



Bank financing and green financing: The influence of sustainable practices on investment sensitivity

Ashfaq Habib^a, Muhammad Asif Khan^{b,*} 

^a Department of Business Administration, Faculty of Management, Humanities and Social Sciences University of Poonch Rawalakot, Pakistan

^b Department of Commerce, Faculty of Management Sciences, University of Kotli, AJK, 11100, Pakistan

ARTICLE INFO

JEL Classification:

Q56

Q01

Q50

Keywords:

Environment sensitivity firms

Sustainability

Investment sensitivity

Bank financing

Green finance

ABSTRACT

This study explores the influence of sustainable investment practices, focusing on how firms' Environmental, Social, and Governance (ESG) activities and environmental disclosure affect the investment sensitivity of environmentally sensitive firms (ESFs). The results reveal that high environment sensitivity firms are more inclined to implement sustainable practices to improve operational efficiency and mitigate risks. The findings explain that ESG and environmental disclosures significantly influence investment sensitivity, with stronger effects observed in high-environment sensitivity firms compared to their low-environment sensitivity firms. Further, the study reveals that bank financing plays a moderating role in the relationship of bank sustainability and investment sensitivity. Additionally, we find that green finance acts as a mediator, reducing investment sensitivity by channeling resources toward sustainable investment initiatives, particularly in high-sensitivity firms. This research underscores the critical role of banks sustainable practices and innovative financing strategies in improving stable and efficient investment decisions.

1. Introduction

The concept of sustainable development and environmental protection was introduced by the World Commission in 1987. Further initiatives like the Paris Climate Summit and the implementation of the United Nations Sustainable Development Goals in 2015 also highlight sustainability not only for broader socio-economic impact but also relevance to sustainable business efforts in pursuit of long-term growth and investment suitability. Recently, the introduction of green deals and environmental taxonomy in the European Union (EU) has encouraged the adoption of green transactions and the integration of sustainability with firm investment policy [28]. Sustainable business practices aim to reduce environmental harm, promote social equity, and contribute positively to long-term investment stability [26].

Companies that implement sustainable practices focus on reducing carbon emissions, conserving resources, improving working conditions, and promoting governance structures. The Environmental, Social, and Governance (ESG) index is mostly used to assess the sustainable business practices of businesses [33]. Pühr and Müllner [31] argue that sustainable business practices reduce the investment cash flow volatility and overcome the market sensitivity by promoting a stable and sustainable

environment in the face of external shocks. Further, Zhang et al. [43] find that implementation of ESG practices addresses the stakes of different stakeholders, increases access to funds providers, and mitigates risks, thereby reducing investment cash flow volatility. ESG success heavily depends on the effectiveness of its implementation to benefit over long-run [7], while there is a need to adopt balanced approach to identify the optimum level to trade-off between cost-benefit ratio [4].

Bank credit is an active source of financing for investment opportunities and firms' engagement in ESG practices may support bank financing at favorable terms and conditions. Recently, banking firms integrated bank credit with ESG projects to encourage sustainable investment [22]. Xie et al. [41] report that financial institutions are regularly access and evaluate the firms' ESG adoption policy to understand the firms' sustainable investment strategy. Financial institutions are appealing to the firms to address the potential environmental risk by issuing special directives [32] and launching campaigns [40]. These efforts promote awareness about environmental risk measures [11] and adopt sustainable practices to reduce investment sensitivity [5].

In particular, the social and environmental pressure from institutional investors is being exercised on firms operating in the EU to align ESG disclosures into their investment policy [3]. In turn, firms'

* Corresponding author.

E-mail addresses: ashfaqhabib@upr.edu.pk (A. Habib), khanasif82@uokajk.edu.pk (M.A. Khan).

<https://doi.org/10.1016/j.sfr.2025.100775>

Received 4 October 2024; Received in revised form 20 May 2025; Accepted 1 June 2025

Available online 6 June 2025

2666-1888/© 2025 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

commitment to sustainable practices can address environmental issues which supports the investment sensitivity [10].

Green finance plays a significant role in achieving the sustainable development goals by directing financial resources toward environmental friendly initiatives that align with global sustainable investment practices [30]. Green finance is actively used to fund the sustainable development initiatives like renewal energy, sustainable agriculture and green infrastructure, affordable and clean energy, sustainable cities and communities that enable the transition to low-carbon and resource efficient economics [2]. Green finance also promotes green innovation eco-friendly technologies and initiatives, enhance economic growth while reducing environmental harm. Further, green finance addresses the SDGs by encouraging the creation of inclusive and resilient communities to direct the funds toward the critical challenges like climate change, biodiversity loss, and pollution [2]. By aligning the SDGs into financial decision making, green finance acts as a catalyst for ensuring a balanced integration of environmental, social and governance objectives effectively

Green finance shifted the traditional approach of investment by linking ESG compliance with firms' long-term investment strategy for sustainability [15]. Firms financing through green finance provides a competitive edge to secure funding at a reasonable cost for positive NPV projects to reduce investment sensitivity. Firms undergoing green finance can reduce investment sensitivity by conducting the cost and benefits analysis of potential investment relative to traditional investment [25]. This analysis motivates the investors to finance the positive NPV projects by linking the financial return with firms' sustainable investment. Barko et al. [5] argue that sustainable investment is positively contributes to enhancing efficiency, lowering financing costs, and providing a competitive advantage by reducing investment volatility.

The introduction of a stringent regulatory framework significantly encourages both financial and non-financial firms to adopt sustainable investment strategies. However, the banks are at an advanced stage of adopting ESG compliance, while SMEs are at an earlier stage of incorporating ESG disclosures into their decision-making process [34]. Currently, a large number of firms still fall short of being entirely environmentally friendly and implementation of sustainable operations remains inadequately widespread [18]. Additionally, SMEs tend to less organized and structured approach to adopting sustainability as compared to large companies, often relying on informal strategies. In various EU states, SMEs are following sustainability at different rates, with significant progress reported in Germany, followed by Italy, Portugal, Austria, Spain, and France [37].

The study of SMEs in the EU about sustainable investment has been selected for several important reasons. Firstly, SMEs are major contributors to new employment opportunities in the EU members' countries [1]. In the EU, SMEs play a significant role in the advancement of economic growth by promoting the entrepreneurial spirit within the investment community in the transition to sustainability. Additionally, SMEs provide a unique opportunity for the business community to enhance their competitive advantage [24]. Indeed, SMEs' approach to sustainability drives attractive financing opportunities and fosters strategic relationships with both public and private entities. Finally, SMEs operating in the EU face pressure from different stakeholders due to limited resources, leading to a general reluctance to take more risk. As a result, adopting sustainable business practices can enhance the competitiveness of SMEs in both financial and non-financial markets.

This research gap is addressed by examining the influence of sustainable business practices on reducing the investment sensitivity of SEMs firms listed in EU members' states. We also explore whether adopting sustainable business practices helps companies obtain more loans at a reasonable cost for sustainable investment projects [42]. Further, we analyze how green finance supports the SMEs, in the adoption of sustainable business practices and its impact on reducing investment volatility [1]. We conduct this analysis by selecting the firms listed in EU member countries over the period from 2017 to 2023. We

selected the year starting from 2017 onward because from this year firms registered in EU countries are required to publish Non-financial statements, which is the primary source for assessing a firm's sustainability [16]. The SMEs registered in the EU are well suited for this analysis due to the implementation of distinctive regulatory measures designed to incentivize firms to pursue long-term sustainability [24].

2. Literature review and hypothesis development

Stakeholder theory is an emerging concept that emphasizes the importance of all stakeholders in a business to ensure long-term sustainability. The theory advocates for integrating business policies and procedures with social and environmental sustainability, ensuring that the interests of not just shareholders but also employees, customers, communities, and the environment are equally important for long-term growth and sustainability [38]. The traditional investment theories primarily focus on generating the wealth of shareholders, often ignoring the interests of other stakeholders [29]. In contrast, stakeholder theory broadens this perspective by encouraging companies to invest in opportunities that can balance the interest of stakeholders with shareholders which helps to reduce the investment sensitivity [39]. Consequently, firms that adhere to stakeholder theory prioritize investment opportunities that not only maximize profit but also establish a strong association with ESG practices for long-term sustainability [19].

From the perspective of stakeholders theory, firms emphasize adopting ESG compliance and are invested in projects that generate a higher return for stockholders while also addressing the numerous stakeholders aligned with business operations and performance [9]. The firms that adopt ESG practices are in a better position to reduce the agency's cost of capital by optimizing the rights and interests of different stakeholders. This approach helps to develop trust, transparency, and accountability, which in turn mitigates conflict of interest and aligns the sustainable practices with the firm's long-term investment objectives [41]. The firms adopt the ESG practices to ensure that stakeholders are well-informed and these practices are associated with firm strategic objectives, and reduce asymmetric information and investment volatility [36].

2.1. Research gap

The corporate literature on sustainable investment practices has notable gaps, particularly in addressing how sustainability factors like ESG and ENT influence investment sensitivity and volatility. Previous studies emphasize on broad correlations between sustainability and firm performance, but the particular impact on investment sensitivity is underexplored. Further, the role of moderating and mediating variables, like as bank financing and green finance in increasing the effect of sustainability practices on investment decisions remains limited. Industry-specific and regional differences are often deserted, and reverse causality, where stable investments enable firms to implement more sustainable practices are seldom analyzed. Additionally, critical business metrics like profitability, innovation, and customer satisfaction are often neglected. This study contributes in existing literature to fill these gaps by examining how sustainability practices stabilize investment, particularly in environmentally sensitive firms (ESFs), and by addressing the roles of external financial mechanisms like bank financing and green finance. It also classifies firms into high and low ESFs, providing a nuanced guidelines of sustainability's impact, and offers practical understanding for managers to integrate ESG into investment strategies.

2.2. Hypothesis development

The existing research studies provide mixed results regarding ESG compliance on firms' investment activities. For instance, Drempetic et al. [14] conducted a review study of scientific articles and found that firms' sustainable practices are significantly positively correlated with

investment strategy. Further, Shaikh [35] also documented the positive influence of ESG practices on firm investment volatility. The findings guide that firms’ adoption of sustainable practices helps to achieve long-term investment objectives. On the other hand, Gawusu et al. [17] revealed that the transition to sustainable investment such as installation of sophisticated equipment, advancement in the supply chain, and training workforce may increase upfront costs, which may negatively enhance the influence of ESG compliance on firm investment activities.

Despite the mixed results, stakeholder theory suggests that the adoption of sustainable practices significantly helps to reduce investment sensitivity [13]. Although, the adoption of ESG practices increases the firm’s upfront cost the benefits of ESG practices may mitigate the initial transition expenses of sustainable investment [21]. Therefore, the firms that implement sustainable investment practices are in a better position to generate higher returns for stockholders, while promoting transparency and accountability ultimately leading to more sustainable investment activities and business operations for all stakeholders. In light of this, we proposed our first hypothesis.

Hypothesis 1. The firm’s adoption of sustainable practices significantly helps to reduce the investment sensitivity.

This study also focuses on the sustainable practices of the firm lending process, examining how banks’ lending processes and procedures are aligned with firms’ ESG investment practices. Deng et al. [12] argued that the banking industry emphasizes the adoption of ESG practices to apply for bank financing. This guides that firms seeking bank financing are often required to adopt ESG investment practices. Firms that align ESG practices with bank financing have the potential to reduce investment sensitivity. The growing trend in the banking sector not only pursues financial return but also focuses on investment projects that are effectively linked with firms’ ESG practices [28]. This involves evaluating the firms’ environmental factors like carbon emissions, resource usage, labor practices, social implication, community development, and governance aspects like transparency and accountability of governance practices during the lending process [31]. It helps banks identify and mitigate risks associated with firms’ investment projects by adopting sustainable ESG practices [43]. Barko et al. [5] reported that integrating bank financing with sustainable investment increases a firm’s reputation, reduces financing costs addresses the needs of different stakeholders, supports firms’ sustainability, and reduces investment sensitivity. Therefore, we proposed our second hypothesis.

Hypothesis 2. Integration of bank financing with a firm’s sustainable practices significantly helps to reduce the investment sensitivity.

Green finance is an emerging way of financing environmentally friendly projects, particularly initiatives addressing climate change, combat pollution, and promoting sustainable investment activities [8, 23]. Green finance incorporates a variety of financial initiatives like green bonds, financing the energy efficiency project [10,23], and funding sustainable agriculture initiatives [18]. The objective is to channel funds toward investment projects and initiatives that link with firms’ sustainable activities by preserving natural resources and reducing carbon emissions [25]. Maman et al. [27] explain that green finance and firms’ sustainability are closely associated with each other due to their shared commitment to adopting sustainable investment practices.

Saviano et al. [34] argue that the alignment of green finance with firm-sustainable activities promotes strategic decisions that not only significantly influence environmental objectives but also support ethical business practices and responsible governance practices for sustainable investment initiatives [37]. The integration of green finance with firms’ sustainable practices promotes business transparency and accountability that ultimately contribute to more stable cash flows by reducing investment sensitivity [1]. Carnini Pulino et al. [9] argued that capital providers also assign a higher weight to firms that align green finance with sustainable investment practices for firms’ long-term sustainability

[16]. This enables firms to secure green finance at lower financing costs, supporting sustainable investment initiatives and maintaining stable cash flows [19]. The dual aspect of green finance with ESG compliance promotes the firm’s sustainable practices while reducing the risk of investment sensitivity to market fluctuations [24]. This framework leads to more stable operating cash flows and robust cash flows from investment initiatives over the long term [42]. Therefore, we proposed our next hypothesis.

Hypothesis 3. Green finance plays a key role in mediating the impact of sustainable practices on a firm’s investment sensitivity.

3. Data and methodology

The target audience of this research study is the Environmental Sensitivity Firms (ESFs) that prioritize and manage their business operations to reduce harmful impacts on the environment. The ESFs address these challenges by taking proactive measures to mitigate the harmful effect of business operations on the environment [12]. Chen et al. [10] reported that ESFs introduce environmentally friendly products like recyclability, reducing waste, and energy efficiency for long-term sustainability. Further, Maman et al. [27] explain that ESFs actively engage with different stakeholders like the local community and consumers to create environmental awareness by introducing environmentally friendly policies and procedures. Saviano et al. [34] find that firms adopting ESG practices often benefit from cost saving through efficient get a competitive advantage in the emerging environmentally conscious world. Table 1 represents the sample and summary statistics.

Table 2 reports Environmental Sensitivity Industries (ESIs) and their environmental impact to examine the investment’s sensitivity.

The dependent variable investment sensitivity is measured by the firm investment in fixed assets to total assets representing the firm’s investment in long-term assets to generate future cash flows. The independent variable firms’ sustainability is a proxy of ESG and ENT score secured by a firm during over sample period. The moderating variable bank financing is the proxy of firm bank loans to total assets, while the mediating variable is the ratio of green bonds to total assets issued by a firm to finance sustainable projects and initiatives for long-term investment. The study also considers a set of control variables like liquidity, leverage, sales growth, and GDP to improve reliability and obtain the most robust results. Table 3 explains the variables and their measurement.

3.1. Research methodology

Previous studies Papari et al. [28] and Shaikh [35] have employed regression as an econometric tool to examine the impact of cash flow volatility on investment but failed to address how to minimize correlation errors and biases resulting from omitted variables in the regression estimation process. The heteroskedasticity is checked by using the brush-Pagan test in our regression analysis and finding it positive analysis. The two-stage regression analysis is used to test endogeneity and find no endogeneity errors exist in our regression model. The Variance Inflation Factor (VIF) is used to test for multicollinearity and with VIF values below 10; our analysis indicates that multicollinearity does not exist in our analysis. In examining statistical errors, we

Table 1
Sample and summary statistics.

Sample selection process	
Yearly observations of firms from 2017–2023	170,800
The firms have an incomplete observation	25,620
Fewer firms do not adopt the ESG criteria	34,452
The firms do not issue green bonds to finance investment	20,946
Fewer firms merged and acquired during the period	1680
Final sample to analyze the cash holding with ESG Compliance	90,543

Table 2
Environmental sensitivity industries under study.

Industry	Focus	Environmental Impact	No of Firms
Renewable Energy	Producing energy from sustainable sources	Reduces greenhouse gas emissions and fossil fuels	1800
Green Manufacturing	Sustainable production practices	Minimizes waste, conserves energy, and toxic materials	2200
Sustainable Agriculture	Environmentally friendly farming practices	Protects ecosystems, reduces pesticide use, and conserves water	7000
Eco-friendly Construction	Building with sustainable materials and energy efficiency	Reduces carbon footprint, uses recycled materials, and integrates green technologies	2800
Recycling and Waste Management	Managing waste to promote recycling and reduce landfill use	Reduces pollution, conserves natural resources, and lowers greenhouse gas emissions	1500
Water Treatment and Conservation	Ensuring sustainable water use and treatment	Improves water quality, minimizes waste, and promotes efficient water usage	1800
Sustainable Transportation	Eco-friendly transportation options	Reduces air pollution and greenhouse gas emissions	1100
Forestry and Land Management	Sustainable management of forests and lands	Protects biodiversity, prevents deforestation, and promotes reforestation	900
Sustainable Tourism	Eco-friendly tourism practices	Reduces environmental impact of tourism, conserves natural resources, and supports local economies	2900
Biotechnology and Environmental Science	Developing eco-friendly technologies	Innovates solutions for pollution control, renewable energy, and sustainable agricultural practices	2400

Table 3
Variables selection and measurement.

Variable	Agronomy	Measurement	Multicollinearity	
			Toler	VIF
Investment in fixed asset	I	Investment in long-term assets/ total assets		
Environmental, Social, and Governance Score	ESG Score	ESG Disclosure Score	0.88	1.15
Environmental Score	ENT Index	Firm environmental disclosure score	0.83	1.12
Bank Financing	BF	Long-term borrowing from bank/total assets	0.79	1.23
Green finance	GF	Green Bonds/ Fixed assets	0.82	1.42
Independent Director	INDEP	Dummy variable 1 for independent director in a board and 0 otherwise	0.66	1.23
Sales Growth	Growth	Percent growth in sales	0.87	1.39
Cash flow	CF	Operation cash flows/ fixed assets	0.74	1.87
Leverage	LEV	Long-term debt-(green finance and bank borrowing)/total assets	0.83	1.43
Gross Domestic Product	GDP	Annual growth in GDP	0.75	1.34

observed that residual errors for a given firm are correlated across years and over time, indicating the presence of dependence in the dataset. Results are consistent with the studies of Zhang et al. [43] and Pühr and

Müllner [31].

In observing statistical error, we find the residual errors for a given firm should be correlated across years and across time, indicating the presence of dependency in the dataset. If firm effects are present in the analysis, clustering by firm can produce unbiased residual errors [26]. When clustering by both firm and year, the residual error is estimated based on two dimensions of within-cluster correlations. To control for both firm and year effects, we cluster the dataset based on industry and time effects. To examine the sensitivity of ESG compliance to investment, we formulate the following econometric model, incorporating green finance [33]. To examine the cash flow sensitivity toward the investment, we formulate the following econometric model with green finance.

1- Without integration effect

$$I_{it} = C + \beta_1 ESG_{it} + \beta_2 ENT_{it} + \beta_3 BF_{it} + \beta_4 GF_{it} + \beta_5 INDP_{it} + \beta_6 LIQ_{it} + \beta_7 OCF_{it} + \beta_8 LEV_{it} + \beta_9 SG_{it} + \beta_{10} GDP_{it} + \mu_{it} + \eta_i + \varepsilon_{it}$$

2- Moderation analysis of bank financing

$$I_{it} = C + \beta_1 ESG_{it} + \beta_2 ENT_{it} + \beta_3 BF_{it} + \beta_4 (ESG_{it} \times BF_{it}) + \beta_5 GF_{it} + \beta_6 INDP_{it} + \beta_7 LIQ_{it} + \beta_8 OCF_{it} + \beta_9 LEV_{it} + \beta_{10} SG_{it} + \beta_{11} GDP_{it} + \mu_{it} + \eta_i + \varepsilon_{it}$$

3- Mediation analysis of green financing with ESG

$$GF = C + \beta_1 ESG_{it} + \beta_3 BF_{it} + \beta_5 (ESG_{it} \times GF_{it}) + \beta_6 INDP_{it} + \beta_7 LIQ_{it} + \beta_8 OCF_{it} + \beta_9 LEV_{it} + \beta_{10} SG_{it} + \beta_{11} GDP_{it} + \mu_{it} + \eta_i + \varepsilon_{it}$$

Fig. 1

3.2. Theoretical justification of models

This baseline model examines the direct relationship between investment (I) and key independent variables. The ESG Score (ESG) represents environmental, social, and governance practices, grounded in stakeholder theory, which theorizes that firm ESG performance enhances sustainability and long-term value creation. The Environmental Score (ENT) measures firm-specific environmental disclosures, contributing to strategic resource management under sustainable development theory. Financing aspects include bank financing (BF) explained by capital structure theory, as access to bank credit facilitates firm investment. Green finance (GF) related with sustainable finance theory, emphasizing environmentally friendly financing. Governance quality is measured by the presence of Independent Directors (INDP), align with agency theory, ensuring accountability and better financial policy. Control variables such as Sales Growth (SG), Cash Flow (OCF), Leverage (LEV), and Gross Domestic Product (GDP) integrate firm performance; liquidity, financial risk, and macroeconomic stability provide a comprehensive perspective.

The model 2 incorporates an interaction term of $(ESG_{it} \times BF_{it})$ to examine the moderating effect on firm long-term investment policy.. The interaction represents the synergy between ESG practices and access to bank financing, hypothesizing that bank loans intensify the positive impact of ESG initiatives on long-term investment. For instance, firms that higher ESG scores might secure bank financing on favorable terms, enabling greater investment, consistent with institutional theory, which suggests that financial institutions reward sustainable investment practices.

Finally, **the model-3** investigates the mediating role of Green Financing (GF) in the ESG-investment linkage, hypothesizing that ESG practices indirectly influence investment via green finance. Sustainable finance theory provides that firm ESG performance help to attract the green financing, which is than invested in long-term assets. The inclusion of interaction term $(ESG_{it} \times GF_{it})$ the model accounts for the potential enhancement of green finance's effects by high ESG performance.

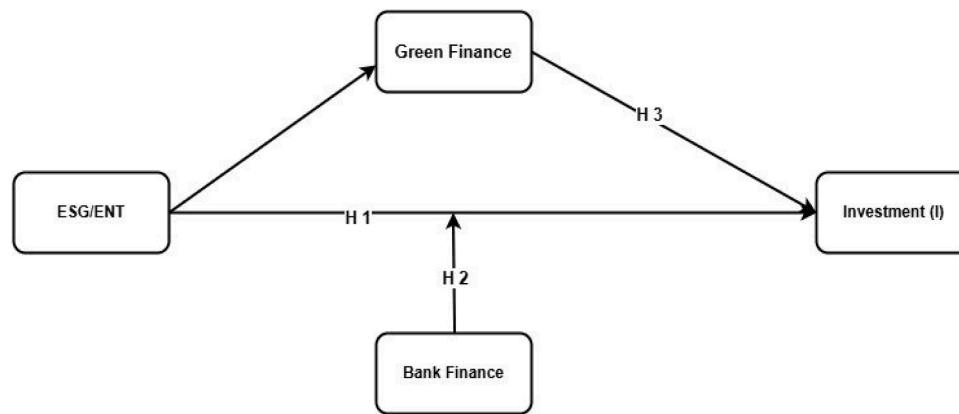


Fig. 1. Impact of ESG and ENT in the presence of GF and BF on investment sensitivity.

4. Results and discussion

4.1. 1 descriptive statistics

Table 4 presents the descriptive statistics for the variables under discussion. The mean value of dependent variable investment (I) is (0.657), with a medium of (0.564), a relatively lower standard deviation of (0.154), a maximum value of (0.815), and a minimum value of (0.541). The statistics show that data for the dependent variable is relatively concentrated and likely follows a normal distribution, as indicated by the small spread between the minimum and maximum values and low variability around the mean. The data for ESG and ENT mean values of (1.423 and 0.483), with medium values of (1.483 and 0.537) and standard deviations of (0.432 and 0.132, respectively).

The range for ESG is (0.195 to 0.875), and ENT is (0.086 and 0.764), suggesting normal distribution for sustainable variables. Similarly, the mean values for BF and GF are (0.286 and 0.141), with medians of (0.237 and 0.164) and standard deviation of (0.087 and 0.052), indicating that the data for bank financing and green finance are also suitable for further analysis [5]. The data for control variables such as INDP, LIQ, OCF, LEV, SG, and GDP also show a normal distribution, with mean values aligning closely with the means [40]. The data exhibit low standard deviations, and their minimum and maximum values fall within a range that further supports the normality of the distribution.

4.2. Correlations analysis

Table 5 upper part represents the high Environmental Sensitive Firms (ESFs) and the lower part represents the Low Environmental Sensitive Firms (LESFs) the result of correlation analysis of the variables over the period from 2010–2023. The upper part shows that the dependent variable investment (I) is significantly positively correlated with the independent variable ESG (0.437) and ENT (0.473). The firms financing variables like BF (0.365) and GF (0.413) are also significantly

positively correlated with investment (I) [42]. Further, the control variables like INDP (−0.193) and LIQ (−0.431) are negatively correlated with investment (I) [10]. The control variables OCF (0.354), LEV (0.421), SG (0.421), and GDP (0.421) are significantly positively correlated with investment (I) [10]. Likewise, independent variables are significantly weakly correlated with each other.

On the other hand, the lower part of the triangle shows that independent variables as measures of sustainability like ESG (0.466) and ENT (0.416) are significantly positively correlated with the dependent variable investment (I) [25]. The financing variables like BF (0.416) and GF (0.442) are significantly positively correlated with the dependent variables investment (I) [27]. The control variables like INDP (−0.344), LIQ (0.390), are significantly negatively correlated with investment (I) and while control variables OCF (0.485), LEV (0.543), SG (0.511), and GDP (0.472) are significantly positively correlated with investment (I). Further, the independent variables are significantly weakly correlated with each other, which indicates that there is no problem of multicollinearity exists in the regression model [5].

4.3. Cluster regression analysis

Table 6 presents the impact of sustainability measures, especially ESG and ENT, on firm investment sensitivity for both high and low ESFs, considering year and industry effects. For high ESFs, under both the year and industry effects, the independent variables ESG and ENT significantly and positively explain the dependent variable, investment (I). Under the year effect, ESG ($\beta=0.045$) and ENT ($\beta=0.041$) are significantly positively associated with investment [43]. Similarly, under the industry effect, ESG ($\beta=0.0444$) and ENT ($\beta=0.040$) also develop a significant positive relationship with investment [12]. The findings indicate that high ESFs are more likely to invest in ESG and ENT practices that help to increase efficiency, reduce risk, and align with stakeholders' expectations. Investors and other stakeholders prioritize firms that focus on sustainability investments as this can lead to access to greater access to capital, lower financing costs, and reduced investment sensitivity [28].

For lower ESFs, the independent variables ESG ($\beta=0.033$) and ENT ($\beta=0.034$) in year effect, and ESG ($\beta=0.031$) and ENT ($\beta=0.032$) in industry effect, significantly positively explain the dependent variable, investment (I). The findings suggest that firms engaging in ESG and ENT investment practices are better positioned to pursue positive NPV (net present value) investment, manage risk, and capitalize on growth opportunities [31]. This, in turn, reduces their investment sensitivity by effectively managing both internal and external factors. Further, the magnitude of the impact of sustainability variables on investment is greater in high ESFs compared to low ESFs [27]. This indicates that high ESFs are more sensitive to sustainable investment practices.

The high ESFs are more inclined to adopt sustainable practices with

Table 4
Descriptive statistics.

Variable	Mean	Median	Std.	Min	Max	observations
I	0.657	0.564	0.154	0.541	0.815	90,543
ESG	1.423	1.483	0.432	0.195	0.876	90,543
ENT	0.483	0.537	0.132	0.086	0.764	90,543
BF	0.286	0.237	0.087	0.016	0.543	90,543
GF	0.141	0.164	0.052	0.000	0.243	90,543
INDP	0.036	0.314	0.011	0.000	0.453	90,543
Liquidity	1.546	1.655	0.343	0.803	2.788	90,543
OCF	0.428	0.402	0.149	0.098	0.643	90,543
LEV	0.341	0.339	0.115	0.075	0.554	90,543
SG	0.233	0.263	0.076	−0.013	0.379	90,543
GDP	3.42	3.253	0.654	−1.28	11.98	90,543

Table 5
Correlation analysis.

Var	I	ESG	ENT	BF	GF	INDP	LIQ	OCF	LEV	SG	GDP
I	1.00	0.437 (0.00)	0.473 (0.00)	0.365 (0.003)	0.413 (0.003)	−0.193 (0.000)	−0.431 (0.002)	0.354 (0.001)	0.421 (0.000)	0.421 (0.000)	0.421 (0.000)
ESG	0.539 (0.001)	1	0.210 (0.000)	0.174 (0.000)	0.173 (0.000)	0.132 (0.000)	0.451 (0.002)	0.554 (0.021)	0.572 (0.041)	0.482 (0.041)	0.241 (0.041)
ENT	0.466 (0.000)	0.332 (0.051)	1	0.394 (0.001)	0.337 (0.001)	0.231 (0.002)	0.296 (0.001)	0.314 (0.000)	0.335 (0.000)	0.341 (0.000)	0.295 (0.000)
BF	0.416 (0.003)	0.214 (0.001)	0.183 (0.000)	1	0.241 (0.000)	0.332 (0.000)	0.342 (0.000)	0.412 (0.002)	0.331 (0.000)	0.466 (0.000)	0.378 (0.000)
GF	0.442 (0.002)	0.279 (0.000)	0.211 (0.000)	0.277 (0.003)	1	0.213 (0.003)	0.334 (0.003)	0.332 (0.001)	0.380 (0.040)	0.411 (0.040)	0.445 (0.040)
INDP	0.344 (0.001)	0.267 (0.001)	0.233 (0.001)	0.241 (0.000)	0.230 (0.000)	1	0.410 (0.001)	0.271 (0.001)	0.452 (0.000)	0.311 (0.000)	0.275 (0.000)
LIQ	0.390 (0.001)	0.315 (0.001)	0.197 (0.000)	0.234 (0.021)	0.234 (0.021)	0.234 (0.000)	1	0.214 (0.001)	0.274 (0.002)	0.332 (0.002)	0.235 (0.002)
OCF	0.485 (0.000)	0.341 (0.001)	0.234 (0.000)	0.197 (0.000)	0.175 (0.000)	0.254 (0.022)	0.276 (0.000)	1	0.240 (0.001)	0.187 (0.002)	0.316 (0.002)
LEV	0.543 (0.000)	0.321 (0.001)	0.354 (0.000)	0.252 (0.003)	0.286 (0.003)	0.250 (0.000)	0.292 (0.001)	0.276 (0.000)	1	0.176 (0.001)	0.225 (0.001)
SG	0.511 (0.000)	0.331 (0.001)	0.250 (0.000)	0.232 (0.000)	0.236 (0.000)	0.242 (0.000)	0.240 (0.000)	0.243 (0.040)	0.276 (0.000)	1	0.273 (0.001)
GDP	0.472 (0.001)	0.276 (0.001)	0.298 (0.000)	0.276 (0.021)	0.244 (0.021)	0.276 (0.022)	0.287 (0.003)	0.234 (0.000)	0.261 (0.002)	0.312 (0.002)	1

^{0.00} significant at 1 %, ^{0.05} significant at 5 %, ^{0.10} significant at 10 %.

Table 6
Regression analysis of high-ESFs and Low-ESFs.

	High ESF (Model-1)						Low ESF (Model-2)					
	Panel A (Yearly Effect)			Panel B (Industry Effect)			Panel C (Yearly Effect)			Panel D (Industry Effect)		
	Coff	T	VIF	Coff	T	VIF	Coff	T	VIF	Coff	T	VIF
ESG	0.045 ^a	2.16	1.56	0.044 ^a	2.25	1.67	0.033 ^a	2.25	1.84	0.031 ^a	2.23	1.90
ENT	0.041 ^a	2.19	1.79	0.040 ^a	2.34	1.98	0.034 ^b	2.28	1.96	0.032	2.23	1.74
BF	0.033 ^a	3.41	1.87	0.035 ^a	3.51	1.76	0.029 ^b	3.24	1.88	0.028 ^a	3.17	1.65
GF	0.023 ^b	2.11	1.24	0.026 ^b	2.21	1.39	0.029 ^c	1.89	1.35	0.027 ^b	1.86	1.14
INDP	0.024 ^a	2.32	1.36	0.026 ^a	2.41	1.79	0.034 ^a	2.67	1.54	0.035 ^a	2.41	1.47
LIQ	0.034 ^c	2.73	1.43	0.037 ^c	2.53	1.78	0.021 ^c	2.44	1.55	0.024 ^c	2.24	1.33
OCF	0.048 ^a	2.39	1.29	0.046 ^b	2.33	1.29	0.451 ^a	2.28	1.63	0.043 ^b	2.34	1.33
LEV	0.022 ^b	2.73	1.36	0.014 ^a	2.26	1.36	0.021 ^b	2.38	1.16	0.035 ^a	2.51	1.22
SG	0.046 ^b	2.45	1.41	0.045 ^a	2.31	1.43	0.031 ^b	2.67	1.73	0.014 ^a	2.67	1.54
GDP	0.036 ^b	2.50	1.53	0.035 ^a	2.43	1.44	0.011 ^b	2.28	1.16	0.034 ^a	2.51	1.78
Year	0.020 ^a	2.55	1.45	0.020 ^a	2.65	1.54	0.035 ^a	2.89	1.09	0.021 ^a	2.78	1.39
Industry effect	0.034 ^a	2.76	1.34	0.020 ^a	2.47	1.45	0.035 ^a	2.36	1.09	0.021 ^a	2.29	1.87

^a significant at 1 %.

^b significant at 5 %.

^c significant at 10 %.

Table 7
Regression analysis of moderating analysis.

	High ESF (Model-1)						Low ESF (Model-2)					
	Panel A (Yearly Effect)			Panel B (Industry Effect)			Panel C (Yearly Effect)			Panel D (Industry Effect)		
	Coff	T	VIF	Coff	T	VIF	Coff	T	VIF	Coff	T	VIF
ESG	0.045 ^a	2.16	1.56	0.044 ^a	2.25	1.67	0.033 ^a	2.25	1.84	0.031 ^a	2.23	1.90
ENT	0.041 ^a	2.19	1.79	0.040 ^a	2.34	1.98	0.034 ^b	2.28	1.96	0.032	2.23	1.74
BF	0.032 ^a	3.48	1.87	0.033 ^a	3.44	1.67	0.029 ^b	3.24	1.88	0.028 ^a	3.17	1.65
BF* ESG	0.053 ^a	3.08	1.65	0.062 ^a	3.18	1.75	0.048 ^b	3.19	1.95	0.042 ^b	2.87	1.31
BF* ENT	0.063 ^a	3.29	1.78	0.068 ^a	3.47	1.86	0.054 ^b	3.29	1.54	0.054 ^c	3.29	1.54
GF	0.037 ^b	2.97	1.53	0.035 ^b	2.89	1.34	0.039 ^c	2.63	1.74	0.035 ^b	1.65	1.36
INDP	0.029 ^a	2.54	1.66	0.026 ^a	2.33	1.75	0.024 ^a	2.52	1.63	0.025 ^a	1.49	1.76
LIQ	0.034 ^c	2.54	1.83	0.037 ^c	2.49	1.65	0.038 ^c	2.49	1.59	0.036 ^c	2.29	1.41
OCF	0.044 ^a	2.17	1.19	0.042 ^b	1.78	1.27	0.46 ^a	1.89	1.39	0.045 ^b	1.79	1.39
LEV	0.032 ^b	2.93	1.18	0.032 ^a	1.84	1.26	0.035 ^b	2.69	1.37	0.036 ^a	2.51	1.57
SG	0.031 ^b	2.49	1.48	0.034 ^a	2.35	1.46	0.035 ^b	2.69	1.78	0.015 ^a	2.69	1.63
GDP	0.035 ^b	2.59	1.70	0.036 ^a	2.49	1.49	0.037 ^b	2.29	1.56	0.036 ^a	2.59	1.79
Year	0.038 ^a	2.51	1.34	0.037 ^a	1.56	1.44	0.039 ^a	2.39	1.34	0.039 ^a	2.78	1.39
Industry effect	0.039 ^a	2.59	1.41	0.037 ^a	1.72	1.49	0.036 ^a	2.39	1.43	0.037 ^a	2.79	1.64

^a significant at 1 %.

^b significant at 5 %.

^c significant at 10 %.

long-term investment policies to address the needs of different stakeholders [25]. The firm's commitment to adopting ESG and ENT practices to promote long-term sustainability by balancing environmental stewardship, social ethics, and strong corporate governance practices [5]. Saviano et al. [34] argue that ESFs integrate their ESG and ENT practices with a firm investment policy to mitigate investment volatility and enhance sustainability. Further, both in high ESF and low ESFs, dependent variable investment sensitivity (I) is significantly explained by the moderating variables BF ($\beta = 0.033$ and 0.035) and mediating variables GF ($\beta = 0.023$ and 0.026) respectively [37]. The findings show that both moderating (BF) and mediating variables (GF) perform a crucial role in determining investment volatility under various circumstances [20].

4.4. Moderation analysis

Table 7 reports the results of high and low ESFs under the year and industry effect; showing the effect of moderating variable (BF) in the relationship between investment and firm sustainability. First, we test whether the moderating variable BF significantly explain the dependent variable investment (I) before analyzing the moderating effect.

The findings indicate that both in high and low ESFs, moderating variable BF is significantly positively explains the dependent variable investment (I), under the year effect ($\beta = 0.032$) and ($\beta = 0.029$) and ($\beta = 0.033$) and ($\beta = 0.028$) under the industry effect respectively. The findings indicate that both in high and low ESFs, the moderating variable BF is a significant source of financing for sustainable investment [1]. Further, in high ESFs, the moderating effect of (BF \times ESG; $\beta = 0.053$) and (BF \times ENT; $\beta = 0.063$) under the year effect and (BF \times ESG; $\beta = 0.062$ and BF \times ENT; $\beta = 0.068$) under the industry effect significantly positively explain the dependent variable investment (I) [24]. Similarly, in low ESFs, the moderating effect of (BF \times ESG; $\beta = 0.041$) and (BF \times ENT; $\beta = 0.054$) under the year effect and (BF \times ESG; $\beta = 0.042$) and (BF \times ENT; $\beta = 0.054$) under the industry effect are significantly positively explained the dependent variable investment (I) [39].

The findings indicate that BF is playing a moderating effect in the relationship between sustainably and investment as proposed in hypothesis 2. The findings indicate that bank financing is significantly positively associated with firms' sustainable investment practices to reduce investment volatility [42]. Further, the findings explain that banks enforce more rigorous rules and regulations on high ESFs for granting loans as compared to low ESFs [9]. Further, Fiechter et al. [16] argue that the banking industry aligns their financing with global sustainable development goals to ensure granting loans for sustainable

investment likewise, Xie et al. [41] report that firms seeking bank loans are required to submit their sustainability report to ensure environmental protection and steps to adopt sustainable investment.

4.5. Mediation analysis

The Baron and Kenny [6] three-step approach is used to analyze the mediating role of green finance between the relationship of firm sustainability and investment volatility. Table 8 reports the results of the mediation analysis of high and low ESFs under both the year and industry effects. According to Baron and Kenny [6] mediation exists if the inclusion of mediators like in our case (GF \times ESG and GF \times ENT) significantly affects the relationship between the independent variable on the dependent variable.

The findings indicate in high ESFs, interaction terms of (GF \times ESG; $\beta = 0.068$) and (GF \times ENT $\beta = 0.054$) under the year effect and (GF \times ESG; $\beta = 0.066$ and GF \times ENT; $\beta = 0.062$) under the year effect significantly positively explains the dependent variable investment (I) [28]. Similarly, in low ESFs, the interaction term of (GF \times ESG; $\beta = 0.053$) and (GF \times ENT; $\beta = 0.046$) under the year effect and (GF \times ESG; $\beta = 0.050$) and (GF \times ENT; $\beta = 0.049$) under the industry effect significantly positively explains the dependent variable investment (I) [34]. The results indicate that the magnitude of the mediator effect is greater on investment than the direct effect of independent variable ESG and ENT on dependent variable investment (I) [43]. This guides that green finance acts as a mediator, increasing the effect of both independent variables ESG and ENT on the dependent variable firm investment (I) as proposed in hypothesis 3.

Further, we observed that mediating variable green finance is more effectively correlated with firm sustainability like ESG and ENT, leading to a greater reduction in investment volatility in high ESFs than in low ESFs. The findings indicate that investors are more cautious about providing funds to high ESFs than low ESFs [42]. The results suggest that high ESFs typically face more rigorous sustainability standards and greater scrutiny from investors to grant loans for long-term investment [24]. Maman et al. [27] explain that investment decisions about high ESFs are more complex and sensitive than the low ESFs for long-term investment. Therefore, green finance provides a mechanism for investors to assess the long-term sustainability of investment projects to reduce investment sensitivity.

5. Conclusion and managerial implication

This study examines the impact of firms' sustainable investment

Table 8
Mediation analysis.

	High ESF (Model-1)						Low ESF (Model-2)					
	Panel A (Yearly Effect)			Panel B (Industry Effect)			Panel C (Yearly Effect)			Panel D (Industry Effect)		
	Coff	T	VIF	Coff	T	VIF	Coff	T	VIF	Coff	T	VIF
ESG	0.043 ^a	2.16	1.56	0.044 ^a	2.25	1.67	0.033 ^a	2.25	1.84	0.031 ^a	2.23	1.90
ENT	0.042 ^a	2.19	1.79	0.040 ^a	2.34	1.98	0.034 ^b	2.28	1.96	0.032	2.23	1.74
BF	0.032 ^a	3.48	1.87	0.033 ^a	3.44	1.67	0.029 ^b	3.24	1.88	0.028 ^a	3.17	1.65
GF	0.033 ^b	2.27	1.44	0.031 ^b	2.32	1.34	0.029 ^c	2.89	1.35	0.027 ^b	2.86	1.87
ESG \times GF	0.068 ^a	2.11	1.42	0.066 ^a	2.09	1.46	0.053 ^a	2.17	1.83	0.050 ^a	2.12	1.96
ESG \times ENT	0.054 ^a	2.34	1.54	0.062 ^a	2.19	1.56	0.046 ^a	2.11	1.73	0.049 ^a	2.16	1.87
INDP	0.043 ^a	2.54	1.66	0.052 ^a	2.33	1.70	0.034 ^a	2.67	1.54	0.035 ^a	2.41	1.47
LIQ	0.043 ^c	2.79	1.78	0.042 ^c	2.49	1.75	0.021 ^c	2.44	1.55	0.024 ^c	2.24	1.33
OCF	0.0541 ^a	2.94	1.76	0.042 ^b	1.87	1.24	0.451 ^a	1.84	1.38	0.043 ^b	1.78	1.27
LEV	0.042 ^b	2.93	1.56	0.041 ^a	2.55	1.56	0.046 ^b	2.67	1.53	0.034 ^a	2.51	1.75
SG	0.031 ^b	2.49	1.48	0.034 ^a	2.35	1.46	0.035 ^b	2.69	1.78	0.015 ^a	2.69	1.63
GDP	0.035 ^b	2.59	1.70	0.036 ^a	2.49	1.49	0.037 ^b	2.29	1.56	0.036 ^a	2.59	1.79
Year	0.022 ^a	2.64	1.65	0.020 ^a	2.47	1.64	0.027 ^a	2.33	1.54	0.025 ^a	2.78	1.43
Industry effect	0.024 ^a	2.56	1.44	0.029 ^a	2.47	1.76	0.027 ^a	2.24	1.87	0.029 ^a	2.16	1.54

^a significant at 1 %.

^b significant at 5 %.

^c significant at 10 %.

practices on investment sensitivity. The Environmental, Social, and Governance (ESG) score and overall Environmental Index (ENT) score are used to categorize the firms into high environments sensitivity firms (ESFs) and low Environmental Sensitivity Firms (ESFs) respectively. The findings reveal that sustainability measures like ESG and ENT significantly positively explain the dependent variable investment (I), as proposed in hypothesis 1. Notably, the ESG and ENT more significantly explain the dependent variable investment (I) in high (ESFs) than the low (ESFs). The findings indicate that sustainable investment practices more significantly help to reduce the investment volatility in high (ESFs) than low (ESFs) by promoting long-term sustainability and risk management. The firm's focus on sustainability leads to more stable cash flows, lower risk premiums, and increased investors' confidence, thereby reducing fluctuation in investment.

Further, we examine whether bank financing works as a moderator to enhance the influence of sustainability like ESG and ENT on firm investment (I). The findings explain that moderating variable bank financing more significantly explains the dependent variable investment (I) in high ESFs than the low ESFs as proposed in hypothesis 2. It indicates the banking industry applies more rigorous rules and regulations on high ESFs compared to low ESFs. The ESFs are regularly assessing their investment strategies to improve their sustainable practices, aiming to secure more loans on favorable terms and conditions for long-term investment. This may allow firms to design the optimal capital structure, which in turn supports their long-term growth and sustainability initiatives.

Additionally, this study finds that mediating variable green finance significantly positively explains the dependent variable investment (I) as explained in hypothesis 3. The findings guide that integration of green finance with firms' sustainable investment practices is significantly helpful in reducing investment volatility. This not only enhances the firms' appeal to capital providers but also aligns with global trends encouraging environmentally and socially responsible business practices. Therefore, the firms use green finance as a strategic instrument to secure sustainable investment that supports both growth and sustainability objectives.

The findings of this study provide valuable guidelines for managers seeking to enhance their investment stability and sustainable growth by adopting sustainable investment practices that significantly contributed to attain the SDGs. The managers should align the ESG and ENT compliance with firms' investment strategies to promote long-term sustainability. The integration of ESG practices with firm investment policy can help managers to reduce investment volatility and leading more stable cash flows. The adoption of ESG and ENT initiatives are not simply as compliance requirements but also a strategic tool for mitigating risk and driving sustainable financial performance for attain the SDGs. Further, the managers can align the ESG and ENT practices with investment policy to attain bank financing on favorable terms and conditions. Additionally, the managers should view green finance not just as a source of financing but also help to attract environmentally conscious investors to reduce investment volatility and long-term sustainability for achieving the SDGs. The integration of bank financing and green finance with a firm sustainable investment policy can attract more capital inflows and generate higher financial benefits. Therefore, the managers should take a strategic approach by integrating ESG compliance with firm investment policy, leveraging bank and green financing to reduce the investment sensitivity to remain competitive in a rapidly changing environment to response SDGs.

Likewise, this study recommends that government and financial institutions should design the sophisticated policy framework to adopt the green finance mechanism to positively contribute the SDGs. This can include offering tax benefits or reduce interest rate for businesses integrating green finance with sustainable investment practices to attain the SDGs. Further, the government should introduce the mechanisms to regularly monitor and evaluate the influence of green finance initiatives on sustainable development. The national development strategies

should incorporate green finance as key instrument to attain the sustainable development. The policies should highlight the role of green finance in reducing environmental risk, promoting social equality and promote economic stability for sustainable development initiatives.

5.1. Future research and study limitations

Future research can explore how firms' sustainability practices can influence investment volatility across different industries. The researchers may delve into the role of ESG and ENT practices on industry-specific variables like regulatory pressure, technological innovations, or market competition to reduce investment sensitivity. Further, the studies may also conduct a cross-country analysis of how ESG and ENT practices could help to address the national economic policies, cultural attitudes, and local market conditions to overcome investment volatility. Therefore, future research directions can enhance the practical understanding of how sustainable practices can influence on firms' behavior and performance, enabling businesses to contribute positively in a dynamic global economy focused on sustainability.

This study has also some limitations to investigate the effect of sustainable practices on firms' investment sensitivity. The study uses the ESG and ENT index to categorize firms into high and low ESFs which may not purely capture the dynamic of sustainability practices across the different industries and regions. The study did not explore the reverse causality of ESG and ENT with investment sensitivity, where businesses that have more stable cash flows may be better position to adopt the ESG and ENT disclosures. Additionally, the study primarily focuses on sustainable practices on investment sensitivity and ignores the other critical business metrics like profitability, innovation, and customer satisfaction that may also play an important role in enhancing the firms' performance. Therefore, these factors may provide a clearer picture of sustainable investment practices on firm performance.

CRediT authorship contribution statement

Ashfaq Habib: Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Muhammad Asif Khan:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization.

Declaration of competing interest

There is no competing interest to declare.

Data availability

Data will be made available on request.

References

- [1] R. Agrawal, S. Agrawal, A. Samadhiya, A. Kumar, S. Luthra, V. Jain, Adoption of green finance and green innovation for achieving circularity: an exploratory review and future directions, *Geosci. Front.* 15 (4) (2024) 101669.
- [2] M. Ahmad, U.K. Pata, Z. Ahmed, R. Zhao, Fintech, natural resources management, green energy transition, and ecological footprint: empirical insights from EU countries, *Resour. Policy* 92 (2024) 104972.
- [3] N. Apergis, T. Poufinas, A. Antonopoulos, ESG scores and cost of debt, *Energy Econ.* 112 (2022) 106186.
- [4] S.A. Athari, Does the sovereign environmental, social, and governance sustainability activities jeopardize the banking sector's stability: evidence from the Arab economies, *Sustain. Futures* 7 (2024) 100204, <https://doi.org/10.1016/j.sfr.2024.100204>.
- [5] T. Barko, M. Cremers, L. Renneboog, Shareholder engagement on environmental, social, and governance performance, *J. Bus. Ethics* 180 (2) (2022) 777–812.
- [6] R.M. Baron, D.A. Kenny, The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations, *J. Pers. Soc. Psychol.* 51 (6) (1986) 1173.

- [7] K. Belcaid, Morocco's green shield: ESG stock performance under global climate, economic, geopolitical and oil uncertainties, *Sustain. Futures* 8 (2024) 100250, <https://doi.org/10.1016/j.sfr.2024.100250>.
- [8] S. Cantele, A. Zardini, Is sustainability a competitive advantage for small businesses? An empirical analysis of possible mediators in the sustainability–financial performance relationship, *J. Clean. Prod.* 182 (2018) 166–176.
- [9] S. Carnini Pulino, M. Ciaburri, B.S. Magnanelli, L. Nasta, Does ESG disclosure influence firm performance? *Sustainability*. 14 (13) (2022) 7595.
- [10] S. Chen, Y. Song, P. Gao, Environmental, social, and governance (ESG) performance and financial outcomes: analyzing the impact of ESG on financial performance, *J. Env. Manage* 345 (2023) 118829.
- [11] S. Cosma, S. Galletta, S. Mazzù, G. Rimo, Banks' fossil fuel divestment and corporate governance: the role of board gender diversity, *Energy Econ.* 139 (2024) 107948.
- [12] W. Deng, Z. Zhang, B. Guo, Firm-level carbon risk awareness and green transformation: a research on the motivation and consequences from government regulation and regional development perspective, *Int. Rev. Financ. Anal.* 91 (2024) 103026.
- [13] G.W. Dowell, S. Muthulingam, Will firms go green if it pays? The impact of disruption, cost, and external factors on the adoption of environmental initiatives, *Strateg. Manag. J.* 38 (6) (2017) 1287–1304.
- [14] S. Drempetic, C. Klein, B. Zwergel, The influence of firm size on the ESG score: corporate sustainability ratings under review, *J. bus. ethics* 167 (2) (2020) 333–360.
- [15] M. Dukan, L. Kitzing, The impact of auctions on financing conditions and cost of capital for wind energy projects, *Energy Policy* 152 (2021) 112197.
- [16] P. Fiechter, J.M. Hitz, N. Lehmann, Real effects of a widespread CSR reporting mandate: evidence from the European Union's CSR Directive, *J. Account. Res.* 60 (4) (2022) 1499–1549.
- [17] S. Gawusu, X. Zhang, S.A. Jamatutu, A. Ahmed, A.A. Amadu, E. Djam Miensah, The dynamics of green supply chain management within the framework of renewable energy, *Int. J. Energy Res.* 46 (2) (2022) 684–711.
- [18] A. Gholami, P.A. Murray, J. Sands, Environmental, social, governance & financial performance disclosure for large firms: is this different for SME firms? *Sustainability*. 14 (10) (2022) 6019.
- [19] J.S. Harrison, A.C. Wicks, Stakeholder theory, value, and firm performance, *Bus. ethics q.* 23 (1) (2013) 97–124.
- [20] J.-L. Hervás-Oliver, M.D. Parrilli, A. Rodríguez-Pose, F. Sempere-Ripoll, The drivers of SME innovation in the regions of the EU, *Res. Policy*. 50 (9) (2021) 104316.
- [21] R. Huang, Z. Zhu, R. Ruan, X. Lou, Linking low-carbon practices with ESG performances: exploration evidence from the configurational perspective, *J. Clean. Prod.* 435 (2024) 140532.
- [22] F. Khairunnessa, D.A. Vazquez-Brust, N. Yakovleva, A review of the recent developments of green banking in Bangladesh, *Sustainability*. 13 (4) (2021) 1904.
- [23] M.A. Khan, H. Riaz, M. Ahmed, A. Saeed, Does green finance really deliver what is expected? An empirical perspective, *Borsa Istanbul. Rev.* (2021), <https://doi.org/10.1016/j.bir.2021.07.006>.
- [24] D. Kinderman, The challenges of upward regulatory harmonization: the case of sustainability reporting in the European Union, *Regul. Gov.* 14 (4) (2024) 674–697.
- [25] Z. Li, T.-H. Kuo, W. Siao-Yun, L.T. Vinh, Role of green finance, volatility and risk in promoting the investments in renewable energy resources in the post-covid-19, *Resour. Policy* 76 (2022) 102563.
- [26] J. Lu, M. Liang, C. Zhang, D. Rong, H. Guan, K. Mazeikaite, J. Streimikis, Assessment of corporate social responsibility by addressing sustainable development goals, *Corp. Soc. Responsib. Environ. Manag.* 28 (2) (2021) 686–703.
- [27] A. Maman, J.G. Dias, F. Bassi, Sustainability-oriented management in the SMEs. A multilevel analysis in the European Union, *J. Env. Manage* 365 (2024) 121559.
- [28] C.-A. Papari, H. Toxopeus, F. Polzin, H. Bulkeley, E.V. Menguzzo, Can the EU taxonomy for sustainable activities help upscale investments into urban nature-based solutions? *Env. Sci Policy* 151 (2024) 103598.
- [29] B.L. Parmar, R.E. Freeman, J.S. Harrison, A.C. Wicks, L. Purnell, S. De Colle, Stakeholder theory: the state of the art, *Acad. Manag. Ann.* 4 (1) (2010) 403–445.
- [30] U.K. Pata, A. Samour, Assessing the role of the insurance market and renewable energy in the load capacity factor of OECD countries, *Environ. Sci. Pollut. Res.* 30 (16) (2023) 48604–48616.
- [31] H. Pühr, J. Müllner, Foreign to all but fluent in many: the effect of multinationality on shock resilience, *J. World Bus.* 57 (6) (2022) 101370.
- [32] A. Reghezza, Y. Altunbas, D. Marques-Ibanez, C.R. d'Acqui, M. Spaggiari, Do banks fuel climate change? *J. Financ. Stab.* 62 (2022) 101049.
- [33] D. Sardana, N. Gupta, V. Kumar, M. Terziowski, CSR 'sustainability' practices and firm performance in an emerging economy, *J. Clean. Prod.* 258 (2020) 120766.
- [34] M. Saviano, G. Russo, M. Farina Briamonte, L. Di Nallo, The challenges in integrating ESG factors into banks' credit department: a knowledge management enhanced framework, *J. Knowl. Manag.* (2024).
- [35] I. Shaikh, Environmental, social, and governance (ESG) practice and firm performance: an international evidence, *J. Bus. Econ. Manag.* 23 (1) (2022) 218–237. -218–237.
- [36] R. Sinha, M. Datta, Institutional investments and responsible investing, *Financ. Sustain. Dev.: Key Chall. Prospects* (2019) 127–168.
- [37] A. Somoza, Voluntary sustainability assurance in small and medium-sized entities: the role of country origin in Europe, *Bus. strategy environ.* 32 (1) (2023) 462–483.
- [38] D. Springett, Business conceptions of sustainable development: a perspective from critical theory, *Bus. Strategy Environ.* 12 (2) (2003) 71–86.
- [39] J. Stoelhorst, P. Vishwanathan, Beyond primacy: a stakeholder theory of corporate governance, *Acad. Manag. Rev.* 49 (1) (2024) 107–134.
- [40] M.A. Urban, D. Wójcik, Dirty banking: probing the gap in sustainable finance, *Sustainability*. 11 (6) (2019) 1745.
- [41] J. Xie, W. Nozawa, M. Yagi, H. Fujii, S. Managi, Do environmental, social, and governance activities improve corporate financial performance? *Bus. Strategy Environ.* 28 (2) (2019) 286–300.
- [42] Q. Yang, Q. Du, A. Razzaq, Y. Shang, How volatility in green financing, clean energy, and green economic practices derive sustainable performance through ESG indicators? A sectoral study of G7 countries, *Resour. Policy* 75 (2022) 102526.
- [43] R. Zhang, Y. Fu, Y. Chen, B. Du, Down to earth: implementing project-level ESG metrics in Chinese AEC firms' Practices, *J. Manag. Eng.* 40 (5) (2024) 04024035.