Inzinerine Ekonomika-Engineering Economics, **2025, 36(1), 72–95**

Moving Toward Sustainable Finance: Leveraging Environment, Social and Governance (ESG) Performance and Risk Management to Drive Corporate Financing Efficiency

Li Li[1], Muhammad Suhrab[2], Magdalena Radulescu[3,4*], Mariana Banuta[5]

[1]*School of Accounting, Guangzhou College of Commerce*
Guangzhou 511363, China
E-mail. lili@graduate.utm.my

[2]*School of Management, Huazhong University of Science and Technology (HUST)*
No.1037 Luoyu Road, Wuhan City, Hubei Province, 430074, China
E-mail. writetosohrab@gmail.com

[3]*Institute of Doctoral and Post-Doctoral Studies, University Lucian Blaga of Sibiu*
Bd. Victoriei, no.10, Sibiu, 550024, Romania
[4]*UNEC Research Methods Application Center, Azerbaijan State University of Economics (UNEC)*
Istiqlaliyyat Str. 6, Baku 1001, Azerbaijan
E-mail. mag.radulescu@yahoo.com; (*) Corresponding author

[5]*National University of Science and Technology Politehnica Bucharest*
str. Targu din Vale, no.1, Pitesti, 110040, Romania
E-mail. mariana.banuta@upb.ro

https://doi.org/10.5755/j01.ee.36.1.36361

The growing demand for companies to adopt environmentally sustainable and ethical practices has led to a greater focus on the organization's environmental, social, and governance accomsplishments. This study aims to investigate the relationship between environmental social and governance (ESG) and corporate financial risk (CFR) on corporate finance efficiency (CFE) in China, using a dataset of 400 Chinese firms registered on the Shanghai and Shenzhen A-share exchanges between 2013 and 2022, the analysis uses a data envelopment analysis (DEA) model with entity-fixed effects regression and a robustness test. The findings show a positive relationship between ESG and corporate finance efficiency, implying that promoting ESG practices can boost corporate financing efficiency. However, the study also found the negative effect of high financial risk on corporate financing efficiency. These findings have significant implications for businesses, investors, and policymakers. Businesses can enhance their long-term financial performance by giving ESG practices top priority and controlling financial risks. Policymakers can utilize these findings to encourage businesses to enhance their ESG practices and risk management to increase overall financing efficiency.

Keywords: *Environmental, Social; Governance; ESG; Corporate Financing Efficiency; Corporate Financial Risk; Sustainable Finance.*

Introduction

In an era of growing environmental consciousness and evolving social expectations, businesses are transitioning from a sole profit focus to fulfilling a broader role due to increasing environmental awareness and shifting social norms (Pinheiro *et al.*, 2024; Kandpal *et al.*, 2024; Liou, Liu, & Huang 2023). Companies are now being encouraged to not only focus on making profits but also to promote sustainable practices and enhance the overall welfare of the community. This essential shift is based on the significance of Environmental, Social, and Governance (ESG) criteria, which are now crucial metrics for evaluating corporate performance (Lei, & Yu, 2024; Sun, & Zhu 2024; Elamer, & Boulhaga 2024; Singhania, & Saini 2023). ESG standards encompass a diverse approach that encompasses environmental stewardship, social impact, and transparent governance (Hsu, 2024; Dziadkowiec, & Daszynska-Zygadlo 2021). Companies are evaluated based on their efforts to tackle climate change, reduce resource consumption, and lower pollution levels within the environmental sector (Lodhia *et al.*, 2022; Mu *et al.*, 2023). Social elements encompass a range of factors such as diversity, inclusion, labor practices, community engagement, and human rights. Governance metrics focus on the transparency, accountability, and independence of corporate boards (Arvidsson, & Dumay, 2022; Sonko, & Sonko, 2023; Kazmierczak 2022). Collectively, these components establish a comprehensive framework for assessing a company's influence on environmental sustainability and societal well-being.

The growing worldwide focus on sustainability makes it more important than ever to incorporate ESG concepts into business strategies (Weston & Nnadi 2023; Delgado-

Ceballos *et al.,* 2023). This mandate derives from the awareness that businesses operate within a broader ecosystem, and their choices can have a profound impact on the environment, societies, and economies (Sandberg *et al.*, 2023; Meira *et al.,* 2023). Embracing ESG principles is crucial for a company's sustainable growth, not merely a moral responsibility. Staying pertinent in the future is essential. Businesses that fail to adapt face the danger of falling behind in a rapidly evolving market, where sustainability is gaining significance for consumers, investors, and regulators (Chen, & Yang, 2020; Moslehpour *et al.*, 2023). Moreover, there is a growing body of evidence showing that companies that perform well in ESG measures typically outperform their rivals in terms of financial results over time (Dmuchowski *et al.*, 2023; Afanas & Shash 2022). This link showcases the key connection between sustainable business plans and economic success, challenging the notion that generating profit involves compromising on environmental and social responsibilities. Understanding the complex relationship between ESG factors and corporate financial performance is essential as companies navigate through this environment. Therefore, this study sets out to explore the many different aspects of ESG, including its effects, obstacles, and potential in today's business environment. This research aims to uncover the transformative power of ESG principles and their significant impact on corporate strategy and social welfare through in-depth analysis and thoughtful exploration.

The increased emphasis on ESG factors is due to the rising concern among both government and citizens for safeguarding the environment and promoting sustainable growth. This heightened focus has led to a substantial expansion in China's energy conservation and environmental protection (ECEP) industry (Jin, Y., Gao, X., & Wang, 2021; He, Du, & Yu 2022). According to data from the National Bureau of Statistics, China's ECEP industry output value saw a significant increase from 2 trillion Chinese yuan in 2010 to 7.3 trillion in 2018. In 2020, the figure surpassed 8 trillion Chinese yuan (see Figure 1), underscoring the increasing significance of the sector in China's economy. The rapid growth of the ECEP sector not only demonstrates the nation's commitment to environmental conservation but also underscores the significance of sustainability in China's economic strategies. Due to regulations and market forces, China's ESG environment is evolving rapidly alongside the growth of its ECEP industry. The increasing recognition of the essential link between environmental sustainability, social accountability, and financial prosperity is demonstrated by the notable shift towards sustainable practices and enhanced reporting standards.

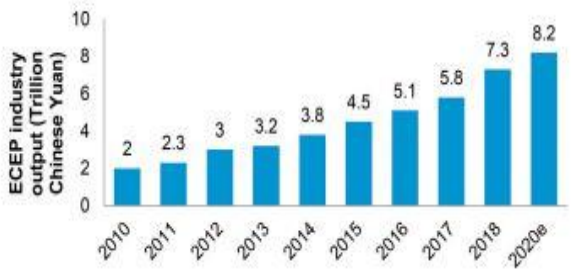

Figure 1. ECEP Industry Total Output in China Data
Source: http://www.cnii. com.cn/

ESG criteria serve to identify sustainable and socially conscious businesses by centering on the ESG aspects of a company's operations (Das Gupta, R. 2022; Khoury *et al.,* 2023; Zhao *et al.,* 2018; Nekhili *et al.,* 2021). When assessing a company's performance, ESG criteria are often utilized since they provide insight into the effectiveness of the organization's operations and whether or not the company meets its social and environmental goals. The utilization of ESG criteria in corporate finance has seen a significant upsurge in recent years (Ouni *et al.,* 2020; Zhai *et al.,* 2022). ESG standards afford investors a more comprehensive understanding of a company's activities and enable them to evaluate businesses that are more sustainably managed and better governed (Le & Ikram 2022; Nirino *et al.,* 2021; Huang *et al.,* 2022; Salamzadeh *et al.,* 2022). Moreover, investors can identify businesses more likely to provide higher profits in the long run by including ESG criteria in their investment decisions (Alareeni *et al.,* 2023). ESG performance helped companies reduce financial risk during the COVID-19 epidemic in China (Shakil 2021; Broadstock *et al.,* 2021; Mendiratta, Varsani, & Giese, 2021; Landi *et al.,* 2022). Geographic worldwide diversification and financial slack can mitigate the unfavorable correlation between firm ESG score and financial performance (Coelho *et al.,* 2023; Duque *et al.,* 2022; Grisales & Caracue, 2021; Suttipun 2023). ESG performance can enhance financial development sustainability in emerging nations (Paltrinieri *et al.,* 2020).

Despite the increasing importance of ESG factors in evaluating a company's financial performance, the specific influence of these factors on corporate financial efficiency remains underexplored. Previous studies have mainly focused on the relationship between ESG ratings and financial performance, yet financial performance alone may not fully capture firms' ability to generate financing and optimize resource utilization. This study introduces a unique approach by employing the DEA-BCC model to measure overall corporate financing efficiency, considering various dimensions of firm performance. While only one study has utilized this model to examine the impact of ESG on corporate financing efficiency in China, this paper aims to fill these gaps by investigating the nexus between ESG practices, corporate financial risk, and financing efficiency. Furthermore, within the context of the SDGs, achieving financial efficiency is crucial.

This study made use of a dataset comprising 400 companies, with the analysis timeframe running from 2013

to 2022. Specifically, we recommend investigating the following research questions (RQ):

1. What is the nature and extent of the relationship between ESG practices and corporate financing efficiency, considering factors such as cost of capital, capital structure optimization, and efficient allocation of financial resources?
2. How does corporate financial risk influence corporate financing efficiency, and what mechanisms are at play in mitigating or exacerbating this impact?

This paper also aims to make a novel contribution by exploring the specific impact of the SDGs on the relationship between ESG, corporate financial risk and financial efficiency by incorporating the SDG framework, which has gained significant global attention and acceptance. This research adds a new dimension to the exploration of this relationship. Furthermore, this research has practical relevance for businesses and investors since it provides insights into the potential benefits of aligning business practices with sustainable development goals. The study's theoretical implications are important because they offer insight into the possible trade-offs and benefits of sustainability practices in achieving financial efficiency. This has the potential to enhance the development and improvement of theoretical frameworks associated with ESG ratings, financial performance, and the SDGs.

The paper follows a structured approach, beginning with a comprehensive literature review that delves into existing research on ESG, corporate financial efficiency, and corporate financial risk. Subsequently, the paper details the methodology employed, encompassing the process of data collection, company selection criteria, and the variables utilized to gauge both ESG ratings and financial efficiency. Following this, the paper presents its findings, elucidating the observed relationship between ESG ratings and corporate financing efficiency and comparing these findings with prior research outcomes, thereby contextualizing and validating the study's results. Subsequently, a discussion section interprets the implications of the findings within the context of existing literature. Finally, the conclusion succinctly summarizes the key findings and contributions of the research, underlining its significance in advancing comprehension of the interplay between ESG ratings and corporate financing efficiency, and suggests avenues for further investigation and practical applications in corporate and investment spheres.

Literature Review

Theoretical Framework

Efficiency in corporate financing has received an extensive amount of attention in recent years, demonstrating a business's ability to efficiently utilize its financial resources and funding options. The concept is critical to corporate performance, especially in today's complicated financial markets and global economic dynamics (Myers & Majluf, 1984). Central to debates on financing efficiency is an idea of capital structure, which refers to the combination of debt and equity used by a company to support its operations and growth objectives. According to Abdullah and Tursoy (2002), an ideal capital structure should reduce capital costs while providing sufficient financial resources for organizational efforts. The cost of capital, which is frequently used as a measure of financing efficiency, measures the return expected by debt and equity investors and is influenced by factors such as operational risk and future cash flow expectations (Tressel *et al.,* 2020). However, it is critical to understand that the cost of capital is only one aspect of corporate financing success; other indicators such as return on assets, return on invested capital, and total profitability provide further insights into a company's financial strategy (Nan & Wen, 2014).

How a company handles its cash flow has a significant impact on corporate financing efficiency. Effective capital structure and liquidity management, including accounts receivable and payable, is critical for maximizing cash flow generation and maintaining operating activities (Zhao *et al.,* 2021). Theoretical frameworks such as resource-based theory and stakeholder theory provide useful perspectives on corporate financing. According to resource-based theory, a firm's competitive edge is determined by its distinctive resources and capabilities, which include financial, technological, and human assets that, when appropriately exploited, can improve financial efficiency (Giustiziero *et al.,* 2023). Stakeholder theory, on the other hand, emphasizes the significance of considering the interests of numerous stakeholders, such as employees, consumers, and society as a whole, when making business decisions (Marcon Nora *et al.,* 2023). Companies that prioritize stakeholder interests can improve their reputation, develop stronger relationships, and obtain access to vital resources, thereby increasing financial efficiency (Lee *et al.,* 2021).

The empirical evidence supports the importance of these theoretical perspectives, with research showing that organizations with a balanced debt-equity mix have lower capital costs and higher profitability than those with imbalanced capital structures. Effective cash flow management has also been linked to increased financial performance and access to funding, highlighting its importance in achieving financing efficiency (Habrosh, 2017). Furthermore, resource-based theory research has shown that harnessing unique organizational resources improves financial outcomes (Hitt *et al.,* 2001), whereas stakeholder theory research has shown that social responsibility and ethical practices improve investor trust and facilitate capital access (Suto & Takehara, 2020).

Empirical Review

Nexus between Environment, Social and Governance (ESG) and Corporate Financing Financial Efficiency

In recent years, there has been a significant rise in focus on Environmental, Social, and Governance (ESG) factors in the corporate environment. ESG encompasses three key characteristics of company operations, emphasizing ethical, social, and environmental factors. As more businesses work to implement more sustainable and ethical practices, they are realizing the importance of ESG in several areas related to business performance, such as corporate governance, ethical behavior, innovation, risk management, and financial performance. Notably, studies like Bahmani-Oskooee and Yousefnejad (2022), who found a positive relationship between ESG scores and financial outcomes, have shown that stronger ESG performance has continuously been linked to improved financial

performance. Chen et al. (2018) demonstrated how higher ESG performance led to better access to financing opportunities for businesses, demonstrating its impact on financial accessibility. Furthermore, increased ESG ratings have been connected with more effective risk management techniques, as revealed by Hsieh et al. (2022), who discovered that firms with superior ESG performance had reduced risk levels.

To highlight the diverse impact of ESG, Li and Tang (2020) confirmed its function in improving investment efficiency by facilitating efficient resource allocation inside enterprises. Furthermore, ESG has been demonstrated to stimulate creativity within enterprises, with study by Luo et al. (2020) proving a strong association between better ESG ratings and more innovation capacity, emphasizing its potential for driving positive change and advancement within businesses. Similarly, Ozturk et al. (2021) discovered that there is a negative correlation between unethical behavior, such as tax evasion, and ESG performance. Crucially, Saleh et al. (2021) found a positive correlation between ESG ratings and better financing and credit opportunities. This suggests that ESG affects borrowing capacity. Furthermore, ESG has been shown to improve corporate governance structures and processes, with Wang et al. (2017) citing the presence of stronger governance mechanisms in businesses with high ESG ratings.

Moreover, various studies have looked into the relationship between ESG and company financing costs, and the results consistently show that better ESG performance is connected with reduced loan and equity costs. Antonopoulos et al. (2022) investigated the impact of ESG scores on the cost of financing for S&P 500 companies and found that firms with high ESG ratings had lower borrowing costs. Similarly, Zhang (2021) discovered that enterprises with higher ESG scores had reduced loan spreads, indicating improved financing efficiency enabled by ESG concerns. Furthermore, Garzon Jimenez and Zorio-Grima (2021) discovered that better ESG scores were connected to decreased stock costs, which was especially useful for enterprises experiencing financial restrictions. Beyond the cost of equity, Hu et al. (2023), Mariani et al. (2021), Mehmeti et al. (2019), and Zhu et al. (2023) found that ESG had a favorable impact on numerous areas of corporate finance, including loan costs, stock pricing, and capital expenses. Furthermore, Kotro and Markus (2020) and Oueghlissi et al. (2017) found that strong ESG ratings were associated with lower corporate bond yields and debt costs, demonstrating that ESG has broader implications for financing efficiency.

H1: *There is no significant relationship between Environmental, Social, and Governance (ESG) scores and corporate financing efficiency*

Nexus between Corporate Financial Risk and Corporate Financing Financial Efficiency

The study of the relationship between corporate financial risk and financing efficiency has been a focus of academic research in finance and economics. Scholars have attempted to explicate how companies manage financial risk while optimizing their financing decisions using theoretical frameworks such as agency theory, signaling theory, and the trade-off theory of capital structure (Myers, 1984; Jensen and Meckling, 1976; Ross, 1977). These theories give a foundational knowledge of the intricate interplay between risk management approaches and capital structure decisions.

Empirical research on this nexus have used a variety of approaches to study the relationship between financial risk and financing efficiency. Regression analysis, event studies, and structural equation modeling are some of the methodologies used to examine data from various industries and geographical situations (Su *et al.*, 2022; Lee *et al.*, 2002). Although the findings range from positive to negative connections and non-linear associations, these studies collectively add to our understanding of the intricate processes at work.

Risk perception has an important role in the link between financial risk and financing efficiency. Managers, investors, and creditors assess and respond to perceived risk variables such as market volatility, credit ratings, and macroeconomic conditions, which influences enterprises' financing options (Colak *et al.*, 2021; Luo, Zhou, & Xu, 2023). Understanding the mechanisms through which risk perceptions shape financing decisions is essential for unraveling this intricate relationship. Moreover, the use of financial instruments such as derivatives, insurance, and hedging strategies can mitigate specific types of financial risks, impacting firms' financing efficiency and risk profiles (Alsahlawi 2021; Tapang *et al.*, 2022; Ferri *et al.*, 2022). Studies have examined how the adoption of these instruments' influences capital structure decisions, highlighting the importance of integrating risk management practices into financing strategies.

Differences at the sectoral and firm level complicate the link between financial risk and financing efficiency. Industries with distinct risk profiles, such as banking, real estate, and manufacturing, may display different financing patterns (Morales *et al.*, 2022; Buch, & Goldberg 2022; Caruso *et al.*, 2021). Furthermore, firm-specific factors such as size, profitability, and growth prospects can mitigate the influence of financial risk on financing decisions, highlighting the importance of context-specific analysis. Insights from studies into the relationship between financial risk and financing efficiency have important implications for corporate governance, regulatory frameworks, and risk management methods. Policymakers and practitioners can improve financial market stability and resilience by guiding the development of effective risk management methods and fostering openness in financial reporting.

H2: *There is no significant relationship between corporate financial risk and corporate financing efficiency*

Measuring Financing Efficiency

Financing efficiency is an important concept that analyzes the optimal allocation of financial resources among micro-entities to meet development needs with limited capital available (Xia *et al.*, 2017; Jin, Gao, & Wang, 2021). This concept can be broken down into inputs and outputs, with the former defining the efficiency of capital collected by financial institutions and the latter demonstrating the efficiency and effectiveness of capital allocation to achieve an optimal state in which investors and firms are

compatible. Researchers used two basic strategies to quantify finance efficiency: input-oriented and output-oriented approaches (Wang & Geng 2017). These evaluations indicate that limiting financial resource inputs can improve output in support of industrial development or transition. Cikovic, Kecek, & Lozic, (2022) and Liu et al. (2019) used the Data Envelopment Analysis (DEA) method to evaluate bank efficiency.

Furthermore, a dynamic assessment of financing efficiency is essential for understanding the response to economic and market conditions, as well as relevant policies (Arabi *et al.,* 2014). This approach enables researchers to expose fluctuations in financing efficiency across time, providing policymakers with useful insights into the effectiveness and efficiency of policies. For example, Arabi et al. (2014) examined the influence of procurement restructuring on power plant performance by assessing the efficiency, eco-efficiency, and technical developments in the power industry from 2003 to 2010. Previous research has investigated the impact of financial development on industry transformation (Biswas & Koufopoulos, 2020; Guevara *et al.*, 2007). However, financial resources are fundamentally restricted and insufficient to meet the funding needs of all projects, raising the challenge of how to enhance financing efficiency under tight credit conditions. Previous research has looked into the effect of numerous economic and corporate variables on financing efficiency.

To summarize, financing efficiency is a multi-dimensional notion that includes the optimal allocation of financial resources, the efficiency of capital gathering by financial institutions, and the efficacy of capital allocation to achieve investor and firm compatibility. The employment of input-oriented and output-oriented techniques, as well as dynamic analysis tools, such as the Malmquist index, has proven useful in understanding the intricacies of finance efficiency and its implications for industry development, transition, and sustainability.

Despite the enormous body of literature investigating the relationship between ESG variables and various financial measures, there is a significant study gap in corporate finance efficiency. This gap is due to the lack of a full evaluation that includes both input and output variables of financial performance. Furthermore, previous research primarily focuses on Western economies, ignoring emerging markets such as China. Bridging this gap is critical in fostering a thorough understanding of the impact of ESG on corporate finance efficiency across varied economic climates. As a result, this study attempts to bridge this gap by investigating the relationship between ESG rankings and corporate finance efficiency. It specifically seeks to study this link in the context of rising economies. By doing so, the study hopes to contribute to a better understanding of the relationship between ESG considerations and financial outcomes.

We expand on this analysis by including another independent variable: corporate financial risk. Despite its well-recognized importance in corporate decision-making, research into its impact on corporate financing efficiency is limited. Incorporating corporate financial risk into the research provides a diverse perspective, allowing for a thorough assessment of the factors impacting financing decisions within organizations. Furthermore, by investigating the joint influence of ESG scores and corporate financial risk on corporate financing efficiency, this study aims to elucidate the complex dynamics that shape firm finance strategy. This comprehensive approach is critical for reflecting the intricacies inherent in modern corporate finance operations and their interrelationship with sustainability considerations.

Data & Methodology

Data Source

Data for this study were gathered from 400 Chinese companies listed on the Shanghai and Shenzhen A-share markets between 2013 and 2022. These firms were chosen based on the availability of data on ESG performance and corporate financial risk, as well as their adherence to conventional reporting criteria. The total sample contained 4000 annual observations. The Wind and China Stock Market databases served as the primary data sources, providing complete financial and market information for Chinese enterprises. The ESG rating scores for the selected companies were obtained from the Bloomberg database, which gives quantitative assessments of a company's sustainability performance. Certain categories of data were removed from the analysis to prevent biases or anomalies from affecting the results. This includes financial services and real estate companies, whose business operations and ESG performance may differ dramatically from that of other industries. The Chinese companies selected cover a wide range of business sectors and industries, including manufacturing, technology, energy, consumer products, and finance.

Methodology

We have used the DEA-BCC (Data Envelopment Analysis) model Charnes et al. (1979) for evaluating hypotheses on the relationship between ESG ratings, company financing efficiency, fewer financial constraints, and more investment efficiency. The DEA-BCC model is an appropriate technique for evaluating these assumptions since it considers numerous input and output parameters (Qiu *et al.*, 2023). The choice of input and output variables in the DEA-BCC model is critical since it directly affects the measurement of corporate finance efficiency (Jin *et al.*, 2021). The study can use input variables such as total liabilities to assets ratio, total asset value, total obligation, and ownership interest. These input variables capture the financial structure and resource use of the company, which are directly related to its financing efficiency. Measures including the corporate growth ratio, substantial business revenues, liquid asset turnover ratio, and returns on net assets (ROE) might be included in the output variables. As important determinants of a company's financing efficiency, these output variables show its profitability, growth, and liquidity. Previous research has used different financial ratios and performance indicators as inputs and outputs in DEA models to evaluate financing efficiency (Banker *et al.*, 1984; Chang *et al;* 2023; Goel *et al.*, 2020; Gu 2023). These metrics were chosen due to their significance in corporate finance theory, previous study results, and ability to evaluate various aspects of financial efficiency, including

financial structure, performance, profitability, and growth opportunities.

The DEA-BCC model, by including these input and output variables, can give a thorough assessment of the overall efficiency of corporate financing, considering performance, restrictions, and risk (Fotova Cikovic, K., & Lozic 2022; Banker *et al.*, 1984). This allows for a complete assessment of the theories about the impact of ESG scores on firm financing efficiency. Furthermore, the DEA-BCC model has been widely used in previous studies (Placek *et al.*, 2020; Wang *et al.*, 2023; Yin, Pan, Kuang, & Zhuang, 2020). These studies have proved the effectiveness of the DEA-BCC model in capturing the multidimensional features of finance efficiency, making it an appropriate choice for the current research. All input and output indicators in this model are described in Table 1.

The Bootstrap-DEA approach fixes the DEA method's flaws; the method's primary steps are as follows:

1) Under the DEA technique, calculate the efficiency $\hat{\theta}_j$ and $j = 1,,2.n$ for each unit of decision-making

2) 2) Apply the Bootstrap approach and repeat sampling with a change in the initial efficiency value $\hat{\theta}_j$ produces sample $(\theta_{*1b},.,\theta_{*nb})$ of n size where b denotes the of Bootstrap iterations and $b = 1 \ldots.,B$.

3) Determine the theoretical sample $\left(X *_{jb}, X_j\right)$ where $X *_{jb} \hat{\theta}_j/ (\theta *_{jb})X_j, j = 1, \ldots, n$

4) Using this hypothetical sample, compute the efficiency values $\theta *_j$ and $,j = 1, \ldots n$ with the DEA approach.

5) Steps two to four should be repeated for each unit (firm) (take = 2000) to create a sequence of efficiency values $\theta *_{jb}$ and $b = 1, \ldots., B$

6) Adjust the expected deviation of the DEA efficiency as bias $\left(\hat{\theta}_j\right) = E\left(\hat{\theta}_j\right) - \hat{\theta}_j$

7) bias $\left(\hat{\theta}_j\right) = B - 1 \sum_{b=1}^{B} \theta *_{jb} - \hat{\theta}_j$, the correct efficiency value is $\bar{\theta}_j = \hat{\theta}_j -$ bias $\left(\hat{\theta}_j\right) = 2\hat{\theta}_j - B - 1 \sum_{b=1}^{B} \theta *_{jb}$ (Yaghoubi *et al.*, 2022; Li *et al.*, 2021).

The processing technique is as follows:

$$x *_{ij} = \frac{x_{ij} - min_{ij}}{max_{ij} - min_{ij}} * 0.9 + 0.1.$$

max_{ij} and min_{ij} respectively, indicate the maximum and minimum values of the i input or output index of the j_{th} decision-making unit; Among these, *xij* indicate the i input or output index of the j_{th}decision making unit.

The table displays the key inputs and output indicators used by the DEA-BCC model to evaluate corporate financing efficiency. The input variables include the debt ratio (total debt divided by total assets), total assets (the sum of current and non-current assets), total liabilities, and ownership interest. These input indicators reflect the company's financial structure and resource use, both of which are directly related to finance efficiency. Previous studies used similar input variables in DEA models to evaluate financing performance (Cikovic *et al.*, 2022; Liu *et al.*, 2019; Wang & Geng 2017).

The indicators on the output side include the asset turnover ratio (net sales/average assets), return on equity (net profit/total equity), total sales revenue, and corporate growth ratio (current sales minus base sales). These output variables indicate the company's profitability, growth, and liquidity, all of which play an important role in determining financing efficiency. Previous DEA studies have utilized similar output variables to evaluate funding performance (Wang *et al.*, 2023; Jin, Gao, Wang 2021). These input and output indicators were selected because they are relevant to the research aims and have been widely used in empirical studies on corporate financing efficiency using the DEA-BCC model. When combining these variables, the DEA-BCC model can give a thorough assessment of corporate financing efficiency, considering factors such as performance, restrictions, and risk (Charnes *et al.*, 1994). This allows for a detailed assessment of the theories concerning the impact of ESG scores on a company's financing efficiency. The indicators included in this study's analysis are listed in Table 1 and are based on the input and output variables utilized in earlier research on corporate finance efficiency. These metrics were chosen due to their significance in corporate finance theory, previous study results, and ability to evaluate various aspects of financial efficiency, including financial structure, performance, profitability, and growth opportunities.

Table 1

Input and Output Indicators used in DEA - BCC Corporate Financing Efficiency

Indicator Category	Indicator name	Description of indicators
Input indicators	Debt Ratio = Total Debt/Total Assets	This measure, determined by dividing total debt by total assets, offers a thorough assessment metric that shows the equilibrium between a company's assets and debts. It provides information on the composition of assets and liabilities, essential for comprehending the financial well-being and risk level of the company.
	Total Assets = Sum of Current + Non-current Assets	Both current and non-current assets contribute to determining the enterprise's overall size and financial capacity. It acts as an indicator of the company's capacity to create funding and its level of available resources.
	Total Liabilities	This shows the share of assets funded by debt, providing insight into the level of leverage and financial responsibilities held by the company. There are several reasons why total liabilities are considered as a separate input measure instead of just being shown as a proportion of total assets. Initially, the total liabilities offer a clear view of the exact level of funding acquired through debt, which is essential for grasping a company's financial arrangement and risk level. Additionally, the debt ratio, which is calculated by dividing total debt by total assets, is a significant measure that focuses on a particular aspect of the company's financial well-being and might not encompass all liabilities or offer a comprehensive view of financing effectiveness. Incorporating overall liabilities as an

Indicator Category	Indicator name	Description of indicators
		individual measure enhances the accuracy and thoroughness of the analysis of the company's financial commitments and sources of funding.
	Ownership Investment = Sum of Total Equity	Determined by adding up the total equity, this metric represents the owner(s) investment in the business, giving a glimpse into the ownership makeup and stakeholder concerns.
Output indicators	Asset Turnover Ratio = Net Sale/Average Assets	The computation consists of dividing the total sales by the assets. A higher proportion indicates that the company is making efficient and effective use of its assets.
	Return on Equity = Net Profit/ Total Equity.	Determined by dividing the company's net profit by its total equity, assesses how successful the company is at earning profits for its shareholders' investments.
	Sales = Total Revenue	The overall sales revenue obtained from goods and services sold, indicates the company's ability to generate revenue and its performance in the market
	Corporate Growth Ratio = Current Sale - Base Sale/ Previous Sale	This measure, calculated by subtracting base sales from current sales, assesses the company's potential for revenue growth and expansion in the future.

Note: The table provides information on indicator categories, indicator names, and descriptions for input and output indicators for assessing corporate financing efficiency. Input indicators evaluate elements like debt ratio, overall assets, overall liabilities, and ownership stake, offering information on the financial makeup and ownership of the company. On the flip side, performance measures such as asset turnover ratio, return on equity, sales revenue, and corporate growth ratio serve as indicators for evaluating the company's efficiency, profitability, and potential for growth.

Description and Measurement of Variables

Corporate Financing Efficiency (CFE)

Corporate financing efficiency is a dependent variable that assesses firms' optimal use of financial resources. We employed the DEA-BCC model to calculate this variable, previously used in similar investigations. This model considers several input and output indicators such as total asset value, total liability, total liabilities to assets ratio ownership interest, returns on net assets (ROA), corporate growth ratio, liquid asset turnover ratio, main business revenues. Using the DEA-BCC method, we calculate corporate finance efficiency like prior research (Liu *et al.*, 2019; Jin, 2021; Gao & Wang, 2021; Wang & Geng, 2017).

Environmental, Social and Governance (ESG)

Environmental, social and governance (ESG) disclosure is extensively seen as critical for increasing brand awareness, exhibiting social responsibility, creating investor trust, and assisting firms in assessing opportunities and risks. As a result, many firms now use the disclosure of ESG information as a critical performance measure to represent their ESG efforts accurately. To identify the primary drivers of such innovation and accurately depict a company's ESG operations, ESG disclosure can be translated into a quadratic score. The promotion of investment institutions, regulatory policy requirements, and the growing awareness of ESG among listed firms are among the key factors driving the demand for ESG disclosure. This study considers different environmental, social, and governance assessments to understand their implications better. ESG Bloomberg's score, which considers both environmental and ethical consequences, was employed as a quantitative indicator in this analysis, which is in line with previous research (Landi *et al.*, 2022; Chen *et al.*, 2022; Liu *et al.*, 2022; Fu & Li, 2023). The classifications of the scores are given in Table 2. Previous research has demonstrated that ESG disclosure improves a company's performance; therefore, its impact on financing efficiency must be investigated. The second explanatory variable is corporate financial risk, monthly systematic risk (MSR), calculated as the one-year standard deviation of the daily logarithmic change in stock prices following previous studies.

To validate our findings, we also collected data from Sino-Securities ESG Ratings, a database that evaluates the environmental, social, and governance (ESG) efforts of companies, with a particular emphasis on China. Focusing on a local level allows for a deeper understanding of the regulatory, cultural, and market-specific factors that influence ESG practices in China. Focusing on these unique traits, Sino-Securities ESG Ratings offer valuable insights into the ESG practices and performance of Chinese firms, which can differ significantly from global norms. Sino-Securities ESG Ratings assesses various data points across the three ESG dimensions in their methodology. This includes factors such as environmental impacts, employee regulations, and organizational management procedures. The specialized criteria and weighting utilized in their evaluations provide in-depth insights tailored for the Chinese market, highlighting the distinct challenges and opportunities in this setting. This specific approach ensures that the ratings are highly relevant for stakeholders with an interest in Chinese businesses.

Sino-Securities ESG Ratings offer extensive coverage across different sectors and industries in China. This thorough coverage is particularly beneficial for investors and stakeholders looking to engage with Chinese firms or seeking to understand ESG risks and opportunities in this rapidly growing market. Ratings are based on a mix of publicly available information, company disclosures, and other sources such as annual reports, sustainability reports, regulatory filings, and news sources. This comprehensive gathering of data ensures a robust evaluation of each company's ESG performance. Several previous research studies have utilized the Sino-Securities ESG Ratings to collect data on ESG practices in Chinese companies. For example, a study by Luo et al. (2021) looked into the impact of ESG performance on the stock price crash risk. Similarly,

Wang and Li (2024) examined the connection between ESG disclosure and corporate risk, utilizing data from Sino Securities.

Corporate Financial Risk (CFR)

In this study, corporate financial risk is evaluated using monthly systematic risk (MSR), a widely used measure in financial research that captures the volatility of stock prices and conditions in the market. Previous research used similar metrics to assess organizations' risk exposure in different situations. For example, Tasnia et al. (2021) used MSR as a proxy for corporate financial risk in their study of how corporate social responsibility affects stock price volatility. Similarly, Lee, M. J., & Jang (2007) used MSR as a significant variable in their research on the relationship between market diversification and financial performance. Furthermore, Land et al. (2022) used MSR to evaluate the influence of financial risk on stock returns as part of their market dynamics investigation. This study uses MSR as a measure of corporate financial risk to provide insights into how ESG affects corporate financial risk, in conjunction with other criteria such as environmental, social, and governance (ESG) performance.

Control Variables

The control variables used in the study include company size (SIZE), asset profitability (ROA), company profit margins (FP), and internal monitoring (IC). These variables were selected based on their consistent use in previous research and their demonstrated impact on both ESG performance and corporate financing efficiency. Company size (SIZE) is measured by the natural logarithm of total assets, following the approach used by Sinha & Goel (2023) and Naeem & Cankaya (2022). Asset profitability (ROA) is calculated as the ratio of net income to total assets, in line with the methodology employed by El Khoury et al. (2023), Durguti, & Kryeziu (2021), Rakic et al. (2022) and Duong et al. (2022). Company profit margins (FP) are measured as the ratio of net income to total revenue, consistent with the approach taken by Orazalin, Mahmood, & Narbaev (2019), Noja eta al. (2023), Kumar etl al. (2022) and Ren, Zeng, & Zhao (2023). Internal control (IC) is proxied by the percentage of independent directors on the board, following the methodology used by Chang et al. (2023), Sinha & Goel (2023), Zhu, & Liu (2024) and Naeem & Cankaya (2022). More information about these variables is available in Table 2, Figure 2, and the Appendix.

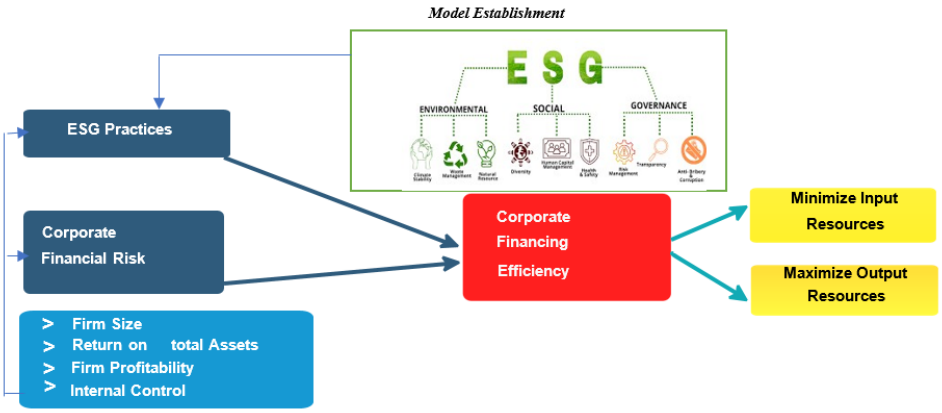

Figure 2. Displays the Study Model, Incorporated by the Authors

Table 2

Variables & Descriptions

Type	Symbol	Variable	Descriptions
Explained variable	CFE	Corporate financing efficiency	The intake and output of financial resources from micro entities are allocated efficiently. The input of financial resources should be kept to a minimum, and resource allocation efficiency should be maximized.
Explanatory variables	ESG	Environmental social and governance disclosure (Dong *et al.*, 2023).	ESG emphasizes the essential aspects of environmental sustainability, human development, and ethical governance practices within an enterprise."
	CFR	Corporate financial risk.	Corporate financial risk is the ability of your company to manage debt and meet financial obligations.
Control variable	SIZE ROA FP IC	Duong et al. (2022) Orazalin, Mahmood, & Narbaev (2019)	The natural logarithm total assets Net Profit/Total Asset profit/Total sales control score natural logarithm

Note: All variables are described in more detail within the main text of the manuscript, providing comprehensive explanations and contextualization for each variable used in the study's analysis

Empirical Technique

Individual characteristics can influence the outcome and/or predictor factors; hence, they must be controlled for. These characteristics are not random and must be considered to ensure the predictors are unbiased. By following fixed effects for each entity, the correlation between the entity's error term and predictors is assumed, but there can be no correlation between the fixed effects of different types of entities (Khalil *et al.*, 2022; Sunardi & Tatariyanto, 2023; Altahtamouni *et al.*, 2022).

Entity-fixed effects are a statistical approach used in panel data analysis to correct for unobserved heterogeneity across distinct entities such as countries, firms, or individuals. Variables that do not change over time yet differ amongst entities. The entity fixed effects regression model is defined as follows:

$$CFE_{e,n} = \alpha_i + \beta_1(ESG)_{e,n} + \beta_2(CFR)_{e,n} + \mu_e + \varepsilon_{e,n} \quad Eq. \qquad (1)$$

Equation (1) represents the model for corporate financing efficiency (CFE) (e and n reflect entity and time respectively) with two explanatory variables, ESG (Environmental, Social, and Governance disclosure) and CFR (Corporate Financial Risk). It also includes μ_e and $\varepsilon_{e,n}$ for unobserved factors and error terms (residual errors) respectively. CFE is calculated through the DEA-BCC model with variable returns to scale (Chang et al., 2023; Wang & Geng, 2017; Jin et al., 2021).

$$CFE_{e,n} = \alpha_i + \beta_1(ESG)_{e,n} + \beta_2(CFR)_{e,n} + \beta_3(SIZE)_{e,n}\,\beta_4(ROA)_{e,n} + \beta_5(FP)_{e,n} + \beta_6(IC)_{e,n} + \mu_e + \varepsilon_{e,n} \quad Eq. \qquad (2)$$

Where:

Equation (2) expands on Equation (1) by incorporating control variables: SIZE (natural logarithm of total assets), ROA (Net Profit/Total Assets), FP (Profit/Total Sales), and IC (Control Score natural logarithm). These variables are included to further explore their potential influence on corporate financing efficiency. It also includes a set of variables, such as entity-specific intercepts, represented by alpha, to control for within-entity heterogeneity. To handle any potential shared impact across all entities, a common effect, denoted by beta, is also added.

Entity and time-fixed effects regression

Variables that vary over time and between entities. The regression model with entity and temporal fixed effects is as follows:

$$CFE_{e,n} = \alpha_i + \beta_1(ESG)_{e,n} + \beta_2(CFR)_{e,n} + \beta_3(SIZE)_{e,n}\,\beta_4(ROA)_{e,n} + \beta_5(FP)_{e,n} + \beta_6(IC)_{e,n} + \delta_n + \mu_e + \varepsilon_{e,n}\; Eq. \qquad (3)$$

Equation (3) represents a regression model with entity and temporal fixed effects, accounting for variables that vary over time and between entities. The dependent variable, $CFE_{e,n}$, denotes corporate financing efficiency for entity e at time n. The model includes explanatory variables such as ESG (Environmental, Social, and Governance disclosure), CFR (Corporate Financial Risk), and control variables includes; $SIZE$ (natural logarithm of total assets), ROA (Net Profit/Total Assets), FP (Profit/Total Sales), and IC (Control Score natural logarithm). Additionally, δ represents temporal fixed effects, μ captures entity-fixed effects, and ε accounts for residual errors.

$$Lagged\ Investment_{i,t} = \alpha_i + \beta_1(ESG)_{e,n} + \beta_2(CFR)_{e,n} + \beta_3(SIZE)_{e,n}\,\beta_4(ROA)_{e,n} + \beta_5(FP)_{e,n} + \beta_6(IC)_{e,n} + \delta_n + \mu_e + \varepsilon_{e,n}\; Eq. \qquad (4)$$

Equation (4) is similar to Equation (3) but focuses on the lagged investment variable, denoted as $Lagged\ Investment$. This variable captures investment levels in entity e at time n. Like Equation (3), Equation (4) incorporates the same set of explanatory variables and fixed effects terms to analyze the relationship between lagged investment and the specified explanatory variables.

In Robust analysis, this study adds lagged investment as an extra variable to investigate the robustness of the results along with the variables in Equation (4). Lagged investment and panel data models to account for potential endogeneity and delayed effects. Our goal is to uphold the accuracy and credibility of our estimation findings by considering these factors. Furthermore, we conduct diagnostic tests to assess the presence of endogeneity and utilize suitable methods to address any issues that are detected. We used lagged investment in the robust analysis to endorse our findings and we also employed data from other sources for ESG to ensure the accuracy of our results Adding lagged investments is meant to explore the potential reverse causal relationship between CFE and ESG effectiveness, indicating that enhanced financial results could prompt more investment in ESG projects. This new feature enables a deeper insight into how fluctuations in financial performance could impact companies' dedication to ESG practices. By adjusting for time-specific effects and incorporating lagged investment, this analysis enhances the model's ability to capture the dynamic relationship between corporate finance efficiency and ESG performance, contributing to a deeper insight into the factors driving corporate sustainability efforts.

Table 5 illustrates three tests used in this analysis: the Breusch-Pagan / Cook-Weisberg heteroskedasticity test, the Hausman (1978) specification test, and the Modified Wald test for groupwise heteroskedasticity, which are critical in determining whether fixed effects regression is an appropriate method of analysis. These tests are intended to detect heteroskedasticity, violating the assumption that a regression model's error term has a constant variance. Heteroskedasticity can lead to inaccurate estimation of regression coefficients and standard errors, affecting the accuracy and validity of the results (Breusch & Pagan, 1979; Hausman, 1978; Hazlett & Wainstein, 2022). The findings of these three tests, shown in Table 5, clearly endorse heteroskedasticity in the data, and the fixed effects model is the best fit for the analysis. The $p < 0.05$ in all three tests indicates a significant presence of heteroskedasticity and justifies the inclusion of fixed effects to account for unobserved individual-specific effects and improve the accuracy of the results. The findings of these tests justify the use of fixed effects regression, which can yield more accurate estimates of the link between ESG, CFR, and CFE. It also assures the regression model's assumptions are met, resulting in more reliable results.

Empirical Results

Preliminary Results

Table 3 shows the descriptive statistics for the study's major variables, based on 1,110 observations. Corporate Financing Efficiency has a mean of 20.679 and a standard deviation of 85.629, with values ranging from 1.525 to 2,159, demonstrating significant variation in financing efficiency amongst companies. The ESG variable has a mean of 58.481 and a standard deviation of 4.742, with a range of 44.304 to 72.644. The Corporate Financial Risk (CFR) variable has a mean of 0.637 and a standard deviation of 0.338, with values ranging from 0.064 to 7.978, showing that most organizations have a moderate level of financial risk, with a few having significantly more.

Firm Size (SIZE) has a mean of 26.139 and a standard deviation of 81.716, with values ranging from 25 to 2,159, indicating a wide variety of firm sizes in the sample. The Return on Assets (ROA) variable has a mean of 0.047, a standard deviation of 0.067, and values ranging from -0.796 to 0.215, showing rather moderate profitability on average for the enterprises in the sample. Firm Profitability (FP) has a mean of 0.437 and a standard deviation of 0.411, with values ranging from 0.064 to 7.978, indicating wide diversity in profitability across the sample. Finally, the Internal Control (IC) variable has a mean of 0.687 and a standard deviation of 0.524, with values ranging from 0.125 to 754, indicating that, on average, the sample organizations have moderately good internal control systems. The descriptive statistics provide a comprehensive review of the sample's primary characteristics, highlighting the differences in corporate finance efficiency, ESG performance, financial risk, business size, profitability, and internal control among the companies under consideration.

Table 3

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Corporate Financing Efficiency (CFE)	3996	20.679	85.629	1.525	2159
Environment, Social Governance (ESG)	3998	58.481	4.742	44.304	72.644
Corporate Financial Risk (CFR)	3998	0.637	0.338	0.064	7.978
Firm Size (SIZE)	4000	26.139	81.716	25	2159
Return on Assets (ROA)	4000	0.047	0.067	-0.796	0.215
Firm Profitability (FP)	4000	0.437	0.411	0.064	7.978
Internal Control (IC)	4000	0.687	0.524	0.125	754

Note: The table provides an overview of the descriptive statistics for the variables used in the regression analysis. The number of observations is indicated in the "Obs" column. "Mean" denotes the typical value of every variable in the dataset, whereas "Std. "Dev." represents the standard deviation, which indicates how spread out the data is from the average. "Min" and "Max" correspond to the lowest and highest values recorded for every variable, respectively. Consult Table 2 located in the appendix for acronyms that match each variable.

Table 4 displays all variables' pairwise correlations and the VIF (Variance Inflation Factor). Results demonstrate a weak negative correlation (-0.071) between year and CFE, indicating that corporate financing efficiency decreases slightly over time. Changes in economic and market conditions could be to blame. ESG and CFE have a weak positive association (0.128), indicating that firms with more significant ESG standards have higher corporate financing efficiency.

This implies that being socially and ecologically responsible can improve a company's ability to secure financing. CFR and CFE have a weak and negative connection (-0.097), indicating that financing efficiency decreases as corporate financial risk rises. This is to be expected, as increased financial risk makes it more difficult for businesses to obtain finance. Finally, ROA and CFE have a slight negative association (-0.358). This implies that companies with higher asset returns have worse corporate finance efficiency. This could be because these enterprises create enough earnings to fund their operations without external financing. The correlations are mostly weak, indicating that the variables do not have substantial associations. All variables have VIF values less than 10, with the highest being 2.984 per year and CFE. This demonstrates that the variables are not substantially correlated and are suitable for the investigation.

Table 4

Pairwise Correlation and VIF

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	VIF
(1) year	1.000								2.984
(2) CFE	-0.071	1.000							2.984
(3) ESG	0.128	-0.190**	1.000						1.082
(4) CFR	0.073**	-0.097**	-0.049**	1.000					2.398
(5) SIZE	-0.056	-0.010	0.086	-0.158**	1.000				1.167
(6) ROA	-0.101	0.030**	0.186	-0.358	0.047	1.000			1.907
(7) FP	-0.126	-0.140**	0.086**	0.058**	0.107**	0.254	1.000		1.524
(8) IC	-0.060**	-0.041	0.096	0.743**	0.007**	0.752**	0.411**	1.000	1.003

*Note: The correlation matrix and Variance Inflation Factor (VIF) values for the variables in the regression model are displayed in the table. The correlation coefficient between each variable is shown in every cell. The final column displays the VIF values, which show the level of multicollinearity among variables. *, **, and *** represent significance at the 10%, 5%, and 1% levels. A VIF value higher than 10 indicates the existence of multicollinearity.*

Table 5

Heteroskedasticity and Heterogeneity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	**Hausman (1978) specification test**	**Modified Wald test for groupwise heteroskedasticity**
chi2(3) = 24.69	Chi-square test value 464.785	chi2 (110) = 1.3e+05
Prob > chi2 = 0.0000	P-value 0.0000	Prob>chi2 = 0.0000

Note: The results of tests for heteroskedasticity and heterogeneity are presented in Table 5. The Breusch-Pagan / Cook-Weisberg test suggests strong evidence of heteroskedasticity. The Hausman (1978) specification test indicates that the model specification does not align with the data. Moreover, the Modified Wald test results further verify the existence of heteroskedasticity within the groups.

Effect of ESG and corporate Financial risk (CFR) on Corporate Financing Efficiency using Entity Fixed Effects

The findings shown in Table 6 illustrate the significant influence of environmental, social, and governance (ESG) factors and corporate financial risk (CFR) on corporate financing efficiency (CFE). In the absence of control variables, the findings in Model 1 show that ESG has a significant positive impact on CFE, with a significant coefficient of 1.229 and a p-value of less than 0.01. This suggests that companies with robust ESG policies are usually more effective in their financing operations. This is in line with previous studies linking ESG factors to financial results (Cheng et al. 2023; Iazzolino et al. 2023). These results highlight the significance of ESG practices and financial risk management in enhancing a company's financing efficiency. Companies with better ESG practices are more likely to have a better reputation, stronger stakeholder relationships, and improved risk management, which can lead to lower financing costs and higher efficiency in financing activities, as proposed by stakeholder theory, which emphasizes the importance of social and environmental responsibility for a company's long-term sustainability (Tian 2023). Conversely, CFR has a significant negative impact on CFE (Coefficient = -0.222, $p < 0.01$), indicating that increased financial risk results in decreased efficiency in funding projects. This outcome is consistent with earlier research, which has revealed a negative association between financial risk and financial performance (Chen, Song, and Gao 2023; Chen 2018). High financial risk can lead to increased financing costs and limited credit access, resulting in lower financing efficiency for these businesses.

In Model 2, when control variables are considered, it was found that the significant relationship between ESG and CFE remains, although the coefficient is reduced (Coefficient = 1.041, $p < 0.05$). This shows that ESG's impact on CFE is influenced by factors like the firm size, its profitability, and its financial structure. The presence of control variables provides further understanding of the factors influencing corporate financing efficiency (CFE). In particular, the study shows that the size of the company (SIZE) has no significant influence on CFE (Coefficient = 0.015, $p > 0.1$), indicating that changes in firm size do not have a substantial effect on financing efficiency when taking other variables into account. On the other hand, there is a significant negative linkage between ROA and CFE (Coefficient = -0.966, $p < 0.01$), suggesting that businesses with increased return on assets often display reduced financing efficiency. FP has a positive and statistically significant impact on CFE, indicating that firms with higher profitability tend to be more efficient in their financing activities. Additionally, effective internal control mechanisms are shown to be a significant positive predictor of financing efficiency, with a coefficient of 0.914 and a significance level below 0.05. This underscores the importance of internal controls in improving financing efficiency. These results highlight the complexity of factors affecting CFE, including financial performance measures and internal governance systems.

Overall, our research indicates that the efficiency of a company's finances is influenced by environmental, social, and governance (ESG) factors as well as corporate financial risk (CFR). Firms with robust ESG practices and reduced financial risk are anticipated to have enhanced effectiveness in their funding activities. The outcomes have significant implications for businesses, investors, and policymakers. Companies can enhance their Corporate Financial Efficiency (CFE) by focusing on enhancing their Environmental, Social, and Governance (ESG) standards and efficiently managing financial risks. Investors should consider factors such as ESG and financial risks when making investment decisions as they can significantly impact a company's financial performance. Policymakers can incentivize businesses to improve their ESG practices and track their financial risks to increase overall economic effectiveness.

Table 6

Impact of ESG and CFR on Corporate Financing Efficiency

Variables	**Model 1**	**Model 2**
	Fixed Effects	**Fixed Effects with Robust**
Environmental Social and Governance (ESG)	1.229***	1.041**
	(0.376)	(0.675)
Corporate Financial Risk (CFR)	-0.222***	-0.207**
	(-0.048)	(-0.102)

Variables	Model 1	Model 2
	Fixed Effects	Fixed Effects with Robust
Firm Size (SIZE)		015
		(0.812)
Return on Assets (ROA)		-0.966***
		(-0.021)
Firm Profitability (FP)		0.194**
		(0.095)
Internal Control (IC)		0.914**
		(0.524)
Constant	2.585	2.585
	(1.532)	(2.751)
R-squared	0.825	0.825
Prob > F	0.000	0.000
Akaike crit. (AIC)	440.433	438.433
Bayesian crit. (BIC)	459.812	452.967

*Note: This table shows results from a regression analysis investigating how ESG factors, CFR, and other variables affect CFE. Robust t-statistics derived from the Huber-White Sandwich estimator's standard errors are provided alongside the coefficient estimates. Indicators of statistical significance are denoted by ***, **, and *, representing 1%, 5%, and 10%, respectively. Model 1 has fixed effects, whereas Model 2 has fixed effects along with robust standard errors. The R-squared value represents the amount of variability in CFE that is accounted for by the independent variables. Prob > F indicates the likelihood linked to the F-statistic assessing the overall importance of the model.*

The results presented in Table 7 for Model 1, which incorporates only entity effects, shows that there are significant relationship between Environmental, Social, and Governance (ESG) factors and Corporate Financial Risk (CFR) with Corporate Financial Efficiency (CFE). More precisely, the ESG coefficient is calculated to be 0.196***, suggesting a significant positive effect on CFE. This implies that companies with better ESG performance typically show greater financial effectiveness. On the other hand, the CFR coefficient is -0.234**, showing a negative association between efficiency and financial risk. This means that increased corporate financial risk is linked to decreased financial efficiency, which is consistent with traditional financial theory. Moreover, Firm Profitability (FP) is another variable that shows a strong positive influence on CFE, highlighting the significance of profitability in assessing financial efficiency. In general, Model 1 shows how ESG factors and financial risk, along with other company-specific variables, impact corporate financial performance.

Expanding on Model 1, Model 2 includes entity and time effects as well as robust standard errors to provide a more in-depth understanding of the variables impacting CFE. In this thorough analysis, the significance of ESG factors is still apparent, although the estimated coefficient has decreased to 0.062***. This means that ESG factors remain important drivers of financial performance, even when considering entity and time factors. Similarly, the estimated CFR coefficient remains at -0.158**, indicating the negative relationship between financial risk and efficiency. Even with additional variables such as company size and ROI, the findings still support the significant impact of ESG factors and financial risk on corporate financial performance. As a result, Model 2 showcases the robustness of these relationships and provides further insight into the variables impacting CFE over time. These results are consistent with previous studies that have documented a positive correlation between ESG and finance efficiency, as well as profitability and CFE (Wei & Zhang, 2021; Bruna *et al*., 2022).

Control variables are crucial in enhancing the robustness of regression analysis by considering the influence of other significant factors on corporate financial efficiency (CFE). To account for possible variations in firm characteristics that may impact CFE, both Model 1 and Model 2 incorporate firm-specific controls such as Size and Return on Assets. Although these variables do not exhibit levels of significance that are statistically significant, their inclusion aids in minimizing biases and results in a more accurate calculation of the influence of primary variables like Environmental, Social, and Governance (ESG) factors and Corporate Financial Risk (CFR) on CFE. By taking into consideration both the size and profitability of a company, the research differentiates the specific effects of ESG performance and financial risk, resulting in a better understanding of the elements affecting the financial performance of companies. Furthermore, including Internal Control (IC) as a controlling factor enhances the examination by considering the variations in internal governance structures that may affect CFE, resulting in a more comprehensive assessment of the factors shaping corporate financial performance.

Table 7

Impact of ESG and Corporate Financial Risk on Corporate Financing Efficiency

Variables	Model 1	Model 2
	Entity Effects	Entity and Time Effects with Robust
Environmental Social and Governance (ESG)	0.196***	0.062***
	(0.025)	(0.004)
Corporate Financial Risk (CFR)	-0.234**	-0.156**
	(-0.046)	(-0.071)
Firm Size (SIZE)	-0.014	-0.014
	(-0.241)	(-0.425)
Return on Assets (ROA)	0.998	0.998
	(0.015)	(0.018)
Firm Profitability (FP)	0.351	0.351
	(0.652)	(0.962)
Internal Control (IC)	0.191	0.191
	(0.153)	(0.352)
Constant	-3.142	-3.142
	(-1.546)	(-2.717)
Time	Yes	Yes
Entity	Yes	Yes
R-squared	0.845	0.845
Prob > F	0.000	0.000
Akaike crit. (AIC)	440.433	326.939
Bayesian crit. (BIC)	353.163	346.318

*Note: This table displays findings from a regression analysis examining how ESG factors, CFR, and other variables impact CFE. The coefficients are shown with the robust t-statistics derived from the Huber-White Sandwich estimator's standard errors, alongside the coefficient estimates. Indicators of statistical significance are denoted by ***, **, and *, representing 1%, 5%, and 10%, respectively. Model 1 includes entity influences, while Model 2 incorporates both entity and time influences along with robust standard errors. R-squared shows how much of the variability in CFE can be accounted for by the independent variables.*

Robustness Analyses

By Incorporating Lagged Investment

To further investigate the robustness of the results, this study incorporated lagged investment as an additional variable in Model 3. This study aimed to explore the idea that improved financial performance could lead to increased investment in ESG initiatives, suggesting a reversed causal connection between corporate finance efficiency (CFE) and environmental, social, and governance (ESG) performance. The findings presented in Table 8 demonstrate that even after controlling for lagged investment, the positive relationship between ESG and CFE remains statistically significant. This suggests that the observed relationship is more indicative of a causal effect and that reverse causality does not appear to be a significant concern in the current context. Moreover, the results reveal a significant negative coefficient for lagged investment, implying that firms with higher investment levels tend to exhibit lower CFE. This finding is consistent with previous studies that documented a negative correlation between investment and CFE (Kalia & Aggarwal, 2023; Bruna et al., 2022). Overall, the results of the robustness test lend further support to the initial findings, indicating that higher ESG performance and lower financial risk promote greater corporate finance efficiency. Importantly, the inclusion of additional control variables, such as lagged investment, does not diminish the positive relationship between ESG and CFE, thereby strengthening the validity and reliability of the study's conclusions.

Table 8

Adding additional variables to robust the impact of ESG and CFR on Corporate Financing Efficiency

Variables	Model 1	Model 2	Model 3
	Corporate Financing Efficiency	Corporate Financing Efficiency	Robust and lagged investment
Environmental Social and Governance (ESG)	1.219***	1.228**	1.292***
	(0.375)	(0.674)	(0.385)
Corporate Financial Risk (CFR)	-0.212***	-0.232**	-0.188**
	(-0.051)	(-0.101)	(-0.093)
Firm Size (SIZE)	0.014	0.013	0.067
	(0.811)	(0.882)	(1.025)
Return on Assets (ROA)	-0.965***	-0.958***	-0.988***

Variables	Model 1 Corporate Financing Efficiency	Model 2 Corporate Financing Efficiency	Model 3 Robust and lagged investment
	(-0.022)	(-0.022)	(-0.034)
Firm Profitability (FP)	0.193**	0.202**	0.154
	(0.414)	(0.434)	(0.462)
Internal Control (IC)	0.913**	0.888**	0.951**
	(0.721)	(0.736)	(0.961)
Investment (INV)			-0.374***
			(-0.078)
Constant	2.579	2.584	3.095*
	(1.512)	(2.752)	(1.283)
Time	Yes	Yes	
R-squared	0.835	0.835	0.835
Prob > F	0.000	0.000	
Akaike crit. (AIC)	451.413	441.433	454.715
Bayesian crit. (BIC)	458.812	453.967	481.166

*Note: This table presents findings from a regression study examining the influence of Environmental, Social, and Governance (ESG) factors, Corporate Financial Risk (CFR), and additional variables on Corporate Financing Efficiency (CFE). Standard errors are displayed in parentheses alongside the coefficients. Symbols ***, **, and * indicate various levels of significance. Model 1 includes basic variables, while Model 2 incorporates Firm Size, Return on Assets, Firm Profitability, and Internal Control. Model 3 features a robustness test incorporating lagged investment data. R-squared indicates the proportion of the variability in CFE that can be explained by the predictor variables.*

By using Different Databases (Sino-Securities ESG Rating Index) of Data for the Independent Variable

Table 9 provides further analysis to support the results on how Environmental, Social, and Governance (ESG) factors and Corporate Financial Risk (CFR) influence Corporate Financing Efficiency (CFE), using data from Sino-Securities ESG ratings. This analysis aims to support the findings from earlier regressions carried out with Bloomberg data. Upon examining the coefficients in Table 8, it becomes apparent that the relationship between ESG and CFE remains consistent with previous findings. ESG still has a significant positive influence on CFE, showing that companies with better ESG practices tend to have better efficiency in their financing. Likewise, the link between CFR and CFE remains negative, indicating that increased financial risk hinders the effectiveness of corporate financing.

Including additional control variables such as Company Size, ROA, FP, and Internal Control improves the analysis. These variables help to capture more details in the relationship between ESG, CFR, and CFE. While Firm Size, ROA, and FP have limited influence on CFE with small coefficients in this analysis, Internal Control shows a significant positive coefficient, highlighting its crucial role in enhancing financing efficiency. Despite accounting for prior investments, the strong correlation between ESG and CFE remains intact, suggesting that the relationship is more likely to be causal rather than the other way around. Moreover, the noteworthy negative lagged investment coefficient signifies its negative impact on CFE, in line with the previous Table indicating a negative association between investment and financing efficiency. The results in Table 8 support and strengthen the outcomes from earlier analyses, thereby boosting the study's findings' credibility and dependability. Businesses, investors, and policymakers can use this information to emphasize the significance of ESG practices and efficient risk management in promoting corporate financing effectiveness and long-lasting sustainability.

Table 9

Finding the Impact of Environmental Social and Governance and Corporate Financial Risk on Corporate Financing Efficiency (Using different ESG Score)

Variables	Model 1 Corporate Financing Efficiency	Model 2 Corporate Financing Efficiency
Environmental Social and Governance (ESG)	1.304***	1.311**
	(0.367)	(0.687)
Corporate Financial Risk (CFR)	-0.198***	-0.215**
	(-0.048)	(-0.094)
Firm Size (SIZE)		0.012
		(0.872)
Return on Assets (ROA)		-0.941***
		(-0.011)
Firm Profitability (FP)		0.195**
		(0.432)

Variables	Model 1	Model 2
	Corporate Financing Efficiency	Corporate Financing Efficiency
Internal Control (IC)		0.872**
		(0.731)
Constant	2.590	2.595
	(1.501)	(2.711)
Time	Yes	Yes
Firm	Yes	Yes
R-squared	0.671	0.740
Prob > F	0.000	0.000
Akaike crit. (AIC)	449.121	439.145
Bayesian crit. (BIC)	456.526	451.674

*Note: The table displays coefficients that show the predicted impacts of each variable on Corporate Financing Efficiency (CFE) in the regression analysis. The table contains data from two different regression models. The initial specification involves ESG and CFR, while the final one incorporates the control variables. The model incorporates fixed effects for time and firm to capture specific heterogeneity for each. R-squared represents the percentage of variation in CFE that can be clarified by the predictors in the model. Robust t-statistics derived from the Huber-White Sandwich estimator's standard errors are provided alongside the coefficient estimates. Indicators of statistical significance are denoted by ***, **, and *, representing 1%, 5%, and 10%, respectively.*

To summarize our findings, we have presented them graphically in figure 3:

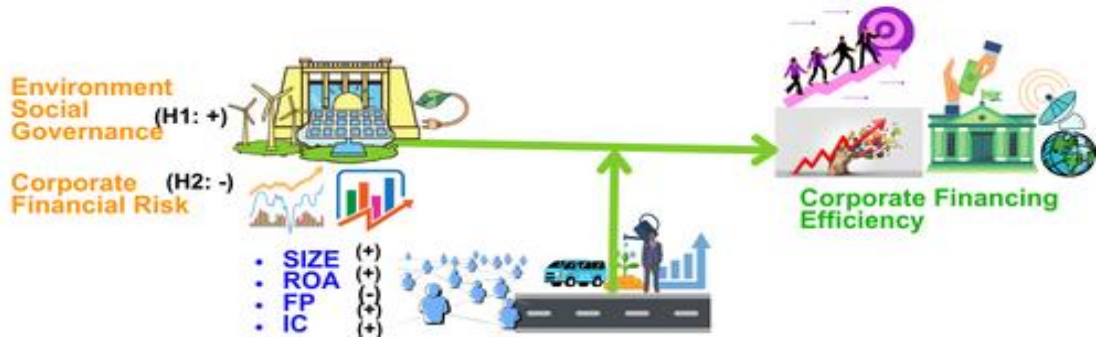

Figure 3. Results of the Study

Conclusions

This study is limited to Chinese enterprises, which could hinder the generalizability of the results to other countries. Future studies could look into this relationship in different regions to provide a more comprehensive understanding. Furthermore, the study only considers a small number of factors. Utilizing other variables, such as corporate governance and technology innovation, may improve knowledge of the relationship between ESG and corporate finance efficiency. This study serves as a model for future research, encouraging greater exploration into the relationship between ESG and corporate financing efficiency in various contexts.

The purpose of this study is to examine the relationship between Environmental, Social, and Governance (ESG) ratings and corporate financial efficiency (CFE) in respect to the United Nations' Sustainable Development Goals. Despite the increased emphasis on sustainability and ethical corporate practices, this relationship has received little attention in the existing research. The study's primary goal is to fill a knowledge gap by examining the relationship between ESG and CFE, which can provide useful insights for decision-makers and investors.

The significance of the investigation is driven by the rising awareness of the SDGs as a framework for attaining a sustainable future, as well as the increasing recognition of ESG practices as necessary for long-term business sustainability. By investigating the possible influence of ESG on corporate finance efficiency, the study contributes to a growing body of studies on the integration of sustainability into business processes. Furthermore, the study's findings demonstrate how ESG can improve long-term financial sustainability by lowering financial risk and increasing profitability. This study contributes to the current literature by conducting an in-depth study of the relationship between ESG, CFR, and CFE, as well as emphasizing the need to take these elements into account when assessing corporate finance efficiency. The findings imply that prioritizing ESG practices and controlling financial risks might lead to better long-term financial performance, which can have positive implications for the overall economy.

The study's findings show that firms with stronger ESG practices have more efficient financing, implying that investing in ESG can lead to greater long-term financial sustainability. This empirical research enhances our understanding of the possible relationship between ESG and corporate finance efficiency, giving significant insights for organizations trying to improve their financial performance while supporting sustainability. The outcomes of this study further emphasize the need of properly handle financial risk

to attain long-term financial efficiency. Companies that integrate ESG principles can identify and reduce potential financial risks, such as regulatory and reputational concerns, resulting in improved financial performance. Furthermore, this study demonstrates that organizations with high ESG ratings may be able to lower their cost of capital, making them more appealing to investors. Although the data is limited to Chinese enterprises, China's substantial economic influence and market diversity underscore its significance in global growth and investment. Consequently, the study's findings may have relevance beyond Chinese borders, particularly for enterprises in other emerging markets. Moreover, the utilization of a broad sample size across diverse industries will bolster the generalizability of the research findings.

The current research has important implications for a variety of stakeholders, including firms, investors, and policymakers. The study's findings highlight the significance of incorporating Environmental, Social, and Governance (ESG) policies into organizational operations to improve financial performance. The study emphasizes the potential value of using ESG ratings in investment decisions, making it critical for investors to consider these issues when assessing possible investments. Furthermore, the findings of this study can help politicians design regulations that support sustainable and ethical business practices, thereby contributing to the long-term viability of firms. In addition, the study advocates for the application of sustainable and ethical standards in the corporate sector through regulatory interventions. Using the United Nations' Sustainable Development Goals (SDGs) as a framework, policymakers can push corporations to adopt ESG practices that help achieve global goals, resulting in a more sustainable and ethical corporate climate. This can have a good impact on both the environment and society in general.

This study is limited to Chinese enterprises, which could hinder the generalizability of the results to other countries. Future studies could look into this relationship in different regions to provide a more comprehensive understanding. Furthermore, the study only considers a small number of factors. Utilizing other variables, such as corporate governance and technology innovation, may improve knowledge of the relationship between ESG and corporate finance efficiency. This study serves as a model for future research, encouraging greater exploration into the relationship between ESG and corporate financing efficiency in various contexts.

Availability of data and materials: The collection of data utilized and/or analyzed during the current investigation are available on reasonable request.

Appendix

Abbreviation Used in this Study

ESG	Environmental, social, and governance
CFE	Corporate financing efficiency
CFR	Corporate financial risk
DEA	Data envelopment analysis
SDGs	Sustainable Development Goals
MSR	Monthly systematic risk
ROA	Return on assets
ECEP:	Energy Conservation and Environmental Protection
MSR	Monthly Systematic Risk
IC	Internal Control
FS	Firm Size
FP	Firm Profitability
Descriptions of terms used in the text	
ESG guidelines	Environmental, Social, and Governance (ESG) guidelines are a collection of standards and principles that businesses can use to evaluate and improve their sustainable and social responsibility activities. These rules often include a variety of categories. Environmental factors include a company's carbon footprint, energy consumption, waste management, and environmental impact; social factors include employee well-being, diversity and inclusion, community engagement, and human rights; and governance factors include board composition, executive compensation, ethical business practices, and reporting transparency. Companies that follow ESG principles can demonstrate their commitment to sustainable and socially responsible business practices, helping them attract investors, improve their reputation, and mitigate various risks. Investors, regulators, and stakeholders are increasingly considering ESG factors when assessing a company's long-term survival and overall performance.
	The United Nations has developed 17 Sustainable Development Goals (SDGs) as a worldwide call to action to eradicate poverty, safeguard the environment, and promote peace and prosperity for all by 2030. These 17 objectives include: No Poverty, Zero Hunger, Good Health and Well-Being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, Industry, Innovation, and Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice, and Strong Institutions, and Goals Partnerships. The SDGs expand on the previous Millennium Development Goals' progress and aim to address a broader variety of social, economic, and environmental concerns in a more integrated and universal manner, applying to all countries regardless of their degree of development.

References

Abdullah, H., & Tursoy, T. (2021). Capital structure and firm performance: evidence of Germany under IFRS adoption. *Review of Managerial Science*, 15(2), 379-398. https://doi.org/10.1007/s11846-019-00344-5

Afanas' ev, M. P., & Shash, N. N. (2022). ESG Transformation in the Corporate Sector: Systematizing the Global Approach. *Studies on Russian Economic Development*, 33(6), 707-715. https://doi.org/10.1134/S107570072 2060028

Ahmad, N., Mobarek, A., & Roni, N. N. (2021). Revisiting the impact of ESG on financial performance of FTSE350 UK firms: Static and dynamic panel data analysis. *Cogent Business & Management*, 8(1), 1900500. https://doi.org/10.1080/ 23311975.2021.1900500

Alam, M. S., Atif, M., Chien-Chi, C., & Soytaş, U. (2019). Does corporate R&D investment affect firm environmental performance? Evidence from G-6 countries. *Energy Economics*, 78, 401-411. https://doi.org/10.1016/j.eneco. 2018.11.031

Alareeni, B. A., & Hamdan, A. (2020). ESG impact on performance of US S&P 500-listed firms. *Corporate Governance: The International Journal of Business in Society*, 20(7), 1409-1428. https://doi.org/10.1108/CG-06-2020-0258

Alsahlawi, A. M. (2021). The role of hedging and derivatives techniques and fintech adoption on financial risk management in Saudi Banks. *Cuadernos de Economía*, 44(126), 10-22.

Altahtamouni, F., Alfayhani, A., Qazaq, A., Alkhalifah, A., Masfer, H., Almutawa, R., & Alyousef, S. (2022). Sustainable Growth Rate and ROE Analysis: An Applied Study on Saudi Banks Using the PRAT Model. *Economies*, 10(3), 70. https://doi.org/10.3390/economies10030070

Apergis, N., Poufinas, T., & Antonopoulos, A. (2022). ESG scores and cost of debt. *Energy Economics*, 112, 106186. https://doi.org/10.1016/j.eneco.2022.106186

Arabi, B., Munisamy, S., Emrouznejad, A., & Shadman, F. (2014). Power industry restructuring and eco-efficiency changes: A new slacks-based model in Malmquist-Luenberger Index measurement. *Energy policy*, 68, 132-145. https://doi.org/10.101 6/j.enpol.2014.01.016

Arvidsson, S., & Dumay, J. (2022). Corporate ESG reporting quantity, quality and performance: Where to now for environmental policy and practice?. *Business Strategy and the Environment*, 31(3), 1091-1110. https://doi.org/10.10 02/bse.2937

Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078-1092. https://doi.org/10.1287/mnsc.30.9.1078

Biswas, S. S., & Koufopoulos, K. (2020). Bank competition and financing efficiency under asymmetric information. *Journal of corporate finance*, 65, 101504. https://doi.org/10.1016/j.jcorpfin.2019.101504

Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica: Journal of the econometric society*, 1287-1294. https://doi.org/10.2307/1911963

Broadstock, D. C., K. Chan, L. T. W. Cheng, and X. W. Wang. 2021. "The Role of ESG Performance during Times of Financial Crisis: Evidencefrom COVID-19 in China." *Finance Research Letters* 38, 1-17. https://doi.org/10.1016/ j.frl.2020.101716

Bruna, M. G., Loprevite, S., Raucci, D., Ricca, B., & Rupo, D. (2022). Investigating the marginal impact of ESG results on corporate financial performance. *Finance Research Letters*, 47, 102828. https://doi.org/10.1016/ j.frl.2022.102828

Buch, C. M., & Goldberg, L. S. (2022). Complexity and riskiness of banking organizations: Evidence from the International Banking Research Network. *Journal of Banking & Finance*, 134, 106244. https://doi.org/10.1016/ j.jbankfin.2021.106244

Cai, X., Zhu, B., Zhang, H., Li, L., & Xie, M. (2020). Can direct environmental regulation promote green technology innovation in heavily polluting industries? Evidence from Chinese listed companies. *Science of the Total Environment*, 746, 140810. https://doi.org/10.1016/j.scitotenv.2020.140810

Caruso, G., Gattone, S. A., Fortuna, F., & Di Battista, T. (2021). Cluster Analysis for mixed data: An application to credit risk evaluation. *Socio-Economic Planning Sciences*, 73, 100850. https://doi.org/10.1016/j.seps.2020.100850

Chang, K., Cheng, X., Wang, Y., Liu, Q., & Hu, J. (2023). The impacts of ESG performance and digital finance on corporate financing efficiency in China. *Applied Economics Letters*, 30(4), 516-523. https://doi.org/10.1080/ 13504851.2021. 1996527

Chang, K., Cheng, X., Wang, Y., Liu, Q., & Hu, J. (2023). The impacts of ESG performance and digital finance on corporate financing efficiency in China. *Applied Economics Letters*, 30(4), 516-523. https://doi.org/10.1080/ 13504851.2021. 1996527

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, 2(6), 429-444. https://doi.org/10.1016/0377-2217(78)90138-8

Charnes, A., Cooper, W. W., Lewin, A. Y., Seiford, L. M., Charnes, A., Cooper, W. W., ... & Seiford, L. M. (1994). Basic DEA models. *Data envelopment analysis: Theory, methodology, and applications*, 23-47. https://doi.org/10.1007 /978-94-011- 0637-5_2

Chege, S. M., & Wang, D. (2020). The influence of technology innovation on SME performance through environmental sustainability practices in Kenya. *Technology in Society*, 60, 101210. https://doi.org/10.1016/j.techsoc.2019.101210

Chege, S. M., Wang, D., & Suntu, S. L. (2020). Impact of information technology innovation on firm performance in Kenya. Information *Technology for Development*, 26(2), 316-345. https://doi.org/10.1080/02681102.2019.1573717

Chen, H. L. (2018). Supply chain risk's impact on corporate financial performance. *International Journal of Operations & Production Management*, 38(3), 713-731. https://doi.org/10.1108/IJOPM-02-2016-0060

Chen, H. M., Kuo, T. C., & Chen, J. L. (2022). Impacts on the ESG and financial performances of companies in the manufacturing industry based on the climate change related risks. *Journal of Cleaner Production*, 380, 134951. https://doi.org/10.1016/j.jclepro.2022.134951

Chen, H. Y., & Yang, S. S. (2020). Do investors exaggerate corporate ESG information? Evidence of the ESG momentum effect in the Taiwanese market. *Pacific-Basin Finance Journal*, 63, 101407. https://doi.org/10.1016/ j.pacfin.2020.101407

Chen, H., & Yoon, S. S. (2022). Does technology innovation in finance alleviate financing constraints and reduce debt-financing costs? Evidence from China. *Asia Pacific Business Review*, 28(4), 467-492. https://doi.org/10.1080/ 13602381.2021. 1874665

Chen, S., Song, Y., & Gao, P. (2023). Environmental, social, and governance (ESG) performance and financial outcomes: Analyzing the impact of ESG on financial performance. *Journal of Environmental Management*, 345, 118829. https://doi.org/10.1016/j.jenvman.2023.118829

Chen, Y., Li, T., Zeng, Q., & Zhu, B. (2023). Effect of ESG performance on the cost of equity capital: Evidence from China. *International Review of Economics & Finance*, 83, 348-364. https://doi.org/10.1016/j.iref.2022.09.001

Chipalkatti, N., Le, Q. V., & Rishi, M. (2021). Sustainability and society: Do environmental, social, and governance factors matter for foreign direct investment?. *Energies*, 14(19), 6039. https://doi.org/10.3390/en14196039

Cikovic, K. F., Kecek, D., & Lozic, J. (2022). Does ownership structure affect bank performance in the COVID-19 pandemic period? Evidence from Croatia. *Yugoslav journal of operations research*, 33(2), 277-292. https://doi.org/10.2298/ YJOR220615018F

Coelho, R., Jayantilal, S., & Ferreira, J. J. (2023). The impact of social responsibility on corporate financial performance: A systematic literature review. *Corporate Social Responsibility and Environmental Management.* https://doi.org/10.10 02/csr.2446

Colak, M. S. (2021). A new multivariate approach for assessing corporate financial risk using balance sheets. *Borsa Istanbul Review*, 21(3), 239-255. https://doi.org/10.1016/j.bir.2020.10.007

Crifo, P., Diaye, M. A., & Oueghlissi, R. (2017). The effect of countries' ESG ratings on their sovereign borrowing costs. *The Quarterly Review of Economics and Finance*, 66, 13-20. https://doi.org/10.1016/j.qref.2017.04.011

DasGupta, R. (2022). Financial performance shortfall, ESG controversies, and ESG performance: Evidence from firms around the world. *Finance Research Letters*, 46, 102487. https://doi.org/10.1016/j.frl.2021.102487

De Guevara, J. F., Maudos, J., & Perez, F. (2007). Integration and competition in the European financial markets. *Journal of International Money and Finance*, 26(1), 26-45. https://doi.org/10.1016/j.jimonfin.2006.10.008

Delgado-Ceballos, J., Ortiz-De-Mandojana, N., Antolín-López, R., & Montiel, I. (2023). Connecting the Sustainable Development Goals to firm-level sustainability and ESG factors: The need for double materiality. *BRQ Business Research Quarterly*, 26(1), 2-10. https://doi.org/10.1177/23409444221140919

Demirguc-Kunt, A., Peria, M. S. M., & Tressel, T. (2020). The global financial crisis and the capital structure of firms: Was the impact more severe among SMEs and non-listed firms? *Journal of Corporate Finance*, 60, 101514. https://doi.org/10.1016/j.jcorpfin.2019.101514

Dmuchowski, P., Dmuchowski, W., Baczewska-Dąbrowska, A. H., & Gworek, B. (2023). Environmental, social, and governance (ESG) model; impacts and sustainable investment-Global trends and Poland's perspective. *Journal of Environmental Management*, 329, 117023. https://doi.org/10.1016/j.jenvman.2022.117023

Do, H. N., Do, L. C., Tran, M. D., Dao, A. T. A., & Tran, T. T. D. (2023). The Impact of Technological Innovation on the Performance of Vietnamese Firms. *Iranian Journal of Management Studies*, 16(1), 299-321

Duerinck, T., Verberkmoes, G., Fritz, C., Leman, M., Nijs, L., Kersemans, M., & Van Paepegem, W. (2020). Listener evaluations of violins made from composites. *The Journal of the Acoustical Society of America*, 147(4), 2647-2655. https://doi.org/10.1121/10.0001159

Duong, K. D., Huynh, T. N., Nguyen, D. V, & Le, H. T. P. (2022). How innovation and ownership concentration affect the financial sustainability of energy enterprises: evidence from a transition economy. *Heliyon*, 8(9), e10474. https://doi.org/10.1016/j.heliyon.2022.e10474

Duque-Grisales, E., & Aguilera-Caracuel, J. (2021). Environmental, social and governance (ESG) scores and financial performance of multilatinas: Moderating effects of geographic international diversification and financial slack. *Journal of Business Ethics*, 168(2), 315-334. https://doi.org/10.1007/s10551-019-04177-w

Durguti, E. A., & Kryeziu, N. (2021). Importance of corporate governance: evidence from kosovo's banking sector. *Croatian Economic Survey*, 23(2), 5-32. https://doi.org/10.15179/ces.23.2.1

Dziadkowiec, A., & Daszynska-Zygadlo, K. (2021). Disclosures of ESG misconducts and market valuations: evidence from DAX companies. *Inzinerine Ekonomika-Engineering Economics*, 32(2). https://doi.org/10.5755/j01. ee.32.2.25209

El Khoury, R., Nasrallah, N., & Alareeni, B. (2023). ESG and financial performance of banks in the MENAT region: concavity-convexity patterns. *Journal of Sustainable Finance & Investment*, 13(1), 406-430. https://doi.org/10.1080/ 20430795. 2021.1929807

Elamer, A. A., & Boulhaga, M. (2024). ESG controversies and corporate performance: The moderating effect of governance mechanisms and ESG practices. *Corporate Social Responsibility and Environmental Management*. https://doi.org/10.1002/csr.2749

Eliwa, Y., Aboud, A., & Saleh, A. (2021). ESG practices and the cost of debt: Evidence from EU countries. *Critical Perspectives on Accounting*, 79, 102097. https://doi.org/10.1016/j.cpa.2019.102097

Faccio, M., Marchica, M. T., & Mura, R. (2016). CEO gender, corporate risk-taking, and the efficiency of capital allocation. *Journal of corporate finance*, 39, 193-209. https://doi.org/10.1016/j.jcorpfin.2016.02.008

Ferri, S., Ricci, F., Ferri, S., & Ricci, F. (2021). The Role of Financial Strategy in Firms: Financing and Investment Decisions. *Financial Strategies for Distressed Companies: A Critical Analysis and Operational Tools*, 47-75. https://doi.org/10.1007 /978-3-030-65752-9_3

Fotova Cikovic, K., & Lozic, J. (2022). Application of data envelopment analysis (DEA) in information and communication technologies. *Tehnički glasnik,* 16(1), 129-134. https://doi.org/10.31803/tg-20210906103816

Fu, T., & Li, J. (2023). An empirical analysis of the impact of ESG on financial performance: the moderating role of digital transformation. *Frontiers in Environmental Science*. https://doi.org/10.3389/fenvs.2023.1256052

Garzon Jimenez, R., & Zorio-Grima, A. (2021). Sustainability engagement in Latin America firms and cost of equity. *Academia Revista Latinoamericana de Administracion*, 34(2), 224-243. https://doi.org/10.1108/ARLA-05-2020-0117

Gigauri, I., & Vasilev, V. (2022). Corporate social responsibility in the energy sector: towards sustainability. In Energy Transition: Economic, Social and Environmental Dimensions (pp. 267-288). Singapore: *Springer Nature Singapore*. https://doi.org/10.1007/978-981-19-3540-4_10

Giustiziero, G., Kretschmer, T., Somaya, D., & Wu, B. (2023). Hyperspecialization and hyperscaling: A resource-based theory of the digital firm. *Strategic Management Journal*, 44(6), 1391-1424. https://doi.org/10.1002/smj.3365

Goel, U., & Sharma, A. K. (2016). Measuring efficiency of working capital management: a two-stage data envelopment analysis approach. *International Journal of Business Excellence*, 10(4), 523-544. https://doi.org/10.1504/ IJBEX.2016.079251

Grillitsch, M., & Hansen, T. (2019). Green industry development in different types of regions. *European Planning Studies*, 27(11), 2163-2183. https://doi.org/10.1080/09654313.2019.1648385

Grisales, E. D., and J. A. Caracue. 2021. "Environmental, Social and Governance (ESG) Scores and Financial Performance of Multilatinas: Moderating Efects of Geographic Interna Tional Diversifcation and Financial Slack." *Journal of Business Ethics* 168 (2), 315-334. https://doi.org/10.1007/s10551-019-04177-w

Gu, M. (2023). Based on financing efficiency evaluation and influencing factors of new energy enterprises based on DEA-Malmquist-Tobit model. *Highlights in Business, Economics and Management*, 7, 402-408. https://doi.org/10.54097 /hbem.v7i.6975

Habrosh, A. A. (2017). Impact of cash flow, profitability, liquidity, and capital structure ratio on predict financial performance. *Advanced Science Letters*, 23(8), 7177-7179. https://doi.org/10.1166/asl.2017.9322

Harb, A. S. M. (2019). The impact of profitability and financial performance on improving productive efficiency in Jordanian Industrial Companies. *Academy of Strategic Management Journal*, 18(5), 1-13.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica: Journal of the econometric society*, 1251-1271. https://doi.org/10.2307/1913827

Hazlett, C., & Wainstein, L. (2022). Understanding, choosing, and unifying multilevel and fixed effect approaches. *Political Analysis*, 30(1), 46-65. https://doi.org/10.1017/pan.2020.41

He, F., Du, H., & Yu, B. (2022). Corporate ESG performance and manager misconduct: Evidence from China. *International Review of Financial Analysis*, 82, 102201. https://doi.org/10.1016/j.irfa.2022.102201

Hitt, M. A., Ireland, R. D., Camp, S. M., & Sexton, D. L. (2001). Strategic entrepreneurship: Entrepreneurial strategies for wealth creation. *Strategic Management Journal*, 22(6-7), 479-491. https://doi.org/10.1002/smj.196

Hsu, C. C. (2024). The Impact of Innovation Adoption on Sustainable Business Development in China: the role of Environmental, Social, and Corporate Governance Performance. *Inzinerine Ekonomika-Engineering Economics*, 35(2), 169-181. https://doi.org/10.5755/j01.ee.35.2.33190

Huang, W., Chau, K. Y., Kit, I. Y., Nureen, N., Irfan, M., & Dilanchiev, A. (2022). Relating sustainable business development practices and information management in promoting digital green innovation: evidence from China. *Frontiers in Psychology*, 13, 930138. https://doi.org/10.3389/fpsyg.2022.930138

Iazzolino, G., Bruni, M. E., Veltri, S., Morea, D., & Baldissarro, G. (2023). The impact of ESG factors on financial efficiency: An empirical analysis for the selection of sustainable firm portfolios. *Corporate Social Responsibility and Environmental Management*. https://doi.org/10.1002/csr.2463

Jin, Y., Gao, X., & Wang, M. (2021). The financing efficiency of listed energy conservation and environmental protection firms: evidence and implications for green finance in China. *Energy Policy*, 153, 112254. https://doi.org/10.1016/ j.enpol.2021.112254

Kalia, D., & Aggarwal, D. (2023). Examining impact of ESG score on financial performance of healthcare companies. *Journal of Global Responsibility*, 14(1), 155-176. https://doi.org/10.1108/JGR-05-2022-0045

Kandpal, V., Jaswal, A., Santibanez Gonzalez, E. D., & Agarwal, N. (2024). Sustainable Financing for ESG Practices. In Sustainable Energy Transition: Circular Economy and Sustainable Financing for *Environmental, Social and Governance* (ESG) Practices (pp. 167-200). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-52943-6_5

Kazmierczak, M. (2022). A literature review on the difference between CSR and ESG. Zeszyty Naukowe. *Organizacja i Zarzadzanie/Politechnika Slaska*, (162). https://doi.org/10.29119/1641-3466.2022.162.16

Khalil, M. A., Khalil, R., & Khalil, M. K. (2022). Environmental, social and governance (ESG)-augmented investments in innovation and firms' value: a fixed-effects panel regression of Asian economies. *China Finance Review International*. https://doi.org/10.1108/CFRI-05-2022-0067

Khanchel, I., & Lassoued, N. (2022). ESG disclosure and the cost of capital: is there a ratcheting effect over time?. *Sustainability*, 14(15), 9237. https://doi.org/10.3390/su14159237

Kim, S., & Li, Z. (2021). Understanding the impact of ESG practices in corporate finance. *Sustainability*, 13(7), 3746. https://doi.org/10.3390/su13073746

Kotro, B., & Markus, M. (2020). The impact of ESG rating on corporate bond yields. *Economy and Finance: English-Language Edition of Gazdasag es Penzugy*, 7(4), 474-488. https://doi.org/10.33908/EF.2020.4.7

Kula, E. (2024). Environmental, Social, and Governance (ESG) Reporting: Attempting to Bridge the Gap on Reporting Standards and the Need for Uniform Standards. *Penn State Journal of Law & International Affairs*, 12(1), 7.

Kumar, R. R., Stauvermann, P. J., Patel, A., Prasad, S., & Kumar, N. N. (2022). Profitability determinants of the insurance sector in small Pacific Island States: A study of Fiji's insurance companies. *Inzinerine Ekonomika-Engineering Economics*, 33(3), 302-315. https://doi.org/10.5755/j01.ee.33.3.19583

Landi, G. C., Iandolo, F., Renzi, A., & Rey, A. (2022). Embedding sustainability in risk management: The impact of environmental, social, and governance ratings on corporate financial risk. *Corporate Social Responsibility and Environmental Management*, 29(4), 1096-1107. https://doi.org/10.1002/csr.2256

Le, T. T., & Ikram, M. (2022). Do sustainability innovation and firm competitiveness help improve firm performance? Evidence from the SME sector in vietnam. *Sustainable Production and Consumption*, 29, 588-599. https://doi.org/10.1016/j.spc.2021.11.008

Lee, C. C., Lee, C. C., & Xiao, S. (2021). Policy-related risk and corporate financing behavior: Evidence from China's listed companies. *Economic Modelling*, 94, 539-547. https://doi.org/10.1016/j.econmod.2020.01.022

Lee, C. C., Li, X., Yu, C. H., & Zhao, J. (2021). Does fintech innovation improve bank efficiency? Evidence from China's banking industry. *International Review of Economics & Finance*, 74, 468-483. https://doi.org/10.1016/j.iref.2021.03.009

Lee, C.-C., Li, X., Yu, C.-H., & Zhao, J. (2021). Does fintech innovation improve bank efficiency? Evidence from China's banking industry. *International Review of Economics & Finance*, 74, 468-483. https://doi.org/10.1016/ j.iref.2021.03.009

Lee, M. J., & Jang, S. S. (2007). Market diversification and financial performance and stability: A study of hotel companies. *International Journal of Hospitality Management*, 26(2), 362-375. https://doi.org/10.1016/ j.ijhm.2006.02.002

Lei, X., & Yu, J. (2024). Striving for sustainable development: Green financial policy, institutional investors, and corporate ESG performance. *Corporate Social Responsibility and Environmental Management*, 31(2), 1177-1202. https://doi.org/10.1002/csr.2630

Li, L., Huang, J., Lyu, H., Guan, F., Li, P., Tian, M., ... & Chen, Y. (2021). Two lathyrane diterpenoid stereoisomers containing an unusual trans-gem-dimethylcyclopropane from the seeds of Euphorbia lathyris. *RSC advances*, 11(5), 3183-3189. https://doi.org/10.1039/D0RA10724G

Li, S., & Zhang, M. (2020). Equity Financing Efficiency Measurement of Listed Companies in Strategic Emerging Industries based on DEA. *Journal of Risk Analysis and Crisis Response*, 10(3). https://doi.org/10.2991/ jracr.k.201027.001

Li, X., & Yang, Y. (2022). Does green finance contribute to corporate technological innovation? The moderating role of corporate social responsibility. *Sustainability*, 14(9), 5648. https://doi.org/10.3390/su14095648

Liou, J. J., Liu, P. Y., & Huang, S. W. (2023). Exploring the key barriers to ESG adoption in enterprises. *Systems and Soft Computing*, 5, 200066. https://doi.org/10.1016/j.sasc.2023.200066

Liu, P., Zhu, B., Yang, M., & Chu, X. (2022). ESG and financial performance: A qualitative comparative analysis in China's new energy companies. *Journal of Cleaner Production*, 379, 134721. https://doi.org/10.1016/ j.jclepro.2022.134721

Liu, X., Yu, X., & Gao, S. (2019). A quantitative study of financing efficiency of low-carbon companies: A three-stage data envelopment analysis. *Business Strategy and the Environment*, 28(5), 858-871. https://doi.org/10.1002/ bse.2288

Lodhia, S., Kaur, A., & Kuruppu, S. C. (2022). The disclosure of sustainable development goals (SDGs) by the top 50 Australian companies: substantive or symbolic legitimation?. *Meditari Accountancy Research.* https://doi.org/10.1108/MEDAR-05-2021-1297

Luo, J., Zhuo, W., & Xu, B. (2023). A deep neural network-based assistive decision method for financial risk prediction in carbon trading market. *Journal of Circuits, Systems and Computers*, 2450153. https://doi.org/10.1142/S0218126624501536

Luo, W., Tian, Z., Fang, X., & Deng, M. (2024). Can good ESG performance reduce stock price crash risk? Evidence from Chinese listed companies. *Corporate Social Responsibility and Environmental Management*, 31(3), 1469-1492. https://doi.org/10.1002/csr.2646

Marcon Nora, G. A., Alberton, A., & Ayala, D. H. F. (2023). Stakeholder theory and actor-network theory: The stakeholder engagement in energy transitions. *Business Strategy and the Environment*, 32(1), 673-685. https://doi.org/10.1002/bse.3168

Meckling, W. H., & Jensen, M. C. (1976). Theory of the Firm. Managerial Behavior, Agency Costs and *Ownership Structure*.

Meira, E., Cunha, F. A. F. D. S., Orsato, R. J., Miralles-Quirós, M. M., & Miralles-Quiros, J. L. (2023). The added value and differentiation among ESG investment strategies in stock markets. *Business Strategy and the Environment*, 32(4), 1816-1834. https://doi.org/10.1002/bse.3221

Mendiratta, R., Varsani, H. D., & Giese, G. (2021). How ESG affected corporate credit risk and performance. *The Journal of Impact and ESG Investing*, 2(2), 101-116. https://doi.org/10.3905/jesg.2021.1.031

Morales, L., Gray, G., & Rajmil, D. (2022). emerging risks in the fintech industry-insights from data science and financial econometrics analysis. *Economics, Management & Financial Markets*, 17(2). https://doi.org/10.22381/ emfm17220221

Moslehpour, M., Ekowati, D., & Sulistiawan, J. (2023). Corporate Sustainability Practices in Indian Automobile Industry: Enhancing Government Initiatives, Economic Improvements, and Environmental Practices. *Inzinerine Ekonomika-Engineering Economics*, 34(4), 456-469. https://doi.org/10.5755/j01.ee.34.4.33160

Mu, W., Liu, K., Tao, Y., & Ye, Y. (2023). Digital finance and corporate ESG. *Finance Research Letters*, 51, 103426. https://doi.org/10.1016/j.frl.2022.103426

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of financial economics*, 13(2), 187-221. https://doi.org/10.1016/0304-405X(84)90023-0

Myers, Stewart C. "*Capital structure puzzle*." (1984). https://doi.org/10.3386/w1393

Naeem, K., & Li, M. C. (2019). Corporate investment efficiency: The role of financial development in firms with financing constraints and agency issues in OECD non-financial firms. *International Review of Financial Analysis*, 62, 53-68. https://doi.org/10.1016/j.irfa.2019.01.003

Naeem, N., & Cankaya, S. (2022). The impact of ESG performance over financial performance: A study on global energy and power generation companies. *International Journal of Commerce and Finance*, 8(1), 1-25.

Nan, L., & Wen, X. (2014). Financing and investment efficiency, information quality, and accounting biases. *Management Science*, 60(9), 2308-2323. https://doi.org/10.1287/mnsc.2013.1864

Nekhili, M., Boukadhaba, A., & Nagati, H. (2021). The ESG-financial performance relationship: Does the type of employee board representation matter?. *Corporate Governance: An International Review*, 29(2), 134-161. https://doi.org/10.1111/corg.12345

Nirino, N., G. Santoro, N. Miglietta, and R. Quaglia. 2021. "Corporate Controversies and Company's Financial Performance: Exploring the Moderating Role of ESG Practices." *Technological Forecasting & Social Change* 162: 1-7. https://doi.org/10.1016/j.techfore.2020.120341

Noja, G. G., Cristea, M., Pirtea, M. G., Panait, M., Drăcea, R. M., & Abrudan, D. (2023). Drivers of firms' financial performance in the energy sector: a comparative approach between the conventional and renewable energy fields. *Inzinerine Ekonomika-Engineering Economics*, 34(2), 205-222. https://doi.org/10.5755/j01.ee.34.2.31274

Nollet, J., Filis, G., & Mitrokostas, E. (2016). Corporate social responsibility and financial performance: A non-linear and disaggregated approach. *Economic Modelling*, 52, 400-407. https://doi.org/10.1016/j.econmod.2015.09.019

Orazalin, N., Mahmood, M., & Narbaev, T. (2019). The impact of sustainability performance indicators on financial stability: evidence from the Russian oil and gas industry. *Environmental Science and Pollution Research*, 26, 8157-8168. https://doi.org/10.1007/s11356-019-04325-9

Ouni, Z., Ben Mansour, J., & Arfaoui, S. (2020). Board/Executive gender diversity and firm financial performance in Canada: The mediating role of environmental, social, and governance (ESG) orientation. *Sustainability*, 12(20), 8386. https://doi.org/10.3390/su12208386

Pellegrini, C. B., Caruso, R., & Mehmeti, N. (2019). The impact of ESG scores on cost of equity and firm's profitability. *New Challenges in Corporate Govenrnace, Theory and Practice*, 3, 38-40. https://doi.org/10.22495/ncpr_9

Pinheiro, A. B., dos Santos, J. I. A. S., Cherobim, A. P. M. S., & Segatto, A. P. (2024). What drives environmental, social and governance (ESG) performance? The role of institutional quality. Management of Environmental Quality*: An International Journal*, 35(2), 427-444. https://doi.org/10.1108/MEQ-03-2023-0091

Placek, M., Krápek, M., Cadil, J., & Hamernikova, B. (2020). The influence of excellence on municipal performance: Quasi-experimental evidence from the Czech Republic. *SAGE Open*, 10(4), 2158244020978232. https://doi.org/10.1177/2158244020978232

Pouzoulet, J., Rolshausen, P. E., Charbois, R., Chen, J., Guillaumie, S., Ollat, N., ... & Delmas, C. E. (2020). Behind the curtain of the compartmentalization process: Exploring how xylem vessel diameter impacts vascular pathogen resistance. *Plant, Cell & Environment*, 43(11), 2782-2796. https://doi.org/10.1111/pce.13848

Prasanna, R. P. I. R., Jayasundara, J. M. S. B., Naradda Gamage, S. K., Ekanayake, E. M. S., Rajapakshe, P. S. K., & Abeyrathne, G. A. K. N. J. (2019). Sustainability of SMEs in the competition: A systemic review on technological challenges and SME performance. *Journal of Open Innovation*: *Technology, Market, and Complexity*, 5(4), 100. https://doi.org/10.3390/joitmc5040100

Rahim, I., & Shah, A. (2019). Corporate financing and firm efficiency: A data envelopment analysis approach. *The Pakistan Development Review*, 58(1), 1-25. https://doi.org/10.30541/v58i1pp.1-25

Raimo, N., Caragnano, A., Zito, M., Vitolla, F., & Mariani, M. (2021). Extending the benefits of ESG disclosure: The effect on the cost of debt financing. *Corporate Social Responsibility and Environmental Management*, 28(4), 1412-1421. https://doi.org/10.1002/csr.2134

Rakic, S., Pero, M., Sianesi, A., & Marjanovic, U. (2022). Digital servitization and firm performance: Technology intensity approach. *Inzinerine Ekonomika-Engineering Economics*, 33(4), 398-413. https://doi.org/10.5755/j01.ee. 33.4.29649

Ren, X., Zeng, G., & Zhao, Y. (2023). Digital finance and corporate ESG performance: Empirical evidence from listed companies in China. *Pacific-Basin Finance Journal*, 79, 102019. https://doi.org/10.1016/j.pacfin.2023.102019

Rezaee, Z., Homayoun, S., Poursoleyman, E., & Rezaee, N. J. (2023). Comparative analysis of environmental, social, and governance disclosures. *Global Finance Journal*, 55, 100804. https://doi.org/10.1016/j.gfj.2022.100804

Ross, S. A. (1977). The determination of financial structure: the incentive-signalling approach. *The bell journal of economics*, 23-40. https://doi.org/10.2307/3003485

Safitri, V. A., Sari, L., & Gamayuni, R. R. (2020). Research and Development (R&D), Environmental Investments, to Eco-Efficiency, and Firm Value. *The Indonesian Journal of Accounting Research*, 22(3). https://doi.org/10.33312/ijar.446

Salamzadeh, Aidin, Morteza Hadizadeh, Niloofar Rastgoo, Md Mizanur Rahman, and Soodabeh Radfard. "(2022). Sustainability-oriented innovation foresight in international new technology based firms." *Sustainability* 14(20), 13501. https://doi.org/10.3390/su142013501

Sandberg, H., Alnoor, A., & Tiberius, V. (2023). Environmental, social, and governance ratings and financial performance: Evidence from the European food industry. *Business Strategy and the Environment*, 32(4), 2471-2489. https://doi.org/10.1002/bse.3259

Saygili, E., Arslan, S., & Birkan, A. O. (2022). ESG practices and corporate financial performance: Evidence from Borsa Istanbul. *Borsa Istanbul Review*, 22(3), 525-533. https://doi.org/10.1016/j.bir.2021.07.001

Shakil, M. H. (2021). Environmental, social and governance performance and financial risk: Moderating role of ESG controversies and board gender diversity. *Resources Policy*, 72, 102144. https://doi.org/10.1016/j.resourpol.2021. 102144

Shanaev, S., & Ghimire, B. (2022). When ESG meets AAA: The effect of ESG rating changes on stock returns. *Finance Research Letters*, 46, 102302. https://doi.org/10.1016/j.frl.2021.102302

Singh, N. P., & Bagga, M. (2019). The effect of capital structure on profitability: An empirical panel data study. *Jindal Journal of Business Research*, 8(1), 65-77. https://doi.org/10.1177/2278682118823312

Singhania, M., & Saini, N. (2023). Institutional framework of ESG disclosures: comparative analysis of developed and developing countries. *Journal of Sustainable Finance & Investment*, 13(1), 516-559. https://doi.org/10.1080/20430795.2021.1964810

Singhania, M., & Saini, N. (2023). Institutional framework of ESG disclosures: comparative analysis of developed and developing countries. *Journal of Sustainable Finance & Investment*, 13(1), 516-559. https://doi.org/10.1080/20430795.2021.1964810

Sinha Ray, R., & Goel, S. (2023). Impact of ESG score on financial performance of Indian firms: static and dynamic panel regression analyses. *Applied Economics*, 55(15), 1742-1755. https://doi.org/10.1080/00036846.2022.2101611

Sonko, K. N., & Sonko, M. (2023). ESG: The Way Forward for Stakeholders. In Demystifying Environmental, Social and Governance (ESG) Charting the ESG Course in Africa (pp. 267-282). *Cham*: *Springer International Publishing*. https://doi.org/10.1007/978-3-031-35867-8_8

Su, Y., Liu, B., Yang, X., & Wang, E. (2022). Research on technological innovation investment, financing constraints, and corporate financial risk: Evidence from China. *Mathematical Problems in Engineering*, 2022. https://doi.org/10.1155/2022/5052274

Sun, Y., & Zhu, L. (2024). Political acuity, ESG atmosphere, and corporate performance---an empirical study based on the acuity dictionary and annual reports. *Journal of Cleaner Production*, 141379. https://doi.org/10.1016/j.jclepro.2024.141379

Sunardi, N., & Tatariyanto, F. (2023). The Impact of the Covid-19 Pandemic and Fintech Adoption on Financial Performance Moderating by Capital Adequacy. *International Journal of Islamic Business and Management Review*, 3(1), 102-118. https://doi.org/10.54099/ijibmr.v3i1.620

Suto, M., & Takehara, H. (2020). Corporate social responsibility intensity, management earnings forecast accuracy, and investor trust: Evidence from Japan. *Corporate Social Responsibility and Environmental Management*, 27(6), 3047-3059. https://doi.org/10.1002/csr.2022

Suttipun, M. (2023). ESG performance and corporate financial risk of the alternative capital market in Thailand. *Cogent Business & Management*, 10(1), 2168290. https://doi.org/10.1080/23311975.2023.2168290

Tapang, A. T., Takon, S. M., Uklala, A. P., Obo, E. B., Efiong, E. J., Ihendinihu, J. U., ... & Nkamare, S. E. (2022). Financial risk management and performance of insurance companies: The moderating role of hedge accounting. *Journal of Management Information and Decision Sciences*, 25(3), 50-66.

Tasnia, M., Syed Jaafar AlHabshi, S. M., & Rosman, R. (2021). The impact of corporate social responsibility on stock price volatility of the US banks: A moderating role of tax. *Journal of Financial Reporting and Accounting*, 19(1), 77-91. https://doi.org/10.1108/JFRA-01-2020-0020

Tian, H. (2023). Does consumer social responsibility augment corporate social responsibility: A reciprocal analysis of external stakeholder from stakeholder theory perspective. *Corporate Social Responsibility and Environmental Management*, 30(2), 968-978. https://doi.org/10.1002/csr.2400

Velte, P. (2017). Does ESG performance have an impact on financial performance? Evidence from Germany. *Journal of global responsibility*, 8(2), 169-178. https://doi.org/10.1108/JGR-11-2016-0029

Wang, J., Ma, M., Dong, T., & Zhang, Z. (2023). Do ESG ratings promote corporate green innovation? A quasi-natural experiment based on SynTao Green Finance's ESG ratings. *International Review of Financial Analysis*, 87, 102623. https://doi.org/10.1016/j.irfa.2023.102623

Wang, J., Wang, S., Dong, M., & Wang, H. (2024). ESG rating disagreement and stock returns: Evidence from China. *International Review of Financial Analysis*, 91, 103043. https://doi.org/10.1016/j.irfa.2023.103043

Wang, N., Pan, H., Feng, Y., & Du, S. (2023). How do ESG practices create value for businesses? Research review and prospects. *Sustainability Accounting, Management and Policy Journal, (ahead-of-print)*. https://doi.org/10.1108/SAMPJ-12-2021-0515

Wang, Q., & Geng, C. X. (2017). Research on financing efficiencies of strategic emerging listed companies by six-stage DEA model. *Mathematical problems in engineering*, 2017. https://doi.org/10.1155/2017/3284657

Wang, S., & Esperança, J. P. (2023). Can digital transformation improve market and ESG performance? Evidence from Chinese SMEs. *Journal of Cleaner Production*, 419, 137980. https://doi.org/10.1016/j.jclepro.2023.137980

Wei, S., & Zhang, C. (2021). ESG rating, operating capacity and corporate financing efficiency. *Frontiers in Economics and Management*, 2(11), 93-100.

Weston, P., & Nnadi, M. (2023). Evaluation of strategic and financial variables of corporate sustainability and ESG policies on corporate finance performance. *Journal of Sustainable Finance & Investment*, 13(2), 1058-1074. https://doi.org/10.1080/20430795.2021.1883984

Wooldridge, J. M. (2010). Econometric analysis of cross section and panel data. MIT press.

Wu, Y., Lee, C. C., Lee, C. C., & Peng, D. (2022). Geographic proximity and corporate investment efficiency: evidence from high-speed rail construction in China. *Journal of Banking & Finance*, 140, 106510. https://doi.org/10.1016/j.jbankfin.2022.106510

Xia, C., Cao, C., & Chan, K. C. (2017). Social trust environment and firm tax avoidance: Evidence from China. *The North American Journal of Economics and Finance*, 42, 374-392. https://doi.org/10.1016/j.najef.2017.07.013

Xie, Z., Wang, J., & Zhao, G. (2022). Impact of green innovation on firm value: evidence from listed companies in China's heavy pollution industries. *Frontiers in Energy Research*, 9, 1026. https://doi.org/10.3389/fenrg.2021.806926

Yaghoubi, V., Cheng, L., Van Paepegem, W., & Kersemans, M. (2022). A novel multi-classifier information fusion based on Dempster-Shafer theory: application to vibration-based fault detection. *Structural Health Monitoring*, 21(2), 596-612. https://doi.org/10.1177/14759217211007130

Zhai, Y., Cai, Z., Lin, H., Yuan, M., Mao, Y., & Yu, M. (2022). Does better environmental, social, and governance induce better corporate green innovation: The mediating role of financing constraints. *Corporate Social Responsibility and Environmental Management*, 29(5), 1513-1526. https://doi.org/10.1002/csr.2288

Zhang, D., Rong, Z., & Ji, Q. (2019). Green innovation and firm performance: Evidence from listed companies in China. *Resources, Conservation and Recycling*, 144, 48-55. https://doi.org/10.1016/j.resconrec.2019.01.023

Zhang, D., Wang, C., & Dong, Y. (2023). How does firm ESG performance impact financial constraints? An experimental exploration of the COVID-19 pandemic. *The European journal of development research*, 35(1), 219-239. https://doi.org/10.1057/s41287-021-00499-6

Zhang, F., Lai, X., & Guo, C. (2024). ESG disclosure and investment-financing maturity mismatch: Evidence from China. *Research in International Business and Finance*, 70, 102312. https://doi.org/10.1016/j.ribaf.2024.102312

Zhang, Y., Khan, U., Lee, S., & Salik, M. (2019). The influence of management innovation and technological innovation on organization performance. A mediating role of sustainability. *Sustainability*, 11(2), 495. https://doi.org/10.3390/su11020495

Zhao, C., Guo, Y., Yuan, J., Wu, M., Li, D., Zhou, Y., & Kang, J. (2018). ESG and corporate financial performance: Empirical evidence from China's listed power generation companies. *Sustainability*, 10(8), 2607. https://doi.org/10.3390/su10082607

Zhou, G., Liu, L., & Luo, S. (2022). Sustainable development, ESG performance and company market value: Mediating effect of financial performance. *Business Strategy and the Environment*, 31(7), 3371-3387. https://doi.org/10.1002/bse.3089

Zhou, G., Liu, L., & Luo, S. (2022). Sustainable development, ESG performance and company market value: Mediating effect of financial performance. *Business Strategy and the Environment*, 31(7), 3371-3387. https://doi.org/10.1002/bse.3089

Zhu, X., & Liu, J. (2024). The Effect of Inventory Flexibility on Financial Performance: Moderating Role of Firm Size and Growth. *Inzinerine Ekonomika-Engineering Economics*, 35(1), 119-132.

Authors' Biographies

Li Li is a senior lecturer in Accounting and Finance at the School of Accounting, Guangzhou College of Commerce, Guangzhou, China. She received her master's degree from Guangdong University of Technology in July 2019 and started her PhD program in 2021 at Universiti Teknologi Malaysia. Throughout academic career, Li Li has conducted extensive research on various functional domains, including ESG disclosure, Board diversity, corporate governance, and Sustainability disclosure. Li Li's articles are published in academic journals, including the Business Strategy and development, International Journal of Academic Research in Business and Social Sciences. Li Li presided over the subject project of the 14th Five-Year Plan of Guangdong Higher Education Society in July 2014, project name: ESG Accounting Talent Cultivation Model in the Context of New Quality Productivity. ORCID: https://orcid.org/0009-0008-6500-1246

Muhammad Suhrab is a Ph.D. student at the School of Management, Huazhong University of Science and Technology (HUST), Wuhan, China. He remained a lecturer at ILMA University Pakistan and is now associated with the university as a research associate. He has published high-quality papers in different top journals. He is serving as part of the editorial team for the Journal of Effective Teaching Methods. ORCID: https://orcid.org/0000-0002-6680-7494.

Magdalena Radulescu* is a Full Professor at Department of Finance, Accounting and Finance, National University of Science and Technology Politehnica Bucharest, University of Pitesti Romania. She authored more than 100 papers in IF journals indexed in WOS. H-index 30. She was included in World Top 2 % Scientists by Standford University in 2024. ORCID: https://orcid.org/0000-0002-4050-8170

Mariana Banuta is a Lecturer PhD at the Department of Finance, Accounting, and Finance at the National University of Science and Technology Politehnica Bucharest, University of Pitesti Romania. She graduated from the Faculty of Accounting at the University of West Timisoara, Romania. She has authored numerous papers indexed in international databases.

The article has been reviewed.

Received in February 2024; accepted in December 2024.