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RESEARCH ARTICLE

Investor Bias in ESG Ratings: Implications for Sustainable Portfolios

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Abstract – ESG ratings are crucial tools that align financial strategies with the purpose of sustainability. Their reliability is often undermined because biases distort their comparability and dependability. The present study offers a novel contribution to the multidimensional analysis of biases in ESG ratings. Focusing on methodological inconsistencies, like firm size disparities, media influence, and self-disclosure practices. The unique contribution is integrating a behavioural finance perspective, considering psychological biases related to confirmation, overconfidence and herding behaviour factors that affect investor interpretation of ESG scores. This study synthesizes literature from diverse sources to identify the combined effects of these biases on capital allocation, market dynamics, and sustainable investment outcomes. It is a call for standardized ESG rating methodologies, increased transparency, and heightened awareness in practice to overcome these biases effectively. The actionable insights provided will help policymakers, rating agencies, and investors to create a more equitable and trustworthy ESG evaluation frameworks.

Keywords – ESG ratings, sustainability, green investing, bias, behavioural finance

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1.INTRODUCTION

The integration of Environmental, Social, and Governance (ESG) criteria into investment strategies has become a cornerstone of modern finance, reflecting a growing emphasis on sustainability and ethical business practices (Christensen et al., 2021). ESG ratings have emerged as indispensable tools for investors seeking to align their portfolios with sustainability objectives. However, the reliability and objectivity of these ratings remain highly debated due to multiple biases. Existing studies have already dealt with single biases such as methodological inconsistencies of rating agencies (Berg et al., 2019; Kotsantonis and Serafeim, 2019), firm size effects (Akgun et al., 2021; Dobrick et al., 2023), and industry or media biases (Barkemeyer et al., 2023; Cakir et al., 2023). While useful, these studies often either focus on isolated bias types or lack a cohesive framework for analyzing their combined effects on investment decisions and market dynamics. Furthermore, behavioural biases, such as availability, herding, and confirmation biases, in shaping investor perceptions of ESG ratings remains underexplored. While some studies recognize the psychological influences involved, such as Deka et al. (2023) and Leite and Uysal (2023), these contributions often remain confined to regional or institutional contexts and fail to integrate such biases with concerns about structure and methodology. This approach leaves a critical gap in understanding how multidimensional biases-sometimes systemic, sometimes psychological-interact to distort ESG ratings and influence capital allocation decisions. This paper fills this lacuna by providing a comprehensive, multidimensional analysis of ESG rating biases. It uniquely integrates insights from structural biases-such and from behavioural finance on how investor psychology further amplifies distortions in ratings.

The novel contributions of this research are manifold. First, it categorizes and contrasts multiple sources of bias systematically, hence giving a better understanding of their interlinkages. Second, it integrates psychological biases into the discussion, allowing for a more nuanced perspective on investor behaviour. Third, it provides actionable recommendations for policymakers, rating agencies, and investors on increasing the transparency, comparability, and reliability of ESG ratings. By addressing these deficiencies, this paper moves the debate on sustainable finance one step

further and equips stakeholders with the knowledge to advance a more equitable and efficient ESG evaluation framework.

1.1 Review of literature

As Berg et al. (2019) noted, the difference in the ESG ratings between various agencies may develop into confusion and mispricing of capital. To such inconsistencies in rating methods, Kotsantonis and Serafeim (2019) add that one of the reasons lies in the use of various imputation techniques in cases of gaps in data. This fact itself can cause ESG ratings to deviate far from each other. Such variability of ESG scores challenges their objectivity and reliability, especially since investors are increasingly using the ratings in making decisions.

One of the most persistent sources of disparity in ESG ratings is bound up with the differences in methodology adopted across rating agencies. The fact that different agencies use different criteria, weighting, and scoring while rating the same company, might explain why very different ratings may show up. Yunus (2024) emphasizes that the kind of methodologies have been exposed to certain difficulties concerning the efficient performance of sustainability rating because it is highly subjective, which leads to inconsistent ratings between agencies. One of the major reasons for biases within the ESG ratings is the non-existence of standardized methodologies among the rating agencies. Since various agencies use different criteria and weightings, the ratings accorded to the same company differ so much. For instance, Kim and Bonha (2023) found out that in cases where ESG ratings disagree, this may lead to weakened corporate value, insofar as a greater dispersion of the rating is expected to be associated with greater volatility and lower future stock prices. Kim and Bonha (2023) The disagreement could arise such that in an environment where investors are surrounded by uncertainty, little clear-cut way forward might be available due to conflicting trends from different agencies.

Findings by Berg et al. (2019) point out that these differences in measurement stand for a great part of the variation in ESG ratings and therefore demand further standardization and more transparency in applied methodologies by the rating agencies. Berg et al. (2022) analyse the pervasive issue of measurement error in ESG ratings, emphasizing that the inherent noisiness of these scores leads to substantial attenuation bias when using standard regression methods to study ESG's impact on financial variables. While the traditional assumption is that ESG ratings provide some real measure of sustainability, shows that such scores are afflicted by inaccuracies in measurement that make the regression coefficients shrink toward zero. One of the most cited issues with ESG ratings is about biased firms with larger sizes. Several studies find that larger firms are more likely to have better ESG scores compared to small ones, ceteris paribus (García et al., 2020; Gratcheva et al., 2021; Akgun et al., 2021). This has been attributed to the fact that larger companies can spend more resources on ESG disclosures and reporting, thereby distorting the rating outcomes in their favour. For example, García et al. (2020) point out that larger firms are likely to use more resources in making ESG data available and, therefore, are often scored higher than they should be. Similarly, the results of Keeley et al. (2022) also reveal that high ESG ratings do not signal actual inclusions of ESG strategies.

Company size is a bias in ESG ratings, as larger firms may have more resources to spend on ESG reporting and disclosure, therefore artificially inflating their scores relative to smaller firms, which may be equally or more sustainable but lack the same reporting capability. This will only make the problem of asymmetric information worse, whereby the low-rated small companies will appear less sustainable than they perhaps are. More frequently than not, says Liu (2024), a firm's ESG performance reflects its size and financial performance, hence making it so hard to judge the true sustainability of that company. Furthermore, ESG score biases are not only statistical but also structural, originating from firm characteristics such as size and industry. Cakir et al. (2023) argue that smaller firms are systematically assigned lower ESG ratings compared to larger firms, which is attributed to a factor of firm-size bias. This is driven by the greater resources and ability of larger firms to meet stringent reporting and disclosure requirements for high ESG ratings. Small firms, lacking these resources, often receive lower scores despite potentially having comparable sustainability practices. The European Union's directive to prevent "greenwashing" in ESG ratings acknowledges these distortions, calling for the need for an affordable and transparent rating tool that allows for consistent assessment across different firm sizes and sectors (Cakir et al., 2023).

Heavily regulated industries, like finance and telecommunications, have more developed and tight regulatory compliance structures, thus higher ESG scores, while other sectors such as tobacco and gambling bear higher ESG risks with lower scores. Those industry biases may mislead investors, overemphasizing industries that rightly carry lower environmental risks, irrespective of the companies' actual practices about sustainability. While rating providers, such as Refinitiv, claim size bias correction, recent work shows the contrary. For example, Dobrick et al. (2023) find that size bias in ESG scores of Refinitiv is highly significant, noting that the association between company size and ESG score has increased compared to ASSET4 data. More specifically, for every unit increase in firm size, the ESG score rises by 5.8 points under Refinitiv scoring, up from 3.5 points in the ASSET4 data. This difference suggests that the size bias is still quite pervasive and applies to all three dimensions of ESG scoring. These biases then carry over into investor decision-making, where larger firms are going to appear more sustainable by being able to disclose more detailed ESG information and meeting the rating standards more easily (Dobrick et al., 2023). Due to the lack of a common definition and standards among the providers of ESG

ratings, there is seen a divergence in the ratings (Billio et al., 2012).

The media concentration and self-selection bias represent another layer of intricacy about the biases in ESG scores, particularly regarding ESG controversy data (Cappucci, 2018). Barkemeyer et al. (2023) indicate that ESG scores tend to be more reliable for firms operating in well-represented media markets, such as France, the UK, and the US. On the other hand, those firms operating in areas where the level of media coverage is lower demonstrated lower ESG ratings driven by media concentration bias. This selection bias presents a latent risk to investors based on global ESG performance data since the focused bias is toward companies based in prominent markets. For investors who prefer focusing on diversified global ESG portfolios, the related risk elevates because their operating companies are under-covered in less assessed areas (Barkemeyer et al., 2023). The issue of predisposition also relates to the nature of ESG disclosures. As suggested by Murata and Hamori (2021) firms with superior ESG performance are unlikely to withhold adverse news, thereby helping in decreasing the likelihood of a stock price crash.

However, the nature of ESG disclosures is self-reported, which often leads to a predisposition in which companies paint their ESG efforts to be more favourable than they are. This self-disclosed bias complicates the articulation of the true sustainability performance of a firm to investors and thus complicates the landscape of socially responsible investing (de la Fuente and Velasco, 2024). The subjectivity of ESG ratings may make information asymmetry even worse. As Keeley et al. (2022) mention, a high ESG rating does not mean that investors have used ESG strategies. Hence, the real strength of ESG ratings in ensuring responsible investment decisions is very hard to find. The subjectivity will result in circumstances where investors depend on misleading ratings leading to misaligned investment strategies and capital allocation. More importantly, Wong et al. (2022) point out that ESG scores may be viewed as important private information about the firms' ESG practices, carrying reputational risks for those being downgraded. This, of course, only adds to the complications in the information environment where firms would be more concerned with increasing their ESG score rather than enhancing their sustainability performance.

Investor behaviour, influenced by psychological biases too, plays a role in ESG-related investment strategies, especially in periods of market volatility. Gavrilakis and Floros (2024) study the tendency of European ESG managers to tilt their portfolios toward large-cap and value stocks that promise stable returns and avoid aggressive investment strategies likely to raise volatility. Such a trend uncovers one more diversification bias in ESG portfolios since investors increasingly use diversification as a means of managing risk. In turbulent times, ESG managers act like a herd by being concentrated in large-cap stocks, thereby reducing any benefits of diversification, and increasing their exposures to market wide risks that are difficult to hedge out. Besides the rating biases, psychological biases also play a serious role in investors' decisions. Using a survey-based approach, Deka et al. (2023) present an inquiry into the impact of availability bias, herding behaviour, and regret aversion on ESG investment decisions. Availability bias makes investors give too much weight to the most recent ESG events, while herding behaviour simply makes investors follow the actions of others always in the best interest of the individual investor from a financial point of view. Ex ante regret aversion may make investors refrain from stocks that have shown losses in the past and thus perhaps miss favourable opportunities. The authors identify ESG awareness as a moderator of these biases: the higher it is, the more objective the assessment of risks will be, and appropriate decisions accordingly might be taken by investors. That indicates ESG consideration can help an investor avoid some one-sided distortions in his choice, thus better corresponding to the goal of sustainability (Deka et al., 2023). Confirmation bias in ESG-related investment decisions is further elaborated by Leite and Uysal (2023), to show that high ESG scores enhance investors' positive perceptions, especially when there is the release of positive news. Ciciretti et al. (2023) show that demand-driven "equilibrium shifts" may introduce upward biases in the estimates of the ESG premium. They find evidence that after the bias correction, the expected return is lower by 3.41% annually than estimated. This result suggests that previous estimates of the ESG premium may have been conservative, as positive realized returns due to increasing demand decrease long-run expected returns and thus inflate the ESG premium. Contrary to the earlier studies, this bias-corrected approach allows for an appropriate estimation of ESG returns, which investors need when seeking sustainable portfolios in combination with realistic return expectations (Ciciretti et al., 2023).

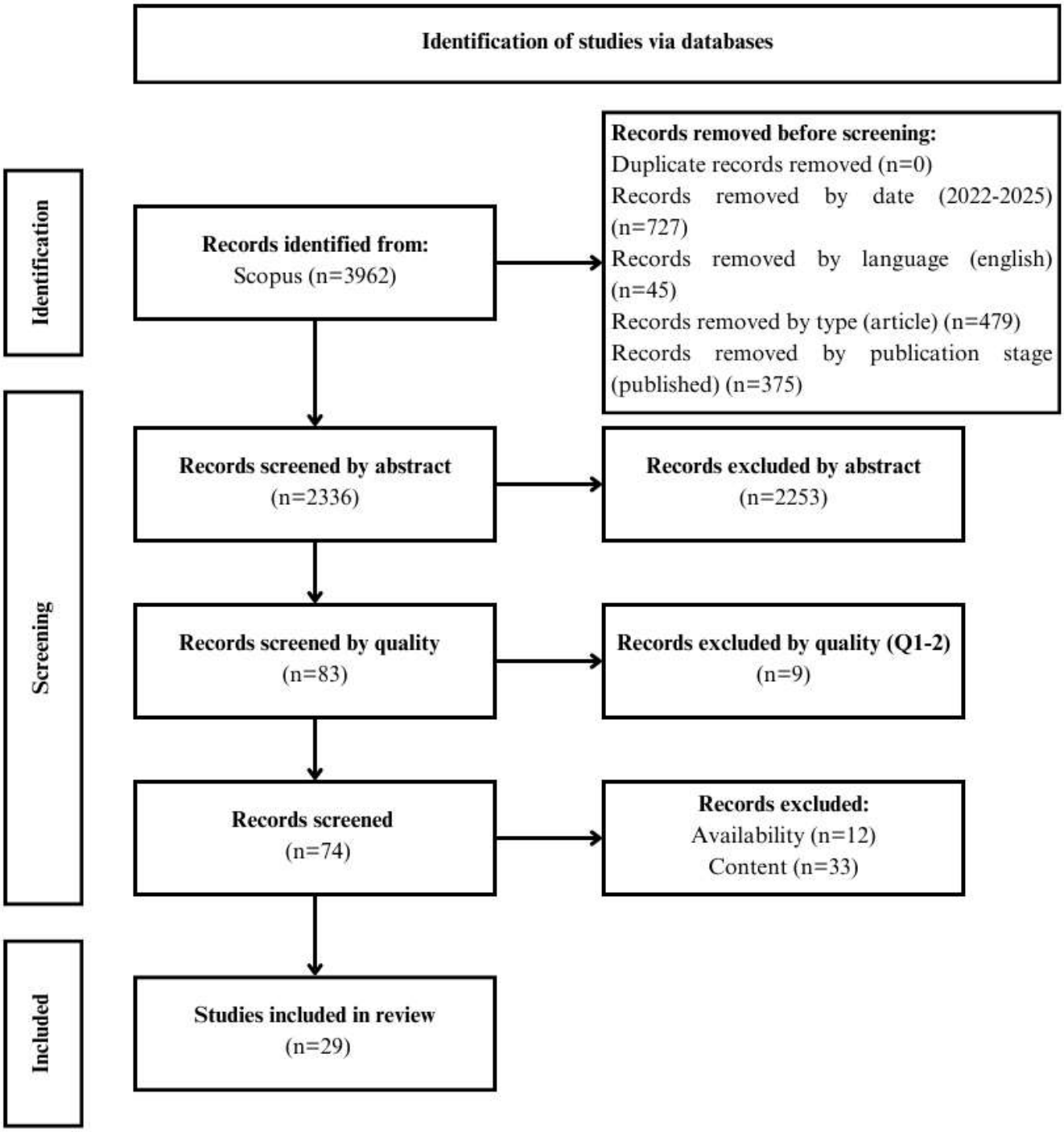
These biases make the proper valuation of corporate sustainability performance not only difficult but also compromise the ability of ESG ratings to play their role as reliable indicators of sustainable investment. This body of research highlights the need for rigorous methodologies and standardized rating frameworks to reduce the impact of biases. Allowing ESG ratings to better fulfil their role in advancing sustainable finance and aligning investment strategies with ethical and environmental objectives. Although individual sources of bias are a mainstay of the literature, it is far less exhaustive in providing an integrated framework that highlights their interdependencies. Meanwhile, the role of behavioural biases remains underrepresented, specifically concerning its interaction with structural biases. This paper adds to the existing literature by providing a comprehensive, multidimensional framework that integrates both structural and behavioural biases. It further contends that such biases are not independent from each other but instead complement one another in the manner of systemic distortions, decreasing comparability and reliability in ESG ratings. By addressing these gaps, this study advances the literature in three keyways: (1) it integrates behavioural finance with ESG bias research, (2) it explores the cumulative effects of

multiple biases on capital allocation and market dynamics, and (3) it provides actionable recommendations for improving transparency, comparability, and trust in ESG ratings.

2. MATERIALS AND METHODS

The systematic literature search selected the following keywords "esg AND bias". The search was performed in the Scopus scientific database. The Prisma framework was used to filter the results (Tóth et al., 2023). The filtering criteria and results are detailed in Figure 1. From the initial 3962 hits, 29 studies were processed as part of the systematic literature search.

Figure 1 Prisma framework

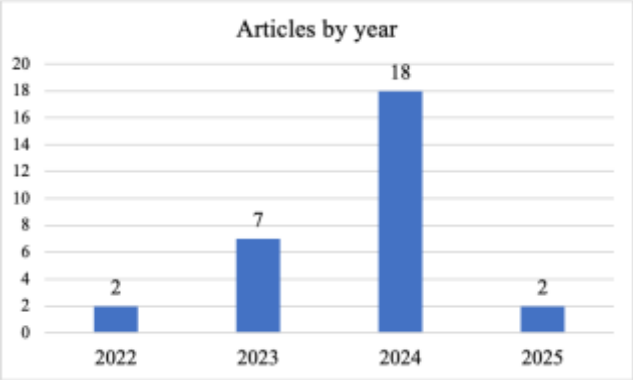


Source: Tóth et al., (2023), author's own contribution, 2025

3. RESULTS AND DISCUSSION

At the end of the process, 29 studies were quantitatively analysed by publication and reference number (Figure 2). Many of the studies analysed were from 2024 (18), while the fewest studies were from 2022 and 2025. It is expected that more studies will be published in 2025. Thus, a steadily increasing trend can be seen over the period under review.

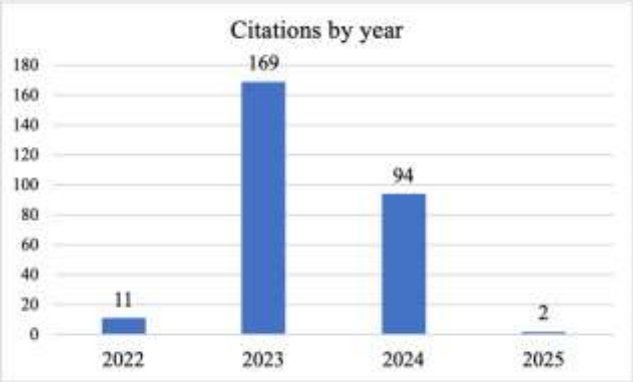
Figure 2 Articles by year in the systematic literature review



Source: author's own contribution, 2025

Studies published in 2023 achieved the highest number of citations up to the date of the study (Figure 3). Studies published in 2024 are still considered recent, so there are fewer citations in this case. Of note is that studies published in 2025 already have 2 citations, which is a good performance in such a short time frame. This underlines the importance and timeliness of the topic.

Figure 3 Citations by year in the systematic literature review



Source: author's own contribution, 2025

3.1 Behavioural biases

Optimism bias

Del Río et al. (2024) explores the influence of sustainability disclosure on financial analysts' optimism bias in the context of European corporate sustainability reporters. Their findings reveal that high-quality sustainability disclosure mitigates investor sentiment-driven optimism bias, improving the accuracy of financial analysts' recommendations. Specifically, during periods of favorable investor sentiment, buy recommendations for firms with good sustainability practices are not very informative, while sell recommendations for firms with bad sustainability disclosure are more informative. The research points out the importance of sustainability reporting in reducing market information asymmetry, making financial analysts more impartial, and facilitating accurate stock valuation. These results point to the need to possess stronger sustainability reporting standards to support investor trust and align analysts' valuations with facts of firm performance (del Río et al., 2024).

Overconfidence bias

Rabbani et al. (2024) analyzes the effect of overconfidence bias on stock returns, trading volume, and liquidity in G7 nations during pre- and post-COVID-19 times. The findings reveal that overconfidence bias generates trading volume and is also influenced by market liquidity, lagging market returns but not vice versa. The results show that overconfidence increases market volatility, particularly during times of crisis, in favor of the regulatory intervention aimed at combating behavioral biases and improving the stability of the market (Rabbani et al., 2024). Wang et al. (2024) examines the relationship between Chinese capital market stock returns and ESG rating disagreement using six rating agency data from 2009 to 2021. Findings establish a significant negative relationship, whereby increased ESG rating disagreement is associated with decreased stock returns. Mechanism analysis attributes this to decreased investor sentiment and trading volume, which is driven by uncertainty and confusion among investors because of inconsistent ESG evaluations. Furthermore, of the three dimensions of ESG, governance rating disagreement has the most negative effect on stock returns, which suggests the prominent role played by corporate governance in investor confidence (Wang et al., 2024).

Herding bias

Gabrilakis and Floros (2024) analyzes the behavioral biases and performance in portfolios of ESG leaders, focusing on European and Global ESG indices from 2012 to 2022. It finds large-cap value stocks with good profitability and conservative investors' tilts. The analysis, for the first time, finds volatility and herding tilts that reduce diversification advantages and increase risk exposure. These findings suggest that ESG investors cannot generate high risk-adjusted returns, indicating the importance of volatility management and behavioral biases when constructing sustainable portfolios (Gavrilakis and Floros, 2024).

Dispersion bias

Dupuy and Garibal (2022) examines the cross-dispersion bias of ESG rankings and the ways that aggregation methods in scores disproportionately give importance to the most statistically dispersed categories. It leads to unbalanced ESG scores that pinpoint methodological differences among raters like Refinitiv and Bloomberg rather than genuine firm performance. The article proposes a way to correct it through standardizing all categories' scores by their standard deviation before aggregating. This adjustment reduces bias and ensures balanced category influence, enabling more comparable and consistent ESG rankings between data providers. Empirical results show that this adjustment has a strong impact on the ranking of companies and better reflects investor perceptions.

Media and reputational bias

Galletta et al. (2023) analyzes the relationship between ESG scores and operational risk for banks worldwide between 2011 and 2020. Findings indicate a negative correlation, with higher ESG scores reflecting lower operational risks, particularly through enhanced reputational management and compliance with ESG values. The study reveals how ESG controversies such as media scandals can increase reputational damage and operational risk. Big banks, with higher asset diversification, have less business risk, while risk is positively correlated with profitability indicators like return on assets (ROA) (Galletta et al., 2023).

Chu et al. (2025) examines the effect of political connections on ESG sentiment ratings of Chinese listed firms and establishes a significant positive effect. Politically connected companies are endowed with improved sentiment scores largely because they can determine how the media cover them, but not necessarily their actual ESG performance. The effect is also strongest for state-owned companies, mature companies, and highly educated or predominantly male-managed companies. Anti-corruption measures were also seen to counteract the effect of political connections on ESG sentiment, and this captures the effectiveness of anti-corruption measures in eliminating such biases (Chu et al., 2025). Zheng and Zhang (2024) examine the effect of network public opinion (NPO) on ESG ratings in China's emerging market. The results demonstrate that NPO, specifically negative sentiments (NNPO) on retail investor forums, decreases ESG ratings significantly, primarily by causing managerial stress and enhancing short-term performance pressures. The depressive impact is even more robust in non-state-owned enterprises (non-SOEs). The study recognizes the unique challenge NPO poses in less developed capital markets and demands strong corporate governance and stricter disclosure requirements to counterbalance the power of public opinion on long-term ESG commitment (Zheng and Zhang, 2024).

Selection bias

Barkemeyer et al. (2023) investigates selection bias in ESG controversies data based on media sources used by ESG data providers being skewed. It determines that companies listed in English-speaking countries are five times more likely to be named in controversies than non-English ones. Such bias results from overdependence on a limited group of US and UK-headquartered news sources, limiting diversity of information and disproportionately affecting multinational companies that operate in less visible regions. The study indicates that such media concentration distorts ESG analysis, promotes ESG centralization approaches, and increases non-financial risk for investors with insufficient reporting on ESG-related incidents. Research calls for more media sources geographically and linguistically spread in character to provide ESG data validity and reliability (Barkemeyer et al., 2023).

Self-disclosure bias

Self-disclosure bias in ESG ratings, one refers to companies' practice of disclosing their sustainability practices selectively, and typically in the manner of emphasizing positive data and omitting negative data. As ESG reporting is typically voluntary and self-reported, companies can frame a narrative about their sustainability efforts. This can form a distorted view of what needs to be viewed as the true reflection of the ESG performance of an organisation and thereby misalign what's reported and what occurs (de la Fuente and Velasco, 2024).

Confirmation bias

Psychological or behavioral biases in ESG investments mean different cognitive tendencies of investors when interpreting and reacting to various ESG ratings or sustainable investment opportunities. These can, in fact, have a significant bearing on the strategy of investing and decision-making therein, often resulting in far-from-rational objective assessments of financial or sustainability performance (Deka et al., 2023). Leite and Uysal (2023) investigates the impact of ESG ratings on stock price responses to new information, specifically credit-rating changes. Using an event-study methodology, the study reveals that firms with high ESG ratings experience significantly stronger stock price reactions to credit-rating upgrades, with cumulative abnormal returns (CAR) increasing by 130 basis points. This effect, attributed to confirmation bias, highlights investors' tendency to reinforce their positive perceptions of firms with strong ESG attributes when presented with favorable news. Conversely, credit-rating downgrades showed no statistically significant moderation by ESG ratings. The findings emphasize that investors focus on overall ESG ratings rather than individual components and value high ESG rankings as a signal of corporate attractiveness (Leite and Uysal, 2023).

Recency and Negativity bias

Christophe et al. (2024) analyzes the behavior of short sellers that is aggressive in response to ESG news, with a focus on the role of recency and negativity biases. Using a FactSet TruValue Labs dataset, the study finds that short sellers are most worried about companies with recent negative ESG news, particularly when accompanied by a long-term positive ESG reputation. This pattern aligns with expectancy violation theory, in which bad news impacts well-reputed firms more strongly. Interestingly, even though short selling is directed at firms with long-term poor ESG reputations, large negative abnormal returns occur only for firms with good ESG reputations and recent bad news. These findings highlight how short sellers interpret ESG signals, with consequences for financial decision-making and market efficiency, and the materiality of ESG factors (Christophe et al., 2024).

Familiarity bias

Hamdan et al. (2024) examines the function played by wealth and familiarity bias in investment in sin stocks, specifically European countries from 2000 to 2020. Sin stocks, i.e., stocks linked to alcohol, tobacco, and gambling, experience greater risk-adjusted returns in richer North European countries, where they continue to be comparatively more under-valued compared to Eastern and Southern Europe. One salient factor here is familiarity bias, and there is less resistance from investors of countries with a higher consumption level of alcohol and gambling towards respective stocks. In addition, studies further indicate that sin stocks also exhibit lower volatilities as well as insensitiveness towards economic depression (Hamdan et al., 2024).

Managerial and market myopia bias

The impact of ESG scores on credit risk for Chinese A-share listed companies is discussed in Deng et al.'s (2024) study. The main findings are that improved ESG scores significantly decrease credit risk by improving stock liquidity, quality of internal control, reducing financing costs, and limiting negative ESG-related news sentiment. The study determines that brown companies derive less advantage from improved ESG performance than do green companies since the former will be vulnerable to suspicion and regulatory concerns. Further, high manager myopia or low information quality disclosure companies are more likely to credit risk deterioration through improved ESG scores (Deng et al., 2024). Del Río et al. (2023) examines the extent to which sustainability disclosure mechanisms, including engagement in sustainability ratings, mitigate market myopia for European firms listed on the S&P Europe 350 Index.

Market myopia, which is defined as a short-term earnings overestimation and underestimation of long-term earnings, was less prevalent among high sustainability reporters (HSRs) compared to low sustainability reporters (LSRs). Long-term participation in sustainability ratings also reduces this anomaly by demonstrating that long-term expectations of earnings and price reliability are enhanced by long-term commitment towards sustainability practices. The study emphasizes that information asymmetry is reduced, and market efficiency is promoted by sustainability disclosure mechanisms. The mechanisms serve as signals for a firm's long-term value to investors (del Río et al., 2023). Lu et al. (2024) analyzes the impact of managerial myopia on corporate ESG performance, with special reference to Chinese A-share listed companies during the period 2010-2020. It finds that managerial myopia has a significant negative impact on ESG performance by suppressing green innovation capabilities and decreasing the quality of information disclosure. However, such adverse effects are balanced by outside governance frameworks, such as increased stock liquidity and the engagement of Big Four accounting firms. The study emphasizes the importance of strategic long-term planning and good governance frameworks to overcome short-term managerial biases, thus promoting sustainable firm growth (Lu et al., 2024).

3.2 Structural biases

Methodological bias

Methodological bias exists because different criteria, weighting, and scoring methodologies of the various rating agencies result in inconsistent ratings for the same company. This will mislead investors and distort resources and capital allocations. This could be highly generic: some of these agencies may place a strong emphasis on environmental metrics, such as carbon emissions, while others may look at social or governance indicators, including gender diversity or supply chain integrity. After that, these ESG components are weighted differently by the agencies themselves, further complicating comparability. In addition, different agencies apply other methods of handling missing information, including estimation models, proxy data, and conservative assumptions, which themselves can easily introduce inconsistencies and inherent biases into the ratings (Kotsantonis and Serafeim, 2019). Such methodological bias in the ESG ratings has huge implications, especially for investors. This means that the different methodologies make investors rely on certain ratings that may not agree with each other, thereby creating portfolio construction and investment divergence. Those kinds of inconsistencies could divert capital toward companies with inflated scores, which do not mean they have better practices, while more sustainable but poorly reported companies continue to be overlooked. Equally, methodological changes and adjustments can also induce volatility in stock prices for companies whose ratings are pivotal for ESG-driven investment interest (Christensen et al., 2021).

Size bias

Large companies tend to have more substantial resources available for ESG disclosure and reporting, which may artificially inflate their score, whereas generally good sustainability practices of smaller firms are then reflected in lower scores simply because they cannot afford to generate long and involved reports (Cakir et al., 2023; Dobrick et al., 2023). First, company size bias has a threefold impact: larger firms tend to give a feeling of heightened sustainability, which, in most instances, is supported more by their better reporting infrastructure than actual ESG performance. This leads to distorted views over the sustainability landscape in which investors would then favor larger firms based on inflated ratings. These preferences may result in biased investment decisions that can overlook the small firms, which could well be the truly sustainable ones, only that they are too small to report on their practices effectively. Smaller firms could thus be caught in a vicious circle of poor ESG ratings and reduced interest from investors, hindering their potential growth and development in ESG-related areas (Akgun et al., 2021; Dobrick et al., 2023; Cakir et al., 2023). Dobrick et al. (2023) investigates the persistence of size bias in Refinitiv ESG data, following similar findings in the predecessor ASSET4 dataset. Despite claims by Refinitiv to address this bias, the study identifies that firm size continues to significantly influence ESG ratings. Key drivers include the resources larger firms dedicate to sustainability reporting, such as CSR committees and adherence to GRI guidelines. The study recommends implementing correction factors to mitigate this bias and ensure equitable ESG evaluations (Dobrick et al., 2023).

Cakir et al. (2023) introduces "esg2go," a sustainability rating and reporting tool designed to minimize bias and improve the practicality of ESG assessments for small and medium-sized enterprises (SMEs). Developed through collaboration with stakeholders, the tool uses a calibrated benchmarking system tailored to firm size, industry, and specific sustainability goals. Unlike traditional ESG ratings, esg2go emphasizes transparency, coherence, and accessibility, with SMEs maintaining ownership of their data while providing input through verifiable metrics (Cakir et al., 2023). Roger (2024) investigates the extent to which financial analysts consider ESG factors in their target price evaluations. Initially, univariate analysis suggested that analysts penalize firms with high ESG scores, influenced by a size bias and the relative industry-level construction of ESG ratings. However, multivariate regression results revealed the opposite, showing that analysts issue higher target prices for firms with better

ESG scores, particularly in the environmental dimension. A one-standard-deviation improvement in environmental scores increases implied returns by 2.09 percentage points (Roger, 2024).

Commercial ties bias

Li et al. (2024) examines the effect of commercial relationships on ESG ratings using the study of Moody's and S&P purchases of ESG rating firms Vigeo Eiris and RobecoSAM. The findings show that ESG rating firms assigned higher ESG ratings to firms that already had credit rating relationships with Moody's or S&P after the purchases. Such a bias was highest for firms that had more elaborate business relationships but lower for firms with transparent ESG disclosures and higher long-term institutional ownership. In addition, such inflated ESG ratings facilitated firms to issue more green bonds and benefited the parent companies' credit rating business. The quality of the ESG ratings subsequently declined to a less reliable indicator of subsequent ESG performance, while emphasizing the conflict of interest inherent in such commercial arrangements (Li et al., 2024).

AI Usage bias

Suárez Giri and Sánchez Chaparro (2024) suggest the Drivers-Dimensions-Impacts (DDI) framework to assess AI adoption and its implications in the ESG ratings industry. It refers to extensive and growing use of AI technology, particularly Natural Language Processing (NLP) and Machine Learning (ML), in big ESG rating companies in a bid to enhance data acquisition, analytics, and forecasting capability. The study ascertains that while AI promotes efficiency, timeliness, and innovation in ESG ratings, it also creates concerns about perpetuating biases, exacerbating rating inconsistency, and undermining trust due to the opaque nature of AI approaches. The authors recognize the need for transparency in AI usage, standard guidelines, and stakeholder engagement to eliminate these concerns and produce reliable and equitable ESG ratings (Suárez Giri and Sánchez Chaparro, 2024). Saxena et al. (2022) discusses how Industry 4.0 technologies can improve ESG practices and reporting in a more sustainable direction and towards alignment with the SDGs. It explains how significant a role such technologies as the Internet of Things (IoT), artificial intelligence (AI), blockchain, and big data can play in terms of enabling real-time data capture, improving data quality, and transparency. IoT enables real-time monitoring of social and environmental data, while AI enhances analytical and predictive power in ESG decision-making. Blockchain technology guarantees data integrity and authenticity, making greenwashing less likely. Big data analytics enables the uncovering of latent trends in ESG data, making it more and more valuable for investment decisions. Notwithstanding these gains, the research acknowledges lingering concerns such as incompleteness in ESG frameworks, reporting biases, and implementation costs being exponentially high (Saxena et al., 2022).

Challenges and further research areas

Liu et al. (2024) analyzes the impact of ESG rating disagreement on idiosyncratic return volatility in Chinese capital markets. Using 2015-2021 data, it finds that firms with greater ESG rating disagreement have greater idiosyncratic return volatility because of increased investor attention and noise trading. The article explains how heterogeneous ESG ratings create information asymmetry, decrease market efficiency, and distort price mechanisms. Mechanism tests validate that ESG score discrepancies lead to more investor awareness and speculative trade volume, ultimately causing increased volatility. Further, heterogeneity tests present evidence that these effects are more evident for companies with high analyst coverage and forecast dispersion; foreign and institutional investors, nevertheless, are found to mitigate such effects (Liu et al., 2024). Wang and Wang (2024) examine the connection between ESG performance and firm-level innovation using the data of Chinese-listed firms between 2009 and 2021. The results according to the study demonstrate a positive significant relationship between ESG performance and innovative output quantity and quality. The mechanisms underlying such a relationship are the alleviation of agency problems, enhanced transparency of information, and internal corporate governance practices being strengthened. The paper also discovers that the effect of ESG performance on innovation is particularly robust in China's central and western regions and in pollution-intensive industries. The findings are verified through validation tests, such as truncation bias corrections for patent information and alternative measurements (Wang and Wang, 2024).

Zhang et al. (2024) analyze the impact of green fund investors on firm ESG performance improvement in China's A-share market between 2011 and 2020. The results indicate that green fund investment exerts a positive significant influence on ESG rating of companies, especially state-owned companies, companies engaged in polluting industries, and after the green finance policy release. We identified that the long-term green investors possess a more favorable effect than their short-term counterparts since their presence appeals to other long-term green investors, stimulates new mutual fund player interest, and results in increased media attention in ESG issues. The research points out that the companies of green fund investors are more expected to be part of ESG index constituents, thereby enhancing their status and financial well-being (Zhang et al., 2024).

Zhang et al. (2022) studies the long-term impact of the timing when retail investors join the stock market on their disposition effect, selling winning stocks prematurely and holding losing stocks for too long. Using trading histories of over 19,000 individual investors in China's stock market, the article demonstrates that the disposition effect is extremely sensitive to the initial market environment. Investors who put in money when there are low market returns, negative investor sentiment, high market volatility, or higher economic policy uncertainty tend to have a more robust disposition effect. These early experiences shape the investor's perception of risk and emotional responses, which then affect their trading behavior (Zhang et al., 2022). Kleffel and Muck (2024) examine the impact of classifying sustainability information as financially material or immaterial on the investment choices of retail investors through a stated-choice experiment among German investors. The results show that investors possess a strong non-pecuniary preference for sustainability but favor positive over negative ratings. The poor sustainability ratings' financial materiality designation, nonetheless, compels investors to require higher return

premiums, meaning that they view these designations as financial signals. Such behavior is highly pronounced for investors utilizing sustainability information for financial reasons in the experiment, albeit it fails to appear in actual investment settings (Kleffel and Muck, 2024).

4. Conclusion

The study of biases in ESG ratings was meant to point out the complicated topography of sustainable investment and the manifold challenges that come with using ESG assessments. On one hand, ESG ratings have gained momentum gradually as an important resource that investors utilize in their struggle to bring their portfolios in line with sustainability goals. On the other hand, they do not come without serious shortcomings. These behavioural and structural biases constitute both challenges and opportunities for the refinement of the ESG evaluation framework and improvement of investment practices. Aggregating the reviewed various biases suggests that more harmonized and transparent approaches to ESG ratings are desirable. A set of international standards guiding rating methodologies and data disclosures would help decrease biases related to methodology and size. Transparency could also be increased through third-party audits and independent data verification, therefore enhancing the quality of self-reported ESG data, and reducing bias from self-disclosure. Future studies should be directed toward constructing sophisticated frameworks for standardizing practices that can transcend regional gaps. Although ESG ratings are indispensable for guiding responsible investments, the susceptibility to a range of various biases erodes their reliability and comparability. Refined ways of ESG evaluation can help the stakeholders build more trust in those ratings while having a more balanced and effective sustainable finance framework.

Future studies based on this research should seek to empirically validate how various biases in ESG ratings interact. This research could use quantitative analyses such as testing of firm-level data and state-of-the-art statistical methods like instrumental variable regression. More studies concerning regional and sector-specific divergences would also be relevant for identifying how these biases play out across both developed and emerging markets and industry-wide. Further, the perspectives from behavioural finance might be considered with the help of either experimental or survey-based studies on how various psychological biases, such as availability, herding, and confirmation bias, impact ESG investment decisions in volatile times. Also, the current landscape of emerging technologies, like blockchain, artificial intelligence, and machine learning, can offer chances of reducing these biases through a more transparent, standardized, and reliable approach. In the end, policymakers, rating agencies, and researchers should work together in the development and testing of ESG rating frameworks that could be globally applicable, reducing methodological inconsistencies and firm size discrepancies. Addressing these aspects, future research will enhance the credibility of ESG ratings and contribute to a more fair and efficient sustainable finance landscape.

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