Proceedings of Business and Economic Studies, 2026, Volume 9, Issue 8
http://ojs.bbwpublisher.com/index.php/PBES
Online ISSN: 2209-265X
Print ISSN: 2209-2641

Research on the Impact of Green Credit on the Green Transformation of Power Generation Enterprises

Yuanmei Gao

School of Finance, Tianjin University of Finance and Economics, Tianjin 300222, China

Abstract: Against the backdrop of the implementation of the "dual carbon" strategy and green transformation in the power industry, green credit is an important financial tool for promoting the low-carbon development of power generation enterprises. This paper takes Chinese listed power generation enterprises from 2013 to 2023 as samples, adopts the difference-in-differences model, measures the green transformation by the ESG performance of enterprises, and uses the issuance of green bonds as a proxy variable for green credit. The impact of green credit on the green transformation of power generation enterprises was empirically tested, and robustness tests were conducted, including parallel trend tests, placebo tests, and time window tests. The results show that green credit significantly promotes green transformation: for every 1% increase in green bond issuance, ESG performance improves by 0.060%. Heterogeneity analysis indicates that green credit significantly improves the environmental (E) and social (S) dimensions, but has no significant impact on the governance (G) dimension. Enterprise scale and cash flow have a positive impact on ESG performance, while leverage ratio and duality have a negative impact. Finally, policy recommendations are put forward to the government, financial institutions, and enterprises to provide empirical support for the low-carbon transformation of the power industry.

Keywords: Green credit; Power generation enterprises; Green transformation; ESG performance; Difference-in-differences

Online publication: August 31, 2026

1. Introduction

With the intensification of global climate change and the continuous growth of energy consumption and carbon emissions, promoting the green transformation of the power generation industry has become an urgent task. Green credit, as a green financial tool based on national environmental policies and aiming at energy conservation and emission reduction, has become a key driving force for the transformation and upgrading of the power generation industry with the implementation of policies such as the "Green Credit Guidelines," and related research has also become a hot topic in both academic and industrial circles. Against this backdrop, in-depth research on the impact of green credit on the green transformation of the power generation industry is of

great significance for the sustainable development of the power generation industry.

This research holds significant theoretical and practical significance. First, green credit supports clean energy projects such as wind power and photovoltaic power through preferential financing, accelerating the green transformation of industries. Second, it guides capital towards efficient and environmentally friendly fields, forces high-pollution and high-energy-consuming power generation methods to exit, and optimizes the industrial structure. Thirdly, in the long run, it helps enterprises achieve a synergy between economic benefits and low-carbon social benefits, ensuring stable returns.

2. Literature review

The pressure of global climate governance continues to increase, and energy consumption and carbon emissions are growing rapidly. Promoting the green and low-carbon transformation of the power generation industry has become a key link in achieving the "dual carbon" goals. Scholars at home and abroad have conducted extensive research on topics related to green credit and the green transformation of the power generation industry, forming relatively rich theoretical and empirical achievements.

2.1. Research status

2.1.1. Research on the development of green credit

The economic and environmental effects of green credit policies are the focus of academic attention. Chen *et al.* confirmed, based on the difference-in-differences model, that green credit policies can significantly enhance the total factor productivity of green enterprises [1]. Lei *et al.* indicated that green credit has an inhibitory effect on the total factor productivity of "high energy consumption, high pollution and overcapacity" enterprises [2]. Lin *et al.* found that green credit policies have a significant promoting effect on the green performance of enterprises in high energy-consuming industries [3].

2.1.2. Research on green transformation of the power generation industry

Under the guidance of the "dual carbon" strategy and green development policies, China's power generation industry has accelerated its transformation towards low-carbon, with the proportion of non-fossil energy installed capacity steadily increasing and the power structure continuously optimizing. As a major carbon-emitting industry, the power generation sector urgently needs to achieve transformation and breakthroughs with the support of green financial tools. Among them, green credit has become an important tool for promoting the green development of the industry.

2.1.3. Green credit and green transformation of the power generation industry

There are obvious differences in the existing research conclusions. Most studies support the positive role of green credit: Hu *et al.* empirically found that green credit steadily promotes the low-carbon transformation of the power generation industry [4]; Zhang *et al.* confirmed that green finance can significantly reduce carbon emission intensity [5]. Wan *et al.* used the ARDL–ECM model based on Chinese data and found that green investment significantly promotes carbon emission reduction in the long run. Meanwhile, some studies have reached different conclusions: Hammoudeh *et al.* constructed a time-varying causal algorithm model from the green bond dimension and found that green bonds have no significant causal impact on carbon emission allowance prices [6].

2.2. Research gaps

Although existing literature has laid a foundation for research on green credit and green transformation, several limitations remain. First, most studies adopt a macro or single-region perspective, with limited targeted research on the power generation industry. Second, studies tend to focus on broad green finance, while few concentrate specifically on green credit and systematically measure the green transformation of power generation enterprises using ESG performance. Third, relevant findings remain inconsistent, requiring further verification of the underlying impact mechanism. Accordingly, this paper uses ESG performance to represent the green transformation level of power generation enterprises, empirically examines the effect of green credit, supplements existing research gaps, and provides empirical support for advancing the high-quality green transformation of the power generation industry.

3. Research design

3.1. Sample selection and data sources

This paper takes Chinese listed power generation enterprises as the research sample. Given that the green credit data of enterprises cannot be directly obtained, the issuance of green bonds is adopted as the proxy variable for green credit. Enterprises that issue green bonds are set as the treatment group, and listed power generation enterprises that have not issued green bonds are set as the control group. Excluding missing data and data such as ST and *ST, the research period was from 2013 to 2023. The enterprise's financial and governance data are sourced from the CSMAR database, while the data on green patents and green bonds are from the Wind database.

3.2. Variable selection

3.2.1. Dependent variable

Green transformation (ESG) is measured by the Huazheng ESG rating system, which encompasses three core dimensions: environmental responsibility, social responsibility, and corporate governance. With favorable timeliness and representativeness, this rating system indicates that a higher ESG score corresponds to superior corporate performance in green transformation practices.

3.2.2. Independent variables

Green Credit (Green×Post): Use the issuance of green bonds as a proxy variable and set two dummy variables.

(1) Green: If the enterprise has issued green bonds from 2016 to 2023, 1 will be given; otherwise, 0 will be given.

(2) Post: Take 1 for the year the enterprise issues and subsequent years; otherwise, take 0.

The core independent variable is the interaction term between the two, Green×Post.

3.2.3. Mediating variable

Technological Innovation (Patent): Measured by the number of corporate green patent applications, it reflects the output level of green technological innovation.

3.2.4. Control variables

To alleviate the omitted variable bias, the following control variables are selected:

Firm Size (Size): Natural logarithm of total assets at the end of the period.

Return on Equity (ROE): Used to measure corporate profitability.

Cash Flow (Cashflow): Adopted to reflect the corporate cash flow status.

Shareholding Ratio of the Largest Shareholder (Top1): Applied to measure ownership concentration.

CEO-Chairman Duality (Dual): Assigned as 1 if the chairman concurrently serves as the general manager, and 0 otherwise.

3.3. Model construction

To examine the net effect of green credit on the green transformation of power generation enterprises, this paper constructs a difference-in-differences (DID) fixed-effects model:

$$ESG_{it} = \beta_0 + \beta_1 GREEN_i * POST_{it} + \Sigma \beta_i Control_{it} + \mu i + \varepsilon it$$

Among them, ESG denotes the dependent variable; i refers to different power enterprises, and t represents different years. Green is a dummy variable indicating whether a listed enterprise issues green bonds; POST is a time dummy variable after the issuance of green bonds. The interaction term Green×Post serves as the difference-in-differences variable. Controls represents the set of control variables, which are consistent with those defined in the preceding section. To better evaluate the impact of green bonds on corporate ESG performance, this study adopts a fixed-effect DID model, where εit denotes the random error term.

4. Analysis of empirical results

4.1. Descriptive statistics

This paper conducts descriptive statistics on the main variables, based on 1,135 firm-year observations. The results show that there are significant differences in the dependent variable ESG among the samples (mean lnesg = 4.288, std.dev. = 0.065, ranging from 3.897 to 4.474), indicating that the green transformation levels of different power generation enterprises are significantly differentiated. The mean value of the independent variable Green×Post is relatively low (mean = 0.060, std.dev. = 0.182), indicating that the proportion of enterprises issuing green bonds during the sample period is not high. The distribution of control variables is all within a reasonable range (size: 20.209–27.072; lev: 0.013–1.334; ROE: -6.577–0.419; cashflow: -0.397–0.291; top1: 0.003–0.841; dual mean = 0.099), which conforms to the typical characteristics of listed power generation enterprises.

4.2. Correlation analysis

This paper conducts a correlation analysis of the variables. Green credit is significantly positively correlated with the ESG performance of enterprises (correlation coefficient of 0.120, $P < 0.01$), initially indicating that green credit helps enhance the green transformation level of power generation enterprises. The correlation coefficients among all variables are below 0.39 in absolute value, well under the 0.5 threshold, so there is no problem of highly linear correlation. Further regression analysis can be conducted.

4.3. Multicollinearity test

To avoid multicollinearity interfering with the regression results, the variance inflation factor (VIF) test is conducted in this paper. The results show that the VIF values of all variables range from 1.05 to 1.86, far below

the common threshold of 10, with an average VIF of 1.32, indicating that there is no multicollinearity problem in the model.

4.4. Benchmark regression analysis

The Hausman test results support the adoption of the fixed-effect model. The benchmark regression results based on **Table 1** show that the coefficient of Green credit (Green×Post) is significantly positive, indicating that green credit can significantly promote the improvement of ESG performance of power generation enterprises. Control variables were added sequentially across unreported specifications, and the core conclusion remains robust throughout; **Table 1** reports the full specification with all control variables included.

From an economic perspective, for every 1% increase in green bond issuance, the ESG performance of enterprises improves by 0.060%. In terms of control variables, enterprise size and cash flow have a significant positive impact on ESG performance, while leverage ratio and CEO duality show a significant negative impact.

Table 1. Benchmark regression results

	(1)	(2)	(3)
	lnesg	lnesg	lnesg
Green×Post	0.069***	0.056**	0.060**
	(2.587)	(2.192)	(2.383)
size		0.025***	0.024***
		(3.901)	(3.705)
lev		-0.098**	-0.097**
		(-2.302)	(-2.310)
roe		-0.064	-0.057
		(-1.424)	(-1.286)
cashflow		0.142**	0.157**
		(2.258)	(2.483)
top1			-0.034
			(-0.813)
dual			-0.026*
			(-1.878)
_cons	4.261***	3.735***	3.769***
	(651.945)	(28.058)	(28.162)
N	1135	1135	1135
R^2	0.045	0.1809	0.2145

***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

5. Robustness test

5.1. Parallel trend test

The difference-in-differences model needs to satisfy the assumption of parallel trends. This paper examines the dynamic effects. The results show that there is no significant difference in ESG trends between the pre-treatment group and the control group before the issuance of green bonds, and the parallel trend hypothesis holds true. Just as shown in **Figure 1**.

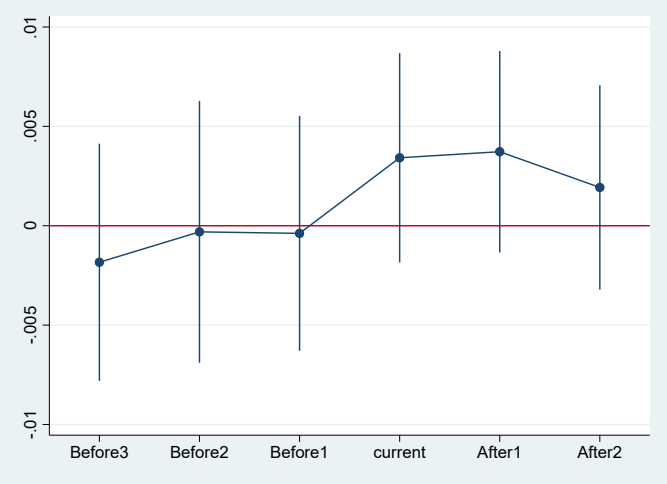

Figure 1. Parallel trend test results

5.2. Placebo test

To eliminate the interference of other factors, this paper randomly assigned the experimental group and the control group to conduct a placebo test. **Figure 2** illustrates the placebo test plot. The repeated regression results show that the estimated coefficients of the core variables are concentrated around 0, proving that the benchmark conclusion is robust and not disturbed by non-random factors.

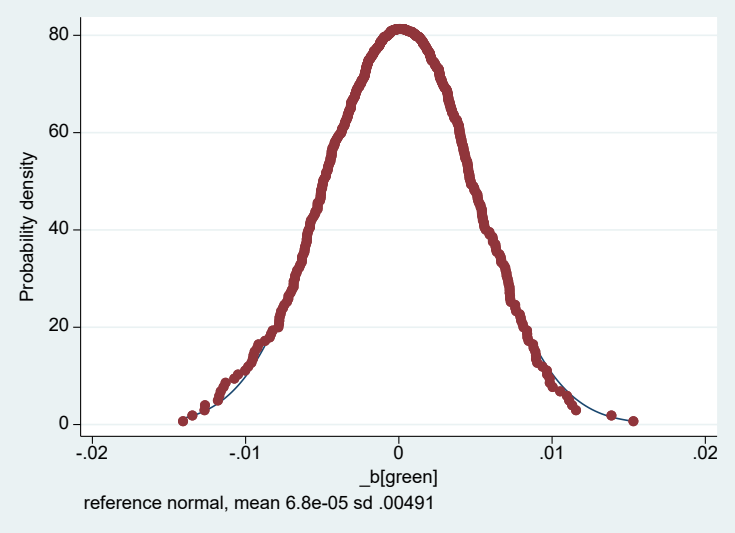

Figure 2. Placebo test plot

5.3. Robustness test in the time dimension

Given that green bonds have been officially implemented since 2016, the sample period has been shortened to 2016–2023 for a re-estimation. The results show that the coefficient of Green×Post remains significantly positive (0.056, $P < 0.05$, $N = 951$, $R^2 = 0.2454$), consistent with the benchmark conclusion in **Table 1**, further verifying the robustness of the results.

6. Heterogeneity analysis

This paper further explores the heterogeneous impact of green credit across the environmental, social, and governance dimensions of ESG. The results in **Table 2** show that green credit is significantly positively correlated with the E and S dimensions at the 5% level, effectively improving the environmental and social performance of power generation enterprises, while its effect on the G dimension is statistically insignificant.

Table 2. Results of heterogeneity analysis

	Environment	Society	Governance
	lne	lns	lng
Green×Post	0.138**	0.114**	0.026
size	0.078***	0.033***	0.007
lev	-0.124	-0.019	-0.102**
roe	-0.217**	-0.040	-0.027
cashflow	0.061	0.178	0.189**
top1	-0.200	-0.267***	0.116**
dual	0.029	-0.030	-0.025
_cons	2.344***	3.648***	4.200***
N	1135	1135	1135
R^2	0.2030	0.1805	0.1348

***$P < 0.01$, **$P < 0.05$, *$P < 0.10$

7. Conclusion and recommendations

7.1. Conclusions

This paper takes Chinese listed power generation enterprises from 2013 to 2023 as samples and empirically examines the impact of green credit on the green transformation of enterprises by using the difference-in-differences model. The results show that green credit can significantly promote the green transformation of power generation enterprises. For every 1% increase in the issuance scale of green bonds, the ESG performance of enterprises improves by 0.060%. Heterogeneity analysis shows that green credit has a significant enhancing effect on the environmental (E) and social (S) dimensions, but has no significant impact on the corporate governance (G) dimension.

7.2. Recommendations

Based on the above analysis and conclusions, this paper puts forward the following suggestions:

For the government: (1) Improve the standards and dynamic supervision mechanism for green credit. Relevant departments should further refine the technical directory for green credit in the power generation industry and establish a dynamic adjustment mechanism. Differentiate the ratings of clean coal power and renewable energy projects to guide precise financial support. (2) Strengthen policy coordination and regional differentiated incentives. Local governments should, in light of the regional energy structure (such as the abundant wind and solar resources in the northwest region and the great potential for nuclear power in the eastern coastal areas), formulate differentiated green credit assessment indicators. At the same time, link the scale of green credit with the allocation of local carbon quotas to form a policy synergy of “finance and environment.”

For financial institutions, the default risk of high-carbon enterprises should be quantified. Establish a long-term assessment mechanism for green credit, bind the green credit performance of banks to the compensation incentives for management, and avoid short-sighted lending behavior.

For power generation enterprises, they should proactively disclose their transformation paths to reduce financing costs and obtain green loans with lower interest rates through transparent information. They should also introduce talents to actively promote their own green innovation.

Disclosure statement

The author declares no conflict of interest.

References

[1] Chen XY, Huang W, 2024, Green Financial Policies and Total Factor Productivity of Green Enterprises: Empirical Evidence from the Implementation of the Green Credit Guidelines. Collected Essays on Finance and Economics, (04): 60–69.

[2] Lei ZH, Guo AJ, 2023, Can Green Credit Policy Affect Firms' Total Factor Productivity?—Empirical Evidence from A-Share Listed Companies. Journal of China University of Geosciences (Social Sciences Edition), 23(06): 100–113.

[3] Lin LF, Sun X, 2024, An Empirical Study on the Impact of Green Credit on Green Performance of Listed Enterprises in Energy-Intensive Industries. Modern Economic Research, (02): 82–92.

[4] Hu RC, Liao ZS, 2023, Research on the Impact of Green Credit on the Low-Carbon Transformation of Power Generation Industry. Industrial Technology & Economy, 42(01): 79–89.

[5] Zhang RH, Zhou YH, 2024, Green Finance, Carbon Emission Intensity and Corporate ESG Performance: An Empirical Study Based on Micro Data of Listed Enterprises. Social Sciences, (03): 126–140.

[6] Hammoudeh S, Ajmi AN, Mokni K, 2020, Relationship Between Green Bonds and Financial and Environmental Variables: A Novel Time-Varying Causality. Energy Economics, 92: 104941.