Review of Accounting and Auditing Studies
會計審計論叢，第 15 卷第 1 期，2025 年 6 月
第 1-40 頁

衡量企業永續：相對排名在 ESG 績效預測中的作用

劉啟群
國立臺灣大學會計學系

黃祥宇
國立臺灣大學會計學系

葉念祖*
國立臺灣大學會計學系

收稿日：2024 年 12 月 30 日；接受日：2025 年 5 月 22 日

摘要

本研究旨在探討企業相對永續排名對未來永續績效的預測能力，回應現行永續評分方法論在準確性與穩定性方面的侷限。相對永續排名是透過企業在產業或群體中的相對排名與絕對分數結合評估，能有效減緩不同評分機構之間由於分歧造成的困擾，並補足僅使用單一衡量進行跨產業比較的盲點。本研究使用 Refinitiv 2004-2023 年資料，實證顯示企業於前一年的相對永續排名能穩定預測其未來永續績效，且此結果在控制先前績效後仍具顯著性。進一步納入永續爭議事件後發現，雖相對排名具預測力，但在永續爭議下相對永續排名將提供負向的預測力，本研究亦探討財務特徵與相對排名的額外分析，對資本市場參與者具有參考價值。

關鍵詞：相對排名、ESG 評分、永續

* 通訊作者，地址：106319 台北市大安區羅斯福路四段一號，連絡電話：(02)3366-1136，E-mail: d09722001@ntu.edu.tw；作者感謝總編輯與兩位匿名審查委員提供的寶貴意見，文中言論由作者自行負責。

臺灣大學學術期刊資料庫

Review of Accounting and Auditing Studies
Vol. 15 No. 1, June 2025
pp.1-40

Measuring Corporate Sustainability: The Role of Relative Rankings in ESG Performance Prediction

Chi-Chun Liu
Department of Accounting, National Taiwan University

Xiang-Yu Huang
Department of Accounting, National Taiwan University

Nian-Zu Yeh*
Department of Accounting, National Taiwan University

Received 30 December 2024; accepted 22 May 2025

Abstract

The purpose of this study is to investigate the ability of relative sustainability rankings of firms to predict future sustainability performance and to address the limitations of the current sustainability scoring methodology in terms of accuracy and stability. Relative sustainability rankings are assessed through a combination of relative rankings and absolute scores of firms within an industry or group, which can effectively mitigate the confusion caused by disagreements between different rating agencies and fill the gap left by using only a single measure for cross-industry comparisons. Using data from Refinitiv 2004-2023, this study empirically demonstrates that a firm's relative sustainability ranking in the previous year is a stable predictor of its future sustainability performance, and this result remains significant after controlling for prior performance. Further incorporation of sustainability controversies reveals that while relative rankings have predictive power, relative sustainability rankings will predict future performance in the opposite direction in the presence of sustainability controversies. This study also examines how financial characteristics interact with relative rankings, providing insights for capital market participants.

Keywords: Relative ranking; ESG scores; Sustainability

* Correspondence author, address: No. 1, Sec. 4, Roosevelt Rd., Taipei 106319, Taiwan (R.O.C.). Tel: (02)3366-1136, E-mail: d09722001@ntu.edu.tw; The authors acknowledge the helpful comments of the editor and two anonymous reviewers, and take sole responsibility for their views.

臺灣人文社會學術期刊資料庫

1. Introduction

This study explores the predictive validity of firms' relative sustainability rankings for future sustainability performance, addressing a critical gap in existing sustainability evaluation frameworks. The rankings are constructed by assigning firms to tiers based on both their relative standing within peer groups and overall firms, thereby reducing variability and structural biases inherent in raw ESG scores (Drempetic et al. 2020; Refinitiv 2021; Christensen et al. 2022). Given the documented divergence among ESG rating agencies (Berg et al. 2022), relying on a single score may fail to adequately reflect sustainability risks and opportunities (Edmans 2011; Boffo and Patalano 2020; Gibson 2021), particularly in cross-industry analyses (Khan et al. 2016). This study investigates whether relative rankings provide a more stable and insightful metric for capital market participants.

The sustainability relative ranking of companies is compared based on industry or overall firms. Firms may have different levels of regulation depending on the industry they belong to (North 1990), and different industries correspond to different industry structures (McGahan and Porter 2003). On the other hand, cross-industry comparisons may be affected by cultural differences among firms (Gordon 1991), which also lead to discrepancies between firms and their comparators. Therefore, it is worthwhile to examine the underlying groupings on which firms' relative rankings are based. For example, the Carbon Disclosure Project (CDP) is a global non-profit organization established in 2000. CDP's main function is to collect, manage, and disclose data from companies and cities on environmental issues such as climate change, water security, and forest management.[1] CDP reports indicate that inclusion in the A List helps companies outperformed market peers by an average of 6% in stock gains (CDP 2025). The result suggests that companies' sustainability strategies do not necessarily aim to maximize absolute sustainability performance at all costs but rather focus on enhancing relative performance to differentiate themselves from competitors or peers. Therefore, this study aims to inform the capital market about the importance of relative sustainability rankings. Although absolute ESG scores already exist for measurement, failing to compare companies within their industry or across the overall market may lead to

[1] CDP rates companies based on their performance, using scores ranging from A, A-, B, B-, C, C-, to D and D-. According to recent statistics, approximately 22,400 companies are assessed, but only about 2% are recognized as top-tier performers in the A List (CDP 2025). For example, in 2023, Taiwanese companies such as Formosa Plastics Corporation and Delta Electronics were included in the A List.

臺灣人壽保險股份有限公司

misestimating their performance (Drempetic et al. 2020).

In capital markets, sustainability increasingly becomes an essential factor in investment strategies (Douglas et al. 2017). Prior research points out the limitations of using ESG scores as direct measures of sustainability performance (Berg et al. 2022) and also highlights the advantages of alternative methods, such as relative sustainability rankings. For instance, analysts and investors perceive a firm's relative sustainability performance through various signals (Zheng et al. 2023). The effectiveness of corporate governance relative rankings as indicators of stock market risk is demonstrated (Wu et al. 2020), and firms with higher relative sustainability rankings tend to achieve greater abnormal returns over the long term (Chen et al. 2020). From the perspective of strategic development, firms tend to achieve better economic outcomes when they demonstrate stronger relative sustainability performance (Eccles et al. 2014; Baldini et al. 2018; Awaywsheh et al. 2020). Firms, on the other hand, likely continue the effects of prior relative performance (Greve 1998; Greve 2003; Chen and Miller 2007) and likely improve future sustainability performance based on behavioral continuity theory and relative target-setting mechanisms. In subsequent sections, this study seeks to clarify the relationship between relative rankings and future absolute performance. If this relationship holds, this study provides evidence for capital market participants that relative rankings, in addition to absolute performance indicators, mitigate rating agency disagreements. More importantly, the validity of relative rankings provides a robust benchmark for evaluating corporate sustainability performance.

The theoretical foundation of this study is based in behavioral persistence theory, which suggests that past success reinforces organizational routines and collective beliefs, increasing the likelihood that firms persist in these practices over time (Greve 2003; March 1981; Feldman and Pentland 2003). When firms consistently benefit from high relative rankings, they are more likely to integrate sustainability practices into their corporate culture, strategy, and resource allocation (Waldman et al. 2006; Linnenluecke and Griffiths 2010; Roper and Hewitt-Dundas 2008). Empirical evidence shows that firms with superior ESG performance achieve better future valuations and operational outcomes (Awaysheh et al. 2020), supporting the proposition that prior ESG success creates both capabilities and incentives for continued sustainability engagement. At the same time, this research acknowledges that relative rankings and ESG scores are not immune to external shocks such as sustainability controversies or managerial influences. Prior literature suggests that managerial overconfidence or narcissism reduces the effectiveness of

臺灣人文學術期刊資料庫

sustainability initiatives (Tang et al. 2015; Petrenko et al. 2016), and high-profile corporate crises (e.g., Volkswagen, BP) illustrate that strong past performance does not guarantee future sustainability outcomes (Jong and van der Linde 2022). Therefore, this study also incorporates sustainability controversy data to capture both upward and downward predictive effects, providing a more balanced assessment.

The Refinitiv database combines industry-adjusted sustainability metrics and corporate sustainability controversies to calculate a company's final ESG Combined Score (ESGC Score) and also retrospectively adjusts previous ESGC Scores based on sustainability controversies identified in the subsequent two years (Refinitiv 2021). In addition, the Refinitiv database features in several recent articles (Wang 2023; Amiraslani et al. 2024; Lin et al. 2024), prompting this study to analyze the relationship between relative rankings and future performance using Refinitiv data from 2004 to 2023, thereby providing insights to aid decision-making in the capital markets. The empirical findings indicate a strong association between firms' prior-year relative rankings and their subsequent sustainability performance.

Furthermore, while past performance may influence the relationship between rankings and future performance, the results remain significant even when controlling for historical performance and rankings. This study uses a more detailed approach to relative rankings and consistently finds a stable relationship between relative rankings and future performance, regardless of the level of breakdown. Beyond the main results, this study also incorporates sustainability controversy data from the Refinitiv database. This test reveals additional downward predictive effects, complementing the upward predictive power found in the main test by accounting for inevitable sustainability controversies. Additionally, this study examines how firms' financial characteristics influence the ranking-performance relationship.

This study contributes to the literature in three key ways. First, as sustainability garners increasing public attention, capital markets integrate corporate sustainability performance into investment strategies (Eccles and Klimenko 2019; Boffo and Patalano 2020; Berg et al. 2021). While sustainability scores are directly available, different rating agencies assign varying scores to the same firms (Berg et al. 2021; Berg et al. 2022). By demonstrating that relative rankings exhibit similar trends regardless of whether firms receive high or low scores from different rating agencies, this study provides capital market participants with an alternative metric for evaluating firms' sustainability execution. Compared to traditional absolute scores, which are influenced by asset scale and other factors (Artiach et al. 2010), relative

臺灣大學學術期刊資料庫

rankings offer an additional benchmark for assessing corporate sustainability performance.

Second, when assessing firms' relative rankings, it is essential to consider the ranking framework's hierarchical level, as different levels exert distinct influences on firms. Specifically, variations in industry structures and regulatory environments (North 1990), as well as differences in corporate cultures and internal resources, come into account. For capital market participants looking to incorporate multiple firms into an investment portfolio and use relative rankings as a key evaluation metric, this study underscores the importance of considering firms' relative standings across different hierarchical levels to obtain the most accurate assessments. Meanwhile, this study analyzes the degree of discrepancy between the high/low relative rankings of different rating agencies (Berg et al. 2022). Through decile analysis, this study finds that the correlation between the rankings of different rating agencies and their future performance remains robust, which addresses the literature's argument on the discrepancy of rating agencies.

Finally, considering the impact of negative sustainability incidents (Tamayo-Torres et al. 2019) and managerial factors identified in prior studies (Tang et al. 2015), this study finds that unforeseen operational disruptions or extreme weather events inversely support the association between relative ranking and future sustainability performance. This means that in addition to providing upward predictive power for firm performance in the capital market, this study also captures downward predictive effects driven by controversial events. This study's analysis of sustainability controversies helps bridge the gap in the existing literature and clarify the link between relative rankings, sustainability controversies, and future performance. Previous literature often analyzes only a single type of controversy (Minor and Morgan 2011; Yu et al. 2020; Flammer 2021).

This study is structured as follows: Chapter 2 reviews existing literature and establishes the hypotheses. Chapter 3 outlines the research methods and criteria for sample selection. Chapter 4 focuses on presenting and interpreting the findings. Chapter 5 offers robustness and additional tests, and Chapter 6 concludes, summarizing key takeaways.

2. Hypotheses development

The concept of sustainability first gains prominence in the 1970s, highlighted by the United Nations' Conference on the Human Environment held in Stockholm, Sweden. This event brings global attention to environmental issues, laying the

臺灣大學學術期刊資料庫

foundation for subsequent developments in sustainability discourse. A pivotal moment occurs in 2004 when UN Secretary-General Kofi Annan urges the integration of ESG principles into capital markets, which leads to a paradigm shift in investment strategies. This initiative spurs the development of ESG-focused asset management and brokerage services. While sustainability remains a subject of debate, it demonstrates considerable academic and practical value, particularly in investment methodologies. Prominent asset management firms, including BlackRock and Vanguard, incorporate ESG considerations into their investment decisions, underscoring the role of corporate sustainability in long-term investment strategies (Eccles and Klimenko 2019; Boffo and Patalano 2020; Berg et al. 2021). Empirical evidence suggests that strong ESG performance enhances firms' competitiveness and financial outcomes (Kotsantonis and Serafeim 2019). Despite persistent challenges related to data quality and standardization, the broad adoption of ESG scores, their established connection to financial returns, and the focus on key sustainability issues underscore their growing importance in current research and practice.

Assessing corporate performance within capital markets is a crucial aspect of investment decision-making. Performance feedback models serve as a means of evaluating whether a firm's performance merits investment (Cyert and March 1963; Alessandri and Pattit 2014; Lee and Yang 2022). Prior studies employ ESG scores as an investment strategy indicator, further illustrating the increasing significance of corporate sustainability in public discourse (Eccles and Klimenko 2019). However, corporate sustainability performance may be influenced by various financial characteristics, which introduce measurement biases. Employing relative rankings rather than absolute scores improves the accuracy of performance assessments (Drempetic et al. 2020). Additionally, market participants are capable of interpreting firms' relative rankings as potential investment signals (Ding et al. 2016; Wu et al. 2020; Zheng et al. 2023). Relying solely on ESG scores from different agencies leads to divergent investment conclusions (Berg et al. 2022), as investors are often more concerned with whether a firm performs relatively better than its peers rather than its absolute sustainability score (Edmans 2011). In summary, while ESG scores are widely used as performance indicators, the potential of relative rankings as a complementary measure supports their use in investment assessments.

If a firm achieves a relatively superior sustainability ranking and derives tangible benefits from it (Awaysheh et al. 2020), behavioral persistence theory provides a theoretical foundation to explain why firms continue such practices over

臺灣人壽學術期刊資料庫

time. Behavioral persistence theory argues that past success reinforces organizational routines, decision rules, and collective beliefs, making organizations more likely to repeat the same strategies in the future (Greve 2003; Greve 2008). Success generates cognitive commitment and enhances cognitive efficiency, reinforcing the perceived legitimacy of existing practices (March 1981; Feldman and Pentland 2003). For instance, when firms consistently benefit from high relative rankings, they likely embed sustainability practices into their corporate culture, organizational structures, and strategic frameworks (Waldman et al. 2006; Linnenluecke and Griffiths 2010). This persistence is not limited to symbolic actions; it involves substantial resource commitments and long-term investments in sustainability (Roper and Hewitt-Dundas 2008; Bartoloni 2012). Empirical research supports this mechanism. For example, Awaysheh et al. (2020) show that firms with superior ESG performance achieve higher future valuations and operational performance, suggesting that prior ESG success creates both incentives and capabilities for persistence. Greve (1998) also demonstrates that firms tend to continue prior behaviors when they meet or exceed performance targets, a pattern that holds across industries and organizational types. Overall, behavioral persistence theory provides a useful lens to understand why firms with strong past sustainability performance are likely to sustain and even amplify these efforts over time.

Past literature suggests that when firms perform better relative to others in sustainability, firms will have better financial performance and attract long-term investors in the future (Eccles et al. 2014), firms will have higher operating performance and relative valuation (Awaysheh et al. 2020), and higher analyst attention (Baldini et al. 2018). Furthermore, relative rankings can mitigate the influence of external environmental factors on performance evaluations, enabling firms to assess their internal performance more accurately by comparing themselves to industry peers (Aranda et al. 2014). Synthesizing prior literature, firms tend to achieve better future economic outcomes when they have demonstrated stronger relative sustainability performance in the past. This study suggests that firms are motivated to continue their previous efforts and set goals, and that firms can use “relative target setting” to enhance the strategic consideration of relative sustainability rankings in their decision-making (Greve 1998; Chen and Miller 2007), leading to improved future economic and sustainability outcomes driven by strong past relative sustainability performance. In the example of CDP, market participants assess whether a company’s performance is strong enough to be rated as a relatively outstanding A List member. The CDP report states that about 2% of approximately

臺灣人文與藝術期刊資料庫

22,400 companies become part of the A List, and these relatively high-performing companies achieve stock returns that are 6% higher compared to non-A List members (CDP 2025). This study uses practical examples to demonstrate that companies with strong past relative performance can subsequently obtain additional returns.

Nevertheless, both ESG scores and relative sustainability rankings can fluctuate due to unexpected controversies or managerial influences. Prior research shows that managerial overconfidence may lead to underestimating sustainability risks, while narcissistic CEOs often pursue symbolic CSR for image rather than substance, undermining ESG outcomes (Hirshleifer et al. 2012; Tang et al. 2015; Petrenko et al. 2016). Other characteristics, such as CEO political ideology, temporal focus, and risk aversion, alongside organizational-level drivers such as competitiveness, seeking legitimacy, and ecological responsibility, have been shown to jointly shape sustainability decisions and performance (Bansal and Roth 2000; Chin et al. 2013). For example, liberal-leaning or long-term-oriented CEOs are more inclined to invest in CSR, while risk-averse managers may avoid ESG initiatives with uncertain payoffs. Empirical studies highlight that managerial traits affect not only resource allocation but also corporate culture and stakeholder relationships (McCarthy et al. 2017; Zhang et al. 2020), making them key factors in explaining why past ESG rankings may not always predict future sustainability performance. Additionally, sustainability risks, such as labor exploitation and adverse environmental impacts, can further diminish corporate sustainability performance (James and Wooten 2005; Williams et al. 2017; Tamayo-Torres et al. 2019; Lin et al. 2021). While previous studies suggest that capital markets incorporate relative rankings as part of investment strategy development, managerial factors and external uncertainties may still disrupt the link between past and future sustainability performance. This study aims to empirically investigate whether firms' relative sustainability rankings can serve as a reliable investment metric.

In addition to academic research, real-world cases also highlight the limitations of relying on relative rankings in investment decisions. High-profile cases, such as Volkswagen and BP, underscore the unpredictable nature of corporate sustainability trajectories (Jong and van der Linde 2022). Despite initially strong sustainability performances, both companies experience significant deviations from their projected trajectories. Moreover, while up to 90% of executives acknowledge the importance of sustainability to their businesses, only 60% implement sustainability-related strategies (Rafi 2022). By integrating both supportive and critical perspectives, this

臺灣大學學術期刊資料庫

study seeks to provide academia and industry with a nuanced evaluation of the applicability of relative rankings as a reference metric.

Among corporate groups, different hierarchical levels have different influences on firms and the criteria used for benchmarking. First, industries are subject to differing levels of regulatory oversight (North 1990). Although rating agencies adjust ESG scores based on industry characteristics, the final ratings are not always comparable across industries (Berg et al. 2022). Additionally, industry structure and market competition significantly affect corporate performance, with industry-level factors serving as key determinants of firm behavior (McGahan and Porter 1997; Hawawini et al. 2003; McGahan and Porter 2003). Second, at the firm level, variations in internal resources (Barney 1991) and firm heterogeneity contribute to performance differences (Schmalensee 1985; Rumelt 1991). Furthermore, when conducting cross-industry comparisons, cultural disparities among firms are substantial (Gordon 1991). Thus, this study argues that corporate relative sustainability rankings should be evaluated across different hierarchical levels. On one hand, firms operating within similar environments exhibit distinct sustainability performances, and absolute ESG scores fail to fully capture a firm's standing relative to the market (Baldini et al. 2018). On the other hand, comparing firms across hierarchical levels offers capital markets more detailed insights, guiding investors in determining the appropriate hierarchical level for relative ranking analysis in investment strategies. Therefore, in view of the assessment through the relative performance of the firms and the uncertain sustainability behavioral continuity, the hypotheses established in this study are as follows:

Hypothesis 1a: There exists an association between a firm's relative sustainability position within its industry peer group and its subsequent sustainability performance.

Hypothesis 1b: There exists an association between a firm's relative sustainability position across all firms and its subsequent sustainability performance.

3. Data and research design

3.1. Data

This study primarily utilizes corporate sustainability data from the Refinitiv database, covering the sample period from 2004 to 2023. The starting year of 2004

臺灣人文與學術期刊資料庫

is chosen because, although Refinitiv begins providing ESG scores in 2003, the data for that year remains incomplete. Financial characteristics of firms are obtained from the COMPUSTAT database, which collects financial information on North American firms over the same period. Finally, given that market participants actively influence the ESG behavior of firms (Jo and Harjoto 2011; Dimson et al. 2015; Chen et al. 2020), we obtain from LSEG and LSEG IBES the percentage of institutional holdings as well as the number of analysts who issue forecasts for firms in the current year.

The selection of U.S. and Canadian firms allows access to earlier sustainability data, enabling a longer sample period and facilitating a more granular analysis through a by-year regression model. Additionally, market participants in the United States and Canada have a long-standing practice of incorporating corporate sustainability performance into investment strategies, leading to a stronger market response to sustainability-related factors. As Taiwan establishes a roadmap for future sustainability policies and witnesses increasing recognition and emphasis on corporate sustainability, findings based on mature markets like the U.S. and Canada provide insights for potential adjustments to investment strategies in Taiwan's capital markets. Although the sample size from Canada is relatively small, this study re-examines the hypothesized results with samples from different countries in the future to mitigate the possibility that empirical results are influenced by cultural differences or extreme factors in some countries.

Table 1 presents the sample selection process. Firms in the financial and insurance industries, classified under SIC codes between 6000 and 6799, are excluded, as are firms lacking consecutive-year observations. These selection criteria result in a final sample of 9,194 firm-year observations. To mitigate the influence of extreme values, data processing includes winsorization at the 1% and 99% levels.

Table 1 Sample selection

Criteria	Sample
Compustat merged sample (2004-2023)	263,642
Companies operating in the financial industry	(93,829)
Data requirements	(50,917)
Without ESG data	(107,241)
Without institutional holdings and number of analyst data	(1,935)
Without dynamic data	(526)
Final Sample	9,194

臺灣大學學術期刊資料庫

3.2. Research design

This study follows the regression models established by Artiach et al. (2010) and Li et al. (2024) to structure the control variables and the primary empirical model. Specifically, this study examines whether a firm's sustainability performance in a given year surpasses the median performance of its industry peers or the overall corporate landscape, thereby testing the proposed hypotheses. Additionally, it analyzes whether a firm's past relative ranking is associated with its future sustainability performance. Although Artiach et al. (2010) primarily investigated the determinants of ESG performance, which differs from the objective of this study, this study adopts the following regression model to test the hypotheses:

$$\begin{aligned} ESGCScore_{it} = {} & \beta_0 + \beta_1 Ind_abvM\,(All_abvM)_{it-1} + \beta_2 SIZE_{it} \\ & + \beta_3 GROWTH_{it} + \beta_4 CASH_{it} + \beta_5 RD_{it} + \beta_6 ROA_{it} \\ & + \beta_7 MTB_{it} + \beta_8 LEV_{it} + \beta_9 SGA_{it} + \beta_{10} PPETA_{it} \\ & + \beta_{11} Institution_{it} + \beta_{12} Analyst_{it} + \beta_{13} RelativeSIZE_{it} \\ & + \beta_{14} GDP_{ct} + \sum Industry\ FE + \sum Year\ FE + \varepsilon_t \end{aligned} \tag{1}$$

The key independent variable in this study is Ind_abvM_{it-1}, which indicates whether a firm's sustainability performance in year $t-1$ exceeded the industry median. If the firm performed above the median, it is assigned a value of 1; otherwise, it is assigned a value of 0. Similarly, All_abvM_{it-1} denotes whether a firm's sustainability performance in year $t-1$ exceeded the median performance of all firms in the dataset for that year, using the same binary coding approach. The dependent variable, $ESGCScore_{it}$, represents the firm's ESG Combined Score in year t. This study investigates the relationship between relative sustainability rankings and future sustainability performance while controlling for year effects and two-digit SIC industry classifications. All variable definitions are provided in Appendix A. Although the Refinitiv database adopts the Thomson Reuters Business Classification (TRBC) for industry categorization, prior research shows that not only SIC but also the Fama-French industry classifications have been combined with the ratings produced by ESG rating agencies (Wang 2023; Amiraslani et al. 2024; Lin et al. 2024). This study acknowledges the potential limitations of using the SIC classification, such as its relatively static nature, its weaker ability to capture emerging industries, and its primary focus on production activities rather than market-oriented characteristics (Clarke 1989). However, given that this study subsequently cross-validates its findings with other databases, it is necessary to

臺灣人文學學術期刊資料庫

adopt a widely recognized industry classification to ensure consistency in the analysis (Roll 1992). Furthermore, regulatory and statistical institutions such as the SEC continue to use SIC as the official industry standard for reporting and data collection purposes (SEC 2025). This underscores the continued relevance of SIC-based groupings in empirical and policy-aligned research.

This study includes several control variables based on prior literature to account for firm-specific characteristics that may influence sustainability performance. First, firm size ($SIZE_{it}$) and the ratio of property, plant, and equipment to total assets ($PPETA_{it}$) are controlled, as previous studies suggest that larger firms and those with greater tangible assets tend to exhibit stronger sustainability engagement (Brammer and Millington 2006). Additionally, sales growth ($GROWTH_{it}$) and profitability (ROA_{it}) are included, as firms experiencing higher growth and greater profitability are more likely to engage in corporate philanthropy (Petrovits 2006). Moreover, research and development intensity (RD_{it}) is controlled. This study also controls for market-to-book ratio (MTB_{it}), which serves as a proxy for investment efficiency and has been shown to mitigate moral hazard and adverse selection frictions among investors (Biddle et al. 2009). However, certain financial constraints and risk factors, such as selling, general, and administrative expenses (SGA_{it}), leverage (LEV_{it}), and cash holdings ($CASH_{it}$), have been found to negatively affect ESG scores (Humphrey et al. 2012). Since market participants actively influence firms' ESG behaviors (Jo and Harjoto 2011; Dimson et al. 2015; Chen et al. 2020), this study controls for the average end-of-quarter holdings ratio of institutions in the current year ($Institution_{it}$) as well as the number of analysts who have made forecasts on firms in the current year ($Analyst_{it}$). To further address industry heterogeneity in corporate sustainability performance (Orlitzky et al. 2003), this study incorporates industry-adjusted firm characteristics, including relative size ($RelativeSIZE_{it}$). Additionally, GDP (GDP_{ct}) is controlled to account for the potential influence of macroeconomic conditions on firms' sustainability behavior.

Unlike Artiach et al. (2010), this study includes additional controls related to resource allocation and asset composition ($CAPEX_{it,}$ $PPETA_{it}$) to capture firms' capital investment decisions. Furthermore, given that innovative firms are more likely to engage in green innovation, RD expenditures are explicitly controlled. Lastly, since firms with higher SGA expenses (SGA_{it}) may allocate more resources to sustainability-related marketing and management, this study accounts for relative firm characteristics ($RelativeSIZE_{it}$) and macroeconomic (GDP_{ct}) factors to mitigate the risk of omitted variable bias.

臺灣大學學術期刊資料庫

4. Results

4.1. Descriptive statistics

Table 2 Panel A shows the results of the descriptive statistics of ESG scores. The average ESG Combined score obtained by the sample is 42.485, ranging from a minimum of 7.870 to a maximum of 81.608. The mean value of the focus variable for industry and overall corporate landscape relative performance is around 0.5. The slight deviation is due to the exclusion of firms that lacked data for two consecutive years. The Refinitiv database contains ESG Combined scores adjusted for sustainability issues and ESG scores before sustainability issues were adjusted, as well as environmental, social, and governance scores, which will be used to analyze the overall performance of the firms more comprehensively in the following analysis. The ESG Combined score will be used in subsequent analyses to analyze sustainability behaviors in a more holistic manner.

The average size ($SIZE_{it}$) of the firms is 8.272, which is slightly higher than the previous study using Russell 1000, 2000 (Darendeli et al. 2022). The results for the remaining control variables are $GROWTH_{it}$ (1.093), $CASH_{it}$ (0.145), RD_{it} (0.046), MTB_{it} (3.180), LEV_{it} (0.523), SGA_{it} (0.252), ROA_{it} (0.047), and $PPETA_{it}$ (0.396) respectively, and the sizes of these control variables are also similar to previous studies. In addition, this study controls the firm size ($RelativeSIZE_{it}$) relative to the industry in order to mitigate excessive heterogeneity affecting the industry as a whole if the firms themselves are among the top performers in the industry. Additionally, the average institutional ownership ratio at the end of each quarter in our sample was 76.6%, and each company had an average of about seven analysts forecasting the company's financial condition.

臺灣大學學術期刊資料庫

Table 2 Panel A Summary statistics (focal variables)

Variable	Mean	Std	Min	25%	50%	75%	Max
$ESGCScore_{it}$	42.485	17.532	7.870	28.751	40.909	55.318	81.608
$ESGScore_{it}$	44.670	19.030	7.885	29.398	42.857	59.091	85.667
$CONSScore_{it}$	87.219	26.392	4.487	98.096	100.000	100.000	100.000
$ENVScore_{it}$	33.029	27.374	0.000	6.265	29.905	55.766	89.639
$SOCScore_{it}$	46.776	21.684	6.139	29.463	44.260	62.968	92.733
$GOVScore_{it}$	51.190	21.405	4.481	34.390	52.298	68.367	91.987
$\Delta ESGCScore_{it}$	1.905	8.571	-43.791	-2.171	0.968	5.690	52.120
Ind_AbvMi_{t-1}	0.519	0.500	0.000	0.000	1.000	1.000	1.000
All_AbvMi_{t-1}	0.545	0.498	0.000	0.000	1.000	1.000	1.000
$Ind_Percent_{it-1}$	5.467	2.884	1.000	3.000	6.000	8.000	10.000
$All_Percent_{it-1}$	5.822	2.847	1.000	3.000	6.000	8.000	10.000
$\Delta Ind_Percent_{it,t-2}$	2.559	19.988	-75.397	-7.633	0.601	13.190	91.667
$\Delta all_Percent_{it,t-2}$	3.609	17.975	-61.332	-5.854	2.083	13.292	83.525
$SIZE_{it}$	8.272	1.494	3.889	7.310	8.209	9.179	12.188
$GROWTH_{it}$	1.093	0.220	0.484	0.994	1.066	1.155	2.797
$CASH_{it}$	0.145	0.141	0.000	0.042	0.098	0.202	0.772
RD_{it}	0.046	0.079	0.000	0.000	0.006	0.058	0.958
ROA_{it}	0.047	0.085	-0.615	0.018	0.052	0.089	0.280
MTB_{it}	3.180	1.979	0.335	1.695	2.658	4.177	9.995
LEV_{it}	0.523	0.184	0.089	0.405	0.539	0.654	0.988
SGA_{it}	0.252	0.178	0.013	0.114	0.216	0.346	0.989
$PPETA_{it}$	0.396	0.264	0.005	0.177	0.333	0.593	1.000
$Institution_{it}$	0.766	0.229	0.000	0.700	0.839	0.919	0.992
$Analyst_{it}$	6.248	4.603	1.000	3.000	5.000	9.000	22.000

All variables are described according to the table of variable definitions. All variables are winsorized at the 1st and 99th percentiles

In the untabulated results, this study analyzes the differences between U.S. and Canadian firms at the headquarters. U.S. firms have a sample size of 8,785, while Canadian firms have a sample size of 409. U.S. firms are larger and have higher RD expenses, better profitability, and higher MTB and SGA. Canadian firms are less likely to have sustainability concerns in Controversy scores, but U.S. firms have higher ESG scores than Canadian firms on average across all ESG scores.

Table 2 Panel B provides descriptive statistics of the sample by year. The sample size is relatively small until 2016 due to early data collection difficulties and incomplete standardization. However, this study tests the hypothesis in the empirical results through year-by-year regression, and the hypothesis is almost always confirmed based on the samples of different years in this study. Through by year regression, this study also indirectly controls for the effects of major economic events or sustainability regulation changes that occurred during the sample period, as the hypothesis is supported by the samples from different years. Even if a major economic event or a change in sustainability regulations occurs, it does not affect the study's conclusion that relative rankings are a good measure for guiding capital market decisions.

臺灣大學學術期刊資料庫

Table 2 Panel B Summary statistics (control variables)

Year	Observation
2004	85
2005	128
2006	157
2007	178
2008	204
2009	280
2010	373
2011	389
2012	418
2013	404
2014	378
2015	345
2016	526
2017	707
2018	734
2019	775
2020	793
2021	773
2022	795
2023	752
Total	9194

This table presents the sample distribution for 2004-2023.

The correlations between the variables are shown in Table 2 Panel C. The positive correlation between the focal variables and the ESG composite scores provides initial evidence of the predictive nature of historical relative rankings of future sustainability performance. Because the main test variables in this study are also derived from changes in sustainability performance, significant correlation with each other cannot be avoided. However, in the VIF check of the main test results, the VIFs of $Ind_AbvM_{it\text{-}1}$ and $All_AbvM_{it\text{-}1}$ are 2.85 and 3.00, respectively, which initially mitigates the concern of a high degree of covariance. In addition, the proportion of fixed assets to total assets is not correlated with industry relative ranking because, with the difference of industries, high capital-intensive industries have a positive and significant effect on firms' sustainability (Clarkson et al. 2008), but the correlation between PPETA and industry relative ranking may not be available in the averaging results of each industry. The difference between fixed assets to total assets and sales growth may be due to the fact that with the advent of digitization, high-growth firms have become more reliant on intangible assets (David 1990). In addition, the association between RD and sustainability is currently mixed, as RD intensity may increase green innovation to improve sustainability performance (Padgett and Galan 2010), or it may make sustainability difficult due to

臺灣大學學術期刊資料庫

resource constraints caused by innovation (Lys et al. 2015). Previous findings in the literature that there may be no significant correlation between RD and growth rates (Coad and Rao 2008), that RD-intensive firms typically have fewer assets (Hsu et al. 2014), and that firms with higher RD typically have higher cash reserves (Falato et al. 2022) support the results of the correlation matrix in which RD is associated with other variables.

Among other control variables, this study finds that ESG scores decrease as the firm's share of cash increases. Previous studies have found that firms do not invest sustainably even when they hold cash when their governance is weak, and firms with poorer sustainability performance often need to retain cash for financial uncertainty (Harford et al. 2008; Benlemlih 2017). Second, leverage is positively and significantly correlated with ESG scores because sustainable performance reduces capital market constraints, and highly leveraged firms have an incentive to improve their sustainability performance to obtain favorable lending terms, and it also serves to reduce the cost of capital (Dhaliwal et al. 2011; Goss and Roberts 2011). Highly sustainable firms have more efficient spending, and long-term oriented strategies, all of which may account for the negative significant correlation between SGA and sustainability (Albuquerque et al. 2019). Finally, as previous literature suggests that market participants actively influence firms' ESG behaviors (Jo and Harjoto 2011; Dimson et al. 2015; Chen et al. 2020), this study finds that both the institutional investor ownership ratio and the level of analyst interest are positively and significantly related to firms' sustainability performance.

It is also worth noting that while there is often a high correlation between pre- and post-ESG scores, this does not guarantee that a firm's sustainability performance will remain stable. Past research and practice examples suggest that companies may experience dramatic fluctuations in ESG performance due to sudden sustainability disputes, extreme weather events, or managerial characteristics (Tang et al. 2015; Petrenko et al. 2016; Jong and van der Linde 2022). For example, overconfidence or symbolic CSR strategies by senior managers may undermine the tangible effects of sustainability investments, while major negative events may immediately pull down ESG ratings. These factors suggest the need to be cautious about the stability of variables even when their correlation coefficients are at significant levels. Therefore, empirically examining the predictive validity of past relative rankings for future ESG performance would provide more complete evidence for this study to assess their long-term validity.

臺灣大學學術期刊資料庫

Table 2 Panel C Pearson correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. $ESGCScore_{it}$	1.00																
2. $ESGCScore_{it-1}$	0.88***	1.00															
3. Ind_AbvM_{it-1}	0.67***	0.74***	1.00														
4. All_AbvM_{it-1}	0.72***	0.80***	0.78***	1.00													
5. $SIZE_{it}$	0.42***	0.43***	0.36***	0.38***	1.00												
6. $GROWTH_{it}$	-0.10***	-0.12***	-0.09***	-0.10***	-0.06***	1.00											
7. $CASH_{it}$	-0.11***	-0.11***	-0.09***	-0.10***	-0.26***	0.03***	1.00										
8. RD_{it}	-0.01	-0.00	0.00	-0.01	-0.10***	0.00	0.51***	1.00									
9. ROA_{it}	0.12***	0.11***	0.08***	0.10***	0.17***	0.15***	0.05***	-0.14***	1.00								
10. MTB_{it}	0.07***	0.07***	0.05***	0.06***	-0.02*	0.07***	0.23***	0.19***	0.29***	1.00							
11. LEV_{it}	0.15***	0.15***	0.13***	0.13***	0.35***	-0.10***	-0.45***	-0.31***	-0.21***	0.05***	1.00						
12. SGA_{it}	-0.09***	-0.08***	-0.07***	-0.08***	-0.26***	-0.01	0.46***	0.66***	-0.21***	0.22***	-0.29***	1.00					
13. $PPETA_{it}$	0.06***	0.06***	0.02	0.06***	0.06***	-0.06***	-0.22***	-0.30***	0.02**	-0.12***	0.11***	-0.36***	1.00				
14. $Institution_{it}$	0.13***	0.14***	0.15***	0.15***	0.50***	0.01	0.13***	0.17***	0.14***	0.09***	-0.06***	0.03***	0.03**	1.00			
15. $Analyst_{it}$	0.14***	0.13***	0.12***	0.11***	0.05***	-0.09***	0.04***	0.09***	0.09***	0.10***	0.05***	0.06***	-0.22***	0.01	1.00		
16. $RelativeSIZE_{it}$	-0.04***	-0.05***	-0.09***	-0.00	0.14***	-0.01	-0.14***	-0.23***	0.06***	-0.02	0.10***	-0.19***	0.21***	0.10***	-0.04***	1.00	
17. GDP_{it}	0.12***	0.15***	0.07***	0.05***	-0.10***	-0.00	0.04***	0.09***	-0.10***	0.04***	0.04***	0.13***	-0.17***	-0.28***	0.44***	-0.24***	-0.24***

This table shows the pairwise Pearson correlation table for the regression model. Asterisks indicate significant correlations. All variables are winsorized at the 1st and 99th percentil

學術期刊資料庫

4.2. Empirical results

Table 3 Panel A shows the results of the main test to examine whether firms' relative sustainability rankings can predict future sustainability performance. The focus variable in the first column, $Ind_abvM_{it\text{-}1}$,is positive and significant, confirming Hypothesis 1a of this study. In economic significance, for every one standard deviation change in the dependent variable, the future sustainability performance is equivalent to an increase of 9.348 points, which is also equivalent to a change of 22.000%. The results of this study suggest that the relative sustainability rankings of companies in the same industry can be used as an indicator of future sustainability performance and serve as a valuable predictor for ESG investors, fund managers, and financial institutions. Among the control variables, the positive significant relationship between $SIZE_{it}$, ROA_{it} , $PPETA_{it}$, MTB_{it} and corporate sustainability behavior is similar to the findings of previous literature. The literature reveals that financially performing firms tend to be more active in sustainability behavior (Brammer and Millington 2006; Petrovits 2006). On the other hand, the negative significant correlation between $GROWTH_{it}$ and SGA_{it} with corporate sustainability behavior suggests that firms with high growth rates may allocate most of their resources to their core business rather than satisfying external stakeholders. Finally, this study found that the higher the analyst coverage, the more likely the organization is to have better sustainability performance (Jo and Harjoto 2011).

The second column of Panel A of Table 3 examines whether future sustainability performance remains consistent if firms' performance on sustainability in the previous year exceeds the median for all firms ($All_abvM_{it\text{-}1}$). The coefficient on the focal point variable is positive and significant, confirming Hypothesis 1b of this study. In economic significance, each one standard deviation increase in the main test variable is associated with a 10.087 point change in the firm's future sustainability performance, which is equivalent to a 23.742% change. By analyzing the firms' relative sustainability rankings and future sustainability performance of all firms in the same year, this study once again provides capital market participants with an effective predictor of a firm's future sustainability performance. The third column of Panel A in Table 3 attempts to examine whether firms are affected by only one of the relative rankings when there is both individual heterogeneity and industry influence. It is found that a firm's ESGC score will be affected by the relative sustainability rankings of both the industry and overall corporate landscape's relative performance as a whole. In economic significance, for every one standard deviation change in $Ind_abvM_{it\text{-}1}$ and $All_abvM_{it\text{-}1}$, the future

臺灣大學學術期刊資料庫

performance of the firm is equivalent to a change of 4.512 and 6.625 points, which is equivalent to 10.620% and 15.594%.

To provide a comprehensive view of relative ranking analysis, this study has also examined the relationship between past relative performance and future relative performance in un-tabulated results. The findings reinforce the robustness of this study's conclusions. Regarding other possible relationships, predicting future absolute performance using past absolute performance primarily addresses the continuity of ESG performance, which is not the primary focus of this study. This study is particularly interested in whether relative rankings serve as a useful indicator for capital market participants. Furthermore, predicting future relative performance based on absolute performance is inherently problematic. Since relative rankings are determined by a firm's standing among its peers, rather than by its absolute ESG score alone, using absolute performance to forecast relative positioning may yield misleading implications. The emphasis on past relative performance influencing future absolute performance is particularly relevant for investors, as relative rankings reflect a firm's competitive sustainability positioning within its industry or the broader market. This approach helps market participants better assess long-term ESG trajectories beyond absolute ESG scores alone.

臺灣大學學術期刊資料庫

Table 3 Panel A Examination of the impact of relative sustainability performance on future sustainability behavior

	$ESGCScore_{it}$	$ESGCScore_{it}$	$ESGCScore_{it}$
Ind_AbvM_{it-1}	18.703***		9.001***
	(39.929)		(21.610)
All_AbvM_{it-1}		20.271***	13.341***
		(44.911)	(31.113)
$SIZE_{it}$	3.219***	2.898***	2.653***
	(15.805)	(14.256)	(14.029)
$GROWTH_{it}$	-3.418***	-3.092***	-2.729***
	(-5.611)	(-5.314)	(-4.876)
$CASH_{it}$	-0.869	-1.198	-0.913
	(-0.515)	(-0.735)	(-0.595)
RD_{it}	3.719	4.374	3.940
	(1.027)	(1.215)	(1.185)
ROA_{it}	11.919***	10.267***	10.236***
	(5.579)	(4.973)	(5.183)
MTB_{it}	0.308***	0.314***	0.279***
	(2.985)	(3.214)	(2.991)
LEV_{it}	-1.095	-1.110	-1.103
	(-0.772)	(-0.809)	(-0.865)
SGA_{it}	-1.240	-1.617	-1.473
	(-0.640)	(-0.837)	(-0.831)
$PPETA_{it}$	3.444***	2.969***	2.739***
	(3.340)	(2.979)	(2.964)
$Analyst_{it}$	7.653***	7.124***	6.586***
	(6.192)	(5.779)	(5.842)
$Institution_{it}$	-0.069	-0.055	-0.066
	(-1.234)	(-0.996)	(-1.272)
$RelativeSIZE_{it}$	7.685***	1.555	4.301**
	(2.943)	(0.759)	(2.128)
GDP_{ct}	-0.285***	-0.252***	-0.236***
	(-3.843)	(-3.206)	(-3.348)
Constant	7.267***	8.772***	9.597***
	(3.449)	(4.075)	(4.926)
Adj.R-squared	0.579	0.605	0.628
N	9194	9194	9194
FE:	Industry and Year	Industry and Year	Industry and Year
Cluster:	Firm	Firm	Firm

This table shows the results for hypotheses 1A and 1B which state that a company's ESG score over the next year will be positively correlated with the relative sustainability performance of its industry peers and the overall corporate landscape over the last year. All variables are described according to the table of variable definitions. This study reports the coefficients of the variables and the t-statistics in parentheses. All variables are winsorized at the 1st and 99th percentiles. *, **, and *** denote statistical significance (two-tailed) at the 10%, 5%, and 1% levels, respectively. To mitigate concerns about whether the variable selection in this study achieves the optimal level of fit, this study sequentially excludes each variable and checks the AIC/BIC values to confirm that the current model produces the minimum AIC/BIC, and that removing the main explanatory variables does not result in lower AIC/BIC values.

In the case of untabulated results, this study conducts the analysis in two parts for more detailed examination. Firstly, the test is based on a single year to mitigate the impact of sustainability-related regulatory implementation or major economic

臺灣大學學術期刊資料庫

events. Secondly, the test is conducted by analyzing the sample in two cohorts: the U.S. and Canada. In all of these tests, this study obtained the same results as the main test, and therefore it is hypothesized that the effect of either country or year is not sufficient to affect the usefulness of using relative sustainability rankings in the capital markets to measure future sustainability performance.

In view of the fact that companies invest differently in different stakeholders or strategies, the investment in sustainability sub-factors varies (Eccles et al. 2014). Based on the final ESG Score of the rating agencies, this study attempts to examine (1) corporate relative sustainability rankings and pre-adjustment scores, (2) the environmental and social outcomes, and (3) the three sub-components of the companies through the analysis of the different dimensions. The reason for considering E&S in this study is that the E&S policies of corporations enhance corporate value, and investors are concerned about the combined effect of these two dimensions, and therefore this study believes that it is necessary to analyze the sustainability performance of E&S (El Ghoul et al. 2011; Amiraslani et al. 2024).

The results of this study for different variable setups are presented in Table 3B. This study indicates that the relative sustainability rankings of the different dimensions are significantly associated with future sustainability performance, and the results are the same as the main test of this study. In conclusion, when capital market participants try to use the relative ranking of firms as a measure, they can achieve good predictive results regardless of the constructs they focus on.

臺灣大學學術期刊資料庫

Table 3 Panel B Examination of the impact of relative sustainability performance on future sustainability behavior

	$ESGScore_{it}$	$ESGScore_{it}$	$ESGScore_{it}$	$E+SScore_{it}$	$E+SScore_{it}$	$E+SScore_{it}$	$ENVScore_{it}$	$ENVScore_{it}$	$ENVScore_{it}$	$SOCScore_{it}$	$SOCScore_{it}$	$SOCScore_{it}$	$GOVScore_{it}$	$GOVScore_{it}$	$GOVScore_{it}$
$Ind_ESG_AbvM_{it-1}$	19.759***		9.651***												
	(37.974)		(22.521)												
$All_ESG_AbvM_{it-1}$		21.566***	14.347***												
		(43.558)	(33.104)												
$Ind_E+S_AbvM_{it-1}$				29.802***		13.627***									
				(43.714)		(22.574)									
$All_E+S_AbvM_{it-1}$					33.195***	22.513***									
					(50.654)	(33.601)									
$Ind_ENV_AbvM_{it-1}$							28.848***		14.645***						
							(38.384)		(24.063)						
$All_ENV_AbvM_{it-1}$								32.306***	22.135***						
								(45.033)	(33.664)						
$Ind_SOC_AbvM_{it-1}$										22.701***		11.160***			
										(38.751)		(22.569)			
$All_SOC_AbvM_{it-1}$											24.644***	16.246***			
											(42.561)	(30.967)			
$Ind_GOV_AbvM_{it-1}$													24.181***		11.021***
													(42.468)		(19.131)
$All_GOV_AbvM_{it-1}$														25.732***	17.074***
														(46.026)	(27.750)
Constant	-4.144*	-3.072	-1.097	-44.330***	-38.464***	-34.024***	-40.388***	-36.550***	-33.530***	-10.402***	-9.350***	-6.943***	28.542***	26.737***	27.301***
	(-1.729)	(-1.264)	(-0.485)	(-8.448)	(-7.536)	(-7.083)	(-11.884)	(-11.376)	(-11.036)	(-3.698)	(-3.337)	(-2.630)	(9.116)	(9.092)	(9.746)
Controls:	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R-squared	0.668	0.693	0.715	0.734	0.764	0.784	0.692	0.723	0.752	0.642	0.666	0.689	0.452	0.485	0.509
N	9194	9194	9194	9190	9190	9190	9190	9190	9190	9190	9190	9190	9194	9194	9194
FE:	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year
Cluster:	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm

This table uses raw ESG scores, environmental and social scores, and construct scores to explore whether the relative performance of the different scores share the same characteristics. All variables are described according to the table of variable definitions. This study reports the coefficients of the variables and the t-statistics in parentheses. All variables are winsorized at the 1st and 99th percentiles. *, **, and *** denote statistical significance (two-tailed) at the 10%, 5%, and 1% levels, respectively.

臺灣證券期貨資料庫

5. Robustness and additional tests

5.1. Difference in scores of other ESG databases

Given the previous literature pointing out the divergence of corporate sustainability performance among different rating agencies (Berg et al. 2022) and the doubts about the Refinitiv database scoring system (Berg et al. 2021), this study aims to alleviate concerns regarding bias in the main test results by incorporating data from different rating agencies.

Although all rating agencies claim to revise their scoring systems from time to time based on more scientific methods (Joubrel and Maksimovich 2023), previous literature still suggests that Refinitiv uses the largest number of individual sustainability indicators and emphasizes financial and economic indicators, whereas MSCI uses firm-specific risk assessments (Exposure Scores), leading to differences between MSCI and most rating agencies (Berg et al. 2022). This study anticipates that relative rankings can reduce discrepancies across different databases, thereby encouraging their broader use as a tool for investment decision-making in capital markets.

By introducing the scores of Bloomberg and MSCI, this study addresses the concern that the main test results are influenced by the Refinitiv scoring methodology, and attempts to analyze whether relative rankings can alleviate the concern of database divergence. Bloomberg and MSCI use a 10-point rating system, and the average ESG scores of the samples are MSCI 6.100 and Bloomberg 3.427, with MSCI's ESG scores derived from the S&P500 constituent for the period 2020-2022 and Bloomberg's ESG scores derived from the S&P1500 constituent for the period 2015-2022.

The results of this study are presented in Table 4, which specifically confirms the correlation between corporate relative sustainability rankings and future sustainability performance through different rating agencies. In the untabulated results, the study analyzes the correlation between future performance of other rating agencies through the sustainability rankings of the rating agencies, and finds that both high and low correlations are significant. Therefore, in Table 4, this study first rules out the doubt that the main test results are derived solely from the Refinitiv scoring standard and second confirms the robustness of the relative rankings regarding future sustainability performance through validation with different rating agencies. This, in turn, mitigates the discrepancy between different rating agencies as mentioned in the previous literature.

臺灣大學學術期刊資料庫

Table 4 Using different ESG databases

	Bloomberg_Score$_{it}$			*MSCI_Score*$_{it}$		
Ind_Bloomberg_AbvM$_{it\text{-}1}$	1.361***		0.732***			
	(19.608)		(11.090)			
All_Bloomberg_AbvM$_{it\text{-}1}$		1.514***	0.984***			
		(21.005)	(13.312)			
Ind_MSCI_AbvM$_{it\text{-}1}$				1.938***		1.176***
				(10.793)		(6.021)
All_MSCI_AbvM$_{it\text{-}1}$					2.018***	1.117***
					(10.655)	(5.404)
Constant	-0.087	0.017	0.159	9.389***	7.200***	7.720***
	(-0.186)	(0.038)	(0.369)	(4.978)	(3.679)	(4.173)
Controls:	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R-squared	0.625	0.639	0.661	0.537	0.526	0.580
N	2225	2225	2225	330	330	330
FE:	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year	Industry and Year
Cluster:	Firm	Firm	Firm	Firm	Firm	Firm

This table uses different ESG databases to validate relative sustainability performance impacts. All variables are described according to the table of variable definitions. This study reports the coefficients of the variables and the t-statistics in parentheses. All variables are winsorized at the 1st and 99th percentiles. *, **, and *** denote statistical significance (two-tailed) at the 10%, 5%, and 1% levels, respectively.

5.2. Absolute versus relative performance

To address concerns that the relationship between relative rankings and future sustainability performance may be influenced by the inertia in rating agencies' scores, this study considers controls for firms' previous year's sustainability performance. When controlling for firms' prior year sustainability performance, the first column of Table 5 still yields significant results on the association of relative ranking with future sustainability performance. By controlling for prior period ESG scores, this study finds that prior period relative sustainability rankings have a significant association with future sustainability performance in addition to prior period ESG scores, suggesting that the additional explanatory power of relative sustainability performance provides the capital market with options for measuring firms' sustainability performance over time.

Second, sustainability is not immediately reflected in market prices; rather, its effect is gradually revealed in the future (Khan et al. 2016). Alternatively, firms may adjust their sustainability behavior already in year t-1, leading to changes in sustainability performance (Lins et al. 2017). In the second column of Table 5, the study considers the cumulative effect of year t-1 versus year t-2, i.e., whether the effect remains significant when measured over a more distant time period. Even after accounting for the cumulative effect from year t-1 to t-3, the study finds that relative sustainability rankings over longer time horizons remain informative.

臺灣大學學術期刊資料庫

Table 5 Relative versus absolute performance, short term versus long term

	$ESGCScore_{it}$	$ESGCScore_{it}$	$ESGCScore_{it}$
$Ind_AbvM_{it\text{-}1}$	0.619*		
	(1.930)		
$Ind_AbvM_{it\text{-}1,t\text{-}2}$		0.727***	
		(2.982)	
$Ind_AbvM_{it\text{-}1,t\text{-}3}$			0.740***
			(3.104)
$All_AbvM_{it\text{-}1}$	0.892**		
	(2.427)		
$All_AbvM_{it\text{-}1,t\text{-}2}$		0.657**	
		(2.424)	
$All_AbvM_{it\text{-}1,t\text{-}3}$			0.707***
			(2.798)
$ESGCScore_{it\text{-}1}$	0.793***		
	(62.116)		
$ESGCScore_{it\text{-}1,t\text{-}2}$		0.399***	
		(52.035)	
$ESGCScore_{it\text{-}1,t\text{-}3}$			0.256***
			(38.902)
Constant	2.173**	4.830***	9.132***
	(2.208)	(3.856)	(5.318)
Controls:	Yes	Yes	Yes
Adj.R-squared	0.786	0.761	0.726
N	9194	7015	5519
FE:	Industry and Year	Industry and Year	Industry and Year
Cluster:	Firm	Firm	Firm

In this table, this study examines the impact of relative and absolute performance on future sustainable behavior and analyze the short-term and long-term effects. All variables are winsorized at the 1st and 99th percentiles. *, **, and *** denote statistical significance (two-tailed) at the 10%, 5%, and 1% levels, respectively. In order to examine whether the inclusion of the prior period sustainability performance resulted in an increase in model covariance, this study conducted a VIF check based on the regression results in the first column, with the following results for each variable: $Ind_AbvM_{it\text{-}1}$ (3.21), $All_AbvM_{it\text{-}1}$ (3.79), $ESGCScore_{it\text{-}1}$ (4.05), $SIZE_{it}$ (2.63), $GROWTH_{it}$ (1.21), $CASH_{it}$ (1.86), RD_{it} (2.66), ROA_{it} (1.67), MTB_{it} (1.52), LEV_{it} (2.02), SGA_{it} (3.02), $PPETA_{it}$ (1.97), Analystit (1.89), Institutionit (2.08), $RelativeSIZE_{it}$ (3.63), $GDPct$ (3.79). This study conducts a residual autocorrelation test based on the first column model to assess the influence of time-series factors on the results. The test finds a residual correlation coefficient of -0.153 with a p-value < 0.01. The negative correlation confirms that the results are not affected by strong time-series issues.

5.3. Other relative performance categories

Although Refinitiv states that the scoring process is measured based on absolute and relative criteria (Refinitiv 2021), the scores are adjusted partially based on the concept of median, so it is possible that, even though the current results support the hypothesis, the findings may still be driven by the use of the median as the main test variable.

Prior literature has stated that one should not simply draw a high/low distinction, but rather a more nuanced delineation. When ESG scores are categorized into quintiles, future risk and reward can be more accurately predicted (Amel-Zadeh and Serafeim 2018; Giese et al. 2019). Therefore, this study examines whether there is a significant change in the correlation between different relative sustainability rankings and future

臺灣大學會計期刊資料庫

sustainability performance through tertiles, quartiles, and quintiles. Table 6 shows that there is a high degree of correlation between a firm's prior relative sustainability performance and its future sustainability behavior, regardless of how the thresholds are replaced. By using these thresholds, this study highlights the stability of relative sustainability rankings in capital markets. These rankings can be flexibly adapted using thresholds aligned with specific investment strategies to achieve the most appropriate measure of the firm.

Table 6 Analysis of different relative performance thresholds

	$ESGCScore_{it}$	$ESGCScore_{it}$	$ESGCScore_{it}$
Ind_Tri_{it-1}	5.497***		
	(19.115)		
All_Tri_{it-1}	10.268***		
	(37.133)		
Ind_Qua_{it-1}		3.392***	
		(15.702)	
All_Qua_{it-1}		8.509***	
		(39.856)	
Ind_Qui_{it-1}			2.351***
			(13.228)
All_Qui_{it-1}			7.329***
			(42.099)
Constant	-5.145***	-2.000	1.416
	(-3.344)	(-1.434)	(1.095)
Controls:	Yes	Yes	Yes
Adj.R-squared	0.705	0.730	0.747
N	9194	9194	9194
FE:	Industry and Year	Industry and Year	Industry and Year
Cluster:	Firm	Firm	Firm

This table uses different classifications for the relative performance threshold setting. All variables are described according to the table of variable definitions. This study reports the coefficients of the variables and the t-statistics in parentheses. All variables are winsorized at the 1st and 99th percentiles. *, **, and *** denote statistical significance (two-tailed) at the 10%, 5%, and 1% levels, respectively.

5.4. The impact of corporate sustainability controversies on sustainability performance

In the course of a firm's operations, it is not immune to sudden extreme weather or negative sustainability events (Tamayo-Torres et al. 2019; Lin et al. 2021). This raises the question of whether sustainability controversies will act as a mechanism to reduce the association between a firm's historical relative sustainability rankings and its future sustainability performance. In column 1 of Table 7, the analysis examines whether firms experienced any sustainability controversies in the preceding year. The results indicate that firms with better industry relative performance in the previous year are more likely to experience a decrease in sustainability behavior as a result of sustainability controversies.

臺灣大學學術期刊資料庫

Secondly, given that different types of sustainability controversies have been examined in previous literature conclusions, this study similarly categorizes sustainability controversies into environmental, social or governance type controversies based on their nature. In column 2 of Table 7, the results are presented for environmental controversies. Environmental problems tend to be cumulative and difficult to ameliorate quickly, and they have cross-sectoral impacts (Flammer 2021). Therefore, this study finds that when firms experience environmental controversies, this expectation can instead be reversed, i.e., the better a firm's sustainability ranking relative to the overall firms, the worse its future sustainability performance will be. However, this study also points out that different industries pay different attention to environmental controversies, which may lead to the mixed results of the environmental controversies in the relative sustainability rankings of the industries.

Next, in Column 3 of Table 7, this study analyzes social controversies. Previous literature suggests that social controversies are more destructive than environmental controversies because they have a more direct impact on consumers and investors (Minor and Morgan 2011). Therefore, this study suggests that regardless of whether a firm's sustainability ranking is better in the industry or in the firm as a whole, the occurrence of a social controversy will lead to a negative correlation between sustainability ranking and future sustainability performance. Finally, Column 4 of Table 7 presents the analysis of governance-related controversies. While governance controversies may make it difficult for investors to identify the real corporate risks when they occur (Yu et al. 2020), this study finds that if a firm has a better industry sustainability ranking in the previous year, the occurrence of governance controversies will change the association between sustainability ranking and future sustainability performance to a negative one.

In general, while previous literature has analyzed specific sustainability debates, this study further verifies the impact of sustainability debates through the association between relative rankings and future sustainability performance.[2] Specifically, the existence of sustainability controversies still supports the predictions of relative rankings on future sustainability performance, but it is important to be aware of negative events that can turn future expectations into negative ones. One limitation this study needs to

[2] This study re-examined the results of Table 7 through the perpetual controversy that occurred at t-2 and found similar results to Table 7. This study points out that according to the Refinitiv methodology (Refinitiv 2021), firms' ESGC scores in year t will be affected by the dynamic backward adjustment of t+1 and t+2 sustainability controversies, but this study points out that inter-period sustainability controversies (t-2) will also affect firms' future sustainability performance.

臺灣人文學術期刊資料庫

point out in the testing of Table 7 is that the current public and academic understanding of sustainability controversies is incomplete (Hulme 2018). Even though this study still offers capital markets a framework for identifying negative predictive signals, it is currently only possible to observe the results with a rough categorization of the different types of controversies.

Table 7 Effect of the permanent controversy mechanism

	$ESGCScore_{it}$			
Type of Controversy:	*All*	*Environmental*	*Social*	*Government*
Ind_AbvM_{it-1}	9.332***	8.940***	9.444***	9.001***
	(21.273)	(21.167)	(21.557)	(21.278)
All_AbvM_{it-1}	13.721***	13.401***	13.689***	13.429***
	(29.805)	(30.724)	(30.239)	(30.595)
$Controversy_{it-1}$	-1.599***	-1.978	-0.911	-4.623***
	(-2.940)	(-0.806)	(-1.541)	(-5.047)
$Ind_AbvM_{it-1} \times Controversy_{it-1}$	-1.700*	1.513	-2.252**	-2.981*
	(-1.935)	(0.542)	(-2.404)	(-1.937)
$All_AbvM_{it-1} \times Controversy_{it-1}$	-1.720*	-6.958**	-1.923*	-0.819
	(-1.859)	(-2.344)	(-1.937)	(-0.538)
Constant	5.948***	8.709***	6.123***	8.756***
	(3.056)	(4.437)	(3.156)	(4.569)
Controls:	Yes	Yes	Yes	Yes
Adj.R-squared	0.635	0.630	0.635	0.634
N	9194	9194	9194	9194
FE:	Industry and Year	Industry and Year	Industry and Year	Industry and Year
Cluster:	Firm	Firm	Firm	Firm

This table analyzes different types of sustainability controversies. All variables are described according to the table of variable definitions. This study reports the coefficients of the variables and the t-statistics in parentheses. All variables are winsorized at the 1st and 99th percentiles. *, **, and *** denote statistical significance (two-tailed) at the 10%, 5%, and 1% levels, respectively.

5.5. Percentile relative performance

Although previous analyses have examined the leverage of tertiles, quartiles, and quintiles variables, this study is concerned that more detailed results can be obtained through the refinement of pre and post yearly variations. Rating agencies inevitably exhibit some degree of score persistence, but as long as there are some slight changes in the ranking of companies, this study can observe the relative ranking of companies in terms of percentile through detailed changes in the ranking.

Examining the results of the recalculated relative performance in column 1 of Table 8, it is found that the better the relative sustainability performance of a firm in its industry or in the overall corporate landscape, the more sustainable its future behavioral persistence is, which is the same as the results obtained through the median, tertile, quartile, and quintile, and this study points out that the relationship between the relative

臺灣大學學術期刊資料庫

ranking of firms and their future sustainability performance is very strong when the capital market is used as a measure. This approach can serve as an evaluation method regardless of whether a shallow or detailed classification is applied.

With the results in column 2 of Table 8, this study attempts to examine whether changes in firms' relative rankings are sufficient as a measure of future sustainability performance through long-term percentile changes. The results show that there is a significant correlation between changes in firms' percentile relative rankings and future sustainability performance. In order to avoid the high stickiness of ratings by rating agencies in a short period of time (Berg et al. 2022), this study simultaneously controls for up-front ESG scores, long-term effects (Khan et al. 2016; Lins et al. 2017), and more detailed categorization (Amel-Zadeh and Serafeim 2018; Giese et al. 2019). In the results presented in Table 8, this study verifies the validity of the finer relative ranking categorization on the one hand, mitigates the predictive value of ignoring small changes due to rating agency stickiness on the other hand, and points out the positive predictive value of relative ranking changes on firms' future sustainable performance.

Table 8　Impact of changes in relative performance and relative performance in percentiles

	$ESGCScore_{it}$	$\Delta ESGCScore_{it}$
$Ind_Percent_{it\text{-}1}$	0.015*	
	(1.746)	
$All_Percent_{it\text{-}1}$	0.113***	
	(5.214)	
$ESGCScore_{it\text{-}1}$	0.621***	
	(16.915)	
$\Delta Ind_Percent_{it,t\text{-}2}$		0.018**
		(2.315)
$\Delta All_Percent_{it\text{-}t\text{-}2}$		0.292***
		(32.225)
$ESGCScore_{it\text{-}2}$		0.068***
		(11.561)
Constant	2.981***	-1.273
	(2.989)	(-1.401)
Controls:	Yes	Yes
Adj.R-squared	0.787	0.338
N	9194	5519
FE:	Industry and Year	Industry and Year
Cluster:	Firm	Firm

In this table, the study examines the impact of past percentile relative to sustainability rankings and past sustainability performance on future sustainability behavior, and analyzes both short-term and long-term effects. All variables are winsorized at the 1st and 99th percentiles. *, **, and *** denote statistical significance (two-tailed) at the 10%, 5%, and 1% levels, respectively.

臺灣大學學術期刊資料庫

5.6. The impact of size and RD on sustainability behaviors

While previous literature has suggested that economic visibility increases with firm size (Udayasankar 2008; Young and Makhija 2014), slack resources theory also suggests that a firm's commitment to sustainability depends on its own strategy and the external market environment (Orlitzky et al. 2003). Other literature suggests that RD-intensive firms are more likely to have a positive impact on green innovation performance (Padgett and Galan 2010). Therefore, this study further investigates the relationship between relative sustainability rankings and future performance by incorporating several corporate financial characteristics.

The results in columns 1 and 2 of Table 9 suggest that when firms as a whole have higher historical relative sustainability performance, those with a higher proportion of fixed assets are more likely to show a stronger correlation between their relative ranking and future sustainability performance. The results in column 3 of Table 9 suggest that RD reduces the impact of sustainability behavior. This is because innovation is the main driver of growth for some firms (Aghion et al. 2013), and when firms face limited resources, it becomes difficult to combine innovation and sustainability (Lys et al. 2015). However, this study also suggests that with the increased emphasis on sustainability, firms are developing green RD that is different from traditional RD, although the two cannot be clearly defined (Schiederig et al. 2012). Future research should differentiate RD in more detail to verify the difference between general RD and green RD.

Table 9 Mechanism effect of financial characteristics

	$ESGCScore_{it}$		
Variablet	*SIZE*	*PPETA*	*RD*
Ind_AbvM_{it-1}	9.266***	10.105***	9.233***
	(3.430)	(13.559)	(20.056)
All_AbvM_{it-1}	13.142***	11.951***	13.832***
	(4.832)	(15.640)	(29.725)
Variablet	2.513***	2.526***	2.550***
	(10.983)	(14.360)	(14.360)
$Ind_AbvM_{it-1} \times Variable_t$	-0.017	-2.090	-1.601
	(-0.053)	(-1.357)	(-0.323)
$All_AbvM_{it-1} \times Variable_t$	0.046	3.601**	-7.784
	(0.139)	(2.303)	(-1.555)
Constant	11.336***	11.602***	10.869***
	(4.962)	(5.822)	(5.536)
Controls:	Yes	Yes	Yes
Adj.R-squared	0.624	0.624	0.624
N	9194	9194	9194
FE:	Industry and Year	Industry and Year	Industry and Year
Cluster:	Firm	Firm	Firm

This table presents the results of examining the impact of company characteristics (SIZE, PPETA, RD) on relative sustainability performance effects. All variables are described according to the table of variable definitions. This study reports the coefficients of the variables and the t-statistics in parentheses. All variables are winsorized at the 1st and 99th percentiles. *, **, and *** denote statistical significance (two-tailed) at the 10%, 5%, and 1% levels, respectively.

臺灣上市櫃公司永續發展資料庫

6. Conclusion

This study examines the correlation between relative sustainability rankings and future sustainability performance to provide the capital markets with a stable basis for measurement. The conclusions provided by this study help address the issue of rating divergence across agencies evaluating the same companies, as pointed out in the previous literature (Berg et al. 2022), and suggest that the robust results of relative rankings support the continued use of sustainability as one of the key metrics in investment decision-making (Douglas et al. 2017). By using firms' relative performance within an industry, firms' overall performance, or both, this study continues the previous literature on the existence of different impacts on firms at different levels (North 1990; Gordon 1991; McGahan and Porter 1997). This prior research suggests that when capital markets use the relative ranking of firms as a measure, firms are more likely to be ranked either within their industry or against all firms in the same year, rather than solely within the industry. This study suggests that when capital markets use the relative ranking of firms as a measure, firms become important relative to the industry or relative to all firms in the same year.

Given that firms may have different levels of effort across sustainability dimensions, using overly coarse classifications results in misleading metrics. This study shows that the relative sustainability rankings of the different dimensions are significantly correlated with the future performance of the sustainability dimensions, and the level of refinement in the categorization confirms the robustness of the results. Furthermore, by using percentile relative ranking changes and longer-term relative ranking changes, this study aims to reduce the persistence of ratings issued by rating agencies and to expand the use of relative rankings. In all of these tests, the study achieves results that are valid relative to the rankings, mitigates rating concerns, and maintains the robustness of the conclusions through different definitions.

This study examines whether firms' relative rankings remain significantly associated with future sustainability performance under specific conditions using the financial characteristics presented in the previous literature. In addition, it examines this association using the sustainability controversies that are inevitable in the course of a firm's operations. This study aims to examine the correlation between relative rankings and future sustainability performance through additional firm characteristics. This study points out that better-ranked firms exhibit a negative correlation in the event of sustainability controversies, which indicates how relative

臺灣大學學術期刊資料庫

rankings and event occurrences can be used to forecast future sustainability performance in capital markets. This study further analyzes the relative sustainability rankings through the financial characteristics of different companies. While some of the results suggest that the fixed asset ratio has an incremental explanatory effect, the study also notes that the current categorization of certain firm characteristics (e.g., R&D) lacks clarity, leading to mixed results.

Taken together, this study demonstrates that relative sustainability rankings of companies are a stable predictor of future sustainability performance and serve as a useful tool for capital markets in assessing corporate ESG commitments. Compared to a single ESG score, relative ranking better reflects a firm's competitive position in the market and reduces disagreements among ESG raters. In addition, this study finds that ESG controversial events and firms' financial characteristics affect this correlation, suggesting that future research should further explore how ESG risks affect firms' sustainability paths. These findings carry important implications for investors, regulators, and corporate decision-makers. Given the limitations of current data on sustainability controversies, this study only supplements prior findings by synthesizing multiple events (Minor and Morgan 2011; Yu et al. 2020; Flammer 2021). Furthermore, while the change of relative ranking approach reduces fixed characteristics and mechanical correlations, complex models still risk overfitting, and future research should examine the model's out-of-sample robustness and generalizability.

臺灣大學學術期刊資料庫

Appendix A Definition of Variables

Variable	Definition
Dependent Variables	
$ESGCScore_{it}$	Combined ESG score from Refinitiv.
ESG (E+S, ENV, SOC, GOV) $Score_{it}$	ESG score (sum of environmental and social, environmental, social, governance) from Refinitiv.
*Bloomberg (MSCI)_*$Score_{it}$	ESG score from Bloomberg (MSCI).
$\Delta ESGCScore_{it}$	Combined ESG scores from Refinitiv in year t minus year t-1.
Focal Variables	
$Ind_abvM_{it\text{-}1}$	If a company's ESGC performance in the previous year is better than the median in its corresponding SIC2 industry, the variable is set to 1; otherwise, it is set to 0.
$All_abvM_{it\text{-}1}$	If a company's ESGC performance in the previous year is better than the median among all companies, the variable is set to 1; otherwise, it is set to 0.
Ind(*All*)*_ESG* (*E+S, ENV, SOC, GOV)_*$abvM_{it\text{-}1}$	If a company's ESG (sum of environmental and social, environmental, social, governance) performance in the previous year is better than the median in its corresponding SIC2 industry (overall corporate landscape), the variable is set to 1; otherwise, it is set to 0.
$Controversy_{it\text{-}1}$	Whether there are any controversies (environmental, social, governance) in Refinitiv.
Ind (All)_Bloomberg MSCI)*_*$abvM_{it\text{-}1}$	If a company's Bloomberg (MSCI) ESG performance in the previous year is better than the median in its corresponding SIC2 industry (overall corporate landscape), the variable is set to 1; otherwise, it is set to 0.
Ind (*All*)*_Tri (Qua*, *Qui*)$_{it\text{-}1}$	If a company's ESG performance in the previous year was in the highest classification in the industry (overall corporate landscape) after controlling for overall factors, it equaled 3 (4, 5) and was reduced to 1.
$Ind(All)_abvMi_{t\text{-}1,t\text{-}2(it\text{-}1,t\text{-}3)}$	Results of firms exceeding industry (overall firm) median cumulative sustainability performance in years t-1 to t-2 (t-1 to t-3).

臺灣大學學術期刊資料庫

$ESGCScore_{it\text{-}1,t\text{-}2(it\text{-}1,t\text{-}3)}$	Cumulative ESG scores of firms from year t-1 to year t-2 (year t-1 to year t-3).
$Ind(All)_Percent_{it\text{-}1}$	A company's ESGC performance in the previous year, expressed as its percentile rank against the SIC2 industry (overall corporate landscape).
$\Delta Ind(All)_Percent_{it,t\text{-}2}$	Percentile change in a company's combined ESGC performance in year t versus t-2 for its corresponding SIC2 industry (overall corporate landscape).
Control Variables	
$SIZE_{it}$	Natural logarithm of sales.
$GROWTH_{it}$	Ratio of sales to lagged sales minus 1.
$CASH_{it}$	Cash and cash equivalents divided by total assets.
RD_{it}	Ratio of research and development expenses to sales.
ROA_{it}	Income before extraordinary items scaled by total assets.
MTB_{it}	Book-to-market ratio measured as the market value of equity scaled by book value.
LEV_{it}	Sum of long-term debt and debt in current liabilities scaled by total assets.
SGA_{it}	Ratio of selling, general, and administrative expenses to sales.
$PPETA_{it}$	Property, plant, and equipment divided by total assets.
$Analyst_{it}$	Total number of analysts who have followed a firm in year t.
$AveInstitution_{it}$	Average percentage of corporate shares held by institutional investors of year t.
$RelativeSIZE_{it}$	Company SIZE in the current year divided by the sum of the same SIC2s.
GDP_{it}	Natural logarithm of the GDP of the country where the sample is located in the given year.

Definitions of all variables are provided here. All variables are winsorized at the 1st and 99th percentiles.

臺灣大學學術期刊資料庫

References

Aghion, P., J. Van Reenen, and L. Zingales. 2013. Innovation and institutional ownership. *American Economic Review* 103 (1): 277-304.

Albuquerque, R., Y. Koskinen, and C. Zhang. 2019. Corporate social responsibility and firm risk: Theory and empirical evidence. *Management Science* 65 (10): 4451-4469.

Alessandri, T. M., and J. M. Pattit. 2014. Drivers of R&D investment: The interaction of behavioral theory and managerial incentives. *Journal of Business Research* 67 (2): 151–158.

Amel-Zadeh, A., and G. Serafeim. 2018. Why and how investors use ESG information: Evidence from a global survey. *Financial Analysts Journal* 74 (3): 87-103.

Amiraslani, H., C. Deller, C. D. Ittner, and T. Keusch. 2024. Board risk oversight and environmental and social performance. *Journal of Accounting and Economics* 79 (2-3): 101754.

Aranda, C., J. Arellano, and A. Davila. 2014. Ratcheting and the role of relative target setting. *The Accounting Review* 89 (4): 1197-1226.

Artiach, T., D. Lee, D. Nelson, and J. Walker. 2010. The determinants of corporate sustainability performance. *Accounting and Finance* 50 (1): 31-51.

Awaysheh, A., R. A. Heron, T. Perry, and J. I. Wilson. 2020. On the relation between corporate social responsibility and financial performance. *Strategic Management Journal* 41 (6): 965–987.

Baldini, M., L. D. Maso, G. Liberatore, F. Mazzi, and S. Terzani. 2018. Role of country-and firm-level determinants in environmental, social, and governance disclosure. *Journal of Business Ethics* 150 (1): 79-98.

Bansal, P., and K. Roth. 2000. Why companies go green: A model of ecological responsiveness. *Academy of Management Journal* 43 (4): 717-736.

Barney, J. 1991. Firm resources and sustained competitive advantage. *Journal of Management* 17 (1): 99-120.

Bartoloni, E. 2012. The persistence of innovation: A panel data investigation on manufacturing firms. *International Review of Applied Economics* 26 (6): 787–810.

Benlemlih, M. 2017. Corporate social responsibility and firm debt maturity. *Journal of Business Ethics* 144 (3): 491-517.

Berg, F., J. F. Kölbel, and R. Rigobon. 2022. Aggregate confusion: The divergence of ESG ratings. *Review of Finance* 26 (6): 1315-1344.

Berg, F., K. Fabisik, and Z. Sautner. 2021. Is history repeating itself? The (un)predictable past of ESG ratings. Working paper, Massachusetts Institute of Technology, and Frankfurt School of Finance and Management and ECGI.

Biddle, G. C., G. Hilary, and R. S. Verdi. 2009. How does financial reporting quality relate to investment efficiency?. *Journal of Accounting and Economics* 48 (2–3): 112–131.

Boffo, R., and R. Patalano. 2020. *ESG Investing: Practices, Progress and Challenges*. Paris, France: OECD.

Brammer, S., and A. Millington. 2006. Firm size, organizational visibility, and corporate philanthropy: An empirical analysis. *Business Ethics: A European Review* 15 (1): 6–18.

Carbon Disclosure Project (CDP). 2025. CDP Scores and A Lists. Available online at: https://www.cdp.net/en/data/scores.

Chen, T., H. Dong, and C. Lin. 2020. Institutional shareholders and corporate social

臺灣博碩學術期刊資訊網

responsibility. *Journal of Financial Economics* 135 (2): 483-504.
Chen, W. R., and K. D. Miller. 2007. Situational and institutional determinants of firms' R&D search intensity. *Strategic Management Journal* 28 (4): 369-381.
Chin, M. K., D. C. Hambrick, and L. K. Treviño. 2013. Political ideologies of CEOs: The influence of executives' values on corporate social responsibility. *Administrative Science Quarterly* 58 (2): 197-232.
Christensen, D. M., G. Serafeim, and A. Sikochi. 2022. Why is corporate virtue in the eye of the beholder? The case of ESG ratings. *The Accounting Review* 97 (1): 147-175.
Clarke, R. N. 1989. SICs as delineators of economic markets. *Journal of Business* 62 (1): 17-31.
Clarkson, P. M., Y. Li, G. D. Richardson, and F. P. Vasvari. 2008. Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. *Accounting, Organizations and Society* 33 (4-5): 303-327.
Coad, A., and R. Rao. 2008. Innovation and firm growth in high-tech sectors: A quantile regression approach. *Research Policy* 37 (4): 633-648.
Cyert, R. M., and J. G. March. 1963. *A Behavioral Theory of the Firm*. (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.
Darendeli, A., P. Fiechter, J. M. Hitz, and N. Lehmann. 2022. The role of corporate social responsibility (CSR) information in supply-chain contracting: Evidence from the expansion of CSR rating coverage. *Journal of Accounting and Economics* 74 (2-3): 101525.
David, P. A. 1990. The dynamo and the computer: An historical perspective on the modern productivity paradox. *The American Economic Review* 80 (2): 355-361.
Dhaliwal, D. S., O. Z. Li, A. Tsang, and Y. G. Yang. 2011. Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting. *The Accounting Review* 86 (1): 59-100.
Dimson, E., O. Karakaş, and X. Li. 2015. Active ownership. *The Review of Financial Studies* 28 (12): 3225-3268.
Ding, D. K., C. Ferreira, and U. Wongchoti. 2016. Does it pay to be different? Relative CSR and its impact on firm value. *International Review of Financial Analysis* 47: 86–98.
Douglas, E., T. Van Holt, and T. Whelan. 2017. Responsible investing: Guide to ESG data providers and relevant trends. *Journal of Environmental Investing* 8 (1): 91–114.
Drempetic, S., C. Klein, and B. Zwergel. 2020. The influence of firm size on the ESG score: Corporate sustainability ratings under review. *Journal of Business Ethics* 167 (2): 333-360.
Eccles, R. G., and S. Klimenko. 2019. The investor revolution. *Harvard Business Review* 97 (3): 106–116.
Eccles, R. G., I. Ioannou, and G. Serafeim. 2014. The impact of corporate sustainability on organizational processes and performance. *Management Science* 60 (11): 2835-2857.
Edmans, A. 2011. Does the stock market fully value intangibles? Employee satisfaction and equity prices. *Journal of Financial Economics* 101 (3): 621-640.
El Ghoul, S., O. Guedhami, C. C. Kwok, and D. R. Mishra. 2011. Does corporate social responsibility affect the cost of capital?. *Journal of Banking and Finance* 35 (9): 2388-2406.
Falato, A., D. Kadyrzhanova, J. Sim, and R. Steri. 2022. Rising intangible capital, shrinking debt capacity, and the US corporate savings glut. *The Journal of Finance* 77 (5):

臺灣大學學術期刊資料庫

2799-2852.
Feldman, M. S., and B. T. Pentland. 2003. Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly* 48 (1): 94-118.
Flammer, C. 2021. Corporate green bonds. *Journal of Financial Economics* 142 (2): 499-516.
Gibson Brandon, R., P. Krueger, and P. S. Schmidt. 2021. ESG rating disagreement and stock returns. *Financial Analysts Journal* 77 (4): 104-127.
Giese, G., L. E. Lee, D. Melas, Z. Nagy, and L. Nishikawa. 2019. Foundations of ESG investing: How ESG affects equity valuation, risk, and performance. *Journal of Portfolio Management* 45 (5): 69-83.
Gordon, G. G. 1991. Industry determinants of organizational culture. *Academy of Management Review* 16 (2): 396-415.
Goss, A., and G. S. Roberts. 2011. The impact of corporate social responsibility on the cost of bank loans. *Journal of Banking and Finance* 35 (7): 1794-1810.
Greve, H. R. 1998. Performance, aspirations, and risky organizational change. *Administrative Science Quarterly* 43 (1): 58-86.
Greve, H. R. 2003. *Organizational Learning from Performance Feedback: A Behavioral Perspective on Innovation and Change*. Cambridge, UK: Cambridge University Press.
Greve, H. R. 2008. A behavioral theory of firm growth: Sequential attention to size and performance goals. *Academy of Management Journal* 51 (3): 476–494.
Harford, J., S. A. Mansi, and W. F. Maxwell. 2008. Corporate governance and firm cash holdings in the US. *Journal of Financial Economics* 87 (3): 535-555.
Hawawini, G., V. Subramanian, and P. Verdin. 2003. Is performance driven by industry-or firm-specific factors? A new look at the evidence. *Strategic Management Journal* 24 (1): 1-16.
Hirshleifer, D., A. Low, and S. H. Teoh. 2012. Are overconfident CEOs better innovators?. *The Journal of Finance* 67 (4): 1457-1498.
Hsu, P. H., X. Tian, and Y. Xu. 2014. Financial development and innovation: Cross-country evidence. *Journal of Financial Economics* 112 (1): 116-135.
Hulme, M. 2018. “Gaps” in climate change knowledge: Do they exist? can they be filled?. *Environmental Humanities* 10 (1): 330–337.
Humphrey, J. E., D. D. Lee, and Y. Shen. 2012. The independent effects of environmental, social, and governance initiatives on the performance of UK firms. *Australian Journal of Management* 37 (2): 135–151.
James, E. H., and L. P. Wooten. 2005. Leadership as (un)usual: How to display competence in times of crisis. *Organizational Dynamics* 34 (2): 141–152.
Jo, H., and M. A. Harjoto. 2011. Corporate governance and firm value: The impact of corporate social responsibility. *Journal of Business Ethics* 103 (3): 351-383.
Jong, W., and V. van der Linde. 2022. Clean diesel and dirty scandal: The echo of Volkswagen’s dieselgate in an intra-industry setting. *Public Relations Review* 48 (1): 102146.
Joubrel, M., and E. Maksimovich. 2023. ESG data and scores. In *Valuation and Sustainability: A Guide to Include Environmental, Social, and Governance Data in Business Valuation,* edited by D. Glavas, 67-98. Cham, Germany: Springer International Publishing.
Khan, M., G. Serafeim, and A. Yoon. 2016. Corporate sustainability: First evidence on materiality. *The Accounting Review* 91 (6): 1697-1724.
Kotsantonis, S., and G. Serafeim. 2019. Four things no one will tell you about ESG data.

臺灣期刊學術資料庫

Journal of Applied Corporate Finance 31 (2): 50–58.

Lee, J.-E., and Y. S. Yang. 2022. The impact of corporate social responsibility performance feedback on corporate social responsibility performance. *Frontiers in Psychology* 13: 893193.

Li, X., Y. Lou, and L. Zhang. 2024. Do commercial ties influence ESG ratings? Evidence from Moody's and S&P. *Journal of Accounting Research* 62 (5): 1901-1940.

Lin, W. L., C. Lee, and S. H. Law. 2021. Asymmetric effects of corporate sustainability strategy on value creation among global automotive firms: A dynamic panel quantile regression approach. *Business Strategy and the Environment* 30 (2): 931–954.

Lin, Y., R. Shen, J. Wang, and Y. J. Yu. 2024. Global evolution of environmental and social disclosure in annual reports. *Journal of Accounting Research* 62 (5): 1941-1988.

Linnenluecke, M. K., and A. Griffiths. 2010. Corporate sustainability and organizational culture. *Journal of World Business* 45 (4): 357–366.

Lins, K. V., H. Servaes, and A. Tamayo. 2017. Social capital, trust, and firm performance: The value of corporate social responsibility during the financial crisis. *The Journal of Finance* 72 (4): 1785-1824.

Lys, T., J. P. Naughton, and C. Wang. 2015. Signaling through corporate accountability reporting. *Journal of Accounting and Economics* 60 (1): 56-72.

March, J. G. 1981. Footnotes to organizational change. *Administrative Science Quarterly* 26 (4): 563-577.

McCarthy, S., B. Oliver, and S. Song. 2017. Corporate social responsibility and CEO confidence. *Journal of Banking and Finance* 75: 280-291.

McGahan, A. M., and M. E. Porter. 1997. How much does industry matter, really?. *Strategic Management Journal* 18 (S1): 15-30.

McGahan, A. M., and M. E. Porter. 2003. The emergence and sustainability of abnormal profits. *Strategic Organization* 1 (1): 79-108.

Minor, D., and J. Morgan. 2011. CSR as reputation insurance: Primum non nocere. *California Management Review* 53 (3): 40-59.

North, D. C. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge, UK: Cambridge University Press.

Orlitzky, M., F. L. Schmidt, and S. L. Rynes. 2003. Corporate social and financial performance: A meta-analysis. *Organization Studies* 24 (3): 403-441.

Padgett, R. C., and J. I. Galan. 2010. The effect of R&D intensity on corporate social responsibility. *Journal of Business Ethics* 93 (3): 407–418.

Petrenko, O. V., F. Aime, J. Ridge, and A. Hill. 2016. Corporate social responsibility or CEO narcissism? CSR motivations and organizational performance. *Strategic Management Journal* 37 (2): 262-279.

Petrovits, C. M. 2006. Corporate-sponsored foundations and earnings management. *Journal of Accounting and Economics* 41 (3): 335–362.

Rafi, T. 2022. Why sustainability is crucial for corporate strategy. *World Economic Forum*. Available online at: https://www. weforum. org/agenda/2022/06/why-sustainability-is-crucialfor-corporatestrategy.

Refinitiv. 2021. Environmental, social and governance (ESG) scores from Refinitiv. Available online at: https://cdn-blob.investsmart.com.au/documents/REFINITIV%20ESG%20Scores%20Methodology%20Feb%202021.pdf.

臺灣期刊論文資料庫

Roll, R. 1992. Industrial structure and the comparative behavior of international stock market indices. *The Journal of Finance* 47 (1): 3-41.

Roper, S., and N. Hewitt-Dundas. 2008. Innovation persistence: Survey and case-study evidence. *Research Policy* 37 (1): 149–162.

Rumelt, R. P. 1991. How much does industry matter?. *Strategic Management Journal* 12 (3): 167-185.

Schiederig, T., F. Tietze, and C. Herstatt. 2012. Green innovation in technology and innovation management–An exploratory literature review. *R&D Management* 42 (2): 180-192.

Schmalensee, R. 1985. Do markets differ much?. *The American Economic Review* 75 (3): 341-351.

Securities and Exchange Commission (SEC). 2025. Standard industrial classification (SIC) code list. Available online at: https://www.sec.gov/search-filings/standard-industrial-classification-sic-code-list.

Tamayo-Torres, I., L. Gutierrez-Gutierrez, and A. Ruiz-Moreno. 2019. Boosting sustainability and financial performance: The role of supply chain controversies. *International Journal of Production Research* 57 (11): 3719-3734.

Tang, Y., C. Qian, G. Chen, and R. Shen. 2015. How CEO hubris affects corporate social (ir) responsibility. *Strategic Management Journal* 36 (9): 1338-1357.

Udayasankar, K. 2008. Corporate social responsibility and firm size. *Journal of Business Ethics* 83 (2): 167–175.

Waldman, D. A., D. S. Siegel, and M. Javidan. 2006. Components of CEO transformational leadership and corporate social responsibility. *Journal of Management Studies* 43 (8): 1703–1725.

Wang, L. L. 2023. Transmission effects of ESG disclosure regulations through bank lending networks. *Journal of Accounting Research* 61 (3): 935-978.

Williams, T. A., D. A. Gruber, K. M. Sutcliffe, D. A. Shepherd, and E. Y. Zhao. 2017. Organizational response to adversity: Fusing crisis management and resilience research streams. *Academy of Management Annals* 11 (2): 733–769.

Wu, S.-F., C.-Y. Fang, and W. Chen. 2020. Corporate governance and stock price crash risk: Evidence from Taiwan. *Managerial and Decision Economics* 41 (7): 1312–1326.

Young, S. L., and M. V. Makhija. 2014. Firms' corporate social responsibility behavior: An integration of institutional and profit maximization approaches. *Journal of International Business Studies* 45 (6): 670–698.

Yu, E. P. Y., B. Van Luu, and C. H. Chen. 2020. Greenwashing in environmental, social and governance disclosures. *Research in International Business and Finance* 52: 101192.

Zhang, L., S. Ren, X. Chen, D. Li, and D. Yin. 2020. CEO hubris and firm pollution: State and market contingencies in a transitional economy. *Journal of Business Ethics* 161 (2): 459-478.

Zheng, J., M. Ghorbani, Y. Yan, and Y. Cao. 2023. Signals from CSR competition: The influence of relative CSR performance on analysts' recommendations. *The British Accounting Review* 56 (5): 101298.

臺灣大學學術期刊資料庫