent variables. This aimed to assess the impact of RD and its moderation on the relationship between ESG pillar scores and Financial Performance (FP), without considering other moderating effects variables or control variables for firm performance.

In the second and fifth models, RD was replaced with logB_Escore and F_Escore to moderate the environmental pillar score. Additionally, lev (leverage) and logassets (firm size) are control variables for firm performance FP. This regression aimed to examine the effect of board characteristics variables on the relationship between the environmental pillar score and FP, without considering the influence of RD.

The third and sixth models represented the full model, incorporating all independent variables and control variables in the analysis. This comprehensive model aimed to capture the combined influence of all variables on the relationship between ESG pillar scores and FP.

Therefore, the estimated research models are:

**Model 1:**

\[ ROA_{i,t} = B0 + B1 \ E_{score_{i,t}} + B2 \ S_{score_{i,t}} + B3 \ G_{score_{i,t}} + B4 \ RD_{i,t} + B5 \ RD_{Escore_{i,t}} + \epsilon_{i,t} \]

**Model 2:**

\[ ROA_{i,t} = B0 + B1 \ E_{score_{i,t}} + B2 \ S_{score_{i,t}} + B3 \ G_{score_{i,t}} + B4 \ RD_{i,t} + B5 \ RD_{Escore_{i,t}} + \]
\[ B6 \ logB_{E_Score_{i,t}} + B7 \ F_{E_Score_{i,t}} + B8 \ F_size_{i,t} + B9 \ Lev_{i,t} + \epsilon_{i,t} \]
Model 3:

\[ \text{ROA}_{i,t} = B_0 + B_1 \text{E\_score}_{i,t} + B_2 \text{S\_score}_{i,t} + B_3 \text{G\_score}_{i,t} + B_4 \text{RD}_{i,t} + B_5 \text{RD\_Escore}_{i,t} + B_6 \log \text{B\_Escore}_{i,t} + B_7 \text{F\_Escore}_{i,t} + B_8 \text{F\_size}_{i,t} + B_9 \text{Lev}_{i,t} + \epsilon_{i,t} \]

Model 4:

\[ \text{tobin\_q}_{i,t} = B_0 + B_1 \text{E\_score}_{i,t} + B_2 \text{S\_score}_{i,t} + B_3 \text{G\_score}_{i,t} + B_4 \text{RD}_{i,t} + B_5 \text{RD\_Escore}_{i,t} + \epsilon_{i,t} \]

Model 5:

\[ \text{tobin\_q}_{i,t} = B_0 + B_1 \text{E\_score}_{i,t} + B_2 \text{S\_score}_{i,t} + B_3 \text{G\_score}_{i,t} + B_6 \log \text{B\_Escore}_{i,t} + B_7 \text{F\_Escore}_{i,t} + B_8 \text{F\_size}_{i,t} + B_9 \text{Lev}_{i,t} + \epsilon_{i,t} \]

Model 6:

\[ \text{tobin\_q}_{i,t} = B_0 + B_1 \text{E\_score}_{i,t} + B_2 \text{S\_score}_{i,t} + B_3 \text{G\_score}_{i,t} + B_4 \text{RD}_{i,t} + B_5 \text{RD\_Escore}_{i,t} + B_6 \log \text{B\_Escore}_{i,t} + B_7 \text{F\_Escore}_{i,t} + B_8 \text{F\_size}_{i,t} + B_9 \text{Lev}_{i,t} + \epsilon_{i,t} \]

Where ROA and tobin_q are firm performance (FP) proxies of firm i in year t, E\_score is the environmental pillar score. S\_score is the social pillar score. G\_score is the governance pillar score. RD is the research and development expenditure as percentage of the firm revenue. RD\_Escore is the moderating effect of board size on the relationship between environmental score and firm performance. logB\_Escore is the moderating effect of board size on the relationship between environmental score and firm performance. F\_Escore is the moderating effect of female on board on environmental score and firm performance. Firm size is the log of firm’s total assets. Lev is the ratio of company’s debt to equity.
Results & interpretations

This study estimated the static panel data regression model to test the relationship between the independent variables and dependent variable. Control variables were included to control for firm performance. The Hausman test was used to monitor the data’s unobserved heterogeneities and to decide whether fixed or random effects are more suitable for this study data. The results of this test show that random effect estimators are not consistent and the fixed effect estimators are more appropriate. Specifically, the results present a $p$ value smaller than 0.05 and a significant level of 5% for all models used in this study. Hence, the null hypothesis can be rejected, and a fixed effect model is the preferred one.

The study employed a correlation test to analyze the linear relationship among the variables investigated. Correlation occurs when the coefficient between two variables surpasses the threshold of 0.8, as noted by Diaz & Pandey (2019). The findings presented in the correlation matrix Table 2, indicate the absence of Multicollinearity among the variables examined in the study. In addition, it shows that the correlation between ESG pillars scores; (E_score, S_score and G_score) and ROA are -0.0578, -0.0037 and -0.0539 respectively, indicating that they are weakly negatively correlated. Therefore, higher ESG pillar scores are associated with less profitability. The same conclusion is noticeable in the relationship between ESG pillars scores and Tobin’s q. This suggests, higher ESG pillars scores are associated with less market value. In contrast, the correlation between RD and E_score (the environmental pillar score) is 0.0574, which indicates that they are weakly positively correlated. Higher RD investment is associated with a higher firm’s environmental performance and therefore higher score. In addition, the correlation between RD and ROA is weakly positively correlated. The correlation coefficient between E_score and S_score is 0.6919, which is the highest in the correlation matrix in this study but still below the threshold of 0.8.
Table 2. Correlation matrix

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) <strong>ROA</strong></td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) <strong>tobin_q</strong></td>
<td>0.5600</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) <strong>E_score</strong></td>
<td>-0.0578</td>
<td>-0.1362</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) <strong>S_score</strong></td>
<td>-0.0037</td>
<td>-0.0310</td>
<td>0.6919</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) <strong>G_score</strong></td>
<td>-0.0539</td>
<td>-0.0642</td>
<td>0.2753</td>
<td>0.3143</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6) <strong>RD</strong></td>
<td>0.0059</td>
<td>0.2287</td>
<td>0.0574</td>
<td>0.1119</td>
<td>0.1035</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7) <strong>B_size</strong></td>
<td>-0.1088</td>
<td>-0.1904</td>
<td>0.3294</td>
<td>0.2803</td>
<td>0.0186</td>
<td>-0.0235</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8) <strong>F_board</strong></td>
<td>0.0282</td>
<td>0.0362</td>
<td>0.2602</td>
<td>0.2869</td>
<td>0.2122</td>
<td>0.0469</td>
<td>0.0945</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9) <strong>Firm_size</strong></td>
<td>-0.1094</td>
<td>-0.3254</td>
<td>0.5093</td>
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<td>-0.0351</td>
<td>0.5084</td>
<td>0.1424</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>(10) <strong>lev</strong></td>
<td>-0.0523</td>
<td>-0.0826</td>
<td>0.0380</td>
<td>0.0429</td>
<td>0.0130</td>
<td>-0.0184</td>
<td>0.0499</td>
<td>-0.0228</td>
<td>0.0723</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

To assess multicollinearity, the variance inflation factor (VIF) was calculated and presented in Tables 3 and 4 and ranged from 4.08 to 5.02. These values suggest that there are no significant issues of multicollinearity in the study models. A VIF value greater than 10 is an indication for multicollinearity problems (Kutner, 1996; Pantagakis, 2012), which supports the correlation matrix results in Table 2. This information is sourced and supported by R-squared values. It should be noted that the low R-squared value may be attributed to a small sample size or the need for additional explanatory variables to better explain the variation in the dependent variable, which will be addressed in the limitations section of this paper in the discussion.

Main regressions

The empirical results of the fixed effect regression analysis with ROA as the dependent variable, are presented in Table 3. In model 1, 2 and 3, the E_score shows a negative but insignificant effect and does not support H1. However, the S_score has a positive impact on ROA in the three models, which aligns with H2. This finding is supported by the findings of Bhaskaran et al. (2020) and Ting et al. (2020). The G_score has a significant negative effect on Firm performance, indicating that there is a statically negative relationship between governance score and firm performance. Thus, H3 is violated. Additionally, RD investment has a negative and significant effect on the firm performance in model 1, with a coefficient of B = -0.4146191. This negative impact becomes even stronger in the full model 3,
suggesting that higher levels of R&D investments lead to lower profitability and therefore does not provide a support of H4.

Regarding the moderating effect of R&D on the environmental pillar score and firm performance, it is positive but not statistically significant. Hence, H5 is not supported. In Model 2, logB_Escore negatively moderates the relationship between the E_score and firm performance when excluding R&D effect which is not aligned with H6. Model 3 represents the full model, incorporating the moderating effects of R&D and board characteristics, along with control variables. However, model 3 does not provide sufficient statistical support for H5, indicating that R&D investment does not moderate the relationship between E_score and firm performance. Similarly, H6 and H7, which propose that board characteristics moderate the relationship between E_score and FP, are not adequately supported by model 3.
Table 3. Main regressions

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Dependent variable:</th>
<th>ROA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
</tr>
<tr>
<td>E_score</td>
<td>-.000135</td>
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</tr>
<tr>
<td>S_score</td>
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<td>.000182*</td>
</tr>
<tr>
<td>G_score</td>
<td>-.000172**</td>
<td>-.000201**</td>
</tr>
<tr>
<td>RD</td>
<td>-.414619 ***</td>
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</tr>
<tr>
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<tr>
<td>logB_Escore</td>
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<td>F_Escore</td>
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<tr>
<td>Firm_size</td>
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<td>.012111***</td>
</tr>
<tr>
<td>lev</td>
<td>-.000399</td>
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<tr>
<td>Hausman</td>
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<td>Yes</td>
</tr>
<tr>
<td>N</td>
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<td>4,661</td>
</tr>
<tr>
<td>R-squared</td>
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<td>0.0066</td>
</tr>
<tr>
<td>Number of groups</td>
<td>673</td>
<td>673</td>
</tr>
</tbody>
</table>

***: p-value <0.001, **: p-value <0.05, *: p-value <0.1
Robustness checks

Table 4 presents the results of a fixed effect regression analysis with Tobin’s q as the dependent variable. Comparing Tables 3 and 4, it is evident that E_score has a significant negative effect on firm performance in all three models (p < 0.05), and as a result H1 is violated. Additionally, G_score has a significant negative effect on firm performance in the three models 4,5 and 6 (p < 0.001), which emphasizes the same results of the main regression, indicating that H3 is not supported. On the other hand, S_score exhibits a higher positive impact in models 5 and 6 (p < 0.001), which strengthen the results of the main regression, demonstrating that H2 is supported. The results also indicate that RD has a negative insignificant effect on FP in model 4 and 6 compared to model 1 and 3, which suggests that H4 is not supported. Similarly, the moderating effect of RD remains insignificant in the Robustness checks, consistent with the findings in main regression results.

In model 5, it is observed that F_Escore positively moderates the relationship between E_score and firm performance, while logB_Escore has a positive insignificant moderating role in model 5. In the robustness checks on the full model 6, board characteristics variables exhibit a positive significant moderating role on the relationship between E_score and FP, which support H6 and H7. This suggests that European firms benefit from having a larger board size and a higher representation of women on their boards, as these factors contribute to improved environmental performance. Consequently, these firms tend to achieve higher market value. Hence H6 and H7 are supported.
Table 4. Robustness check

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>tob\textunderscore q</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 4</td>
</tr>
<tr>
<td>( E_score )</td>
<td>-.003307**</td>
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<tr>
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<tr>
<td>( G_score )</td>
<td>-.004072***</td>
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<tr>
<td>( RD )</td>
<td>-1.388004</td>
</tr>
<tr>
<td>( RD_Escore )</td>
<td>.0188697</td>
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<tr>
<td>( logB_Escore )</td>
<td>.001427</td>
</tr>
<tr>
<td>( F_Escore )</td>
<td>.003107*</td>
</tr>
<tr>
<td>( Firm_size )</td>
<td>-.567049***</td>
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<tr>
<td>( lev )</td>
<td>-.011260***</td>
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<td>( N )</td>
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<tr>
<td>( R\textsuperscript{-squared} )</td>
<td>0.0118</td>
</tr>
<tr>
<td>Number of groups</td>
<td>673</td>
</tr>
</tbody>
</table>

\*\*: \( p\)-value <0.001, **: \( p\)-value <0.05, *: \( p\)-value <0.1
Discussion

This study aims to investigate the potential associations between environmental, social, and governance (ESG) scores and firm performance in Europe. It addresses a research gap by exploring how two factors, namely Research and Development (R&D) investment and board characteristics, moderate the relationship between environmental score and financial performance (FP). R&D investment is widely recognized as crucial for fostering innovation and technological advancement, which can, in turn, impact a company’s environmental practices and financial performance. Additionally, the composition and characteristics of a company’s board, such as its size and the representation of women, are acknowledged as influential factors that contribute to the generation of innovative ideas within the organization.

The aim of this thesis was to answer three research questions, firstly: How does ESG pillar scores affect firm performance? The empirical result of this paper shows that social score has a positive significant relationship with firm performance in Europe, which is in line with studies such as those conducted by Nekhili et al. (2017) in France and Li et al. (2018) in the UK. Furthermore, the significant positive impact of the social pillar score on both ROA and market value suggests that the company’s social initiatives are effective in creating value for both society and the organization itself, as also demonstrated by Bhaskaran et al. (2020) and Ting et al. (2020). Their findings regarding firms in emerging and developed markets suggest that the social initiatives implemented by a company illustrate their capacity to generate value for both the organization and society. By addressing social concerns, the company may enhance its brand reputation, attract socially conscious customers, improve employee engagement and productivity, and build stronger relationships with suppliers and other stakeholders, development of competitive advantages (Bernardi & Stark, 2018), leading to higher market valuations by investors.

On the other hand, this thesis found that the environmental score impact becomes significantly negative on market value represented by Tobin’s q ratio in this paper, which is also found in previous research such as by Daszyńska-Zygałło (2016), Semenova & Hassel (2008) and Hassel et al. (2005). Their studies, encompassing analysis across ten global industry classification sectors, revealed a statistically significant negative association in eight sectors. This implies firms with better environmental performance may not be receiving a corresponding market valuation boost. There could be several reasons for this negative relationship, such as the lack of awareness of the positive impact of the environmental practices on firm’s long term financial performance by investors and therefore, not considering it when making investment decisions. Additionally, the cost implemented of maintaining
strong environmental score, such as investment in clean technologies or suitability initiatives can perceived as burden by the market. As a result, it will lead to a decrease in the market value.

The adverse impact of the governance performance on accounting-based measure ROA and market value found in this paper results suggests that organizations with stronger governance practices may not achieve higher profit or operational efficiency, which is found in previous research such as by MacAvoy & Millstein (1999) and Bahadori et al. (2021). Therefore, market value can be less valued by investors. Several reasons can explain this negative effect, for example governance practices strive to align the interests of shareholders and management while minimizing conflicts. However, in certain instances, implementing stringent governance practices can result in excessive control and oversight, which may hinder management’s capacity to make swift and effective decisions, potentially affecting profitability.

The second question is how R&D investment affects firm performance and how it impacts the relationship between the environmental pillar score and firm performance. The R&D investment results do not support hypothesis H4, as it demonstrates a negative significant impact of R&D expenditure on firm performance. These results are supported by research carried out by Chen et al. (2019), Xu et al. (2019), and Lieberman & Montgomery (1988). The researchers discovered an initial negative link between research and development (R&D) activities and the current financial performance of firms. Several factors can contribute to the emerging of this negative impact such as, R&D activities often require significant investments costs and involve uncertainty and risk. These costs can reduce the firm’s profitability in the short term and lower its ROA. Because R&D contributes to revenue growth, profitability, and the firm’s competitive position and its reputation (Chen et al. 2019).

There are many reasons that can explain the negative impact of R&D investment, as found in this paper. For example, the outcomes of R&D efforts may take time to generate revenue and contribute to the firm’s asset base (Xu, 2019). During this development period, the firm may incur expenses without corresponding increases in revenue, which can temporarily lower ROA (Vithessonthi & Racela, 2016). And according to Coşkun et al., as described in Bouaziz (2016), an increase in marketing and R&D expenses can have a favorable impact on a company’s performance. However, beyond a certain threshold of expenditure, this positive effect may be reversed or altered in a negative manner. Additionally, there is no guarantee that a specific R&D project will yield successful outcomes. Hence, failed or unsuccessful R&D projects can result in wasted resources and negatively impact the firm performance and its market value. In addition, if investors or stakeholders do not view the firm’s R&D
activities as value-enhancing or if they have doubts about the firm’s ability to convert R&D investments into successful outcomes, it can result in a negative impact on market value.

The third question of this thesis is: how does board size and female presentation on board moderate the relationship between environmental pillar score and firm performance? The result of this thesis indicates that having a larger board size in European firms hampers the positive impact of environmental sustainability on the firm’s financial performance ROA (Jensen, 1993). A larger board size can present challenges related to decision-making, communication, and coordination. Moreover, large boards may experience slower decision-making processes due to increased complexity and the need for extensive discussions (Boone et al., 2007). The influence of board size on the relationship between environmental score and ROA varies based on industry characteristics, firm strategy, and market conditions.

However, the results from the robust regression analysis highlights a positive relationship between board size and environmental performance, leading to increased market value. This implies that smaller companies can derive significant advantages from having larger boards, as it positively impacts their environmental performance and, consequently, enhances their market value. Moreover, a larger board size frequently indicates greater resources available for environmental projects and more flexibility and agility in decision-making processes. Furthermore, a larger board might promote deeper engagement with stakeholders such as customers, suppliers, and local communities. By bringing on board individuals with various backgrounds and expertise (de Villiers et al., 2011).

The presence of women on boards of European firms seems to have a positive moderating impact in improving the relationship between environmental activities and firm’s market value. While this positive impact is not significant on the firm profitability, it does increase the company’s market value. This finding is consistent with the agency theory, which emphasizes that investors see the inclusion of female board members favorably since it enhances board control (Daily et al., 1999; Jurkus et al., 2011). Gender-diverse boards have been linked to increased innovation and effective risk management. Having female board members brings diverse perspectives and experiences to board discussions and decision-making processes. Moreover, they can play a crucial role in enhancing corporate governance practices, including environmental sustainability by addressing environmental challenges as also discussed by Mattis (2000) and Post et al. (2011).

Firm size has a statically positive impact on profitability in the results of this paper, which is consistent with the findings of García-Teruel & Solano (2007). Large firms can enjoy more profits from different factors such as economic to scale and better access to resources. However, there is a negative
significant relationship between firm size and Tobin’s q supporting the findings of previous research (Alqatan et al., 2019). In contrast, this research results shows that the leverage ratio is related negatively with firm performance supporting the results of Pantagakis et al. (2012) and Al Amosh et al. (2023).
Conclusion

Given the increasing awareness among investors, corporations, and academics regarding the impact of ESG pillar scores on corporate financial performance, this study specifically investigated the relationship between ESG pillar scores and firm performance in Europe, with a particular focus on the influence of R&D investment on firm performance. Additionally, the study explores the role of R&D investments and board characteristics in shaping the relationship between environmental performance and firm performance in European corporations. By examining this factor, this research contributes to the understanding of the complex dynamics between ESG, R&D investment and firm performance, and filling the gap in previous research in providing valuable insights on the moderating role of R&D investment and board characteristics on the relationship between the environmental pillar score and firm performance.

There is limited empirical research on the association between ESG pillar scores and firm performance in Europe. And while there is a consensus among these studies regarding the social pillar score (Nekhili et al., 2017; Li et al., 2018; Bernardi & Stark, 2018), the findings pertaining to the environmental and governance scores exhibit variability in their impact on firm performance. Furthermore, previous investigations on the relationship between R&D investment and firm performance have primarily focused on a few specific European countries, such a study conducted by Hall & Oriani (2006), thereby neglecting a comprehensive examination across the entire European region. Others only examined the impact of R&D investment on the firm's environmental performance (Hart, 1997; Esty & Porter, 1998).

This research gap and the lack of studies exploring the influence of R&D investments and board characteristics, such as board size and female representation, on the relationship between environmental performance and firm performance motivated the investigation conducted in this thesis. The aim was to address these gaps and determine whether the relationship could be strengthened through the presence of R&D investments and specific board characteristics.

This study confirms the findings of previous research, indicating that the social pillar score positively influences a firm's profitability and market value. However, it reveals a negative impact of the governance score on firm performance. Against expectations, the environmental score does not significantly affect firm profitability, but it does have a negative influence on market value. Regarding R&D investment, this study suggests a negative impact on European firms' performance, although it does not significantly moderate the relationship between environmental performance and firm performance. Additionally, the study highlights a negative moderating effect of board size on the relationship between environmental score and firm profitability. However, the presence of female
representation on the board and the size of the board contribute positively to this relationship, resulting in an increased market value for environmentally conscious firms.

In regards to the gap of this research, the results show that R&D investment has a positive but not statistically significant moderating impact on the relationship between a company's environmental performance and its accounting measures and market value. This effect is not evident in European firms, possibly due to variations in criteria and practices between Western and Eastern European companies. Also, this effect could indicate that the company needs more time to notice the significant impact or the need to put more efforts towards increasing this impact. Increasing R&D investment allows managers to enhance long-term green innovation by utilizing resources efficiently, strengthening the workforce, improving operational processes, adopting advanced technology, and meeting knowledge requirements. However, these efforts may also result in short-term improvements and establish the company as environmentally responsible, leading to long-term financial benefits and competitive advantage (Alam, 2019).

The findings of this study provide a foundation for further investigation into the relationship between ESG pillar scores and firm performance in Europe. Given the increasing awareness of the firms' environmental activities and the importance of addressing climate change, this research contributes by examining the moderating role of R&D investments and board characteristics in the relationship of environmental-firm performance. Moreover, this study offers valuable insights to investors into the ESG scores of European firms and how these scores are related to firm performance. Additionally, it provides managers with a deeper understanding of the impact of R&D investments on environmental initiatives, enabling them to contribute to tackling climate change and its repercussions on firm performance. Hence, this study highlights the reality that European firms may incur costs while implementing these investments to enhance environmental-firm performance, and it emphasizes the time required for these efforts to yield positive outcomes. As a result, managers can gain insights from this study regarding the potential financial burdens associated with such investments and the patience required to reap the benefits in terms of improved environmental performance. Furthermore, it highlights the significance of both the number of directors on the board and female representation, particularly underscoring the role of female representation on the board in enhancing the market value of the firm, concerning the relationship between environmental performance and firm performance. Overall, this research equips investors and managers with essential information to make informed decisions and effectively navigate the intersection of ESG factors, R&D investments, environmental concerns, and corporate governance.
However, it is important to acknowledge the limitations of this study. One limitation is the small sample size of European companies, which restricts the generalizability of the findings. Due to data limitations in Eikon, especially for R&D investment, it was not feasible to increase the sample size in this study. Therefore, future research should consider accessing data from multiple databases to overcome this limitation and provide more robust and accurate results. Regardless of the limitations in size, this study does encompass a sample size that covers a wide range of European firms, representing both Eastern and Western European countries. However, it is important to note that governance practices and decision-making processes regarding environmental performance may differ between countries. Additionally, the representation of females on boards of directors can be influenced by cultural factors within these regions. Future research should take these variations into account and consider the difference of culture and legalization differences between the Eastern European firms and Western European firm. By doing so, they can examine whether or not the effects observed in this study are significant across different countries.

Furthermore, this study attempted to include industry effects and firm age as control and dummy variables in the regression analysis. However, the results did not reveal any significant effects, leading to their exclusion from this paper. In addition, the R-squared reported in the Tables 3 and 4 of this paper is relatively low, indicating that the explanatory variables are not explaining the variation in the dependent variable. Despite the results of R-squared in this paper, previous research studies such as Topak (2011), Del Giudice & Rigamonti (2020), Lee & Min (2015) and Jang et al. (2020) have also reported similar R-squared values, indicating that a low R-squared value does not necessarily imply that the sample is weak or of poor quality. Nonetheless, future research should take this limitation into account and aim to work with a larger sample size and explore the inclusion of additional explanatory variables for a higher R-squared and reliable results, especially when considering using industry or country effects as dummy or control variables. Examples of such variables could include green innovation, green technology, employee training, and board independence.

Lastly, there is a growing focus and increased attention on environmental, social, and governance (ESG) activities. However, it is important to note that implementing these activities within a firm comes with costs and requires time to observe the benefits. Similarly, investing in research and development (R&D) is a costly endeavor that takes time to yield results. Hence, this study proposes the inclusion of a longer time frame when examining these factors in order to obtain more accurate and reliable findings. By addressing these limitations and suggestions, future research can provide a more comprehensive understanding of the factors influencing the relationship between ESG pillar scores, firm performance, and the specific contexts of different countries and industries.
Bibliography


PRI a (n.d.) About the PRI. PRI Available via: https://www.unpri.org/about [Retrieved April 19, 2023].

Put the a and the b in between the brackets?


Appendices

Appendix 1. ESG factors definition by the EBA

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Factors</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental (E)</td>
<td>- GHG emissions</td>
<td>Environmental matters that may have a positive or negative impact on the financial performance or solvency of an entity, sovereign, or individual.</td>
</tr>
<tr>
<td></td>
<td>- Energy consumption and efficiency</td>
<td></td>
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<td></td>
<td>- Air pollutants</td>
<td></td>
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<tr>
<td></td>
<td>- Water usage and recycling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Waste production and management (water, solid, hazardous)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Impact and dependence on biodiversity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Impact and dependence on ecosystems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Innovation in environmentally friendly products and service</td>
<td></td>
</tr>
<tr>
<td>Social (S)</td>
<td>- Workforce freedom of association</td>
<td>Social matters that may have a positive or negative impact on the financial performance or solvency of an entity, sovereign, or individual.</td>
</tr>
<tr>
<td></td>
<td>- Child labor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Forced and compulsory labor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Workplace health and safety</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Customer health and safety</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Discrimination, diversity, and equal opportunity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Opportunity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Poverty and community impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Supply chain management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Training and education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Customer privacy</td>
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</tbody>
</table>
Governance (G)

- Community impacts
- Codes of conduct and business principles
- Accountability
- Transparency and disclosure
- Executive pay
- Board diversity and structure
- Bribery and corruption
- Stakeholder engagement
- Shareholder rights

Governance matters that may have a positive or negative impact on the financial performance or solvency of an entity, sovereign, or individual.

Source: own elaboration based on the EBA report on ESG risk management and supervision.
Available online:
## Appendix 2. Variables descriptions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Based on</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ROA</strong></td>
<td>(Net Income before Preferred Dividends + ((Interest Expense on Debt-Interest Capitalized) * (1-Tax Rate))) / Average of Last Year’s and Current Year’s Total Assets * 100</td>
<td>Eikon - Refinitiv Eikon - Thomson Reuters</td>
</tr>
<tr>
<td><strong>ROE</strong></td>
<td>(Net Income before Preferred Dividends - Preferred Dividend Requirement) / Average of Last Year’s and Current Year’s Common Equity * 100</td>
<td>Eikon - Refinitiv Eikon - Thomson Reuters</td>
</tr>
<tr>
<td><strong>tobin_q</strong></td>
<td>Tobin's q : Market cap / total assets</td>
<td>Daines (2001)</td>
</tr>
<tr>
<td><strong>E_score</strong></td>
<td>The environmental pillar assesses how an organization affects both living and non-living natural systems, such as ecosystems in their entirety and the air, land, and water. It demonstrates how well a business employs best management practices to minimize environmental risks and take advantage of environmental opportunities in order to maximize long-term shareholder value.</td>
<td>Eikon - Refinitiv Eikon - Thomson Reuters</td>
</tr>
<tr>
<td><strong>S_score</strong></td>
<td>The social pillar assesses an organization's ability to foster trust and loyalty among its staff, clients, and society at large by implementing best management</td>
<td>Eikon - Refinitiv Eikon - Thomson Reuters</td>
</tr>
</tbody>
</table>
practices. It serves as a reflection of the company's standing and the status of its operating license, both of which are crucial components in assessing its capacity to produce long-term shareholder value.

<p>| G_score | The corporate governance pillar evaluates a company's procedures and systems, which make sure that its executives and board members behave in the long-term shareholders' best interests. It shows a company's ability to govern and control its rights and obligations through the provision of incentives and checks and balances in order to create long-term shareholder value through the implementation of best management practices. |
| Total assets | Represents the total assets of a company |
| Total equity | includes the equity worth of common shareholders, general and limited partners, and preferred shareholders, but excludes the interest of minority shareholders. |
| Total debt | Represents total debt outstanding, which includes Notes Payable/Short-Term Debt, Current Portion of Long-Term Debt/Capital Leases and Total Long-Term Debt. |</p>
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>RD</td>
<td>Represents expenses percentage of the company’s.</td>
<td>Eikon - Refinitiv Eikon - Thomson Reuters</td>
</tr>
<tr>
<td>B_size</td>
<td>The total number of board members at the end of the fiscal year</td>
<td>Eikon - Refinitiv Eikon - Thomson Reuters</td>
</tr>
<tr>
<td>Female_b</td>
<td>Percentage of female on the board</td>
<td>Eikon - Refinitiv Eikon - Thomson Reuters</td>
</tr>
<tr>
<td>RD_Escore</td>
<td>Research and development as moderator of the Environmental pillar score (RD * E_score)</td>
<td>Grisales et al. (2020)</td>
</tr>
<tr>
<td>logB_Escore</td>
<td>The natural logarithm of the Board size as a moderator of the environmental pillar score (logB_size * E_score)</td>
<td>Chen et al. (2019) Elsayed (2009)</td>
</tr>
<tr>
<td>F_Escore</td>
<td>Female on board representation as moderator of the environmental pillar score (F_board * E_score)</td>
<td>Brinette et al., (2023).</td>
</tr>
<tr>
<td>Firm size</td>
<td>Log (Total assets)</td>
<td>McKeown et al., (1991)</td>
</tr>
<tr>
<td>Lev</td>
<td>Leverage ratio</td>
<td>Liu &amp; Zhang (2017)</td>
</tr>
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