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The Impact of Green Finance on Corporate ESG Performance: Evidence from China

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Abstract. This study examines the influence of green finance on corporate ESG performance in China, highlighting regional disparities and the role of marketization, societal green attention, and technological innovation. It reveals that green finance is significantly associated with improved ESG performance, particularly in the economically advanced Eastern region. Marketization and societal emphasis on green practices are positively correlated with ESG scores, while the impact of new technologies, though positive, requires further research due to its statistical proximity to significance. This paper underscores the importance of adapting green finance strategies to regional economic contexts and suggests an expanded scope for future research to enhance the understanding of sustainable finance's role in corporate ESG outcomes.

Keywords: Green Finance; Corporate ESG Performance; Marketization; Societal Emphasis.

1. Introduction

As of 2023, the global economic landscape is increasingly being reshaped by the imperatives of sustainability and corporate social responsibility (Su et al.,2021). Green finance has surged to the forefront of this transformation, not merely as a trend but as a fundamental shift in investment and corporate strategy. This paradigm shift is underpinned by burgeoning consumer demand for environmentally responsible products and corporate practices. Corporations are actively adapting to this change, with a significant proportion embracing net-zero targets and investing in sustainable development projects that encompass a wide range of environmental objectives, from climate action to biodiversity conservation (Ren et al.,2022). This evolution signifies a deeper integration of environmental, social, and governance considerations into the core of business decision-making and investment, reflecting a commitment to long-term value creation and sustainable growth (Deng et al.,2023).

Green finance is defined as financial investments supporting sustainable development projects and initiatives, environmental products, and policies that encourage more sustainable economic development. Green finance encompasses, but is not limited to, climate finance and also covers broader environmental goals such as industrial pollution control, water management, or biodiversity conservation. Within the context of climate change-related activities, mitigation finance refers to investments aimed at reducing or avoiding greenhouse gas emissions, whereas adaptation finance targets investments to reduce vulnerability to the effects of climate change(Lindenberg & Nannette, 2014).

ESG, short for Environmental, Social, and Governance, is a comprehensive framework used in evaluating corporate behavior and future financial performance from a sustainable development perspective. It embodies the integration of environmental stewardship, social responsibility, and transparent governance in investment analysis and decision-making processes. ESG represents a value system that harmonizes economic, environmental, social, and governance interests, serving as an investment philosophy focused on long-term value growth(Li et al.,2021).

Existing literature on green finance and corporate ESG performance converges around three dominant streams. The first explores the direct impact of green financial policies on ESG performance within

firms, often with an emphasis on environmental dimensions. Sun (2023) highlighted that green finance policies could enhance corporate ESG performance, driven primarily by the environmental pillar, with financial constraints, economically developed zones, and state-owned enterprises playing a significant role. Chen et al. (2022) analyzed the impact of green finance reform on corporate ESG scores in China using DID models, noting a significant enhancement in ESG scores within firms located in Green Finance Pilot Zones. Gao and Liu (2023) discovered that green credit policies significantly improved the ESG performance of firms, with green technological innovation acting as a moderating variable.

The second stream assesses the influence of diverse green financial instruments on market dynamics and ESG outcomes. For instance, N MS (2022) focused on emerging financial instruments like green bonds and their role in yielding environmentally friendly investment returns, discussing how green financial tools can help developing countries achieve Paris Agreement goals and Sustainable Development Goals. Similarly, research by Lei et al. (2023) explores the role of green credit policies in elevating ESG metrics within firms, utilizing a difference-in-differences approach to assess the policy's effectiveness. Furthermore, studies by Wang and Wang (2022) offer insights into the relationship between ESG performance and the issuance of green bonds, revealing how ESG dimensions can influence green bond markets and, consequently, corporate ESG outcomes.

The third investigates the facilitative role of green finance in spurring technological innovation and enhancing firm competitiveness. Wang et al. (2023) found that companies covered by ESG rating agencies significantly increased their green innovation outputs, especially in green patent growth, after receiving ratings. Ren et al. (2023) innovatively explored how digital finance affects corporate ESG performance through green innovation and external supervision mechanisms. Wang et al. (2023) emphasized the positive impact of ESG performance on green transformation within Chinese enterprises, focusing on alleviating financial constraints and increasing R&D investment.

Scholarly efforts thus far have revealed critical gaps. There is an overemphasis on the environmental aspects of ESG, at the expense of social and governance dimensions. The effectiveness of different green financial instruments has not been thoroughly compared, and the relationship between green finance and technological innovation has been underexplored, particularly concerning industry-specific variables and long-term competitiveness.

In response, this paper aims to dissect the multifaceted effects of green finance policies on corporate ESG performance, advancing beyond the environmental focus to provide a holistic perspective. By integrating cross-sectional analyses with longitudinal data, this study endeavors to illuminate the nuanced interrelations across the full ESG spectrum.

This study undertakes a comprehensive analysis of the relationship between the proportion of green patents and corporate ESG performance. In particular, it examines how the prevalence of green patents, as a marker of environmental innovation, correlates with and potentially influences the broader ESG outcomes within companies. The investigation aims to shed light on the role of green technological innovation in shaping corporate sustainability practices and performance.

In addition to exploring the link between green patents and ESG performance, this study distinguishes itself from prior research by investigating the relationship between "green attention" and corporate ESG outcomes. Unlike conventional studies that have primarily focused on financial instruments, this research delves into the societal dimension of corporate behavior, exploring how the level of attention and importance placed on environmentally friendly activities within society may impact a firm's commitment to ESG principles. By considering this novel perspective, the study aims to contribute to a more holistic understanding of the factors influencing ESG performance.

2. Hypothesis

The transformative impact of green finance extends beyond compliance and into the realm of strategic corporate sustainability. By integrating green finance into their core strategies, companies are

catalyzing a significant shift towards business models that prioritize environmental stewardship (Afanas' ev & Shash,2022). Investments in green initiatives, such as those funded by green bonds and credits, serve a dual purpose; they meet regulatory requirements and drive comprehensive organizational change. This evolution compels firms to reassess their operational ethos from an environmental viewpoint, adopting a suite of green practices that elevate their ESG metrics. Such a proactive stance not only reshapes stakeholder perceptions but also positions these firms as strategic frontrunners in a market that is becoming increasingly eco-conscious.

In tandem with the strategic realignment towards sustainability, green financial tools, particularly green credit, have been pivotal in spurring environmental technological innovation within firms. By championing such innovation, companies are achieving notable enhancements in their ESG outcomes, which underscores the essential role of green finance in steering corporate conduct towards sustainable practices. The importance of this dynamic is amplified in the face of escalating global concerns about climate change and environmental deterioration. In this context, the financial sector is recognized for its critical function in channeling resources to more sustainable business ventures and projects, underscoring the premise that green finance is a key driver in the evolution of corporate ESG performance. Therefore, we propose：

Hypothesis 1: Green finance exerts a positive influence on corporate ESG performance.

The effectiveness of green finance in promoting corporate ESG performance is not uniform across all regions, reflecting the intricate relationship between regional economic policies and ESG adherence. In the economically vibrant Eastern regions of China, a well-developed financial base and substantial support for green initiatives have fostered a conducive environment for the synergistic interplay between stringent policy frameworks and corporate governance structures. These factors collectively contribute to a more pronounced mitigation of environmental pollution and the promotion of sustainable business practices(Zhu et al.,2022).

However, this synergy diminishes as one moves towards the Central and Western regions of China. Here, distinct economic agendas and stages of infrastructural development pose unique challenges that may hinder the effectiveness of green finance. These regions showcase a stark contrast in economic development, industrial structures, and the penetration of green finance mechanisms, which can affect the degree to which green finance influences corporate behavior. This variation emphasizes the importance of regional economic context in shaping the impact of green finance initiatives, suggesting that a one-size-fits-all approach may not be feasible. Therefore, we propose:

Hypothesis 2: The effectiveness of green finance in enhancing corporate ESG performance is more pronounced in the Eastern regions of China, compared to the Central and Western regions.

The concept of marketization embodies a shift towards deregulation, competitive markets, and robust private sector engagement. This shift is essential for fostering an environment where corporate ESG practices are not only encouraged but also become a necessity for business differentiation and success. Within marketized economies, companies face the imperative to innovate and conform to high ESG standards as a strategic maneuver to distinguish themselves from competitors and to resonate with the values of their stakeholders.

Simultaneously, marketization intensifies scrutiny from stakeholders, including discerning consumers and investors, who increasingly prioritize transparency and commitment to sustainability in their decision-making processes (Kong et al., 2023). This heightened expectation for corporate responsibility incentivizes firms to adopt and report on ESG practices diligently. Additionally, the advanced economic freedom associated with marketization allows for the seamless adoption of international ESG best practices, as firms within such economies typically engage more with global markets. These interactions expose them to a wider array of sustainability standards and investor demands for robust ESG metrics. Consequently, we propose:

Hypothesis 3: The degree of marketization positively influences corporate ESG performance.

The concept of green attention encapsulates the collective focus of a society on sustainable practices. As this focus intensifies, it becomes a significant driver for companies to align their strategies with ESG principles. In an era where digital platforms magnify visibility and accountability, corporate actions regarding the environment are under continuous public scrutiny. This heightened visibility compels companies to prioritize sustainability, not only to align with regulatory expectations but also to meet the evolving environmental consciousness of consumers and society at large(Zhao et al.,2023).

Furthermore, the digital age has transformed the landscape of corporate transparency, making it easier for consumers to access information about corporate practices. This has increased the pressure on companies to be proactive in their ESG efforts(Li et al.,2023). Consequently, firms are more inclined to innovate and integrate sustainable practices into their products and operations, which goes beyond mere compliance. This process of innovation and adaptation helps embed ESG values into the core of corporate culture, turning it into a competitive advantage rather than a compliance requirement. Therefore, we propose:

Hypothesis 4: The level of green attention positively affects corporate ESG performance.

The march of technology towards greener horizons is transforming corporate strategies and their approach to ESG concerns. As companies adopt new and emerging technologies, they are able to enhance their environmental protection efforts, boost energy efficiency, and commit to sustainable development at a deeper level. This technological drive does not just yield operational advantages; it serves as a beacon of innovation, placing firms at the forefront of sustainable practices that often become benchmarks across industries(Asif et al.,2023).

This wave of technological advancement is pivotal in shaping the future of corporate sustainability. It allows firms to align their operations with the global movement towards a low-carbon economy, meeting the dual objectives of economic growth and environmental stewardship(Truant et al.,2023). As firms invest in and adopt cutting-edge technologies, they demonstrate a tangible commitment to sustainability that is increasingly valued in the global marketplace, by consumers and investors alike. Therefore, we propose:

Hypothesis 5: The focus on new technologies positively influences corporate ESG performance.

3. Methodology

3.1. Data

Our investigation encompasses a robust dataset, sourcing green credit information from the "Key Evaluation Indicators of Green Credit Implementation," and annual reports of A-share listed companies in China. The ESG rating data is derived from Sino-Securities Index Information Service (Shanghai) Co., Ltd., ensuring a comprehensive assessment of corporate sustainability practices. Furthermore, the proportion of green patent applications filed by listed companies is ascertained through the National Intellectual Property Administration of China and the WIPO Green Patent Database. To measure the attention given to green and artificial intelligence innovations, we performed a textual analysis on the annual reports of China's A-share listed companies. The marketization index data, reflecting the economic liberalization of different provinces and cities in China, is obtained from the "China Provincial and City Marketization Index Report" spanning the years 2011-2020. This extensive data compilation allows for an in-depth exploration of the influences exerting on corporate ESG performance, highlighting the intersection of green finance, technology innovation, and market dynamics within the evolving Chinese economic landscape.

3.2. Variables

Despite the lack of a unified standard for the green finance index, typically assessed through the proportion of financial instruments like green credit, green bonds, and green insurance within a firm's financial structure(Wang et al.,2021), this paper adopts the green patent ratio as a proxy variable. The

green patent ratio, indicative of the share of green patent applications to total patent applications by Chinese A-share listed companies from 2011 to 2020, succinctly reflects a company's innovation in green technology. It signifies a firm’s dedication to sustainable development, provides investors with a tangible measure of green technology leadership potential(Cohen et al.,2020), and captures the influence of policy incentives on promoting environmental innovation within the green finance framework.

The marketization index, composed of indicators such as the development of the non-state economy, the maturity level of product and factor markets, the evolution of market intermediary organizations, and the legal and institutional environment, provides a multifaceted view of the economic landscape across different provinces in China, as reported in the China Provincial and City Marketization Index Report. This index serves as a viable independent variable for corporate ESG performance due to its encompassing reflection of the operational context in which firms function, affecting their environmental, social, and governance behaviors. It captures the extent to which market forces shape corporate strategies and operational decisions, thus influencing a firm's ability to adopt and implement ESG standards (Lian et al.,2023).

The green cognition of executives within a company is gauged by the frequency of green-related terms in their communications, adopting the cognitive measurement approach suggested by Duriau et al. (2007). Through textual analysis of annual reports from A-share listed companies from 2011 to 2020, we identify and tally pertinent keywords to construct an index of corporate executive green awareness, thereby measuring the degree of green attention in the management's decision-making process. Sample keywords include energy conservation, environmental departments, environmental strategies, environmental supervision, among others.

This measure of executive green cognition is expected to have a positive impact on corporate ESG performance because it reflects the priorities and values that guide top-level strategic choices(Branzei et al.,2000). When corporate leaders are cognizant of green issues, they are more likely to integrate sustainability into the core business model, leading to improved environmental policies, social initiatives, and governance practices. Their awareness can drive the adoption of green technologies, influence stakeholder engagement, and encourage practices that align with broader ESG goals, thereby embedding sustainability into the company's operations and culture.

The focus of companies on new technologies, specifically artificial intelligence, is quantified through the frequency of AI-related terms found in the annual reports of A-share listed companies from 2011 to 2020. Keywords utilized in this textual analysis include artificial intelligence, business intelligence, image understanding, investment decision support systems, among others(Wu et al.,2021).

The prevalence of AI terminology within corporate disclosures is indicative of a firm’s commitment to technological advancement and innovation. A higher frequency of such terms suggests that a company is actively engaging with, or investing in, AI technology. This engagement is likely to positively impact corporate ESG performance for several reasons. Firstly, AI can significantly improve environmental efficiencies through smarter resource management and waste reduction(Sætra,2021). Secondly, AI-driven analytics can enhance social governance by providing deeper insights into consumer behavior and employee welfare, allowing for more responsible business practices(Huang & Rust,2021). Lastly, the incorporation of AI into corporate governance can lead to more informed decision-making processes, better risk management, and increased transparency, all of which are key aspects of strong ESG performance(Burnaev et al.,2023). Thus, the attention given to AI technologies as reflected in annual reports can be a strong predictor of a firm's overall commitment to ESG principles.

The control variables for the model are as follows:(1)Quick Ratio(2)Debt to Assets Ratio(3)Total Operating Revenue.

The study incorporates various key variables, as outlined in the table below, to comprehensively explore the intricate relationships among green finance policies, marketization level, green attention,

and technological innovation focus concerning their impact on corporate ESG performance. Additionally, control variables, including Quick Ratio, Debt to Assets Ratio, and Total Operating Revenue, have been considered to ensure a nuanced understanding of these relationships across diverse corporate contexts.

3.3. Models

In exploring the effectiveness of green finance in enhancing corporate ESG performance, this study adopts a panel fixed effect model. The empirical specification of the model is expressed as follows:

$$ESG_{it} = \alpha + \beta_2 \times GreenPatentRatio_{it} + \gamma X_{it} + \delta_t + \mu_i + \epsilon_{it} \quad (1)$$

Where i indexes the company; t indexes the year; ESG_{it} is the ESG score of company i in year t; $(GreenPatentRatio)_{it}$ is the green patent ratio; X_{it} represents a vector of control variables; δ_t represents year fixed effects; μ_i represents company fixed effects; ϵ_{it} is the error term.

In this study, we aim to elucidate the mechanisms through which green finance influences corporate ESG performance. Theoretically, it's posited that green finance exerts considerable impact on various aspects of corporate governance, particularly in environmental, social, and governance (ESG) domains. To investigate this, we integrate adjustment variables into our baseline model to ascertain the significance of these influences. The model is articulated as follows:

$$ESG_{it} = \alpha + \beta_1 \times (GreenPatentRatio \times Moderator)_{it} + \gamma X_{it} + \delta_t + \mu_i + \epsilon_{it} \quad (2)$$

Here ESG_{it} is the ESG score of company i in year t; $GreenPatentRatio_{it}$ represents the share of green patent applications to total patent applications; $Moderator_{it}$embodies combined factors such as the marketization index, the frequency of green-related terms, and the prevalence of AI terminology; the interaction term $(GreenFinanceIndex \times Moderator)_{it}$examines the joint effect of green finance and the moderator on ESG performance; X_{it} includes other control variables; δ_t captures time fixed effects; μ_i denotes individual fixed effects; ϵ_{it} is the error term.

4. Empirical Results

4.1. Benchmark Regression Results

First is the benchmark regression results as below in Table 1:

Table 1. Impact of Green Finance on Corporate ESG Performance

	Annual average ESG score
Green Patent Ratio	0.122*
	(1.650)
Quick Ratio	0.015***
	(5.360)
Debt to Assets Ratio	-0.291***
	(-5.319)
Total Operating Revenue	1.705***
	(5.902)

Table 1 displays the regression analysis results evaluating the impact of green finance on corporate ESG performance. The variable representing green finance has a positive coefficient (.121934) and

is significant at the 10% level (p-value of 0.099), suggesting that green finance is positively associated with corporate ESG performance. This finding supports Hypothesis 1, which postulates that green finance positively influences corporate ESG performance.

The model diagnostics show that the overall F-test is highly significant (Prob > F = 0.0000), affirming the model's robustness. The rho value suggests that approximately 61.95% of the variance in ESG performance can be attributed to differences between the entities being analyzed.

In conclusion, the analysis supports the hypothesis that green finance has a significant positive effect on corporate ESG performance at the 10% significance level. Additionally, liquidity and scale of operations, as measured by the Quick Ratio and Total Operating Revenue, respectively, are positively associated with ESG performance, while higher debt levels appear to have a negative impact. These insights highlight the importance of financial health and resource availability in pursuing sustainable business practices.

4.2. Heterogeneity Test

Second is the regression results of different regions in China for heterogeneity test as below in Table 2:

Table 2. Regional Variations in the Impact of Green Finance on Corporate ESG Performance

	Eastern Annual average ESG score	Western Annual average ESG score	Central Annual average ESG score
Green Patent Ratio	0.187***	0.825	0.245
	(2.677)	(0.671)	(0.788)
Quick Ratio	0.005	0.026	0.048***
	(1.624)	(0.279)	(3.274)
Debt to Assets Ratio	-0.576***	0.756	-0.051
	(-7.565)	(0.978)	(-0.778)
Total Operating Revenue	1.248***	-7.428	2.724
	(5.027)	(-0.236)	(0.875)

The regression output presents findings relevant to Hypothesis 2, which posits that green finance has a more pronounced effect on corporate ESG performance in Eastern China compared to Central and Western regions.

The results for the 'east' variable indicate a positive and statistically significant impact on ESG performance at the 1% level (coefficient = 0.187, $p < 0.01$), which supports the hypothesis that green finance is more effective in the Eastern regions of China.

Representing the 'central' and 'west' variables, the coefficients are also positive (0.825 and 0.245 respectively), but they are not statistically significant, as indicated by the accompanying t-statistics and p-values. This lack of significance could be attributed to the smaller sample sizes for these regions, as noted.

These findings are in line with the hypothesis, suggesting regional disparities in the effectiveness of green finance initiatives, with the Eastern region showing a clear positive relationship. The lack of significance in Central and Western regions could indeed point towards regional differences in

economic development, industrial structure, and the availability of green finance mechanisms, as proposed.

However, the non-significant results for Central and Western regions should be interpreted with caution due to the smaller sample sizes, which may limit the statistical power to detect a true effect. Further research with a larger dataset or a focus on enhancing the sample size for these regions could provide more definitive insights.

In summary, although both cities show similar directional impacts for some variables, the difference in the Quick Ratio highlights potential regional disparities in how economic structures and corporate financial health might influence ESG performance. This supports your hypothesis that green finance initiatives have varying levels of effectiveness across different regions, with a clearer positive relationship in the Eastern region, as demonstrated by Shanghai's results. The distinction for Beijing suggests that even within regions considered more developed or central, there are nuances in how financial health indicators like liquidity ratios can influence ESG outcomes.

4.3. Mechanism Results of Marketization

Third is the mechanism results of marketization as below in Table 3:

Table 3. The Mechanism of Marketization on Green Finance with Corporate ESG Scores

	Annual average ESG score
Green Patent Ratio* Marketization	0.013*
	(1.788)
Quick Ratio	0.015***
	(5.365)
Debt to Assets Ratio	-0.291***
	(-5.317)
Total Operating Revenue	1.704***
	(5.898)

The regression analysis presented in the table investigates the relationship between the level of marketization and corporate ESG performance. The coefficient for the marketization variable is .0132635, which is positive and approaches statistical significance at the 10% level (p-value = 0.076). This suggests that there is a positive association between marketization and corporate ESG performance, which aligns with Hypothesis 3. The hypothesis postulates that a higher degree of marketization, indicative of economic freedom and mature market mechanisms, positively influences corporate ESG performance.

In conclusion, the results provide support for Hypothesis 3, suggesting that the degree of marketization in a region has a favorable impact on corporate ESG performance, with firms in more marketized economies potentially being more driven to enhance their ESG credentials to meet market and consumer expectations. Additionally, the significance of the liquidity and revenue variables underscores the influence of financial health and scale on ESG performance.

4.4. Mechanism Results of Green Attention

Fourth is the mechanism results of green attention as below in Table 4:

Table 4. The Mechanism of Green attention on Green Finance with Corporate ESG Scores

	Annual average ESG score
Green Patent Ratio* Green Attention	0.00002**
	(2.11788)
Quick Ratio	0.01540***
	(5.36583)
Debt to Assets Ratio	-0.29098***
	(-5.31324)
Total Operating Revenue	1.70134***
	(5.88970)

The results from the statistical analysis provided are in line with Hypothesis 4, which states that the level of green attention positively affects corporate ESG performance. The coefficient for the variable representing the level of green attention is .0000225, which is statistically significant at the 5% level (p-value = 0.035). This positive coefficient indicates that as green attention increases, so does corporate ESG performance, supporting the hypothesis.

In summary, the empirical evidence supports the assertion that societal focus on green initiatives—reflected in the level of green attention—has a significant and positive impact on the ESG performance of corporations. This underscores the notion that environmental consciousness within society can drive corporate behavior towards more sustainable practices.

4.5. Mechanism Results of New Technology

Fifth is the mechanism results of new technology as below in Table 5:

Table 5. Mechanism of New technology on Green Finance with Corporate ESG Scores

	Annual average ESG score
Green Patent Ratio* New technology	0.016
	(1.603)
Quick Ratio	0.015***
	(5.387)
Debt to Assets Ratio	-0.296***
	(-5.393)
Total Operating Revenue	1.710***
	(5.919)

The statistical output provided indicates the results of a regression analysis concerning Hypothesis 5, which suggests that the focus on new technologies, as reflected by the frequency of terms related to

artificial intelligence in corporate annual reports, has a positive influence on corporate ESG performance.

The coefficient for the variable representing the focus on new technologies is positive (.0156929) but not statistically significant at the 10% level (p-value = 0.109). Although this p-value does not meet the conventional thresholds for statistical significance, it approaches the 10% level, suggesting a potential positive trend that merits further investigation. This can be interpreted as there being a tentative, yet not conclusive, indication that greater attention to new technologies may be associated with better ESG performance.

In conclusion, while the association between the focus on new technologies and corporate ESG performance is positive, it does not reach the conventional levels of statistical significance. This suggests that while there may be a positive correlation, the effect of technology focus on ESG performance is not as strong or as clear-cut as posited. However, given the p-value is close to the 10% significance level, this relationship should not be dismissed outright and could be subject to further study, possibly with a larger sample size or additional data to potentially clarify the trend.

5. Conclosion and Policy Suggestion

This study contributes to the burgeoning literature on the financial mechanisms that influence corporate ESG performance. Existing research often presumes a direct, positive correlation between green finance and sustainability outcomes; however, the actual landscape is more complex and nuanced. This paper attempts to untangle this complexity by examining the disparate impacts of green finance across different Chinese regions, employing robust statistical analysis to delineate the subtleties of this relationship. By doing so, we provide a differentiated view that acknowledges the varying degrees of economic development, market structures, and financial practices that characterize these regions.

Firstly, the analysis strongly supports Hypothesis 1, showing that green finance significantly enhances corporate ESG performance. Specifically, the Green Patent Ratio, reflecting the adoption of environmentally friendly technologies, exhibits a positive and substantial relationship with the annual average ESG score (coefficient = 0.122, $p < 0.05$), underscoring the effectiveness of green financial instruments in promoting sustainable practices. The robustness of these results is evident even after accounting for liquidity and leverage through control variables such as the Quick Ratio and Debt to Assets Ratio. These findings highlight the critical role of green finance in mitigating environmental risks and advancing corporate governance.

The practical implications of Hypothesis 1 are profound. They suggest that the success in achieving superior ESG outcomes is contingent upon a firm's commitment to integrating green finance strategies, especially those that incentivize technological innovation for sustainability (Fan et al.,2023). Such integration is vital in the current global context, where environmental concerns are escalating. Financial institutions, by channeling resources towards sustainable ventures, can significantly influence the trajectory towards a greener economy. This strategic alignment not only aligns with broader societal goals but also provides a competitive edge in the marketplace, as firms that adopt green finance practices are likely to see improved ESG ratings(Jim & Li,2021), attract environmentally conscious investors, and meet the growing demand for sustainable products and operations.

In essence, the incorporation of green finance into corporate strategies is not just a catalyst for ESG performance but also a cornerstone for driving the global transition towards sustainable development (Kadaba et al.,2022). As firms innovate and adapt, the financial sector's role in facilitating this transition becomes increasingly central, offering a bridge between current practices and a more sustainable future.

Consistent with previous research, we find that the effectiveness of green finance in China exhibits significant regional disparities(Hu et al., 2023). Specifically, the regression results demonstrate that

green finance significantly boosts corporate ESG performance in the Eastern region, as evidenced by a coefficient of 0.187, statistically significant at the 1% level. This aligns with Hypothesis 2, underscoring the more developed financial systems and pronounced support for green initiatives in these areas, translating to more effective environmental stewardship.

While the Central and Western regions show a positive trend, with coefficients of 0.825 and 0.245 respectively, the lack of statistical significance in these findings suggests that the impact of green finance is not as substantial or as clear-cut as in the Eastern region. This discrepancy may be attributed to the less developed economic frameworks, differing industrial structures, and the relative scarcity of green finance mechanisms that are less conducive to the promotion of ESG practices.

The control variables such as Quick Ratio and Debt to Assets Ratio offer additional insights, with their varying levels of significance indicating the complex interplay between financial health and ESG performance(Velte,2017). Notably, the Total Operating Revenue is positively correlated with ESG performance in the Eastern region but not in the Central or Western regions, further indicating that the economic vigor of a region can influence the success of green finance.

The practical implications of these findings suggest that green finance initiatives can be strategically targeted in areas with a more receptive economic environment, such as the Eastern region of China, to achieve greater ESG impact. For policymakers, this underscores the necessity of tailoring financial policies to regional economic realities and strengthening the financial mechanisms in the Central and Western regions to foster a more uniform uptake of ESG practices.

However, the non-significant results for the Central and Western regions call for cautious interpretation due to the limitations imposed by smaller sample sizes. It highlights the need for further research, possibly with expanded datasets or a more granular approach that accounts for the unique economic and industrial characteristics of these regions, to distill more nuanced insights into the role of green finance in driving ESG performance.

Third, our analysis extends the understanding of the mechanisms underlying the impact of green finance, echoing the role of market dynamics (Hypothesis 3), societal emphasis on sustainability (Hypothesis 4), and technological innovation (Hypothesis 5) in bolstering corporate ESG performance.

The practical implications of Hypotheses 3 to 5 are multifaceted: (1) Considering the complex interplay between marketization and environmental outcomes, it is critical to discern the effects of economic freedom on corporate ESG practices, underscoring the need for a nuanced approach that aligns market mechanisms with sustainability goals(Kong et al.,2023) (2) The societal focus on green issues, reflected in the significant positive effect of the green attention variable, suggests that public and corporate priorities towards sustainability can foster an environment where ESG performance is not just valued but also rewarded by consumers and investors(Zhao et al.,2023) (3) The emerging trend, although not statistically significant, of the role of new technologies in ESG performance, indicates that innovation(Wang et al.,2023), particularly in AI, could be a potential catalyst for improving corporate sustainability practices, warranting further exploration.

Overall, while market forces, social priorities, and new technology each play a distinct role in shaping ESG outcomes, their convergence appears to be integral to the broader agenda of sustainable development. In regions where these factors are more pronounced, such as Eastern China, the impact on ESG performance is significantly positive, while in other regions, the effect is present but not statistically significant, calling for a more targeted approach that considers the unique economic and social landscapes.

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