Performance Evaluation of Green Finance in Supporting the Development of the New Energy Sector

Peilin Yang*

Institute of Economics, Shandong University of Finance and Economics, Jinan Shandong, 250000, China

*Corresponding author: 2869620799@qq.com

Abstract. This study investigates the impact of green financial instruments on the profitability of new energy enterprises in China using panel data from 2019 to 2023. Drawing on fixed effects regression analysis, the results reveal that green credit and green equity financing significantly enhance firm-level net profit, highlighting their dual role in supporting both short-term liquidity and long-term growth. In contrast, green bonds exhibit a negative relationship with profitability. Additionally, carbon emission intensity imposes a significant financial burden on firms, while variables such as disclosure quality and firm age are not statistically significant. The findings underscore the structural heterogeneity in green finance effectiveness and call for improvements in policy alignment, financial institution capacity, and the diversity of financing tools. The study provides theoretical insights and practical policy recommendations for optimizing green finance as a strategic driver of sustainable development in the new energy sector.

Keywords: Green Finance Mechanisms; Emerging Energy Sector; Performance Evaluation; Carbon Emission Intensity

1 Introduction

Against the backdrop of the global "dual carbon" initiative, green development has emerged as a defining pillar of China's economic transformation in the new era. As a strategic cornerstone within the broader low-carbon framework, the new energy sector has been explicitly positioned in the 20th National Congress report as a priority area for high-quality national development. Concurrently, green finance—functioning as an important approach for channeling capital toward environmentally responsible domains—has begun to assert its influence through both policy interventions and market-driven dynamics. The integration of green finance into the core development architecture of the new energy industry not only facilitates a more rational allocation of financial resources and reduces capital acquisition costs, but also significantly strengthens the long-term sustainability and competitive resilience of energy enterprises. In this context, an empirical examination of how green financial instruments support the operational performance and strategic advancement of new energy firms is not only timely, but also holds substantial theoretical and practical significance.

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2 Literature Review

2.1 Domestic Literature Review

In the wake of China's official commitment to its "dual carbon" targets, the academic community has demonstrated growing interest in exploring how green finance can serve as a catalytic force in advancing the new energy sector. Gao Xiaoyan, Ren Ziping, and Wang Zhiguo (2019) argue that green finance—through mechanisms such as green credit allocation, the issuance of environmental bonds, and the gradual maturation of carbon trading markets—is evolving into a systematic financial infrastructure that supports the expansion of renewable energy industries[1]. More recently, based on empirical analysis using panel data, Cao Kunyuan (2024) found that green credit exerts a significantly positive influence on the profitability of publicly listed new energy firms, with particularly strong effects observed in regions characterized by active environmental investment and robust governmental incentives[2]. In addition, Chen Wenjun and Xiong Linbo (2024) highlight the nonlinear nature of green finance's impact, suggesting that its effectiveness varies considerably depending on factors such as the maturity of the technology, the stage of the industry's life cycle, and the degree of regulatory support[3]. Overall, the domestic literature has constructed a solid foundation in analyzing green finance from the perspectives of policy guidance, financial instrument efficacy, and regional disparities. Nevertheless, there remains a discernible gap in empirical research at the firm level—particularly in assessing the differentiated impact of various green financial tools on corporate performance.

2.2 Abroad Literature Review

Compared to domestic scholarship, international research on the interplay between green finance and the new energy sector began earlier and has evolved into a more diversified and multi-dimensional body of inquiry. [4]Drawing on firm-level data from the United States, Flammer (2021) demonstrated that the issuance of green bonds contributes not only to reducing firms' capital costs but also to enhancing their environmental performance—an effect particularly pronounced within the renewable energy domain, where green bonds act as a strong incentive mechanism[5]. Ahmadi (2021), analyzing several emerging market economies, identified a significant positive relationship between green credit and investment willingness among renewable energy firms, especially in contexts where policy incentives and fiscal subsidies operate in tandem[6]. Meanwhile, Li, Zhang, Dai, and colleagues (2022) shifted attention to institutional mechanisms, arguing that policy transparency and well-structured green assessment frameworks are critical to ensuring the effective transmission of green financial support to new energy enterprises. Further, Zhao (2024) observed that the relationship between green finance and corporate performance is highly stage-dependent under increasing carbon constraints, emphasizing the mediating role of regulatory infrastructure in shaping financial impact[7]. Collectively, these international studies have laid the groundwork for a robust theoretical and empirical framework that explores not only the functional efficacy of green financial instruments, but

also the institutional conditions under which such mechanisms yield optimal outcomes—offering valuable insights for emerging economies seeking to refine their own green finance systems.[8]

2.3 Literature Review

A review of both domestic and international scholarship reveals that researchers have extensively explored the pathways through which green finance influences the development of the new energy sector, primarily from the perspectives of green credit, green bonds, and policy intervention. [9]These studies have laid a foundational theoretical and empirical framework that illuminates the broader institutional and financial mechanisms at play. [10]However, much of the existing literature tends to concentrate on macro-level policy dynamics or the structural features of financial instruments themselves, often overlooking the nuanced performance outcomes at the firm level. [11]In particular, there remains a marked deficiency in comparative analyses that examine how different types of green financial tools exert heterogeneous effects on corporate profitability and operational outcomes. [12]Responding to this research gap, the present study takes operating performance as the entry point and incorporates multiple categories of green finance into a firm-level empirical model. In this way, it aims to offer a more targeted and practice-oriented contribution to the ongoing discourse, emphasizing the microeconomic realities of how green finance mechanisms translate into measurable performance impacts within new energy enterprises.

3 Current Landscape of Green Finance in Supporting the New Energy Sector

3.1 Scale of Green Finance Investment in the New Energy Sector

According to statistical reports released by the People's Bank of China and the National Financial Regulatory Administration, by the end of 2023, the total balance of green loans nationwide had exceeded RMB 25 trillion. Of this amount, over 30% was directed toward clean energy and new energy sectors. In the same period, the outstanding volume of green bonds reached RMB 2.9 trillion, with approximately one-fifth of the proceeds channeled into new energy industries such as solar photovoltaics, wind power, and biomass energy. The overall trajectory of green finance investment exhibits a sharp upward trend, with an average annual growth rate exceeding 20%. This acceleration underscores green finance's evolving role as a key funding mechanism for scaling up production, driving technological innovation, and supporting infrastructure development within new energy enterprises. Driven by a synergy of policy initiatives, regulatory frameworks, and market forces, green finance is gradually establishing a more expansive and multidimensional financial support system tailored to the structural needs of China's energy transition.

3.2 Composition of Green Finance Funding for the New Energy Sector

In recent years, China's green finance system has been continuously improved, and the range of financing instruments supporting the new energy sector has become increasingly diversified, encompassing green credit, green bonds, green equity financing, and government-led investment funds. Among these, green credit remains the dominant source of capital. As of the third quarter of 2024, the total balance of green loans nationwide reached RMB 35.75 trillion, representing a year-on-year increase of 19% and accounting for 13.9% of all outstanding loans. Notably, green infrastructure and clean energy projects have attracted a significant proportion of this funding.The green bond market has shown some volatility. In 2024, the issuance of green bonds in China declined by 18% year-on-year, with their share of the domestic bond market falling from 1.17% in 2023 to 0.85%. Nevertheless, innovative instruments such as carbon-neutral bonds and blue bonds have demonstrated certain growth potential.With respect to green equity financing, by 2024 there were more than 296 public funds in China focused on sustainable development themes, with total assets exceeding USD 55.5 billion. These funds primarily invest in sectors such as new energy, green transportation, and environmental technologies.Overall, while green financial instruments are becoming increasingly diversified, the financing structure remains unbalanced, with commercial bank loans still accounting for the largest share of green finance, and support from capital market instruments relatively limited. This structural imbalance has, to some extent, constrained the development of high-risk, high-reward innovation projects, highlighting the urgent need to build a well-integrated, multi-tiered green financial system that can match capital with the complex lifecycle needs of the new energy industry.

3.3 Priority Areas of Green Finance Support for the New Energy Sector

With the deepening implementation of China's dual carbon strategy, green finance has played an increasingly prominent role in guiding capital towards the key areas of the new energy sector. Currently, the primary focus of green financial support lies in renewable power generation such as solar and wind, as well as energy storage and smart grid construction that enable large-scale integration of renewables. At the same time, a growing portion of funds is directed toward the research, development, and commercialization of innovative clean energy technologies—including hydrogen, geothermal, and biomass energy—driving technological breakthroughs and fostering industrial upgrading. Green finance is also supporting energy efficiency retrofitting in traditional industries, promoting the reduction of carbon emissions through upgrades and process optimization. In addition, the emerging carbon trading market and related carbon asset management have become new directions for financial innovation and investment, providing market-driven incentives for emissions reduction. Overall, by channeling resources to these priority areas, green finance is underpinning the high-quality and sustainable growth of China's new energy sector.3.4 Key Challenges in the Current Green Finance Support for the New Energy Sector

3.3.1 Incomplete Policy Support System.

While a preliminary top-level framework for green finance has been established, its implementation at the operational level remains fragmented and underdeveloped. Standards for project classification, financial subsidies, and tax incentives differ considerably across regions and administrative levels, leading to a patchwork of regulatory interpretations and inconsistent enforcement. Moreover, current green finance policies tend to be overly general and principle-based, lacking the detailed operational guidelines necessary for execution. As a result, financial institutions struggle to identify qualified green projects with confidence, increasing institutional risk and reducing their willingness to allocate capital. This regulatory gap undermines the incentive effect of green finance policies and constrains the ability of new energy enterprises to access the financial tools essential for scaling up investment in high-quality green projects.

3.3.2 Low Allocation Efficiency within Commercial Banks.

Commercial banks, as the backbone of China's green financial system, continue to demonstrate both a limited willingness and a constrained capacity to finance new energy enterprises. On the one hand, the green loan approval process is often slow and complex, which impedes access to timely funding for technologically innovative firms. On the other hand, the prevailing risk appetite in the banking sector remains skewed toward traditional, low-volatility industries. This results in a bias toward short-term, low-risk lending products and insufficient financial support for long-cycle, high-risk green projects. Compounding this problem is the fact that most banks lack specialized green finance departments or staff trained in environmental project evaluation. Their limited expertise in assessing environmental returns and quantifying financial performance further reduces allocation accuracy, impeding the goal of "targeted green capital deployment."

3.3.3 Underdeveloped Market-Based Financing Channels.

China's green finance landscape is still dominated by bank lending, with market-based financing tools such as green bonds, green funds, and equity investments playing a relatively minor role. Although these instruments have begun to emerge, their overall scale remains small, and the variety of available tools is limited. More importantly, they often fail to match the diverse capital needs of new energy firms at different stages of development. In the area of equity financing, participation by green industry guidance funds and venture capital remains limited, leaving early-stage clean technology enterprises particularly vulnerable to financing bottlenecks. Furthermore, China's carbon trading market is still in its infancy, lacking a robust pricing mechanism and adequate liquidity, which hinders the establishment of a reliable green asset valuation system. These shortcomings not only constrain the diversification of green financial flows but also impair the optimization of the overall financing structure, making it difficult for the new energy industry to maintain innovation momentum and achieve large-scale, sustained investment growth.

4 Empirical Analysis of the Impact of Green Financial Instruments on Net Profit in New Energy Enterprises

4.1 Data Sources and Sample Selection

This study focuses on publicly listed new energy enterprises on the Shanghai and Shenzhen stock exchanges during the period from 2019 to 2023. The dataset was primarily compiled from authoritative sources including the Wind Financial Terminal, annual reports of listed companies, and statistical bulletins on green finance published by the People's Bank of China. The sample spans key subsectors such as photovoltaic power, wind energy, and biomass, ensuring broad industry representativeness. To enhance the consistency and reliability of the dataset, firms designated as ST or *ST (special treatment) as well as those with incomplete financial disclosures were excluded. The final panel dataset comprises 728 valid firm-year observations, forming a robust empirical foundation for subsequent quantitative analysis.

4.2 Variable Definitions and Measurement

To investigate the impact of green financial instruments on the operational performance of new energy enterprises, this study adopts net profit as the dependent variable. The core independent variables include green credit, green bonds, green equity financing, and green financial product innovation. Control variables are introduced to capture the influence of firm-level environmental and operational characteristics, such as carbon emission intensity, environmental information disclosure quality, and years of operation. A fixed effects panel regression model is employed to account for unobserved heterogeneity across firms, ensuring that the estimation results are both statistically robust and economically interpretable. The construction of all variables is grounded in theoretical relevance and practical operability.

4.2.1 Dependent Variable: Net Profit.

Net profit serves as a central metric for evaluating corporate financial performance, reflecting the residual earnings of a firm after deducting all operational costs, taxes, and other expenses. It offers a comprehensive and direct measure of a company's profitability and financial health. In this study, net profit is used as the dependent variable to assess the real-world financial impact of green financial instruments on new energy firms. This metric allows for an intuitive and transparent evaluation of how different types of green finance affect enterprise profitability.

4.2.2 Independent Variables: Green Financial Instruments.

The independent variables of primary interest consist of a range of green financial tools, namely green credit, green bonds, green equity financing, and the number of green financial product innovations. Green credit and bonds capture the debt-based financial support extended by banks and other institutions, while green equity financing reflects the capital market's direct investment into new energy enterprises. In addition,

the inclusion of financial innovation metrics reflects the dynamic development of new green finance products and their potential to shape financing behavior. All variables are measured on an annual basis at the firm level and undergo appropriate standardization to ensure model comparability.

4.2.3 Control Variables.

To strengthen the model's robustness, several control variables are introduced. Carbon emission intensity is employed to reflect the regulatory and compliance pressures exerted on firms with high environmental externalities. The quality of environmental information disclosure serves as a proxy for corporate transparency and reputational standing in sustainability. Firm age (years of operation) is included to account for potential lifecycle effects, such as experience, stability, and market adaptation. Together, these controls allow for a more nuanced understanding of how green finance interacts with firm-specific factors to influence profitability.

4.3 Empirical Model Setting and Regression Analysis

4.3.1 Model Specification: Construction of a Fixed Effects Panel Model.

To empirically assess the influence of green financial instruments on the profitability of new energy enterprises, this study adopts a panel data fixed effects (FE) model. The fixed effects approach is chosen to control for unobservable, time-invariant firm-specific heterogeneity that may otherwise bias the estimation results—such as managerial quality, regional regulatory environments, or internal governance structures. This modeling strategy enables a more accurate estimation of the net impact of green financial variables by isolating within-firm variations over time.

The basic structure of the model is formulated as follows:

$$\mathrm{Profit}it = \alpha + \beta_1 \mathrm{GLoan}it + \beta_2 \mathrm{GBond}it + \beta_3 \mathrm{GEquity}it + \beta_4 \mathrm{GInnov}it + \gamma \mathrm{Controls}it + \mu_1 + \varphi_t + \epsilon_{it} \quad (1)$$

Where:

$\mathrm{Profit}it$ denotes the net profit of firm i in year t;

$\mathrm{GLoan}it, \mathrm{GBond}it, \mathrm{GEquity}it$, and $\mathrm{GInnov}it$ represent green loan, green bond, green equity financing, and green product innovation respectively;

$\mathrm{Controls}it$ includes carbon intensity, disclosure quality, and firm age;

μ_1 captures firm-specific effects, φ_t accounts for time-fixed effects, and ϵ_{it} is the idiosyncratic error term.

This model structure allows for a rigorous exploration of how green finance variables impact firm-level profitability, while mitigating potential confounding factors.

4.3.2 Empirical Results and Economic Interpretation.

Regression results were obtained using standard econometric software. The outcomes are summarized in Table 1.

Table 1. Regression Results: The Impact of Green Financial Instruments on Net Profit of New Energy Enterprises

Variable	Coefficient	Std. Error	Significance Level
Green Credit (GLoan)	0.002	0.000	***
Green Bond (GBond)	-0.012	0.002	***
Green Equity Financing (GEquity)	0.117	0.028	***
Green Product Innovation (GInnov)	-3.80e+08	3.50e+09	Not Significant
Carbon Emission Intensity (Carbon)	-4091.685	328.839	***
Disclosure Quality (Disclosure)	-3.103	1.965	Not Significant
Firm Age (Age)	1.43e+08	1.37e+08	Not Significant
Constant	3.24e+11	2.66e+10	***
Observations	728		

Note: * p<0.1, ** p<0.05, *** p<0.01

The regression results reveal that both green credit and green equity financing exhibit statistically significant positive relationships with corporate net profit, each at the 1% significance level. Specifically, an incremental increase in green credit is associated with a 0.002 rise in net profit, suggesting that such financing plays an important role in bolstering the short-term liquidity of new energy enterprises. Likewise, the coefficient of 0.117 for green equity financing highlights its contribution to optimizing capital structures and enhancing long-term growth capacity.In contrast, green bonds demonstrate a significant negative effect on profitability, with a coefficient of -0.012. This adverse outcome may stem from the fixed interest burden imposed by bond financing, as well as the delayed return cycles typical of long-horizon infrastructure projects, where capital deployment precedes revenue generation by a substantial margin.Among the control variables, carbon emission intensity exerts a notably negative impact on net profit, underscoring the financial pressure introduced by environmental regulation and carbon reduction mandates. Meanwhile, the variables representing environmental disclosure quality and firm age do not show statistically significant relationships with profitability, suggesting that transparency and operational longevity do not directly translate into immediate financial benefits within the observed period.

4.4 Conclusion and Discussion of Findings

The regression findings suggest that the effects of green financial instruments on corporate profitability are not universally positive. While green credit and green equity financing significantly enhance the net profit of new energy enterprises, green bonds exhibit a statistically significant negative relationship with profitability. This divergence underscores the dual value of green finance—its capacity to support both short-term operational liquidity and long-term strategic growth. Credit-based instruments, characterized by their relatively low thresholds and flexible usage, serve as vital channels for project expansion. In contrast, equity financing strengthens a firm's capital base, reduces financial leverage, and enables firms to undertake large-scale investments and R&D-intensive activities.

However, the negative coefficient associated with green bonds raises concerns about their structural fit within current corporate financial frameworks. One plausible explanation is that bond issuance imposes interest burdens before project cash flows begin to materialize, thereby depressing short-term profitability. Additionally, the lack of statistical significance for green financial product innovation may reflect either limitations in measurement precision or the inherently delayed impact of innovation adoption and diffusion within the market.

Among the control variables, carbon emission intensity was found to exert a strong and negative influence on firm profitability, highlighting the tangible financial cost of meeting environmental compliance targets. This reinforces the urgency for enterprises to accelerate their green transition strategies in response to mounting decarbonization pressures.

Taken together, the empirical evidence reveals that the impact of green finance on corporate performance is structurally differentiated. The findings point to a critical need for policy refinements in three key areas: aligning financial instruments more closely with firm-specific needs, optimizing the capital structure of green financing portfolios, and strengthening incentive mechanisms. These improvements will be essential for enhancing the effectiveness of green finance as a systemic driver of high-quality development within the new energy sector.

5 Policy Recommendations for Enhancing Green Finance Support in the New Energy Sector

5.1 Improving the Policy Framework and Incentive Mechanisms

China's green finance policy framework remains in a stage of ongoing refinement, and current institutional weaknesses in top-level design, regulatory standards, and incentive alignment continue to impede the effective transmission of financial support to the new energy sector. One major challenge lies in the absence of uniform standards for identifying green projects; discrepancies in how green loans, bonds, and ratings are defined across regions and institutions hinder the efficient allocation of capital. To address this, it is essential for central regulatory authorities to develop a nationally unified green taxonomy, performance evaluation criteria, and disclosure guidelines to ensure policy coherence and transparency.

In addition, the government should enhance positive financial incentives for both lenders and borrowers. Mechanisms such as interest subsidies, tax relief, and risk-sharing schemes can help reduce the cost of green financing for enterprises and improve risk tolerance among financial institutions. The establishment of a dedicated green guarantee fund would further support credit enhancement for projects aligned with green standards. Moreover, the implementation of a dynamic policy feedback system is recommended to regularly assess and adjust the effectiveness of green finance instruments, ensuring that incentive mechanisms evolve in step with the capital demands of new energy enterprises. Such measures would enable a transition from top-down policy enforcement to a more self-sustaining, market-driven model.

5.2 Enhancing Financial Institutions' Investment Capacity and Risk Appetite

As the primary allocators of green financial resources, financial institutions play a decisive role in determining whether capital can be delivered to the new energy sector with both precision and efficiency. At present, however, many institutions suffer from inadequate professional expertise, rudimentary project evaluation capabilities, and a limited understanding of the characteristics of green enterprises. These deficiencies contribute to common obstacles such as difficulty in project identification, unreliable risk assessments, and limited implementation of green lending practices.

To address these challenges, financial institutions must improve their internal governance mechanisms related to green finance. This includes the establishment of dedicated approval channels for green credit, as well as classification and rating systems tailored to environmental project risk. Regulatory authorities should also strengthen oversight and guidance by encouraging banks and securities firms to create dedicated green finance teams and invest in specialized training programs to improve their technical competence in green investment evaluation and risk control.

On the policy side, green performance indicators—such as the proportion of green credit, the volume of green bonds issued, and the number of serviced green enterprises—should be integrated into institutional performance appraisals to incentivize active participation in the green transition. At the same time, the government should create mechanisms for financial and fiscal risk-sharing, such as green insurance and credit risk mitigation tools, to reduce institutional hesitation toward high-risk projects in the new energy sector. These interventions would promote a more favorable allocation of capital toward sustainable industries.

5.3 Expanding Financing Channels and Diversifying Green Financial Instruments

A robust green finance system cannot rely solely on conventional bank lending. Currently, China's green financing infrastructure remains underdeveloped, with an over-reliance on credit channels, underutilized capital markets, and a narrow range of financial instruments—factors that constrain the ability of new energy enterprises to meet diversified and evolving financing needs.

To resolve this, the development of a more flexible and mature green bond market should be prioritized. Policymakers should encourage the issuance of innovative debt instruments such as green revenue bonds, green asset-backed securities (ABS), and medium-term green notes, while maintaining high credit standards. These instruments would not only broaden financing options but also enhance investor appeal. Simultaneously, it is essential to foster the growth of green equity financing channels by supporting the establishment of industrial investment funds and venture capital platforms specifically targeting clean technology. Public-private partnerships—especially between local governments and major financial institutions—could serve as effective vehicles for injecting long-term capital into technology upgrades, equipment renewal, and capacity expansion.

Particular attention should be given to early-stage green enterprises, which often face acute financing constraints. Improving access to tiered capital markets, including the National Equities Exchange and Quotations (NEEQ) and the Beijing Stock Exchange, would help these firms gain visibility and capital support. In addition, the integration of carbon finance and green finance should be actively explored. Financial instruments such as carbon-neutral loans and securitized carbon revenue rights would enable firms to leverage environmental assets as collateral, providing an innovative and performance-linked financing path.

Lastly, foundational infrastructure for green finance must be strengthened. A unified national green project database, reliable environmental rating systems, and standardized disclosure platforms would increase transparency and efficiency in capital allocation. Building a financing ecosystem that is tool-diverse, institutionally mature, and responsive to firms' full lifecycle needs is essential for enabling the sustained, high-quality development of the new energy sector.

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