Impact of the Promulgation of Green Credit Policies on the Innovation Ability of Electrical Machinery and Equipment Manufacturing Enterprises

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Abstract. Focusing on China's machinery manufacturing industry, this analysis assesses green financing mechanisms' impact on corporate innovation in electrical equipment production..Due to the background of implementation of green credit issued by China in 2012, Select the data of 33 listed electrical machinery and equipment manufacturers in 2008-2020 to build a fixed-effect panel model with the number of patents as the explanatory variables, the policy dummy variables (bordered in 2012) as the core explanatory variables, and control factors such as enterprise scale and financial indicators. The research found that the patent output in a short period of time has not been improved by policy, indicating that the effect of the policy is lagging or the enterprise needs to adjust the research and development direction for a longer time; Accordingly, it is proposed to optimize the policy design to strengthen long-term incentives, improve the information disclosure mechanism, unify environmental performance standards, reduce the asymmetry of bank-enterprise information, and help the industry's green transformation. The research provides an empirical basis for improving the green finance policy and stimulating the innovation vitality of technology-intensive industries

1 Introduction

Amid escalating global ecological crises, climate change constitutes an existential challenge to human development. Nations worldwide recognize the imperative of sustainable environmental stewardship, implementing coordinated mitigation strategies. China, as a responsible major power prioritizing ecological governance, integrates ecological civilization into national development paradigms. Its "dual-carbon" commitment demonstrates resolute climate leadership while fulfilling global responsibilities. Within this framework, sustainable finance emerges as a pivotal enabler, with green credit mechanisms serving as primary policy instruments. These leverage financial markets to redirect capital from pollution-intensive sectors toward eco-innovative enterprises, thereby catalyzing low-carbon industrial transformation and providing critical funding for corporate environmental initiativesSince

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2012, China has gradually built and improved the green credit policy system, and has issued a series of policy documents, which clarified the support areas of green credit, environmental risk assessment standards and information disclosure requirements. As a core component of China's industrial ecosystem, the electrical machinery manufacturing domain plays a strategically vital role in sustaining the country's overall economic structure. The industry covers many fields such as power generation equipment, power transmission and transformation equipment, battery manufacturing, and household appliances. However, the electrical machinery and equipment manufacturing industry is facing increasingly severe environmental protection pressure in the process of development. On the one hand, the discharge of wastewater, waste gas, waste residue and energy consumption in the production process has a certain impact on the ecological environment; on the other hand, with the global green development tide With the rise of flow, the international market has continuously improved the environmental protection standards and low carbon requirements of electrical and mechanical products, and enterprises are facing stricter environmental protection regulations and market competition pressures. At the same time, the industry's demand for innovation capabilities is becoming more and more urgent. As a technology-intensive industry, the innovative ability of electrical machinery and equipment manufacturing directly determines its position and competitiveness in the global industrial chain. Realizing low-carbon technological breakthroughs and promoting industrial upgrading is the only way for the industry to respond to environmental protection pressure and achieve sustainable development. Nevertheless, unresolved challenges persist regarding industrial characteristics including scale economies and inter-policy coordination. The precise impacts of green credit instruments on electromechanical manufacturers' innovation capacity remain inadequately substantiated. Comprehensive investigation holds dual theoretical-practical importance: refining green finance frameworks, energizing sustainable innovation in electrical equipment sectors, and advancing China's manufacturing modernization.

2 Literature review and hypothesis

2.1 Literature review

In recent years, green finance policies have attracted much attention, and "green finance" as one of them has caused extensive research.In addition, in 2012, the "Green Credit Guidelines" of the China Banking Regulatory Commission was proposed, and the academic community was A systematic empirical study was carried out on the effect of the implementation of this policy, and the in-depth analysis of panel data model and case was discussed, and the multi-level impact of the policy on the efficiency of resource allocation, technological upgrade path and market response mechanism was discussed. In the study of policy effects, the impact of green credit policies on restricting innovation in industries has become the focus of academic disputes [1]. The academic community has formed two opposing views. Among them, Yang Liuyong and Zhang Zeye, who support the first point of view, in 2012 The "Green Credit Guidelines" policy was introduced as a quasi-natural experiment, and it was found that this policy has significantly inhibited the green innovation activities of heavy pollution enterprises, and the inhibition effect is particularly significant in non-state-owned enterprises, small enterprise samples and green invention patents [2]. This finding aligns with Su Dongwei and Lian Lili's empirical work. Their analysis verifies that environmental credit regulations substantially constrict external capital access for high-pollution industries, consequently diminishing corporate innovation investment capacity [3]. From institutional finance frameworks, Ding Ning and co-researchers demonstrated a U-curve effect linking environmental credit policies to banking operational efficiency. Such evidence confirms that credit portfolio realignment during policy initiation stages fundamentally directs firms' innovation pathways [4]. In contrast, the main "reversing effect" supporters, such research is based on the Porter hypothesis, and that environmental regulation can stimulate the innovation compensation effect of enterprises [5]. Wang Xin and Wang Ying's analysis of green financing's role in eco-innovation postulated that sectors targeted by credit restrictions under this policy demonstrate heightened engagement in sustainable R&D activities [6]. Investigating the heterogeneous policy impacts of the "Green Credit Guidance," Ding Jie and colleagues contrasted heavily polluting industries with enterprises focused on energy conservation and environmental protection. Their results demonstrate that the policy meaningfully boosts green innovation outputs among the latter group [7]. Yu Bo's analysis, grounded in external financing and internal environmental factors, revealed that the "Green Credit Guidelines" significantly boosted green patent filings among policy-restricted firms. Crucially, state-owned enterprises (SOEs) with advanced digital capabilities exhibited heightened enthusiasm for pursuing such innovations [8]. At the same time, through Wang Chunying and Chen Hongmin's research on the motivation of the self-transformation of manufacturing enterprises, can know that large electrical manufacturing enterprises, due to the large number of departments involved, have a high degree of digitalization, which can promote their green and low-carbon transformation and effectively reduce carbon emissions [9]. Therefore, it is reasonable to select the policy influence of the electrical machinery and equipment manufacturing industry to study green credit.

Discrepancies observed across the two theories underscore the multifaceted nature of green credit policy implementation mechanisms. Existing research focuses on the direct effect of policies, and the systematic analysis of regulatory factors such as heterogeneity of enterprises and industry characteristics is still insufficient. To this end, this paper mainly takes the electrical machinery and equipment manufacturing industry as an example, analyzes and studies the problem of green credit affecting the innovation ability of this industry, and conducts empirical analysis based on theoretical interpretation

2.2 Hypothesis

The release of the "Green Credit Guidelines" has had many influences on the behavior of enterprises. In terms of green technology innovation, The "Guidelines" improves investment efficiency while reducing agency costs, which is conducive to the purpose of commercial banks to carry out green credit assessment [6]. At the level of R&D capabilities of enterprises, the "Guidelines" will significantly reduce the difficulty of obtaining funds for enterprises, especially those who are committed to green projects, by providing preferential loan conditions, and reduce the financial burden of such enterprises and ensure their long-term innovation capabilities [10]. Regarding innovative capacity, technological advancement serves as the ultimate manifestation of corporate resource allocation efficacy, measurable through patent metrics. Guided by sustainable lending policies, enterprises reorient capital toward low-carbon R&D initiatives, augmenting investments in eco-innovation projects. This resource reconfiguration catalyzes technical progress within electromechanical equipment production - a sector intrinsically aligned with green financing objectives - ultimately elevating intellectual property outputs.

Building upon the established empirical foundation, this investigation postulates its core theoretical premise:

H1: Implementation of environmental financing policies demonstrates significant innovation-enhancing effects for electrical machinery manufacturers, independent of extraneous variables.

3 Research design

3.1 Sample selection and data sources

Research subjects were drawn from listed corporations operating in the electromechanical manufacturing industry. as well as the relevant enterprises obtained in the Guotaian database and the CNRDS database in 2008-2 In 20020, the annual report and independent patent data information, excluding the lack of financial data of the target years, finally established and obtained a total of 416 related indicators of 33 companies

3.2 Model design and variable definition

3.2.1 Interpreted variables

This study employs current-year proprietary patent grants in electromechanical equipment manufacturing as the dependent variable. This composite metric encompasses invention patents, utility model registrations, and design patents secured independently by firms..

3.2.2 Interpretation Variables

This research designates sustainable lending as the primary explanatory variable. Given China's absence of specialized databases disclosing industry-specific credit allocations, the analysis compiles annual reports from six major state-owned commercial banks and eight publicly traded joint-equity banks. These records reveal consistently high growth in environmental financing balances. Following established scholarly practice, the Green Credit Guidelines are treated as an exogenous policy shock affecting new energy investment efficiency. Employing 2012 as the policy implementation threshold within the 2008-2020 observation window, the study conducts quasi-experimental analysis of pre-post regulatory periods to examine relationships between sustainable lending mechanisms and proprietary patent outputs in electromechanical manufacturing.

3.2.3 Model Design

Benchmark model:

Considering the timing and individual heterogeneity of the electrical machinery and manufacturing patent data, the fixed-effect panel model is adopted, and the basic shape is as follows:

$$patent_{it}=\alpha_0+\beta_1 Imp_{it}+\beta_2 X_{it}+\sigma_i+\varepsilon_{it} \tag{2}$$

Description of this formula,$patent_{it}$is the number of patents in Enterprise i in the t year;represents the policy virtual variable, which is bounded by the promulgation year. In 2012 (not included), take 0 in the previous year, otherwise take 1;

$X_{it}$is the control variable, specifically, these include the leverage ratio (LEV), return on total assets (ROA), and firm scale measurements (SIZE).

3.2.4 Control Variables

To preserve methodological rigor and result robustness, this investigation implements systematic controls for potential confounding factors within both green financing regulations and electromechanical manufacturing sector dynamics. As outlined in Table 1, following the principle of volume, screen the financial characteristics of enterprises, including the intensity of R&D investment and the return on assets, as well as the corporate governance attributes covering the scale of assets, which serve as the control variables of the model in this paper.

Table 1. Relevant variable indicators and measurements

Variable type	Variable name	Variable symbol	Variable definition
Interpreted variable	Number of independent patents in the current year	patent	The aggregate measure encompasses three autonomous patent categories: innovative invention patents, self-developed utility innovations, and proprietary design protections.
explanatory variable	policy attribute dummy variables	imp	With the promulgation year as the boundary, in 2012 (not included), take 0 in the previous year, otherwise take 1
control variable	asset-liability ratio	lev	Total liabilities divided by total assets
	return on assets	roa	Net profit divided by total assets
	Enterprise size	size	Logarithmic calculation of total assets

4 Analysis of empirical results

4.1 Descriptive statistics

Table 2 presents descriptive statistics for the study's principal model variables There is a large difference in the variables of the electrical machinery and the manufacturing industry at the level of its own characteristics.

Table 2. Descriptive Statistics of Full Samples.

Variable	Obs	Mean	Std.Dev	Min	Max
patent	416	189.363	694.8516	0	7629
imp	416	0.6923077	0.4620942	0	1
lev	416	0.5154922	0.2093134	0.0697986	1.222844
roa	416	0.0381686	0.094551	-1.012832	0.321968
size	416	22.16595	1.385611	18.78334	26.36861

4.2 Regression results of the baseline model

From the regression results, the policy variables show a significant positive effect in column (1), but the column (2) after adding the enterprise control variable, some variables are not significant compared to (1), the reason includes the interference of intermediary factors.

Different years have different macroeconomic environments and industry development trends, regional resource endowments and industrial facilities are different, and there are areas where resources are scarce or industrial facilities are not perfect. It is difficult for enterprises to effectively convert credit funds into investment efficiency improvement. As well as the difference in policy implementation, different scientific research capabilities of different companies are different, and the actual investment of scientific research by enterprises is different, which affects the effectiveness of the policy to improve the investment efficiency. The diffusion of policy influence equally stems from enterprises' internal operational intricacies. Within diversified corporations, divergent capital utilization efficiencies and financing demands coexist alongside convoluted administrative frameworks, collectively fragmenting intervention outcomes. Due to the limitations of information disclosure, enterprises may understand the deviation of environmental information, the disclosure does not meet the policy and evaluation standards, and it is difficult to adjust credit support promptly, making it difficult to reflect the role of policy promotion. As stated in Table 3:

Table 3. Benchmark regression results.

	(1)	(2)
	patent	patent
imp	205.4887***	263.4505*
	(4.0230)	(1.8760)
lev		-110.0000
		(-0.6008)
roa		-160.0000
		(-0.5724)
size		148.9729***
		(2.7603)
_cons	47.1016	-3100.0000***
	(1.1083)	(-2.6491)
N	416	416
R2	0.041	0.118
adj. R2	-0.040	0.008

5 Conclusion

Based on longitudinal data (2008-2020) from publicly traded electrical machinery producers, this research tests green financing policies' impact on innovation capacity. Initial post-implementation analysis reveals the Green Credit Guidelines failed to elevate patent productivity significantly. Although firm scale demonstrated positive marginal effects - suggesting resource advantages may stimulate innovation in larger entities - the stability of this relationship demands additional empirical validation. The weak correlation between financial indicators and innovation" shows that traditional financial indicators are difficult to explain the driving force of innovation in this industry, and need to focus on non-financial factors such as R&D investment and policy subsidies.

In light of the empirical outcomes, this research formulates actionable policy recommen dations:

First, optimize the design of green credit policies and strengthen long-term incentives. Regulatory bodies should systematically prolong evaluation timeframes for sustainable lending mechanisms at the macro-governance tier, and the evaluation of innovation output lag effect should be included, so as to avoid short-term performance-oriented and weaken the effect of the policy. Financial institutions can develop "green innovation special loans", incorporate the number of patents and low-carbon technology breakthroughs into the credit evaluation system, and target to support the green R&D activities of enterprises.

Second, improve the information disclosure and supervision mechanism to improve policy transparency. Regulatory departments need to unify the green credit environment performance disclosure standards, force enterprises to disclose key indicators such as investment in research and development, carbon emission intensity, etc., and reduce the asymmetry of information on banks and enterprises. The local government should establish a "white list of green innovation enterprises", and cooperate with financial institutions to provide one-stop financing services for enterprises in the list, simplify the approval process, and improve the efficiency of capital utilization.

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