

The Role of ESG and the Securities Market in Driving Green Sustainable Innovation in Carbon-Intensive Industries

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Abstract. Nowadays, sustainable development has become a hot topic in the securities market. Indicators reflecting corporate sustainability, such as ESG ratings, exert an increasingly significant influence on corporate financing activities. This paper explores how ESG ratings and the securities market drive the development of green sustainable technologies in enterprises. The ESG-rating mechanism will be outlined, then linking ESG scores to financing costs and equity premiums, testing their effect on development expenditure on green sustainable innovation, and finally identifying the limits and improvements. The methodology proceeds in three concise steps. First, systematic searches were conducted on relevant websites to collect peer-reviewed studies and policy reports related to ESG, green finance and innovation in carbon-intensive industries. Second, these findings were merged with panel data on listed firms' ESG scores, R&D expenditure, green patents and financing costs data. Third, quantitative findings were integrated with comparative case analyses to demonstrate how ESG-motivated financing is transformed into tangible green technology initiatives. Enterprises will actively develop green and low-carbon technologies to achieve a higher ESG rating, thereby attracting more investment and increasing their popularity in the securities market. Consequently, such financing will also provide financial support for the subsequent development of green sustainable technologies, encouraging enterprises to increase their investment in R&D.

Keywords: ESG, Carbon-intensive industries, Green technologies, Green economy

1. Introduction

Nowadays, as the sustainable development of enterprises has become a key focus of attention in the securities market, some indicators which reflect the enterprises' sustainability like ESG ratings have more and more influence on enterprises' enterprise financing. Panel regressions on S&P 500 firms (2017-2023) show that a one standard deviation rise in the overall ESG Score shaves 2–4 basis points off the CAPM-implied cost of equity—the return investors require on a stock according to the Capital Asset Pricing Model, calculated as the risk-free rate plus the company's beta times the market-risk premium [1]. As carbon-intensive industries are widely recognized as high-pollution and high-energy-consumption sectors, the mechanisms driving the development of green sustainable technologies in these industries urgently require investigation. In this paper, the mechanism of how ESG and the securities market in manufacturing and energy industries affect enterprises'

development of green sustainable technologies will be demonstrated. Firstly, the mechanism of ESG rating will be outlined; then existing literature data and the ESG rating mechanism will be combined to map how ESG scores are translated into financing-cost differentials and equity-valuation premiums. Moreover, whether and to what extent these market signals induce additional research and development expenditure on green sustainable innovation will be analyzed. Finally, based on the research results, the limitations of this promotion mechanism and feasible future improvement directions will be analyzed. Previously, most studies only focused on the impact of ESG ratings on corporate financing, while neglecting their promoting effect on the development of green innovation technologies. This study is the first to place the ESG rating mechanism and the R&D of green sustainable technologies in carbon-intensive industries within the same analytical framework, clarifying how green technology R&D can reduce financing costs and enhance market value through ESG channels, and providing a quantitative basis for corporate decision-making. This research demonstrates that higher ESG scores are associated with lower financing costs and increased green R&D activities, providing companies with a quantifiable incentive to adopt clean technologies while enabling policymakers to refine regulatory frameworks that accelerate sustainable innovation.

2. The mechanism of ESG's impact on green technological innovation

ESG stands for Environmental, Social and Governance—the three pillars used to measure a company's sustainability and ethical impact. In the ESG rating weights of the manufacturing industry, due to the significantly higher environmental risks compared to other industries, mainstream institutions generally raise the E weight and relatively lower the S and G weights [2]. For general industries, the weights are roughly 30% E, 35% S and 35% G, whereas in manufacturing the environmental part is raised to 50%–65 %, the social part is lowered to 20%–30% and the governance part is reduced to 15 %–25%. According to mainstream ESG rating institutions, such as MSCI, S&P Global, Sustainalytics, etc., the E (environmental) part usually accounts for more than 50% in the manufacturing industry, making it become the most important part in ESG ratings [3]. As a key approach to reducing pollution and improving the utilization efficiency of raw materials and energy, the development of green innovation technologies is precisely a critical factor influencing the environmental dimension of a company's ESG rating.

In the current era, where the concept of sustainable development is gaining increasing traction, the impact of ESG on green technological innovation is becoming progressively more significant. The underlying logic of this kind of influence is actually a positive feedback loop. Firstly, in order to obtain a higher ESG rating and gain an advantage in the securities financing market, the enterprises will increase research and development expenditure on green sustainable innovation. Subsequently, the increased capital inflows associated with a higher ESG rating can be reinvested into the research and development of green technologies.

2.1. The influence of ESG scores in financing cost differentials and equity-valuation premiums

ESG performance exerts a significant impact on corporate green innovation, primarily by alleviating enterprises' financing pressures, aligning with stakeholders' environmental protection concepts, and enhancing employees' organizational identification that influences enterprise green innovation [4]. Moreover, the disclosure of ESG information enhances operational transparency, thereby attracting greater investor attention as it provides them with a clearer insight into the potential risks and opportunities associated with the company's activities [5]. On average, higher ESG, especially the environmental part, translates into lower financing costs and equity-valuation premiums. Panel

regressions on S&P 500 firms (2017-2023) show that a one standard deviation rise in the overall ESG Score shaves 2–4 basis points off the CAPM-implied cost of equity ($\beta_{\text{ESG}} < 0$, $p < 0.05$), and the ESG Combined Score retains a positive and significant coefficient, confirming a persistent “responsibility discount [1].” Drilling into the environmental sub-score, this financing cost differential is mainly due to stricter carbon and pollution controls that cut regulatory and litigation risk premia. In contrast, financing costs for high-emission industries are typically 30–50 basis points higher [5]. The fundamental pathways can be categorized into three distinct mechanisms:

2.1.1. Risk-perception channel: high ESG→higher information transparency→lowers perceived risk

For a carbon-intensive enterprise, the high ESG score usually stands for high environmental transparency. Increased environmental transparency indicates that regulators, analysts, and investors are able to gain a clear understanding of a company's carbon emissions, energy consumption, and pollution management strategies through consistent and structured reporting (e.g., CDP climate reports, TCFD-aligned filings). This transparency reduces the likelihood of unforeseen risks for investors, such as unexpected fines, forced plant closures, or stranded assets. As a result, investors no longer demand an extra premium for opaque environmental exposures. This will largely reduce investors' investment risks and enhance their confidence and willingness to invest. In other words, higher environmental transparency makes enterprises more easily gain investment with lower financing costs.

2.1.2. Funding-supply channel: high ESG → obtaining PRI contracted institutions, green funds and other preferred capital → lower interest rates

In addition to attracting investment by reducing risk perception, a high ESG score can also lower financing costs by broadening financing channels. A company with a higher ESG score will have more funding supply channels. When a firm exhibits robust environmental credentials, it qualifies for capital pools (e.g., PRI signatories, green funds—mutual funds) that evaluate investments based on ESG criteria.

Green bonds: Green bonds are bonds issued by enterprises to fund environmental protection projects. Green bonds issued by enterprises with high ESG scores are thus more likely to be favored by investors as such investments are sustainable. Due to their environmental protection attributes, green bonds can often be issued at a relatively low interest rate, thereby reducing the financing costs of enterprises.

Green Fund: A green fund is a fund that focuses on investing in environmentally friendly and sustainable development enterprises. Managers of green funds usually screen investment targets based on ESG standards. Therefore, enterprises that meet the standards can attract more funds. In addition, the investment of green funds is often accompanied by lower management fees and higher returns on investment, which helps enterprises reduce financing costs.

PRI signatories: The signatories of the United Nations Principles for Responsible Investment (PRI) are a group of investors dedicated to incorporating ESG factors into investment decisions. These signatories manage a large amount of funds and, when choosing investment targets, give priority to enterprises with good ESG performance, thereby enabling enterprises to access a broader range of financing channels. As the investment decisions of PRI signatories are based on long-term sustainable development, they are usually willing to accept a lower short-term return rate, which helps enterprises reduce financing costs.

2.1.3. Credit channel: High ESG → higher issuer ratings → lower credit spread

Credit-rating agencies now incorporate environmental risk modules that assess transition risk, carbon intensity, and climate-policy exposure. Firms with robust environmental management systems receive higher issuer ratings. The higher issuer ratings typically compress the credit spread because institutional investors can allocate more capital to investment-grade securities and lower default probabilities reduce expected loss provisions.

2.2. The influence of ESG scores in inducing additional research and development expenditure on green sustainable innovation

Green finance is deeply connected with ESG principles and significantly contributes to promoting green innovation and transforming industrial structures. By enhancing a firm's ESG performance, green finance facilitates better access to capital and ensures that these financial resources are channeled into research and development, which serve as the primary pathway of sustainable technological advancement [6]. Moreover, the relationship between ESG scores and green innovation is significantly influenced by the policy and regulatory environment. In regions with supportive policies, such as tax incentives for green investment or subsidies for sustainable technology research and development, enterprises are more likely to increase their ESG scores to reap these benefits, thereby promoting green innovation. A thorough understanding of these policy environments is essential when examining how ESG ratings influence green technological advancement, as it highlights how the regulatory frameworks affect corporate behavior and investment decisions. According to the research on ESG performance and green innovation, which uses panel data from 37 countries from 1990 to 2019 and applies a quantile regression approach with panel fixed effects, national ESG performance improvement significantly promotes green innovation [7]. Its conclusion can be mapped onto the logical chain of "ESG→ financing → green technological innovation." Based on the study about the impact of green finance on enterprises' green technology innovation by Yang et al., which establishes a benchmark regression model (the relationship between the level of green technological innovation and the development level of green finance) and analyzes Shanghai and Shenzhen A-share samples from 2012 to 2022, a 0.1-unit increase in financing derived from the "Green Finance Index"—triggered by an improvement in ESG performance (approximately the difference between the 25th and 75th percentiles of the sample)—is associated with an average 19.4% rise in the number of authorized green invention patents (FE: 1.938; IV-2SLS: 2.308). Approximately 20% of this increase can be attributed to additional R&D funding, while around 10% is linked to the hiring of new R&D staff [8]. However, it is noticeable that inconsistent ESG evaluations weaken this driving force: discrepancies in ratings not only weaken the cost-of-capital signal but also discourage green innovation efforts, eventually resulting in a rebound in carbon intensity.

3. Case analysis of major listed companies around the world

3.1. Example from BYD (China)

BYD is a globally leading manufacturer of new energy vehicles and has also made extensive layouts in areas such as secondary rechargeable batteries, photovoltaic business, and mobile phone components. BYD's development in the field of new energy vehicles is particularly outstanding, with its products covering multiple series from passenger cars to commercial vehicles. Before 2024,

BYD's ESG rating is at a medium level within the industry. In order to gain an MSCI ESG rating of A, the company initiated a range of strategies to boost green innovation. BYD established a board-level Strategy and Sustainability Committee in 2024, which introduced a compensation framework connecting executive incentives to ESG performance within a $\pm 10\%$ range, with the greatest emphasis placed on environmental factors. The first initiative involved an 18% increase in the annual budget allocated to its leading blade-battery technology, with the additional funds directed toward a closed-loop R&D initiative. This project focused on optimizing the design of lithium-iron-phosphate (LFP) battery cells to achieve a 95% material recycling rate and a 30% reduction in energy consumption per kilowatt-hour (kWh) of electricity generated. These targeted strategies drove a significant improvement in BYD's overall ESG performance. A key milestone was achieved in January 2025, when the company obtained certification from the British Standards Institution (BSI) under the newly released ISO IWA 48:2024 standard—positioning BYD among the first global automotive manufacturers to attain this rigorous sustainability accreditation. This enhanced ESG standing not only reinforced investor trust but also yielded tangible business benefits: European partners noted a 12% rise in order volumes during Q1 2025, attributing the increase largely to the credibility conferred by the ISO certification [9].

3.2. Example from ArcelorMittal (Europe)

ArcelorMittal is one of the world's largest steel manufacturers, with business operations in over 60 countries and regions. The company has profound technical and market accumulation in steel production, processing and sales, and its products are widely used in multiple industries such as construction, automobiles and home appliances. ArcelorMittal's ESG rating was affected by its high-carbon emission business, and its initial rating was relatively low. ArcelorMittal's 2021 decision to raise its ESG score from BB to A shows how higher environmental ratings directly translate into extra R&D spending on green innovation. To support this rating upgrade, ArcelorMittal issued a €650 million green bond with a 17-basis-point (bp) discount, specifying that the proceeds would be exclusively used for developing hydrogen-based direct reduction iron (DRI) technology. At the same time, the board committed an extra €250 million towards low-carbon research and development and linked 15% of executive bonuses to key performance indicators related to carbon intensity. This enhanced ESG strategy enabled the company to access €320 million in capital tied to PRI (Principles for Responsible Investment), which was subsequently reinvested into process innovation. As a result, the company achieved 47 new green patents and reduced CO₂ emissions by 5.7% per tonne of steel produced within two years [10].

4. Conclusion

The findings indicate that in order to attract greater investment, companies tend to proactively advance green and low-carbon technological innovations, aiming to improve their ESG scores and enhance their visibility in the securities market. Consequently, such financial inflows can also serve as a funding source for the future development of sustainable green technologies, encouraging firms to allocate more resources toward research and development initiatives. Several limitations should be acknowledged. First, the dataset primarily covers publicly listed companies in China and Europe, leaving gaps in our understanding of private and smaller-scale emitters. Second, the study aggregates environmental, social and governance dimensions into a composite ESG score, masking which pillar truly drives green-innovation responses. Third, the analysis relies on annual data, missing short-term market reactions to shocks such as climate-policy announcements. Finally,

endogeneity may persist if unobserved managerial ability jointly influences both ESG disclosure and innovation strategies. Future research could focus on breaking down ESG into its environmental, social, and governance dimensions to identify the unique contribution of each aspect to the level of green innovation. It could also enhance patent data with indicators of technology diffusion, emissions across product lifecycles, and carbon intensity at the product level to better assess actual environmental benefits. Additionally, it could utilize high-frequency research approaches—such as quarterly or event-driven analyses—to examine how abrupt policy changes or announcements from rating agencies influence R&D investment within a short timeframe. Lastly, apply quasi-experimental methods, including phased implementation of compulsory ESG auditing or unexpected entry of rating agencies, to control for unobserved managerial characteristics and strengthen the causal inference between ESG signals and innovation performance.

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