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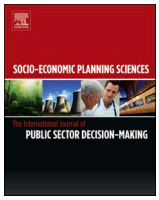

Exploring the nexus between ESG risk variations and investment preferences: Insights from sustainable ETFs during the COVID-19 era

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A B S T R A C T

This study analyzes the impact of Environmental, Social, and Governance (ESG) risk metrics on the financial performance of ETFs in the US and Europe from January 2020 to December 2023, particularly during the COVID-19 pandemic. It explores the influence of ESG investment trends on ETF performance and investor preferences between equities and bonds in response to ESG risk profiles. Results show a positive correlation between higher ESG standards and financial performance, measured by the Sharpe ratio, with a marked preference for bonds amidst increased ESG risks. This highlights the critical role of ESG considerations in investment strategies and risk management, providing insights for sustainable finance.

1. Introduction

In the current context, scholars have endeavoured to delineate a role for corporations beyond mere shareholder value creation, incorporating broader considerations [1]. From this vantage point, the focus on Corporate Social Performance (CSP) has garnered increasing interest from corporations, the financial community, regulators, and policy-makers [2], heralding a new way of assessing business success and sustainability. Companies that fulfil stakeholder expectations and needs through social and environmental activities can reap benefits such as reduced financial risk [3,4], enhanced reputation [5,6], improved evaluations by financial analysts [7,8], higher credit ratings [9], more effective communication with investors on financial matters [10], strengthened corporate governance leading to an increase in company value [11], improved accuracy of analysts' forecasts [12], and a reduction in the cost of equity capital in financial markets [13]. Moreover, it is widely accepted that greater engagement with the external environment tends to decrease risk and uncertainty for investors, ultimately translating into enhanced returns for the company's capital providers, namely Corporate Financial Performance (CFP) [14].

ESG factors, encompassing environmental, social, and governance considerations, play a pivotal role in business operations, particularly in terms of financial outcomes. Bloomberg's analysis forecasts a significant surge in ESG factors, projecting a rise to $53 trillion this year, a notable increase from the $37.8 trillion reported in the preceding year. This remarkable growth trajectory assumes a 15 % increase—half the pace observed over the last five years. ESG assets under management are anticipated to comprise over a third of the projected global assets, surpassing $140 trillion by 2025 [15]. Internationally, Europe has steadfastly advocated ESG investments, which is evident in its dominance, commanding half of the global ESG assets. The continent boasts 3196 ESG funds, representing 77 % of all surveyed instruments and managing 81 % of assets based on sustainability criteria [16]. Italy also exhibits a burgeoning interest, witnessing a rise to 363 distributed ESG funds, accumulating a total collection of 56 billion euros as of September 2020 [17]. Italy stands out for its conscientiousness toward environmental, social, and governance standards, a fact underscored by an analysis conducted by Ref. [18]. Globally, over 60 % of enterprises prioritize sustainability on par with—or even above—financial success. Italy surpasses global and European averages with a remarkable 67 % [18]. The perceived value of ESG for businesses is undeniably positive, with significant potential yet to be fully realized. This sentiment supports [19], which reports that sustainable open-ended funds and ETFs in Europe received net flows of 233 billion euros in 2020, with approximately 100 billion euros recorded in the final quarter alone [19]. estimates a promising market potential of 7.2 billion euros for mini green bonds in Italy, reflecting a cautious yet optimistic stance toward sustainability initiatives.

Therefore, in this context where ESG dynamics are increasingly scrutinized and studied, it is important to emphasize that, despite several studies examining various dimensions and impacts of ESG factors, there is still a significant gap in the literature. Despite efforts to understand the role and impact of ESG practices on corporate and financial performance, no study has specifically addressed the

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relationship between ESG risk and the financial performance of Exchange-Traded Funds (ETFs) issued by sustainable asset management companies. There is a critical gap in the CSR and ESG literature regarding the nuanced interrelation between ESG risk metrics and financial risk. Existing research has investigated the direct effects of ESG practices on financial outcomes, often foregoing a thorough analysis of how ESG risk, distinct from ESG performance, correlates with the financial risk profiles of firms.

Simultaneously, the literature significantly lacks exploration into how market conditions altered by the COVID-19 pandemic have modulated investor preferences, particularly regarding shifts in ESG risk performance. As a global event characterized by high turbulence and extreme uncertainty with a specific onset date, the pandemic offers an unprecedented lens through which to examine whether and how fluctuations in ESG risk performance during such tumultuous epochs have influenced strategic investor choices between stocks and bonds [20]. Addressing these research gaps enriches the academic debate and provides nuanced insights for scholars and practitioners navigating the complex terrain of sustainable investments in an uncertain global economic context.

Thus, this study examines the relationship between ESG risk and the financial performance of ETFs issued by sustainable asset management companies. Our dataset encompasses a wide range of ETFs actively traded in the United States and Europe from January 2020 to December 2023. This period was selected to capture the dynamics of ESG investment trends and their impact on ETF performance before and during the COVID-19 pandemic, offering insights into ESG resilience under market stress conditions.

Our study aims to empirically investigate on a global scale whether bonds provide adequate diversification during financial crises, precisely when diversification is most needed. We seek to examine episodes of flight to quality, contributing to recent studies focusing on the pandemic's role in influencing the reaction of financial markets [21–25]. Furthermore, understanding the correlations between financial assets is crucial for policymakers. Even though authorities do not have explicit price targets for financial assets such as stocks and bonds, they use financial markets as indicators of investor growth expectations and inflation forecasts [26–28].

Our findings contribute to a deeper understanding of the complex interplay between ESG factors and financial performance through the lens of stakeholder theory [29] and the resource-based view [30,31]. They underline the importance of integrating environmental considerations into investment decisions and managing related ESG risks as central components of financial analysis and strategy formulation. This supports the risk management theory [32]. Additionally, a significant inclination of investors towards bond funds in the face of escalating ESG risks highlights a critical narrative within the sustainable investment domain.

In conclusion, this paper significantly contributes to the ongoing discourse surrounding ESG risk management and sustainable finance. By elucidating our findings' managerial and policy implications within the context of relevant literature, we offer insights into the intricate relationship between environmental, social, and governance considerations and investment decision-making processes. Our study sheds light on the evolving landscape of investment preferences in response to sustainability challenges, emphasizing the importance of incorporating ESG factors into financial analysis and decision-making frameworks. Moreover, our research contributes empirical evidence supporting a positive association between environmental performance and risk-adjusted financial returns. This finding adds depth to the discussion on the financial implications of Corporate Social Performance (CSP) and underscores the potential benefits of integrating sustainability initiatives into corporate strategies. By highlighting the positive impact of environmental performance on financial outcomes, our study reinforces the value of proactive ESG risk management and sustainable business practices in enhancing long-term shareholder value and resilience to market uncertainties.

The paper is organized as follows. Section 2 presents a literature review on the CSP-CFP relationship. In section 3, the methodology used to address research questions is presented, and in section 4, the case study is analyzed. Finally, in section 5, conclusions, and theoretical, and managerial implications are presented, while section 6 outlines the research limitations, and future research.

2. Literature review

2.1. CSP-CFP relationship

The association between CSP and CFP inspired numerous studies over the years, although ambiguity persists due to the different methodologies and measurements employed [1,33,34]. This review aims to synthesize these studies into a coherent narrative, critically identifying gaps and outlining how this study will address them. Some studies have shown a positive correlation between CSP and CFP [14], while others have indicated a negative correlation [35]; others have shown the absence of a significant association [36], others a U-shaped relationship [37], or an inverse U-shaped relationship [38].

The positive direction of the CSP-CFP relationship can be attributed to stakeholder theory [29], which posits the benefits of higher CSP as an improvement in employee morale, reduction in legal and compliance costs, increased productivity, and so forth. This can instil confidence in shareholders, making stock prices less volatile and reducing risk. Additionally, sustainable practices can create competitive advantages, leading to higher future cash flows and improved financial performance [39]. Even the risk management theory predicts a positive relationship between CSP and CFP [32]. Based on stakeholder theory, this theory further argues that CSP can cultivate moral capital, acting as an "insurance" to protect shareholders' assets [4]. This implies that CSP is a risk management tool capable of mitigating crises and shielding the company from potential negative impacts on its cash flow [40].

Moreover, other authors argue that CSP destroys firm value due to the "window dressing" phenomenon [41]. This occurs when investors perceive a company's ESG communications as superficial and not reflective of genuine management intentions. Such discrepancies create significant agency risk, where management's interests diverge from those of the shareholders [42,43]. This can lead to losing credibility and investor confidence, lowering stock prices. Increased scrutiny from regulators and the media and potential operational disruptions due to internal dissatisfaction exacerbate the problem. In the long term, insincere ESG practices expose companies to risks such as regulatory penalties and reputational damage, ultimately eroding firm value [44]. Thus, while CSP has the potential to enhance firm value, superficial ESG efforts can have the opposite effect, highlighting the importance of genuine, substantive actions in ESG practices.

Non-linear relationships can also exist. On this ground [37], developed the concept of stakeholder influence capacity (SIC), which he defined as "the ability of a company to identify, act on, and profit from opportunities to improve relationships with stakeholders through CSR [37]. Simply put, SIC is a formalisation of the basic logic by which stakeholders consider some companies more credible than others and consequently reward companies for their acts of social responsibility. Augmenting the variable returns explained by SIC with consideration of the costs of investing in social responsibility leads one to view the expected relationship between CSP and CFP as U-shaped. A negative CSP-CFP relationship, which forms the initial downward slope of the U, is explained by the inherent costs of CSP. A firm with a weak CSP can handle the financial outlay of a firm that invests in additional employee benefits, pollution reduction, charity, community involvement, and other forms of social responsibility. Recognising the costs inherent in social responsibility [45], decried such allocations as examples of agency loss. SIC, however, helps explain why the downward-sloping line eventually switches direction [45]. Even though spending on social

performance is costly, firms that have accrued adequate SIC through significant social performance may earn financial returns that offset and come to exceed the costs. Those firms with the highest SIC will get the most out of their social investments and have the highest financial performance. That is, firms with increasingly favourable SIC earn increasingly favourable returns on their social investments, much as firms with absorptive capacity earn more from their investments in knowledge [46]. This means that before accruing adequate SIC, the curve slopes downward; CSP is an investment that offers negative returns. After that, the curve evens out, and for those firms that accrue adequate SIC, the curve turns upward, and CSP becomes an investment that offers positive returns.

Guo and Lu, on the other hand, studied the inverse U relationship using a Chinese international construction companies (CICCs) panel dataset based on accounting and market-based performance measures and predictive potential measures [38]. Companies' CSR practices can improve their competitiveness up to a certain point. After that, competitiveness decreases. Based on these results, the interaction between the benefits and costs of CSR is not static; instead, its curvilinear nature is reflected in both performance and competitiveness. More specifically, CSP is positively associated with competitiveness below an inflexion value and negatively associated with competitiveness above the value [38].

This study fills a gap in the literature by investigating how ESG risks affect the performance of Exchange-Traded Funds (ETFs). While previous research has extensively explored the relationship between CSP and CFP, the impact of ESG risks on ETF performance remains relatively unexplored. By focusing on ETFs, which are increasingly popular investment vehicles, and examining the comprehensive influence of ESG factors, this research provides valuable insights into the dynamics of ESG investing. The findings have practical implications for investors and asset managers, guiding portfolio allocation strategies and risk management practices in alignment with sustainability objectives.

2.2. CSP and risk

A vast body of research has examined the incidence of CSP on corporate financial performance (see Table 1). However, the previous literature offers only limited evidence of the influence of CSP on corporate risk (Impact of ESG factors on corporate risk in Europe).

Table 1
Types of relationship between CSP and firm risk

RELATIONSHIP	AUTHORS	THEORIES
Positive relationship	Hillman e Keim, 2001 Orlitzky et al., 2003 Posnikoff Chen & Wang, 2011; Liu, 2020; Magrizos et al., 2021; Nyeadi et al., 2018	**Stakeholder Theory** (Freeman, 2010) **Resource-Based Theory** (McWilliams and Siegel, 2011) (Grant, 1991) **Risk Management Theory** (Bouslah, K.; Kryzanowski, L.; M'Zali, 2018)
Negative relationship	Brammer et al., 2006 Vance, 1975; Wright and Ferris, 1997 Wrightand Ferris Pan et al., 2014; Sharma & Aggarwal, 2021	**Neoclassical Theory** (Friedman, 1962) **Theory of Managerial Opportunism** (Preston and O'Bannon, 1997) **Window Dressing** (Palazzo and Richter, 2005)
U-shaped	Barnett e Salomon, 2012	**Concept of SIC** (Barnett, 2007)
Reverse u-shaped	Guo, H., & Lu, W.; 2021	Guo, H., & Lu, W.; 2021
No significant relationship	Renneboog et al., 2008 Cochran and Wood, 1984; Hillman and Keim, 2001 Teoh et al., 1999 Fahad & Busru, 2021; Jia, 2020; Kao et al., 2018	

A growing number of investors, especially institutional ones, prefer investing in companies engaged in specific CSR initiatives [47]. For example, in Europe, 41 % of managed assets, equivalent to 6.9 trillion euros, have been allocated to investments excluding controversial sectors such as weapons, alcohol, or tobacco [48] Prominent institutional investors, such as the Norwegian Pension Fund, which has divested from high-carbon industries, are examples of this trend [48,49].

Furthermore, negotiators recently reached an agreement during the United Nations COP26 climate summit in Glasgow in October 2021, which sets rules for progress towards sustainable development. Globally, regulators and investors are beginning to enforce stricter requirements regarding CSR and ESG. Assessing ESG performance will significantly impact enterprise risk management, primarily on credit risk.

Meanwhile, leading rating agencies are increasingly interested in acquiring ESG data, as sustainability is increasingly relevant in risk assessment. However, while previous studies have mainly focused on the relationship between ESG and financial performance in stock markets [50,51], the extent to which ESG practices influence corporate insolvency risk still needs to be explored. ESG investments can impact companies' cash flow and ability to repay short-term debts.

Research generally reveals consistent results at an aggregated level of CSP practices, indicating a negative relationship between CSP measures and corporate risk. However, recent studies have produced conflicting results depending on the samples, databases used, various CSP measurements, and different risk measures employed.

For instance [40,51], identified a negative correlation between environmental performance and a specific risk measure, while [2] found both negative and positive relationships in various subsets of data.

Corporate risk is the potential loss of a company's value due to uncertain future outcomes or events [3,52]. This risk can be measured through fluctuations in financial performance over time, including stock prices (market risk) or internal accounting returns (accounting risk) [3].

Financial theory distinguishes total (market) risk into idiosyncratic and systematic risks [53]. Idiosyncratic risk is specific to the company and cannot be attributed to general market movements. In contrast, systematic risk reflects the company's sensitivity to changes relevant to all securities [54].

Consistent with stakeholder theory, it is plausible to argue that higher levels of CSP are associated with lower financial risk. Since low levels of CSP can increase the likelihood of legal actions and legal sanctions, a high level of CSP can promote more stable relationships with the government and the financial community [55]. Moreover, market participants tend to allocate more capital to companies with high CSP, which can reduce companies' financial constraints [8].

Research findings suggest that improved CSP practices reduce financial risks, contributing to lower stock market volatility and a lower likelihood of corporate crises [33]. Consistent with this argument, Socially Responsible Investing (SRI) investors appear to be less responsive to negative returns compared to investors in traditional funds [56,57], suggesting that CSP-focused investors may be more inclined to retain their investments even in the presence of negative financial performance.

Despite stakeholder and risk management theories suggesting a negative relationship between a company's Corporate Social Responsibility (CSR) behaviour and corporate risk, the theory of managerial opportunism implies a positive relationship between CSR performance measures and corporate risk [2].

CSR can reduce a company's risk, improving its financial performance (CFP). An aggregate analysis by Ref. [3] found a negative relationship between CSR and business risk. More recent studies have also demonstrated a negative correlation between CSR and the risk of stock price collapse [58] and the risk of corporate insolvency [59]. Given the prevalence of arguments supporting a negative relationship, it is assumed that (ESG) factors hurt all market-based risk measures (total, idiosyncratic, and systematic risk). However, due to the limited empirical evidence and the ambiguous nature of theoretical predictions, no

clear hypotheses are formulated regarding the direction of the influence [60]. The three ESG dimensions involve different stakeholders, which could impact companies' financial and risk parameters [4,61]. Furthermore, investors may attribute different importance to the three ESG dimensions for business activities, generating different market interests [62] and influencing market reactions to ESG activities. The different relevance of ESG dimensions among investors may also result from different levels of measurability and reliability of information [63]. Ultimately, companies with the same overall ESG score may impact business risk differently due to their different scores in the three ESG dimensions [2].

2.3. ESG risk

While ESG scores primarily seek to assess a company's positive ESG disclosures, the increasing relevance assumed by ESG investments has brought heightened scrutiny towards the inherent risk and potential returns associated with such investments. Scholars indicate that ESG factors can influence financial performance in various prudential risks, encompassing credit, market, operational, liquidity, and funding risks [64]. The European Banking Authority defines ESG risks as instances wherein ESG factors harm a company's financial performance or solvency [64].

Furthermore, scholarly discourse suggests that the materialization of ESG risks is contingent upon the varying risks posed by ESG factors over distinct time frames [64]. This implies that ESG scores and ratings should encapsulate pertinent information concerning a company's exposure to and management of these risks to assess its ESG profile comprehensively.

While ESG scores generally assess companies' ability to internalise sustainability issues into their strategies and practices, some agencies are starting to produce ESG risk ratings, which measure companies' exposure to ESG-related risks. This change in perspective might clarify whether investors and decision-makers consider them a signal of market performance.

The financial sector is notably vulnerable to exposure to environmental, social, and governance (ESG) risks, which are crucial considerations in the credit risk management process. Sustainable finance decisions entail integrating ESG risks into the decision-making framework. ESG risk management systems must rely on comprehensive information, encompassing historical data, stakeholder feedback, expert assessments, and other relevant sources [65], making literature on these issues increasingly significant.

Investments devoid of environmental considerations threaten the environment, potentially leading to public protests and social risks. Government approval is requisite before significant investments, especially environmental and social risks, introduce management risks. Neglecting ESG risks may result in reputational damage for investors, amplifying financial risk.

Environmental risk encompasses conditions hindering or affecting investment projects and associated costs. Pollution, climate change, and government misapplication of environmental policies predominantly influence environmental sustainability. Risks considered in institutional analyses of investment activities include escalating raw energy material prices, failure to adhere to scheduled energy efficiency improvements, surpassing permissible greenhouse gas emission levels, water access restrictions, negative environmental impacts, and consideration of biodiversity in the investment location [66].

Social risk encompasses consumer rights, health, human and labour rights, security, and potential unrest. Specific risks involve union-announced strikes, failure to meet production targets due to key employee departures, disruptions from the inability to recruit qualified staff, breaches of labour standards by company suppliers, and conflicts with local communities.

Governance risks pertain to processes and procedures governing organisational management. Evaluated for ESG risk, it encompasses all aspects of governance, including government approvals, licences, and concessions, especially concerning economic assets. Examples of corporate governance risks include losses due to ineffective board oversight, financial losses resulting from employee abuse or conflicts of interest, damage to the company's reputation due to concealing information on ongoing proceedings, penalties, or violations of conduct/requirements/standards, customer loss due to an inefficient complaint process, and leakage of customer personal data.

2.4. Flight to quality

In addition to conventional macroeconomic dynamics, we acknowledge the significance of financial market dynamics, perceptions, and market participants' risk aversion in shaping the relationship between stocks and bonds [26]. Scholars emphasize that crucial and diverse dynamics may emerge between financial assets and markets during periods of stress and turbulence. Therefore, we focus on analysing the link between stock and bond prices during such extreme phases, contributing to the vibrant literature on the "flight to safety" [67–70].

During periods of market stress, the financial press often characterises the extreme and contrasting movements in bond and equity markets as flights to safety or shifts towards quality. A substantial body of theoretical literature investigates such phenomena. Established asset pricing models grounded in consumption, as exemplified by Ref. [71], define a flight to safety as the concurrent occurrence of increased economic uncertainty (viewed as exogenous) with lower equity prices (through cash flow and risk premium channels) and low real interest rates (via the precautionary savings channel). Recent articles explore how market dynamics might trigger or exacerbate such phenomena. In Ref. [72], investors act as fund managers, and their fear of redemptions during periods of high volatility leads them to reduce holdings in less liquid assets, resulting in a flight to liquidity. This same fear also heightens investors' actual risk aversion, prompting a flight to safety that raises risk premiums and depresses prices of risky assets (a flight to quality). In Ref. [73], Knightian uncertainty causes agents to forsake risky assets in favour of safer credits when aggregate liquidity is low, thus inducing flights towards quality and safety [74]. examine a model where speculators, who provide liquidity to the market, face margin requirements that increase the volatility of asset prices.

The research field of "flight to safety" investigates the relationship between stock and bond returns during periods of financial market stress. It is worth noting that although there is generally a positive correlation between stock and bond returns, this relationship may reverse during turbulent times [70]. This phenomenon is explained by the fact that when market participants are optimistic about prospects in normal economic conditions, they are likely to increase their holdings in both stocks and bonds in their portfolios, resulting in a positive correlation between these two financial activities.

Conversely, when investors become pessimistic about future economic prospects, they are likely to sell their stock holdings in favour of bonds, leading to a lower, or even negative, correlation between stocks and bonds [75].

We can thus define a flight to safety, henceforth referred to as FTS, as an event characterised by three main criteria: (1) a broad and positive yield in bond securities coupled with a broad and negative yield in equities, (2) high-frequency negative correlations between bonds and equity returns, and (3) pronounced market stress, evidenced by significant stock market volatility [76].

Previous studies have explored various aspects of the FTS phenomenon, although they have yet to be with the systematic depth proposed in this article [77,78]. have highlighted that periods of increased stock market volatility are associated with lower correlations between equity and bond returns and higher bond yields [79]. identified episodes of "risk aversion" by examining correlations between currency returns, while [67] defined a *flight* to quality as a period in which correlations

between equity and bond returns decrease in the context of a declining stock market, differentiating such episodes from contagion. The recent financial crisis has also spurred research on financial instability and systemic risk indicators closely related to our FTS indicator [80–82].

3. Research gaps and hypotheses development

Within the CSR and ESG scholarship, a notable lack of inquiry persists concerning the nuanced interrelation between ESG risk metrics and financial risk, alongside the differential impact of pandemic-induced market uncertainties on investor allocation strategies. Predominantly, extant research has investigated the direct effects of ESG practices on financial outcomes, frequently eschewing an in-depth analysis of how ESG risk, as distinct from ESG performance, correlates with the financial risk profiles of enterprises. This oversight underscores the imperative for a rigorous academic endeavour to unravel the complex dynamics underpinning ESG risk metrics—beyond mere performance indicators—and their association with financial risk. This endeavour is anchored in the hypothesis that a sophisticated, multi-dimensional relationship exists wherein enhanced exposure to ESG risks, as meticulously captured by precise risk metrics, potentially exacerbates financial risk, irrespective of the ostensibly positive financial ramifications conventionally ascribed to robust ESG performance [3,49].

From a theoretical perspective, Stakeholder Theory provides a valuable conceptual framework for understanding this dynamic [29]. According to this theory, companies have responsibilities to shareholders and a wide range of stakeholders, including employees, customers, suppliers, and local communities. Given that ESG risk metrics can reflect the concerns of shareholders and other stakeholders, increased exposure to ESG risks may lead to negative financial consequences by eroding trust and support from these stakeholders [83,84]. Additionally, the Resource-based View suggests that a company's internal and external resources, including its organizational and relational capabilities, can influence its ability to manage ESG risks and mitigate associated financial risks [30,31]. As suggested by Ref. [85], companies that invest in sustainable resources and develop organizational capabilities to address ESG risks may be better positioned to navigate market uncertainties induced by the pandemic and protect their financial performance. Furthermore, Risk Management Theory emphasizes proactively identifying, assessing, and managing risks [2,86]. Understanding the relationship between ESG risk metrics and financial risk can inform risk management decisions and help investors develop more resilient and sustainable investment allocation strategies [87,88]. In summary, an interdisciplinary approach that integrates concepts from Stakeholder Theory, the Resource-Based View, and Risk Management Theory can provide a robust analytical framework for exploring the complex interaction between ESG risk metrics, financial risk, and investment strategies during periods of uncertainty, such as the COVID-19 pandemic.

Concomitantly, the literature conspicuously lacks an exploration of how the altered market conditions wrought by the COVID-19 pandemic have modulated investor preferences, particularly concerning shifts in ESG risk performance. As a period emblematic of acute market uncertainty, the pandemic offers an unprecedented lens through which to examine whether and how fluctuations in ESG risk performance during such tumultuous epochs have influenced investors' strategic choices between equities and bonds. This line of inquiry posits the hypothesis that in the face of pandemic-induced market volatilities, alterations in the ESG risk performance landscape significantly inform investor behaviour, engendering a pronounced propensity towards the relative sanctuary of bond investments over equities. This hypothesis draws upon the documented phenomenon of "flight to quality," postulating that during intervals of augmented uncertainty, investor predilections may skew towards bonds, a trend conceivably intensified or moderated by the evolving ESG risk profiles of the investment avenues under consideration [70,76].

This investigative thrust, aimed at disentangling the intricate ties between ESG risk metrics and financial risk, as well as delineating the influence of ESG risk performance on investment allocation amid pandemic-driven market perturbations, seeks to fill a critical void in the corpus of CSR and ESG literature. By explicitly articulating these hypotheses within the scholarly narrative, this exploration ventures beyond the superficial examination of ESG impacts, probing the deeper mechanisms through which ESG risks interweave with financial risks and investor decisions in a landscape increasingly characterized by volatility and unpredictability. Addressing these research gaps enriches the academic discourse and proffers nuanced insights pivotal for scholars and practitioners navigating the complex terrain of sustainable investment in an uncertain global economic milieu.

Based on the above assumptions, the two research hypotheses can be articulated as follows:

Hp1. A reduction in ESG risk performance mitigates the ETFs' financial risk performance

Hp2. Higher ETFs' ESG risk performance is positively correlated with a higher likelihood of investors' preferences toward bonds

4. Research design

4.1. Sampa and data

In the architecture of our analysis, the foundation was laid by sifting through the extensive repository of funds evaluated by Morningstar with a discerning eye for those that embody the tenets of sustainability. This search was refined to spotlight funds managed by entities within the Eurosif network, ensuring our sample was populated by funds engaged in sustainability beyond mere label adherence. Criteria for fund selection were meticulously crafted, demanding an active management style emblematic of a proactive stance towards ESG dynamics and a Morningstar ESG rating threshold of three globes or higher, affirming a commendable commitment to ESG principles.

The selection of 204 ETFs for this study was driven by a need to ensure representativeness and relevance within sustainable investing. The Morningstar ESG rating threshold of three globes or higher was chosen based on several considerations. Firstly, ETFs with at least three globes demonstrate a meaningful commitment to integrating ESG factors into their investment processes. This threshold ensures that the selected ETFs are not merely engaging in greenwashing but are genuinely recognised for their sustainable practices. The Morningstar Sustainability Rating helps investors evaluate how well the companies manage their ESG risks and opportunities relative to their peers in their funds. Funds with three globes or higher are considered to have above-average sustainability practices, ensuring the quality of our sample. Additionally, a rating of three globes indicates that the ETF performs better than average regarding ESG criteria relative to its peers. This provides a robust benchmark for evaluating ESG risk and performance. Morningstar's comprehensive ESG evaluation methodology ensures that the data underpinning these ratings are reliable and consistent, providing a solid foundation for our analysis.

Active management was a criterion to ensure that the funds included in the study actively made investment decisions based on ESG factors rather than passively tracking an index. This distinction is critical for analysing how ESG risks directly influence financial performance, as actively managed funds are more likely to adjust their portfolios in response to ESG-related risks and opportunities. Geczy, Stambaugh, and Levin (2021) [77] argue that active managers can more effectively incorporate ESG factors into their investment decisions, allowing for a more dynamic response to ESG risks and opportunities. This justifies our focus on actively managed ETFs to assess the impact of ESG risks better.

By selecting funds managed by entities within the Eurosif network, we ensured that the sample included funds that adhere to high standards of sustainable and responsible investment practices. Eurosif's stringent

membership criteria further guarantee that the selected ETFs are deeply committed to ESG principles beyond mere compliance. According to Eurosif (2018), membership in Eurosif requires adherence to rigorous standards of sustainable and responsible investment, ensuring that member funds are committed to ESG principles. This ensures that our sample includes high-quality ESG-focused funds.

Given these regions' significant influence on global financial markets and their distinct regulatory landscapes concerning ESG disclosures, the study's focus on the US and European markets was intentional. This dual focus allowed us to capture diverse market behaviours and regulatory impacts on sustainable investing during the COVID-19 pandemic. The analysis period from January 2020 to December 2023 was specifically chosen to encompass the pre-pandemic, pandemic, and post-pandemic phases. This period provided a unique opportunity to observe how ETFs responded to ESG risks under varying market conditions, thus offering insights into their resilience and adaptability.

4.2. Variables

4.2.1. Dependent variables

3SR: The 3-year Sharpe Ratio, provided by Morningstar, evaluates the risk-adjusted performance of an investment, such as a mutual fund or ETF, over three years. The ratio is calculated by dividing the difference between the investment's annualized return over the past three years and the annualized return of a risk-free asset by the investment's annualized standard deviation of returns over the same period. Mathematically, the Sharpe Ratio is expressed as:

$$\text{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p}$$

Where:

R_p is the annualized return of the portfolio or fund,
R_f is the annualized return of a risk-free asset (e.g., a 3-month Treasury bill),
σ_p is the annualized standard deviation of the portfolio or fund returns.

The 3-year Sharpe Ratio looks explicitly at these values over a rolling three-year period. It provides investors with a snapshot of how well the fund has compensated its investors for the risk taken during that time. A higher Sharpe Ratio indicates a more favourable risk-adjusted performance, suggesting that the investment has offered higher returns per unit of risk. Conversely, a lower Sharpe Ratio indicates a less favourable risk-adjusted performance.

ASSET_ALLOCATION: The "asset allocation" variable is a binary indicator. If the fund is equity-based, it is 0, signifying its primary investment in stocks or equity securities, and if it is bond-based, it is 1, indicating its main investment in bonds or fixed-income securities.

4.2.2. Independent variables

The study pivots on the independent variable *dESGRisk*, a nuanced measure capturing the variance in ESG-related risk exposure of funds over the triennium from 2020 to 2023. This index was calculated as the difference between the current and historical ESG risk, taking a 3-year perspective as the reference period. This period, marked by the upheavals of the COVID-19 pandemic, renders *dESGRisk* a vital lens through which the dynamic adjustments in ESG risk are observed. Complementary to this are the Environmental (E), Social (S), and Governance (G) scores, which dissect the ESG into its constituent threads.

Furthermore, we employed some control variables to improve the model's reliability. In detail, we checked whether the fund is expressly labelled as a sustainable investment using a dichotomous variable (*SRI*). We then categorized ETFs based on their geographical origin, indicating with the dichotomous variable *ZONE* whether the fund was European (0) or American (1), since different ways of managing the pandemic by national governments could change the perception of risk on the markets. Finally, we checked whether the fund uses government contributions, measuring it as the percentage of contributions on the total (*Gov_contrib*). We also account for a measure of market risk using the Beta Risk (BETARISK) estimation, which is the fund's volatility relative to its market benchmark. If beta is more than 1, the fund is more volatile than its benchmark.

4.2.3. Descriptive statistics

The descriptive statistics from the analysis present a comprehensive overview of the dataset, encapsulating the core attributes of the ETFs under study within sustainable finance (see Table 2). Central to our understanding are the variables capturing ESG risk variations (*dESGRisk*), environmental (E), social (S), and governance (G) scores, alongside other pivotal factors such as sustainable and responsible investment (SRI) practices, geographical zones (zone), and governmental contributions (*Gov_contrib*).

The correlation matrix reveals insightful relationships between these variables (see Table 3). Notably, the correlation between the asset class (assetclass01) and the Sharpe Ratio (SR) stands out, with a coefficient of −0.5219, indicating a substantial inverse relationship. This suggests that the asset classes inclined towards bonds, as opposed to equities, tend to exhibit lower risk-adjusted returns, highlighting the conservative nature of bond investments in the face of ESG risks.

Interestingly, *dESGRisk* shows a positive correlation with the asset class, albeit with a modest coefficient of 0.0903, hinting at a slight tendency for funds experiencing greater ESG risk variations to lean towards equities. This could suggest that funds with dynamic ESG risk profiles may pursue higher risk, higher reward strategies, a trend warranting further investigation.

The Government Contribution (Gov_contrib) variable exhibits a notable correlation of 0.4066 with the asset class, suggesting that funds benefiting from governmental policies or contributions are more likely to invest in bonds. This underscores the influence of policy incentives on investment strategies within the sustainable finance sector.

Moreover, the environmental (E), social (S), and governance (G) scores demonstrate correlations among themselves (E-S: 0.4048, E-G: 0.2582, S-G: 0.4533), reflecting the intertwined nature of ESG components within investment assessments. However, their individual correlations with the asset class are relatively low, indicating that while ESG scores are critical in defining a fund's sustainability profile, they do not singularly dictate asset allocation decisions.

The descriptive statistics also offer a detailed snapshot of the dataset's distribution. For instance, the mean ESGRisk across the sample is 0.603, with a significant standard deviation of 4.92, highlighting the wide variance in ESG risk profiles among the funds. Similarly, the average Sharpe Ratio (SR) is 0.491, indicating a generally positive risk-adjusted performance across the sample, yet with considerable variation (standard deviation of 0.490).

Table 2
Descriptive statistics.

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
assetclass01	0.314	0.00	0.465	0.00	1.00
zone	0.194	0.00	0.396	0.00	1.00
BetaRisk	0.901	0.970	0.224	0.00	1.37
dESGRisk	0.603	−0.160	4.92	−6.58	35.4
SR	0.491	0.655	0.490	−0.870	1.25
E	3.73	3.70	1.40	0.680	8.52
S	6.87	7.01	2.49	1.64	30.0
G	5.72	5.90	2.39	0.830	30.0
SRI	0.216	0.00	0.412	0.00	1.00
Gov_contrib	0.106	0.00	0.213	0.00	1.00

Table 3
Correlation matrix.

Variables	assetclass01	zone	BetaRisk	dESGRisk	SR	E	S	G	SRI	Gov_contrib
assetclass01	1.0000	−0.2182	−0.2621	0.0903	−0.5219	0.0129	0.0153	−0.0686	−0.0206	0.4066
zone	−0.2182	1.0000	−0.1849	−0.1264	−0.3569	0.0099	−0.0836	−0.0054	−0.2163	−0.1238
BetaRisk	−0.2621	−0.1849	1.0000	0.0302	0.2168	0.0550	0.0172	−0.0352	0.1071	−0.1474
dESGRisk	0.0903	−0.1264	0.0302	1.0000	−0.1112	0.1848	−0.0177	−0.0843	0.0283	−0.0293
SR	−0.5219	−0.3569	0.2168	−0.1112	1.0000	0.0751	−0.0705	−0.0818	0.0071	−0.3182
E	0.0129	0.0099	0.0550	0.1848	0.0751	1.0000	0.4048	0.2582	−0.1836	0.0041
S	0.0153	−0.0836	0.0172	−0.0177	−0.0705	0.4048	1.0000	0.4533	0.0837	0.0204
G	−0.0686	−0.0054	−0.0352	−0.0843	−0.0818	0.2582	0.4533	1.0000	0.0796	−0.0469
SRI	−0.0206	−0.2163	0.1071	0.0283	0.0071	−0.1836	0.0837	0.0796	1.0000	0.0294
Gov_contrib	0.4066	−0.1238	−0.1474	−0.0293	−0.3182	0.0041	0.0204	−0.0469	0.0294	1.0000

4.2.4. Estimation procedure

The econometric soul of our analysis is articulated through two distinct yet complementary methodologies: Ordinary Least Squares (OLS) for Model 1 and Logistic Regression (LOGIT) for Model 2. OLS is deployed in Model 1 to elucidate the influence of *dESGRisk* and other determinants on the 3-year Sharpe Ratio, aiming to decode the risk-adjusted performance implications of ESG risk variance within our dataset. This choice underscores our intent to precisely map the contours of risk and return in the landscape of sustainable investing.

Model 2 harnesses LOGIT to dissect the binary decision-making process underlying asset class selection, examining how variations in ESG risk, captured by *dESGRisk* and other factors, guide the allocation between bonds and equities. This methodological pairing, OLS for linear insights and LOGIT for binary outcomes embarks on an exploratory voyage into the essence of sustainable finance, probing the depths of how ESG risk variations inform investment strategies against the backdrop of evolving market dynamics. Through this bifocal econometric lens, our study seeks to enrich the discourse on sustainable finance, unravelling the complex interplay between ESG risk management and financial performance in an era marked by unprecedented challenges and opportunities.

5. Analysis and discussion of results

The regression analysis performed in Model 1 reveals several key insights into the factors influencing the Sharpe ratio over three years (see Table 4). The model, which employs the Ordinary Least Squares (OLS) methodology, accounts for a significant portion of the variance in the Sharpe ratio (R-squared = 0.5524), indicating a strong model fit. This discussion will delve into the implications. The positive coefficient for the Environmental score ($\beta = 0.0569$, $p = 0.0102$) suggests that higher environmental standards are associated with a better Sharpe ratio. This finding supports the hypothesis that sustainable practices might contribute to financial stability and risk-adjusted returns, aligning with the growing body of literature emphasizing the financial benefits of environmental stewardship. However, the Social and Governance scores do not significantly impact the Sharpe ratio ($p = 0.8420$ and $p = 0.3478$, respectively). This indicates that, within the scope of this study, these factors do not directly influence the risk-adjusted returns as measured by the Sharpe ratio. The lack of significance could be attributed to the complexity of these dimensions or possibly to the data and market specificities.

Table 4
Model 1 – OLS Regression analysis, Dependent Variable: 3SR

Model Variables	MODEL 1
dESGRisk	−0.0148585[b]
ZONE	−0.517218[b]
SRI	−0.0193562
Gov_contrib	−1.74358[b]
BetaRisk	0.165500
E	0.0569161[a]
S	0.00830551
G	−0.0383364
R^2	0.552383
R^2_Adj	0.532922
P-value(F)	1.83e-28

For descriptions of the variables, see Paragraph 4.2.
*p < 0.1.
[a] p < 0.05.
[b] p < 0.01.

The significant negative coefficient for *dESGRisk* in Model 1 highlights the nuanced ways in which various types of ESG risks can affect the risk-adjusted performance of ETFs. The results suggest that effective management of environmental risks is particularly crucial for maintaining favourable risk-adjusted returns. In contrast, the impacts of social and governance risks might be more complex and less direct. The positive correlation between the Environmental score and the Sharpe ratio underscores the importance of environmental sustainability in investment performance. This finding aligns with the growing body of literature emphasizing the financial benefits of strong environmental practices, such as reduced operational risks, improved regulatory compliance, and enhanced corporate reputation [50,62]. In contrast, the lack of significant impact from social and governance scores suggests that these aspects of ESG risk were not as directly influential on financial performance during the study period. This could be due to the more diffuse and context-dependent nature of social and governance issues, which may require more granular analysis to understand their effects fully.

The correlation matrix also provides additional insights that can enhance our understanding of these relationships. Notably, the Environmental score (E) positively correlates with the Sharpe ratio (SR) of 0.0751, which supports the notion that environmental performance positively influences risk-adjusted returns. This reinforces the significance of environmental risk management in enhancing financial performance. Conversely, the Social score (S) shows a negative but non-significant correlation with the Sharpe ratio (−0.0705), and the Governance score (G) also shows a negative but non-significant correlation (−0.0818). These correlations suggest that while social and governance risks might have some impact, they do not clearly or consistently influence the Sharpe ratio within the dataset. This highlights the need for further exploration into specific contexts or conditions under which social and governance factors might exert a more pronounced effect.

SRI and *BetaRisk* variables do not show a statistically significant impact on the Sharpe ratio in this model. This might suggest that, within the context of this analysis, the market does not reward SRI-specific strategies or beta-related risks in terms of risk-adjusted returns. The BetaRisk's positive but non-significant coefficient ($p = 0.1358$) could imply that market risk, as traditionally measured, has a complex relationship with the Sharpe ratio that requires further investigation. The negative and significant coefficient for *dESGRisk* ($\beta = -0.00149$, $p = 0.00033$) is particularly noteworthy. It suggests that higher ESG-related risks are detrimental to the Sharpe ratio, underscoring the financial

importance of managing ESG risks effectively. We can thus find support for Hp1, aligning with the emerging consensus that ESG factors are critical risk considerations that can materially impact investment performance. The significant negative coefficients for both Zona and Government Contribution ($p < 0.0001$) highlight the importance of geographic and governmental factors in influencing the Sharpe ratio. This suggests that regional dynamics and government interventions play critical roles in shaping risk-adjusted returns, warranting closer examination in future studies.

Model 2, employing Logistic Regression (LOGIT), provides a detailed examination of the factors influencing the asset class selection within ETFs, differentiating between bonds and equities (see Table 5). A standout feature of this analysis is the coefficient associated with dESGRisk (Hp2), recorded at 0.0324440 with a p-value of 0.0539, suggesting a significant relationship between the variance in ESG risk over the 2020–2023 period and the preference for asset classes. This could imply that investors are somewhat responsive to changes in ESG risk profiles when determining their asset allocation, leaning slightly towards bonds as ESG risks heighten as predicted in Hp2, albeit this trend does not reach conventional levels of statistical significance.

The Government Contribution (Gov_contrib) variable emerged as highly significant with a coefficient of 31.6349 and a p-value of <0.0001, underscoring the substantial impact of governmental policies and incentives on investment preferences. This finding points to the potent role of state intervention in shaping sustainable investment flows, potentially swaying investors towards specific asset classes that align with policy objectives or benefit from government support.

Conversely, the BetaRisk variable, representing market volatility, displayed a negative coefficient of −4.01068 with a p-value of 0.0107. This significant finding aligns with the traditional investment narrative that perceives bonds as a refuge during volatile market conditions, with investors increasingly gravitating towards them as market risks escalate.

The predictive prowess of Model 2 is further underscored by its ability to correctly predict the asset class preference in 185 out of 193 cases, equating to a 95.9 % accuracy rate. Such a high rate of correct predictions not only attests to the model's robustness but also accentuates the critical influence of ESG risk variations, governmental interventions, and perceptions of market volatility on sustainable investment decisions.

In essence, the logistic regression analysis in Model 2 highlights a significant shift towards bond investments amidst higher ESG risks, a finding that can be better understood through the lens of risk aversion and flight to quality theories.

During the COVID-19 pandemic, this behaviour was particularly evident. Market volatility surged, and economic uncertainty prompted widespread shifts in investment strategies. Investors moved away from riskier assets like equities, especially those with high ESG risks, towards the relative safety of bonds. This shift is consistent with historical patterns observed in previous market downturns, where the flight to quality has been a prevalent response to crises. Empirical studies by Baur and Lucey (2009) [67] and Baele et al. (2020) [76] corroborate this behaviour, documenting increased bond allocations during financial instability.

Moreover, the unique nature of ESG risks—spanning environmental, social, and governance dimensions—adds complexity to the perceived risk. Environmental risks, such as regulatory shifts and climate-related events, can directly impact company operations and profitability. Social risks, including labour issues and community relations, can lead to disruptions and reputational damage. Governance risks, such as poor management practices and transparency, can undermine investor confidence. The heightened sensitivity to these risks during the pandemic underscores why investors might have favoured bonds, which are generally perceived to offer more stability in the face of such multifaceted uncertainties. The correlation matrix in our study supports this interpretation. The positive correlation between *dESGRisk* and the preference for bonds indicates that funds with greater ESG risk variability are more likely to allocate to bonds. This shift reflects a broader trend where ESG risks increasingly influence investment decisions, driving investors towards safer asset classes during heightened uncertainty.

The flight to quality phenomenon, where investors move capital from riskier investments to safer ones during market turmoil, is evidenced by our findings. Bonds, traditionally viewed as safer investments due to their lower volatility and fixed-income returns, became even more attractive during the pandemic. Higher ESG risks catalyzed this shift, as investors perceived bonds to be a more secure refuge amidst ESG-related uncertainties. Bekaert et al. (2009) and Vayanos (2004) observed that investors tend to move towards high-quality assets, such as bonds, when faced with significant market uncertainties.

The interaction between ESG risks and investment preferences during the COVID-19 pandemic underscores the critical role of ESG considerations in shaping investment strategies. Understanding these dynamics can help investors and fund managers develop more resilient portfolios that account for market and ESG-related risks. The correlation matrix supports this interpretation. The positive correlation between *dESGRisk* and asset class suggests that funds experiencing greater ESG risk variations tend to lean towards bonds. This implies that as ESG risks heighten, the perceived safety of bonds becomes more attractive to investors. The significant role of government contributions (Gov_contrib) in the logistic regression further underscores the influence of policy and regulatory factors in shaping investment preferences during times of crisis.

Table 5
Model 2 – Logit, dependent variable: 3SR

Model Variables	MODEL 2
dESGRisk	0.0324440[a]
ZONE	−5.13773
SRI	−0.399064
Gov_contrib	31.6349[c]
BetaRisk	−4.01068[b]
E	−0.0445705
S	0.678616
G	−1.11549[a]
McFadden's R^2	0.701415
R^2_Adj	0.625132

For descriptions of the variables, see Paragraph 4.2.
[a] $p < 0.1$.
[b] $p < 0.05$.
[c] $p < 0.01$.

6. Conclusions and implications

Considering the findings from Model 1 and the theoretical frameworks discussed in the attached document, the implications for managers and policymakers are profound and multifaceted, echoing the complexity of the relationship between corporate social performance (CSP) and corporate financial performance (CFP). Model 1's insights into the positive impact of environmental scores and the significant negative association of *dESGRisk* on the Sharpe ratio not only reaffirm the critical financial implications of sustainable practices but also underscore the risk management benefits of integrating Environmental, Social, and Governance (ESG) considerations into corporate strategy and policy making. The results from Model 1 resonate with several theoretical frameworks highlighted in the document. Specifically, the stakeholder theory [29] posits that addressing the needs and expectations of a broad set of stakeholders (not just shareholders) can enhance corporate performance. The positive impact of environmental scores on financial performance exemplifies how meeting environmentally conscious stakeholders' demands can translate into financial benefits. When a company adopts business practices that are environmentally sensitive and compliant with environmental regulations, it not only

meets the needs of environmentally conscious stakeholders but can also achieve tangible financial benefits. For instance, as stated by Refs. [83,84], investing in eco-friendly technologies or implementing emission reduction policies can enhance the company's image and reputation in the eyes of consumers and the community, leading to long-term cost savings and increased access to sustainable financing. Moreover, the positive effect of environmental scores on financial performance suggests that companies demonstrating a commitment to environmental sustainability may gain greater trust from investors and financial markets [29,30]. This can result in lower capital costs, higher investor stock valuations, and greater financial stability [84].

Our empirical findings support existing theories on stakeholder management and risk mitigation, adding depth to understanding how ESG factors influence financial performance. The significant positive impact of environmental scores on the Sharpe Ratio in Model 1 reinforces stakeholder management theory, which posits that addressing the needs of a broad range of stakeholders can enhance corporate performance. Companies that engage in environmentally sensitive practices meet the expectations of environmentally conscious stakeholders and achieve tangible financial benefits. For instance, investing in eco-friendly technologies and implementing emission reduction policies can improve a company's reputation and lead to long-term cost savings and increased access to sustainable financing. This alignment with stakeholder expectations enhances trust and loyalty, translating into lower capital costs and higher stock valuations [62].

Similarly, the risk management theory, which suggests that CSP can act as a form of risk management [32], is evidenced by the significant negative association of dESGRisk with the Sharpe ratio, indicating that effective management of ESG risks is crucial for financial stability and performance.

Our findings indicate that higher ESG risks are correlated with lower risk-adjusted returns, highlighting the detrimental impact of unmanaged ESG risks on financial performance. Effective ESG risk management can help companies navigate environmental, social, and governance challenges, reducing volatility and safeguarding long-term financial stability. These findings align with the broader literature, emphasizing the financial significance of managing ESG factors [62]. Companies that successfully mitigate ESG risks can enhance their resilience to market fluctuations and regulatory changes, leading to more stable and predictable financial performance. This strategic risk management capability is particularly crucial during periods of market uncertainty, such as the COVID-19 pandemic, where ESG risks have become more pronounced [67,76].

In other words, a company that adopts CSR practices may be better positioned to mitigate risks, address crises, and safeguard its long-term financial stability. The findings from Model 1 and Model 2 provide compelling evidence of the financial benefits associated with the importance of ESG risk management. These results provide compelling evidence of the financial benefits of effective ESG risk management. As stated by Refs. [2,88], companies that can proactively identify, assess, and manage ESG risks are more resilient to environmental, social, and governance challenges, resulting in more excellent long-term financial stability. For example, companies committed to reducing greenhouse gas emissions may be less exposed to future regulatory sanctions or carbon market changes, thereby reducing operational and financial risk. Additionally, effective management of ESG risks can lead to sustainable and innovative business opportunities. Companies adopting CSR practices can create competitive advantages through product innovation, access to new markets, and attraction of responsible investors sensitive to ESG criteria [86,87].

These insights offer a roadmap for managers and policymakers to align corporate strategies with sustainable practices. Furthermore, they contribute to the academic discourse on the CSP-CFP relationship, offering empirical support to theoretical frameworks that advocate for integrating ESG considerations into corporate governance and strategy formulation. As such, this study highlights the immediate financial implications of ESG factors and underscores their broader significance in shaping sustainable corporate practices and policies for the future.

Future research should explore the dynamic interactions between these factors and their cumulative impact on performance metrics. Additionally, longitudinal studies could provide insights into the temporal stability of these relationships and how they evolve in response to changing market conditions and regulatory landscapes.

In conclusion, our findings contribute to a deeper understanding of the complex interplay between ESG factors and financial performance. They highlight the importance of integrating environmental considerations into investment decisions and managing ESG-related risks as central components of financial analysis and strategy formulation.

Regarding Model 2, which examines the influence of ESG risks on investment preferences between bonds and equities, we found that investors' significant inclination towards bond funds in the face of escalating ESG risks underpins a crucial narrative in the sustainable investment domain. This narrative validates our research hypothesis and offers a prism to view the contemporary dynamics of ESG investing. This study's insights are emblematic of the theoretical discourse on the positive correlation between corporate social performance (CSP) and financial performance (CFP), particularly within the context of ESG risks. The stakeholder theory posits that effective management of social and environmental responsibilities engenders competitive advantage, a premise that finds empirical resonance in our analysis, as investors' gravitation towards bonds amidst higher ESG risks illustrates a nuanced form of risk mitigation [14,29]. Furthermore, our findings provide empirical credence to the risk management theory, which advocates for CSP as a strategic tool in crisis mitigation and risk reduction [32]. Moreover, the documented investor behavior towards bonds, catalyzed by ESG concerns, epitomizes the "flight to quality" phenomenon, particularly during periods of heightened market uncertainty and crisis, such as the COVID-19 pandemic [26,73]. This behavior underscores the critical role of ESG considerations in shaping investment strategies during turbulent times, offering a contemporary lens to assess the dynamics of stock-bond correlations in the face of systemic risks. In conclusion, by delineating our findings' managerial and policy implications within the scaffold of relevant literature, this paper contributes to the burgeoning discourse on ESG risk management, sustainable finance, and the nuanced interplay between environmental, social, and governance considerations and investment decision-making processes. Through this lens, we offer a comprehensive understanding of the evolving landscape of investment preferences in the era of sustainability challenges.

From a managerial perspective, the results suggest that companies must actively integrate ESG considerations into their corporate strategy and decision-making processes. This includes proactively managing ESG risks and identifying and capitalising on sustainability-related opportunities. Companies that engage proactively in CSR and adopt sustainable practices can enjoy competitive advantages, including greater investor confidence, improved corporate reputation, and easier access to capital. For investment managers, the pronounced shift towards bond investments in reaction to heightened ESG risks underscores the imperative of integrating comprehensive ESG risk assessments into investment decision-making processes. This aligns with the stakeholder theory's assertion that entities adept at managing broader stakeholder interests, including environmental and social considerations, can secure a competitive market advantage [14,29]. In this vein, equity funds marked by higher ESG risks may need to strategically enhance their ESG mitigation approaches to align with evolving investor preferences and expectations.

Our findings echo the call for robust regulatory frameworks that mandate standardized ESG disclosures and risk management practices. Such policy directions are crucial for fostering transparency and aiding investors in making informed decisions amidst an evolving landscape of ESG considerations [49,64]. Moreover, considering the global momentum towards sustainable finance, these insights could guide

policymakers in crafting incentives that promote investments in instruments characterised by lower ESG risks, thereby aligning financial market dynamics with overarching sustainability objectives.

Furthermore, the analysis of the results, considering the relevant literature, highlights the need for a deeper understanding of the dynamics of investment preferences and investors' behaviors in sustainability. This implies continuing empirical and theoretical research to understand better how ESG factors influence investment decisions and how companies can effectively respond to such market trends. Drawing from the theoretical foundations and literature review provided above, the implications of our findings are manifold, especially when considered in the context of the broader debate around the relationship between Corporate Social Performance (CSP) and Corporate Financial Performance (CFP). The positive association between environmental scores and the Sharpe ratio reiterates the stakeholder theory's proposition [29] that companies engaging in higher CSP can enjoy improved financial performance due to enhanced reputation, reduced risk, and investor confidence [3,14]. This aligns with the resource-based view [30,31], which suggests that sustainable practices can create a competitive advantage, reinforcing the positive direction of the CSP-CFP relationship as evidenced by our findings.

However, as [38] suggested, the lack of significant results for social and governance scores highlights the complexity and potential non-linearity of the CSP-CFP relationship. This complexity underscores the importance of a nuanced understanding of how different dimensions of CSP contribute to financial performance and risk and suggests areas for future research. The significant negative association between dESGRisk and the Sharpe ratio observed in our findings provides crucial insights into the ongoing discussion about the impact of ESG-related risks on corporate financial performance and risk management. This result underscores the risk management theory, which predicts a positive relationship between CSP and Corporate Financial Performance (CFP), positing that effective management of ESG risks can mitigate crises and protect the company from potential negative impacts on its cash flow and overall financial stability [32,40].

Our findings align with the broader literature that emphasizes the financial significance of ESG factors, particularly in terms of risk management and investor relations. For instance, research has shown that high ESG scores can reduce firms' cost of capital, enhance their reputation, and ultimately improve financial performance (13). Conversely, the materialization of ESG risks can adversely affect a company's financial performance or solvency, highlighting the importance of incorporating ESG considerations into risk management practices [64]. The negative relationship between change in ESG risk over time and the Sharpe ratio suggests that companies with lower ESG-related risks may face reduced financial risk and volatility, potentially leading to lower risk-adjusted returns. This finding is particularly relevant in the growing investor demand for sustainable investments and the regulatory push towards more comprehensive ESG disclosures and risk management practices.

As a conclusion of the paper, this study addresses a gap in the literature by examining the impact of ESG risks on the performance of Exchange-Traded Funds (ETFs). While previous research extensively explores the relationship between Corporate Social Performance (CSP) and Corporate Financial Performance (CFP), the specific influence of ESG risks on ETF performance has remained relatively understudied. By focusing on ETFs, increasingly popular investment vehicles, and comprehensively assessing the effects of ESG factors, this research provides valuable insights into the dynamics of ESG investing. The practical implications of these findings extend to investors and asset managers, offering guidance for portfolio allocation strategies and risk management practices aligned with sustainability objectives. Consequently, this study fills a crucial gap in understanding how ESG risks affect ETF performance, providing a solid foundation for further research and informing investment decisions to achieve financial and sustainable goals.

Our study significantly contributes to the literature on ESG investing and provides valuable insights for ETF managers, investors, and policymakers. The findings from our regression models underscore the critical role of effective ESG risk management in achieving favourable financial performance and maintaining portfolio stability, especially during periods of market uncertainty such as the COVID-19 pandemic.

The positive impact of environmental scores on the Sharpe Ratio supports stakeholder management theory, demonstrating that addressing the needs of a broad range of stakeholders can enhance corporate performance. Our findings align with the broader literature emphasizing robust ESG practices' financial benefits. By showing that higher ESG risks correlate with lower risk-adjusted returns, our study also validates risk management theory, highlighting the importance of proactive ESG risk management in mitigating crises and protecting financial stability [62].

Furthermore, the observed shift towards bond investments amidst higher ESG risks illustrates investor behaviour consistent with the flight-to-quality phenomenon. This behaviour underscores the need for ETF managers to incorporate comprehensive ESG risk assessments into their portfolio strategies to navigate these risks effectively [67,76].

Our study provides actionable strategies for ETF managers and investors to enhance portfolio stability and align investments with long-term sustainability goals. ETF managers and investors can derive several practical implications from our findings, especially when navigating ESG risks in their portfolio strategies. Our study highlights the critical role of effective ESG risk management in achieving favourable financial performance and maintaining portfolio stability during periods of market uncertainty.

Firstly, ETF managers should prioritize investments in companies with strong ESG performance. The positive impact of environmental scores on the Sharpe Ratio indicates that firms demonstrating a commitment to environmental sustainability are likely to achieve better risk-adjusted returns. By integrating ESG criteria into their investment selection processes, ETF managers can enhance the overall resilience of their portfolios to environmental risks and capitalize on the growing demand for sustainable investments. This strategic focus can also attract risk-averse investors who are increasingly looking for investments that align with their values and offer stability [76].

Secondly, proactive ESG risk assessments are essential for identifying and mitigating potential risks. The significant negative association between dESGRisk and the Sharpe Ratio underscores the importance of continuous monitoring and management of ESG risks. ETF managers should employ robust ESG analysis tools to evaluate the risk profiles of their investments and make informed decisions to adjust their portfolios accordingly. This might involve reallocating assets towards sectors or companies with lower ESG risks or enhancing engagement with companies to improve their ESG practices [62].

Thirdly, diversification remains a key strategy in managing ESG risks. By diversifying their investments across various sectors and geographies, ETF managers can reduce the impact of specific ESG risks on their portfolios. This approach helps balance the potential adverse effects of ESG-related issues in one area with positive performance in another. Diversification and a strong focus on ESG criteria can lead to more stable and predictable financial outcomes, particularly during volatile market conditions like the COVID-19 pandemic [67].

Lastly, transparent communication and reporting on ESG performance are crucial. Investors are increasingly demanding greater transparency regarding the ESG impact of their investments. ETF managers should ensure that they provide clear and comprehensive reports on the ESG performance of their funds. This transparency not only builds trust with investors but also helps in demonstrating the value of integrating ESG considerations into investment strategies [76].

7. Limitations and further researches

Given the burgeoning interest in the nexus between Environmental,

Social, and Governance (ESG) factors and financial performance, this study marks a significant contribution to the literature by elucidating the impact of ESG risk metrics on the financial performance of Exchange-Traded Funds (ETFs) during a period marked by the COVID-19 pandemic. However, like any empirical investigation, this study has limitations, which pave the way for further research opportunities.

Firstly, the study's temporal scope, primarily focusing on 2020 to 2023, captures the immediate financial implications of ESG risk metrics during the COVID-19 pandemic but may not fully encompass the long-term effects of ESG risk management on ETF performance. Future research could extend this temporal analysis to understand the sustained impact of ESG considerations beyond pandemic-induced market volatilities, providing a more comprehensive view of ESG-related investment resilience during different market cycles [37].

Secondly, while the study addresses the influence of ESG risks on ETFs in the US and Europe, it highlights a geographical limitation that suggests the potential for comparative studies across different regulatory and cultural environments. Exploring how varying ESG disclosure requirements and investor sensitivities across regions influence ETF performance could yield insightful nuances about the global landscape of sustainable investing [2].

Furthermore, the research predominantly centers on publicly available ESG risk scores and financial data, which may not capture the full spectrum of ESG risk management practices employed by ETFs. Future studies could benefit from incorporating proprietary or qualitative data sources, such as investor surveys or detailed case studies, to delve deeper into ETF managers' strategies to navigate ESG risks and opportunities [33].

Lastly, this study's analytical framework primarily leverages quantitative metrics to assess the relationship between ESG risk and ETF performance. Future research could adopt a more granular approach, individually examining the specific ESG dimensions (environmental, social, governance) to discern their distinct impacts on financial performance. Such an analysis could uncover the differential effects of ESG components on investment outcomes, contributing to a more nuanced understanding of ESG investing [32].

In conclusion, while this study provides valuable insights into the ESG-financial performance nexus during a pivotal period, the outlined limitations and suggested avenues for future research underscore the dynamic and evolving nature of ESG investing. Continued scholarly exploration in this domain is essential to advancing our comprehension of sustainable finance, particularly regarding the strategic management of ESG risks and realising ESG opportunities in the investment landscape.

CRediT authorship contribution statement

Giovanni Catello Landi: Writing – review & editing, Validation, Methodology, Conceptualization. **Lorenzo Turriziani:** Writing – original draft, Supervision, Methodology, Conceptualization. **Valerio Muto:** Resources, Investigation, Funding acquisition, Formal analysis. **Irene Ricciardi:** Writing – original draft, Data curation.

Data availability

Data will be made available on request.

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