The "Brown Greenwashing" Paradox in Transition Finance—An Empirical Examination Based on ESG Rating Discrepancies of High-Carbon Enterprises and Their Access to Green Credit

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Abstract. With the advancement of China's "dual carbon" goals, ESG ratings have become a core reference for green credit decision-making. However, high-carbon enterprises may engage in "greenwashing" by strategically disclosing information to embellish their environmental performance for financing purposes, creating a "brown-greenwashing" paradox that challenges the effectiveness of transition finance. To examine this issue, this study innovatively constructs a "greenwashing index" based on data from high-carbon industries such as coal power and steel in China's A-share market from 2015 to 2023. It employs a benchmark regression model for empirical analysis. The study found that ESG ratings have a significant positive impact on the scale of green credit. Still, this effect is significantly negatively moderated by carbon emission intensity, confirming the "greenwashing" behavior of high-emission enterprises. Further analysis reveals that, compared to private enterprises, state-owned enterprises are more likely to obtain green credit through ESG ratings, highlighting the resource bias associated with ownership. This study provides empirical evidence for identifying and curbing "brown washing" and offers targeted recommendations for improving ESG ratings and optimizing credit policies.

Keywords: Brown Greenwashing, ESG rating, green credit, high-carbon enterprises.

1. Introduction

Against the macro backdrop of global efforts to actively address climate change and China's deepening "dual carbon" strategy, transition finance has emerged as a crucial financial instrument supporting high-carbon enterprises in achieving green transformation, with its role becoming increasingly prominent [1]. Notably, the emerging phenomenon of "brown washing" in practice is posing challenges to the efficacy of this financial tool—some high-carbon enterprises deliberately embellish their environmental, social, and governance (ESG) performance through carefully crafted information disclosure strategies, thereby securing credit resources originally intended to support the genuine green transition. With the widespread adoption of sustainable development concepts, the release of ESG rating information has garnered increasing attention from various market participants, effectively evolving into an informal environmental regulation (IER) spontaneously formed by market entities [2]. Against this backdrop, this study aims to empirically analyze the intrinsic relationship between ESG rating deviations in high-carbon enterprises and their access to green credit, revealing the paradoxical mechanisms at play.

This paradox raises the core question of this study: In the allocation of green credit to high-carbon enterprises, do ESG ratings function as a "screening filter," or have they transformed into a convenient channel for "greenwashing"? Does their distortive effect exhibit systematic differences among enterprises with varying ownership characteristics?

To address the aforementioned questions, this study utilizes data from China's A-share market between 2015 and 2023, focusing on listed companies in high-carbon industries such as coal power and steel. Innovatively, the study constructs a "Greenwashing Index" (GI) and employs benchmark regression (OLS model) for empirical testing. The findings reveal a significant positive impact of ESG ratings on the scale of green credit, yet this relationship is notably negatively moderated by carbon emission intensity, indicating that high-carbon-emitting enterprises engage in "greenwashing" by leveraging ESG ratings [3]. Furthermore, additional analysis demonstrates that state-owned

enterprises are more likely than private firms to secure green credit through ESG ratings, highlighting the resource bias stemming from government-enterprise relationships [4]. This study provides reliable empirical evidence for identifying and curbing the phenomenon of "brown washing" through empirical analysis. Based on the research findings, it also proposes actionable recommendations on how to improve the ESG rating system and optimize green credit policies, aiming to promote more effective allocation of financial resources in supporting the green transformation of the real economy [5].

Currently, with the significant acceleration of global climate governance, transition finance, as a key supporting mechanism for promoting corporate green transformation, is receiving increasing attention from various sectors [4]. Against the backdrop of China's active promotion of the "dual carbon" strategy, financial institutions are proactively innovating green financial products. Among these, green credit has emerged as a core financing channel for driving the low-carbon transition of the real economy, leveraging its scale effects and guiding role [6]. However, this transition process has not been without challenges. Notably, some high-carbon enterprises have successfully obtained credit resources originally intended for genuinely green projects by deliberately embellishing their performance in environmental, social, and governance (ESG) dimensions. This phenomenon, referred to as "brown washing," has evolved into a pressing real-world issue that demands resolution. This practice not only distorts market signals but may also lead to misallocation of limited green financial resources, thereby undermining overall environmental governance effectiveness [5]. Currently, the existing literature presents considerable debate regarding the relationship between ESG rating biases in high-carbon enterprises and their access to green credit, necessitating in-depth research to uncover the underlying mechanisms and impacts [3].

A typical case is that a large steel group, against the backdrop of rising annual carbon emission intensity, received a rating upgrade due to highlighting a pilot environmental technology in its ESG report, thereby successfully securing substantial green credit. However, the green transformation of its core production model progressed slowly. This phenomenon raises a central research question: Under the current circumstances, does and how does ESG rating objectively provide a channel for "greenwashing" by high-carbon enterprises, leading to the misallocation of green credit resources? While existing studies acknowledge the positive aspects of ESG, they lack micro-empirical examinations of the rating distortion mechanisms in the specific context of high-carbon industries [7, 8]. Furthermore, they fail to clearly differentiate the performance of enterprises with varying ownership structures in the "greenwashing-green credit acquisition" chain and lack targeted measurement tools and quantitative analyses for "greenwashing" behaviors.

To address the aforementioned research gap, this study takes China's A-share listed companies in the coal power and steel industries from 2015 to 2023 as samples, innovatively constructs the "Greenwashing Index" (GI) to quantify corporate "greenwashing" suspicions, employs benchmark regression (OLS model) to examine the relationship between ESG ratings, carbon emission intensity, and green credit acquisition, and introduces corporate ownership nature qualitative analysis.

Therefore, this study aims to establish new measurement indicators and empirical models to deeply analyze the relationship between ESG rating deviations and green credit acquisition, providing theoretical foundations and empirical evidence for effectively identifying and addressing "brown washing", particularly their deviations in ESG ratings and how to utilize these deviations to obtain green credit [9, 10]. Through an in-depth analysis of this phenomenon, this paper hopes to reveal the actual situation of green transformation in high-carbon enterprises, providing an effective reference for relevant policy formulation [11].

2. Literature Review and Theoretical Mechanism

2.1. The Economic Consequences and Potential Biases of ESG Ratings

Existing literature generally agrees that favorable ESG ratings can facilitate green transformation in high-carbon industries, thereby achieving high-quality development [7]. This is specifically

reflected in helping enterprises reduce financing costs and enhance corporate value, driving firms toward high-quality development. However, as a comprehensive evaluation system, ESG ratings still possess certain inherent limitations. Particularly in the environmental (E) dimension, varying disclosure standards and rating methodologies may lead to deviations in assessment outcomes [4, 9]. For enterprises in high-carbon industries such as coal power and steel, their production and operational activities inherently carry significant environmental negative externalities, placing them at an inherent disadvantage in ESG ratings. However, it is noteworthy that such rating pressure may instead prompt enterprises to adopt strategic information disclosure behaviors—tending to emphasize social responsibility initiatives such as community welfare and employee care that are more likely to receive positive evaluations, while deliberately downplaying their environmental impacts in core operational areas such as carbon emissions and energy consumption. This selective disclosure behavior may lead to a divergence between ESG scores and the actual environmental performance of enterprises, resulting in misleading "inflated" outcomes [8]. It is precisely the existence of such systematic bias that necessitates a re-examination of the effectiveness and applicable boundaries of ESG ratings in high-carbon industries [3].

2.2. Policy Effects of Green Credit and Risks of Resource Misallocation

As an important environmental economic policy, the green credit policy aims to guide capital flows toward green and low-carbon sectors while curbing polluting investments through differentiated allocation of credit resources [5]. Since its implementation, the policy has indeed generally restricted the credit scale of high-pollution enterprises. However, its effectiveness may be significantly undermined by information asymmetry and regulatory arbitrage behaviors. Furthermore, Pan Dapeng constructed a tripartite evolutionary game model involving the government, enterprises, and financial institutions from the perspective of green preferences [12]. Their study highlights that corporate green preferences play a decisive role in green transformation, while effective government supervision and the investment choices of financial institutions are crucial for combating "greenwashing" and promoting green development.

Meanwhile, empirical observations reveal significant discrepancies in ESG ratings among different enterprises, and such systematic biases are likely to have profound implications for the actual effectiveness of corporate green transitions [8]. Huang Meihui further corroborated this point through a study focusing on A-share listed companies in high-carbon industries within the Shanghai and Shenzhen markets from 2015 to 2021: while ESG performance overall significantly enhances organizational resilience, the impact levels of environmental (E), social (S), and governance (G) dimensions on organizational resilience exhibit notable differences. This finding unveils potential structural issues within the current ESG rating system from a new perspective.

When ESG ratings become a critical indicator in bank credit approval processes, the aforementioned rating deviations may create opportunities for high-carbon enterprises to engage in "greenwashing" operations [12]. Specifically, companies may selectively disclose or embellish environmental data to boost their ESG scores, thereby meeting the eligibility criteria for green credit and securing preferential funding that should have been allocated to genuinely green projects [1]. This not only leads to misallocation of green credit resources but also undermines the credibility and effectiveness of transition finance policies in the long run, forming a paradoxical scenario of "brown greenwashing" [4].

In summary, the deviation analysis of ESG ratings for high-carbon enterprises reveals that rating biases may impact the effectiveness of corporate green transformation. Therefore, it is necessary to further improve the ESG rating system to ensure it accurately reflects the progress of corporate green transformation [10].

2.3. Research on Utetheisa Kong and the Theoretical Advancement

Although existing studies have extensively explored the economic consequences of ESG ratings and the policy effects of green credit separately, research combining these two aspects and focusing

on the "greenwashing" mechanism in high-carbon industries remains relatively scarce [3]. Specifically, prior studies have failed to fully reveal the applicability boundaries of ESG ratings in high-carbon industries and lack micro-empirical examinations of how enterprises strategically utilize the rating system for disclosure (i.e., "greenwashing") [9]. More importantly, existing research has not provided clear answers regarding whether enterprises with different ownership structures (such as state-owned enterprises and private enterprises) exhibit differential behaviors in this process [8]. Based on the above research gaps, this study proposes the following core hypotheses:

H1: ESG ratings have a positive impact on the scale of green credit for high-carbon enterprises.

H2: The carbon emission intensity of enterprises weakens the positive impact of ESG ratings on green credit (i.e., a moderating effect).

H3: Compared to private enterprises, the impact of ESG ratings on the scale of green credit is stronger for state-owned enterprises.

3. Research Design

3.1. Sample Selection and Data Sources

This study takes listed companies in the coal power and steel industries in China's A-share market from 2015 to 2023 as the initial research sample. On this basis, samples that were subject to ST or *ST treatment during this period or had missing key variable data were excluded, ultimately resulting in an unbalanced panel dataset. ESG rating data were sourced from authoritative domestic databases, namely Sino-Securities ESG and SynTao Green Finance ESG. Corporate green credit data were manually collected by reviewing items such as "special loans" and "long-term loans" in the annual reports of listed companies to compile credit information related to green projects. Financial data and corporate governance data were obtained from the CSMAR database and Wind database. Carbon emission data were calculated based on emissions disclosed in the annual reports or corporate social responsibility reports of listed companies or estimated according to relevant standards.

3.2. Variable Definition

The explained variable is the scale of green credit (Green_Loan). It is measured by the natural logarithm of the total annual green credit of the enterprise plus 1 to reduce data disparity and meet the requirements of econometric analysis. The explanatory variable is the ESG rating (ESG_Score), which adopts the comprehensive score of the Huazheng ESG rating as a continuous variable. The moderating variable is carbon emission intensity (Carbon_Intensity), measured by the ratio of the enterprise's annual total carbon emissions to operating revenue, to further examine the impact of Phoxinus phoxinus subsp. Phoxinus' actual environmental performance on the relationship between ESG ratings and green credit. The core mechanism variable is the greenwashing index (GI), an innovative indicator constructed in this study. The calculation formula is: GI = (CO2 emissions per unit of operating revenue) / (ESG environmental dimension score). A higher value of this index indicates that the enterprise may receive a relatively high ESG environmental score despite poor environmental performance, suggesting a greater suspicion of "greenwashing." To control for the influence of other factors, this paper introduces a series of control variables: enterprise size (Size), asset-liability ratio (Leverage), profitability (ROA), growth (Growth), listing duration (Age), and enterprise ownership nature (SOE, where state-owned enterprises are assigned 1, otherwise 0), among others. Additionally, annual and industry fixed effects are controlled.

3.3. Model Broussonetia papyrifera Construction

To test the research hypotheses proposed in this paper, the following benchmark regression model was constructed.

$$\begin{aligned}\text{Green Loan}_{it} = \beta_0 + \beta_1 \text{ESG Score}_{it} + \beta_2 \text{Carbon Intensity}_{it} \\ + \beta_3(\text{ESG Score}_{it} \times \text{Carbon Intensity}_{it}) + \gamma \text{Controls}_{it} + \lambda_t + \mu_t + \in_{it}\end{aligned} \quad (1)$$

Here, i represents the enterprise, and t represents the year and denotes the year and individual fixed effects, respectively. Measures the direct effect of ESG on green credit, while the core moderating effect coefficient. If it is significantly negative, then Hypothesis H2 is supported. To further test Hypothesis H3, this paper will conduct grouped regressions based on enterprise ownership type (SOE) and compare the inter-group coefficient differences.

4. Analysis of Empirical Results

4.1. Descriptive Statistics

The descriptive statistics of the main variables reveal that the average ESG score of the sample firms is 68.2 (standard deviation 12.3), indicating significant disparities in ESG performance among different enterprises. The distribution of the green credit scale (after logarithmic transformation) exhibits a pronounced right-skewed characteristic, with a substantial gap between state-owned enterprises (SOEs) and private enterprises (the mean value of SOEs is significantly higher than that of private firms). This preliminarily suggests potential disparities in resource acquisition attributable to the ownership nature.

A significant positive correlation exists between the core explanatory variable, the Greenwashing Index (GI), and carbon emission intensity (correlation coefficient 0.73, P<0.001). This provides preliminary validity support for the "greenwashing" measurement indicator constructed in this study (detailed regression analysis results are presented in Table 1). Note: *p<0.1, **p<0.05, ***p≤0.01; t-values are in parentheses.

4.2. Descriptive Statistics

The table 1 below presents the regression results of the model:

Table 1. Regression analysis results

Variable	(1)Full sample	(2)Full sample	(3) State-owned enterprise sub-sample	(4) Sub-sample of private enterprises
ESG Score	0.073*** （3.92）	0.071*** （3.81）	0.098*** （4.17）	0.041* （1.89）
Carbon Intensity	-0.105* （-1.75）	-0.098* （-1.65）	-0.088 （-1.23）	-0.134*** （-2.01）
ESG×Carbon	-0.42** （-2.56）	-0.41** （-2.48）	-0.31* （-1.83）	-0.63*** （-3.02）
Green washing （GI）		-0.187** （-2.89）		
SOE	0.185** （2.41）	0.177** （2.32）	——	——
Control variable	Yes	Yes	Yes	Yes
Sample size	1372	1372	892	480
Adjusted R^2	0.32	0.33	0.38	0.25

Note: *p<0.1, **p<0.05, ***p≤0.01; t-values are in parentheses.

4.2.1Main effects and moderating effects

As shown in Column (1) of Table 1, the full-sample regression results indicate that the coefficient of ESG rating (ESG Score) is significantly positive at the 1% level (B=0.073), supporting Hypothesis H1. This suggests that an improvement in ESG ratings can indeed lead to an expansion in the scale of green credit. More theoretically significant is the finding that the coefficient of the interaction term between ESG rating and carbon emission intensity (ESG×Carbon) is significantly negative at the 5% level (B=-0.42). This provides strong evidence for Hypothesis H2, indicating that a firm's carbon emission intensity significantly weakens the positive impact of ESG ratings on green credit. In other

words, for firms with high carbon emissions, the financing effect of their ESG ratings is substantially diminished, confirming the existence of "greenwashing" behavior and its negative consequences.

4.2.2Qualitative analysis of Parazacco

Impact of ownership nature: The grouped regression results in columns (2) and (3) show that in both state-owned enterprise (SOE) and private enterprise subsamples, the main effect of ESG and the moderating effect of carbon emissions remain significant, but with notable intergroup differences. The main ESG effect coefficient for SOEs (0.098) is significantly larger than that for private enterprises (0.041), and the absolute value of the moderating effect is smaller for SOEs. This strongly supports Hypothesis H3, indicating that SOEs exhibit a stronger "ESG-green credit" linkage, potentially benefiting from their closer ties with government and financial institutions. Even when facing potential "greenwashing" suspicions, SOEs experience relatively looser financing constraints. Meanwhile, qualitative analysis reveals that non-SOEs, enterprises in non-heavy pollution industries, and those operating in poorer financial ecosystems are more sensitive to ESG rating divergence. Furthermore, mechanism analysis demonstrates that negative media attention and corporate financing constraints mediate the relationship between ESG rating divergence and debt financing costs [13].

5. Research Conclusions and Policy Implications

Based on the empirical research findings of the "brown greenwashing" paradox, to effectively enhance the efficacy of transition finance and ensure the precise allocation of green credit resources to enterprises genuinely transitioning, this paper proposes the following systematic policy recommendations from the perspectives of three key stakeholders: regulators, financial institutions, and enterprises.

Promote "sector-specific refinement" in ESG rating systems: Regulatory authorities should take the lead in formulating ESG rating standards or guidelines for high-carbon industries, significantly increasing the weight of core environmental indicators such as "carbon emissions" and "energy consumption," while reducing the operational space for enterprises to engage in "greenwashing" through marginal environmental activities.

Implement "penetrative" supervision: Financial institutions should avoid over-reliance on overall ESG scores in credit decision-making. Instead, they should establish a linkage analysis mechanism between ESG scores and key environmental performance indicators (e.g., carbon emission intensity). For instance, a "greenwashing index" threshold could be set to automatically trigger stricter due diligence for enterprises with excessively high indices.

Strengthen information disclosure and accountability: Mandate enterprises, particularly those in high-carbon sectors, to clearly and quantitatively disclose their core environmental data [9]. Additionally, establish follow-up tracking and impact assessment mechanisms for the use of green credit funds to ensure they are genuinely allocated to green transition activities [5].

6. Conclusion

6.1. Research Summary

Under the framework of transition finance, the phenomenon of "brown washing" has emerged as a paradox warranting vigilance. This paper reviews relevant literature and finds that although some high-carbon enterprises perform well in ESG ratings, there exists a significant gap between their actual environmental performance improvements and the rating outcomes. Such discrepancies enable these companies to readily access credit resources originally intended to support green transitions, thereby creating a misalignment between policy objectives and practical outcomes. Not only does this undermine the effectiveness of green finance policies, but it also leads to efficiency losses in resource allocation. To address this dilemma, future efforts must focus on establishing a rating system that more accurately reflects corporate environmental performance, while strengthening whole-

process supervision of green credit fund flows. Additionally, how to fully leverage the corrective role of market mechanisms and enhance transition efficiency through precise policy design should remain key priorities for subsequent research.

6.2. Future Research Directions and Policy Recommendations

Based on an empirical analysis of the phenomenon of "brown washing," this study reveals the asymmetric relationship between ESG ratings and access to green credit among high-carbon enterprises. Data indicate that the ESG ratings of some companies fail to adequately reflect their actual environmental performance, and this discrepancy directly affects the accurate assessment of their green transition outcomes. Although green credit policies demonstrate positive effects in incentivizing corporate green innovation, the transmission mechanism between capital allocation and substantive corporate transformation still requires in-depth exploration. Subsequent research could focus on developing more refined ESG discrepancy measurement methods to empirically examine the specific impacts of these discrepancies on the transition pathways of high-carbon enterprises. At the policy level, recommendations include the following: first, establishing an ESG rating quality oversight mechanism to enhance the transparency of the rating process and the credibility of results; second, refining the policy design of green credit to strengthen post-funding effect evaluations, ensuring financial resources genuinely support corporate green transition processes.

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