https://doi.org/10.63894/2024122501

A Study on The Impact of Financial Mismatch on Green Innovation Performance of Enterprises: Evidence from Listed Companies in China

Zhang Zhen Bo [1*] , Xia Zhen Zhou [2]
[1] Zhoukou Rural Commercial Bank, ZhouKou
[2] Zhoukou Branch of the People's Bank of China, ZhouKou
*Corresponding Email: zhangzhenbo2021@163.com

Abstract

Using Chinese listed companies from 2011 to 2022 as the research object, this study employs a two-way fixed effects model to empirically examine the impact of financial mismatch on corporate green innovation performance. The findings are as follows: First, based on regression analysis of the listed company sample and robustness tests, financial mismatch inhibits the development of both the "quantity" and "quality" of corporate green innovation; Second, regional heterogeneity analysis reveals that the impact of financial mismatch on the "quantity" and "quality" of corporate green innovation is significantly negative in eastern and western regions, while the impact is not significant in central regions; Enterprise heterogeneity analysis reveals that financial mismatch inhibits the "quality" and "quantity" of green innovation in technology-intensive enterprises, while its impact on the "quantity" and "quality" of green innovation in labor-intensive enterprises and the "quantity" of green innovation in asset-intensive enterprises is not significant. However, it promotes the "quality" of green innovation in asset-intensive enterprises; Third, financial mismatch inhibits the development of corporate green innovation through the financing constraint pathway. This explains the substantive impact of financial mismatch on corporate green innovation behavior, providing data support for optimizing financial resource allocation and promoting green innovation development.

Keywords: Financial mismatch, corporate green innovation, financing constraints

This is an open access article. Published by MC Global Eduinfo Sdn. Bhd.
DOI: 10.63894/2024122501
ISSN: 3030-6272 eISSN: 3030-6779

1.0 Introduction

China's past economic growth has primarily relied on the input of factors such as labor, land, and capital. While this model has been significantly successful, its limitations have become increasingly evident and unsustainable. Amid the ongoing global pandemic, the world economy has been experiencing a broad decline, and enterprises face multiple pressures, including shrinking demand, disrupted supply chains, and weakened expectations, which have led to exceptionally difficult business conditions. In this context, the traditional factor-driven model can no longer effectively support sustained economic growth. Faced with this challenge, China must urgently transition from a factor-driven model to one driven by innovation to sustain its economic development.

Meanwhile, China is at a pivotal stage of economic transformation and upgrading, with a large population, substantial resource constraints, and pressing environmental challenges. Thus, prioritizing green technological innovation in Chinese enterprises is imperative. However, enterprises face significant challenges in green innovation due to high investment costs and long R&D cycles, resulting in financial constraints and inefficient resource allocation. Among these, financial misallocation is a particularly significant issue. Therefore, in-depth research into financial misallocation and its mechanisms is crucial to constructing a financial system framework that effectively supports green innovation within enterprises. This would enable enterprises to better access and utilize financial resources, strengthen their green innovation capacity, and achieve breakthroughs in the green transformation process, thereby promoting the coordinated development of the economy, society, and the environment.

2.0 Literature Review

To clarify the research context and identify the theoretical gap, this section systematically combs the relevant literature from four thematic streams, and constructs a cumulative argument to lay the foundation for subsequent research hypotheses.

2.1 Measurement of Financial Mismatch

The measurement of financial mismatch is the basis for empirical research, and existing studies mainly form two technical paradigms based on different theoretical perspectives. The first is the factor price distortion-based micro-econometric method, which quantifies the degree of financial mismatch by the deviation between the actual factor price of enterprises and the optimal equilibrium price. For example, Brandt et al. (2013) proposed the capital cost deviation method, which measures the individual mismatch level by

comparing the gap between the capital cost of a single enterprise and the industry average; Aoki (2012) further improved this method and constructed a simple accounting framework to identify the impact of resource mismatch on total factor productivity. The second is the production efficiency-based frontier analysis method, which evaluates the efficiency of financial resource allocation from the perspective of marginal output. Representative methods include Stochastic Frontier Analysis (SFA) (Yang et al., 2019; Li et al., 2018), Data Envelopment Analysis (DEA) (Kablan, 2009; Liao et al., 2020), and Wurgler's (2000) capital allocation efficiency model. The core idea of this paradigm is that the closer the marginal output elasticity of financial resources is to the optimal level, the lower the degree of mismatch. These measurement methods provide a solid technical basis for subsequent research, but most of them focus on the overall financial mismatch, and lack targeted improvement for the characteristics of green innovation activities.

2.2 Financial Mismatch and Corporate Innovation Performance

A large number of studies have confirmed that financial mismatch is an important factor restricting corporate innovation. From the perspective of resource allocation, financial mismatch leads to the distortion of capital flow, making financial resources deviate from high-efficiency innovation projects and flow to low-productivity fields, thus crowding out corporate R&D investment (Ji et al., 2025; Li & Pang, 2023). From the perspective of risk transmission, the credit market friction caused by financial mismatch increases the risk premium of corporate innovation activities, and enterprises tend to reduce long-term R&D investment to avoid risks (Li & Zhao, 2022; Wang et al., 2024). From the perspective of institutional distortion, financial mismatch induces credit rent-seeking behavior. Enterprises that obtain preferential capital through rent-seeking form organizational inertia and reduce innovation motivation, while enterprises facing financing discrimination have to bear additional rent-seeking costs, which further squeezes R&D funds (Zhou, 2013; Fungáčová et al., 2015). However, these studies mostly focus on the “general innovation” of enterprises, and lack in-depth discussion on the impact of financial mismatch on “green innovation” which has the dual attributes of public goods and high risk.

2.3 Financial Mismatch and Green Innovation

With the rise of green development, a small number of studies have begun to explore the relationship between financial mismatch and corporate green innovation. Whited & Zhao (2021) pointed out that financial mismatch will exacerbate the misallocation of environmental resources and indirectly inhibit the improvement of corporate green total factor productivity; Li et al. (2024) further found that financial mismatch will increase environmental pollution by reducing green technology investment; Wang et al. (2024) verified that fintech

can mitigate credit mismatch and thus promote green innovation, indirectly reflecting the inhibitory effect of financial mismatch on green innovation. However, the existing research on this theme still has obvious shortcomings: First, the research perspective is relatively single, mostly focusing on the direct impact, and lack of analysis on the intermediate transmission mechanism; Second, the measurement of green innovation is mostly limited to a single dimension, and fails to distinguish the differential impact of financial mismatch on the "quantity" and "quality" of green innovation; Third, the heterogeneous characteristics of the impact are not fully explored, and the differences in the impact effects under different regional and enterprise type backgrounds are not clarified.

2.4 Mediating Role of Financing Constraints

Financing constraints are widely regarded as a key channel connecting financial mismatch and corporate innovation. According to the pecking order theory and information asymmetry theory, financial mismatch will increase the external financing cost of enterprises and reduce the availability of funds, thus forming financing constraints (Li et al., 2023; Yin & Wang, 2025). For innovation activities with high investment, long cycle and uncertain return, financing constraints will directly lead to insufficient R&D investment (Aghion et al., 2012). In the field of green innovation, the high specificity of green technology and the long payback period of projects make enterprises more dependent on stable financial support. However, existing studies have not systematically analyzed how financial mismatch affects the "quantity" and "quality" of green innovation through financing constraints, and the theoretical chain between the three is still unclear.

2.5 Research Gap and Research Orientation

To sum up, the existing literature has laid a preliminary foundation for understanding the relationship between financial mismatch, financing constraints and corporate innovation, but there are still three core research gaps: First, the research on financial mismatch and green innovation is relatively scattered, lacking a systematic theoretical framework and empirical test targeting the dual dimensions of green innovation "quantity" and "quality"; Second, the intermediate mechanism of financing constraints needs to be further clarified, especially the specific transmission path combining the characteristics of green innovation; Third, the heterogeneous impact of financial mismatch on green innovation under different regional and enterprise type contexts has not been fully revealed. Therefore, this paper takes Chinese listed companies as the research object, constructs a theoretical framework of "financial mismatch → financing constraints → corporate green innovation", and examines the direct impact, mediating mechanism and heterogeneous

characteristics of financial mismatch on green innovation, so as to make up for the above research gaps.

In contrast to existing literature, this paper focuses on Chinese listed companies from 2011 to 2022 and uses a panel fixed-effects model to empirically examine the impact of financial misallocation on corporate green innovation. The key contributions of this study are as follows: First, by applying relevant econometric models, this study empirically validates the specific impact of financial misallocation on corporate green innovation performance, revealing the variation in the effects of financial misallocation and its underlying mechanisms across different contexts. Second, from the perspective of financing constraints, this paper explores the intrinsic mechanisms through which financial misallocation affects corporate green innovation performance. Third, by analyzing the heterogeneous impacts across different types of firms and geographical locations, this study identifies how financial misallocation influences the differentiated pathways to corporate innovation capabilities and explains the substantive effects of financial misallocation on corporate green innovation behavior. These findings provide empirical support for policymaking, offering insights into optimizing financial resource allocation and fostering green innovation development.

3.0 Theoretical Analysis and Research Hypothesis

3.1 The Direct Impact of Financial Misallocation on Corporate Green Innovation Performance

According to the Pareto optimality theory, the core of financial mismatch lies in market failure, manifested as the deviation of financial resource allocation from an efficient equilibrium state. This phenomenon exhibits unique structural characteristics within China's financial markets. Integrating financial resource allocation theory with information asymmetry theory, this paper analyzes its direct impact mechanisms on corporate green innovation from three perspectives:

First, it reduces the resource allocation efficiency of green innovation. Optimal factor allocation theory posits that financial resources should flow toward sectors with the highest marginal output. However, the temporal, scale, and structural imbalances triggered by financial mismatch compel enterprises to redirect resources toward short-term profit-generating projects. This leads to uneven resource allocation for green innovation, inefficient capital utilization, and deviation from optimal resource allocation efficiency, ultimately undermining enterprises' long-term green innovation capabilities. Moreover, under the backdrop of increasingly stringent environmental regulations, such efficiency losses are further amplified.

Second, it heightens operational risks associated with green innovation.

Financial misallocation simultaneously increases both financial risk and operational uncertainty for enterprises. According to risk aversion theory, high risk and uncertainty cause enterprises to become cautious, even conservative, in green innovation decisions, thereby reducing the frequency and intensity of innovation activities.

Third, it induces credit rent-seeking and distorts innovation incentives. In a bank-dominated financial system, the scarcity of credit resources and the concentration of allocation power can easily foster rent-seeking behavior, directly hindering green innovation. On one hand, firms benefiting from positive mismatches can secure stable returns or excess profits through credit rent-seeking, fostering R&D inertia. Moreover, the crowding-out effect of rent-seeking on R&D investment causes firms to neglect long-term strategic investments in green innovation (Zhou & Wu, 2013). On the other hand, firms facing negative mismatches must resort to rent-seeking to obtain credit resources, which inflates actual financing costs (far exceeding nominal interest rates). The funds obtained are predominantly short-term loans (0, which not only compresses innovation profit margins but also increases the risk of R&D activities, ultimately suppressing green innovation investment.

In summary, financial mismatch imposes direct constraints on corporate green innovation through three pathways—inefficient resource allocation, heightened risk, and distorted incentives — significantly inhibiting the pursuit of green innovation activities.

Hypothesis H1: Financial misallocation will hinder the development of corporate green innovation.

3.2 Financial Misallocation Indirectly Inhibits Corporate Green Innovation Performance Through Financing Constraints

Based on the theories of information asymmetry and Pecking Order, corporate financing constraints primarily arise from external financing cost premiums, which manifest as high financing costs, limited access to financing channels, and mismatched loan durations. First, from the perspective of scale misallocation, according to the theory of optimal allocation of production factors, green innovation projects require sustained large-scale funding for research and development equipment, talent reserves, and experimental validation. However, there is a significant gap in the financial market's supply. For example, the average funding requirement for research and development projects in China's new energy vehicle sector exceeds 1 billion yuan, while small and medium-sized enterprises (SMEs) typically receive less than 50 million yuan in credit support. The vast disparity in funding amounts makes it difficult for firms to establish a comprehensive RD system, forcing them to reduce investments in critical areas, which ultimately lowers the technological content and industrial feasibility of green innovation outcomes. Second, from

the perspective of structural misallocation, there is a conflict between the long-term, low-cost funding needs of green innovation projects and the short-term, high-cost financing available in financial markets. Taking the photovoltaic industry as an example, the payback period for project investment is typically 8-10 years, while bank loan terms usually range from 3 to 5 years, forcing firms to rely on high-cost, non-standard financing to bridge the funding gap. Moreover, if firms accept high-interest short-term loans, they not only bear the burden of high interest costs but also face challenges from interest rate fluctuations and the pressure of loan renewal. This mismatch leads to an increase in financial expenses, which in turn crowds out the funds available for green innovation investment. Lastly, from the perspective of term mismatching, it exacerbates firms' liquidity risks and undermines their ability to plan for long-term green innovation. The mismatch between short-term financing and the long duration of green innovation projects forces firms to frequently refinance, raising the risk of disruptions in their funding chains. This uncertainty prompts firms to adopt conservative strategies, shorten RD cycles, avoid high-risk technological explorations, and opt for low-innovation technological paths instead. Ultimately, this delays the development of breakthrough green technologies and weakens firms' competitive advantage in the global green market.

In summary, we propose **Hypothesis H2:** Financial misallocation inhibits corporate green innovation performance through financing constraints.

3.3 The Regional Heterogeneity of Financial Mismatch on Corporate Green Innovation Performance

Due to differences in economic development levels, financial market maturity, policy environments, and industrial structures across regions, the impact of financial misallocation on corporate green innovation performance varies across different regions.

In the eastern region, due to its advanced economy, mature financial markets, and strong policy support, firms are relatively well-equipped to handle issues related to financial misallocation. First, the developed economy in the eastern region enables firms to possess strong self-financing capabilities, allowing them to secure necessary funds through internal capital accumulation and diversified financing channels. Additionally, local governments have implemented various incentive policies, including tax reductions, fiscal subsidies, and low-interest loans, to support green innovation projects, significantly easing firms' financing pressures. However, despite the abundance of financial resources in the eastern region, these resources are often concentrated in a few large firms and specific industries, making it difficult for small and medium-sized enterprises (SMEs) and emerging sectors to access adequate funding. This uneven distribution of resources exacerbates financial misallocation and restricts many firms' investment in green

innovation. Furthermore, although the eastern region is economically developed, the financing costs for firms remain high. Financial institutions, such as banks, tend to allocate funds to low-risk projects, and due to the high risks and long return periods associated with green innovation projects, these firms often struggle to secure low-cost financing, which negatively impacts their motivation for green innovation. Therefore, the effects of financial misallocation on corporate green innovation performance in the eastern region require specific analysis based on empirical research. In contrast, due to the economic gap, firms in the western region possess weaker self-financing capabilities and are more reliant on external financing. The underdeveloped financial market in this region makes it difficult for firms to identify appropriate financing channels. Furthermore, there are fewer local financial institutions, and the financial products available are limited. As a result, firms often have no choice but to rely on high-cost, short-term loans, which fail to meet the long-term funding needs of green innovation projects. Moreover, local government support for green innovation is relatively weak, with a lack of specialized support and incentive measures, which makes it difficult for firms to access policy-driven financial assistance. As a result, in the western region, due to the underdeveloped financial market and insufficient policy support, firms face more severe financing constraints, which adversely affect their green innovation performance. The central region, with its moderate level of economic development, financial market maturity, and policy support, presents a more balanced situation. The impact of financial misallocation on corporate green innovation performance in this region is likely to exhibit a buffering effect. Although firms in the central region generally lag behind their eastern counterparts in terms of green innovation capacity, the relatively well-developed financial system in the central region can still foster some green innovation leaders.

In conclusion, we propose **Hypothesis H3**: There is heterogeneity in the impact of financial misallocation on corporate green innovation performance across the eastern, central, and western regions.

3.4 The Heterogeneity of Enterprise Types in the Impact of Financial Mismatch on Corporate Green Innovation Performance

The impact of financial misallocation on corporate green innovation performance varies across different types of firms. This heterogeneity is particularly evident between labor-intensive, technology-intensive, and asset-intensive firms.

Firstly, labor-intensive firms, whose production and operations primarily depend on a large workforce, have a relatively low reliance on capital. Therefore, the impact of financial misallocation on these firms is relatively minor. In contrast, technology-intensive firms face a very different situation.

These firms rely on advanced technology and significant RD investments for production and operations, and their green innovation activities require substantial financial support. Such funding needs are often uncertain and high-risk, and financial misallocation can severely constrain RD investments in technology-intensive firms, directly impacting their green innovation performance. Financing difficulties and capital shortages may prevent firms from continuing their innovation projects, thereby hindering the implementation and promotion of green innovation. Consequently, the impact of financial misallocation on the green innovation performance of technology-intensive firms is significant. Similarly, asset-intensive firms face comparable challenges. These firms depend on significant fixed assets for production and operations and require substantial capital to purchase and maintain equipment, facilities, and other assets. Financial misallocation can prevent asset-intensive firms from securing sufficient funds for equipment upgrades and technological transformation, thus affecting their green innovation performance. A lack of financial support may lead to aging equipment and outdated technologies, severely hindering the improvement of a firm's green innovation capabilities. However, when asset-intensive firms face financial misallocation, they may become more cautious in allocating and utilizing their existing resources to ensure that green innovation projects proceed smoothly, thereby avoiding resource waste and improving the quality of innovation outcomes. Therefore, the specific impact of financial misallocation on asset-intensive firms requires further empirical analysis.

In conclusion, we propose **Hypothesis H4**: The impact of financial misallocation on corporate green innovation performance exhibits heterogeneity across different firm types.

4.0 Methodology

4.1 Variable Setting and Data Description

4.1.1 Dependent Variable

Currently, the measurement of corporate green innovation performance is primarily divided into two categories: one involves questionnaire surveys, though this method carries significant subjectivity; the other utilizes data related to green patents for assessment. This study adopts the method of existing research and uses the total number of green patents filed by a firm annually to measure its green innovation performance for that year (Rauf et al., 2024). Furthermore, green patent data not only reflects the "quantity" of green innovation but also indicates its "quality". Therefore, this study selects the number of green patents filed annually and the number of green invention patents filed as proxies for the "quantity" and "quality" of green innovation, respectively.

4.1.2 Core Explanatory Variable

This study builds on the work of existing research and uses the degree of capital utilization to quantify the extent of financial misallocation across different industries (Yin et al., 2025). The specific method is as follows: Financial Misallocation Index = (Interest Rate Industry Average Interest Rate) / Industry Average Interest Rate.

4.1.3 Controlled Variable

This study selects the following control variables: firm size (Size), return on assets (ROA), proportion of independent directors (Indep), Tobin's Q (TobinQ), capital intensity (CAP), debt-to-equity ratio (Lev), cash flow ratio (Cashflow), proportion of the largest shareholder (Top1), and proportion of tangible assets (Tangible). These variables correspond respectively to dimensions such as a firm's resource endowment, profitability and operational capabilities, corporate governance structure, market valuation, and financial risk. Each of these dimensions may independently influence both the "quantity" and "quality" of a firm's green innovation. Incorporating them into the model effectively eliminates interference from irrelevant factors and avoids estimation biases caused by omitted variables. This approach enables more precise identification of the causal relationship between financial mismatch and corporate green innovation performance, thereby enhancing the robustness and credibility of empirical findings as shown in Table 1.

4.1.4 Mediating Variable

Building on the approach of existing research, this study constructs a financing constraint (SA) index to measure the degree of financing constraints faced by firms (Fungáčová et al., 2015)0. A higher SA index indicates a greater severity of financing constraints.

4.2 Data sources and Descriptive Statistics of Variables

The sample for this study includes listed companies from Chinese listed companies in Shanghai and Shenzhen from 2011 to 2022. Companies classified as ST (Special Treatment) and those with substantial missing data were excluded. For companies with minor missing data, interpolation methods were applied to impute the missing values. The financial data were obtained from the CSMAR and Wind databases. Descriptive statistics of the data are presented in Table 2.

Table 1: Variablede Scription

Variable Name	Variable Symbol	Variable Definition
Green Innovation Quantity	gin	The number of green patents filed + 1, logged
Green Innovation Quality	ginq	The number of green invention patents filed + 1, logged
Financial Misallocation	fm	(Interest rate - Industry average interest rate) / Industry average interest rate
Firm Size	Size	The natural logarithm of total assets in a year
Returnon Assets	ROA	Net profit / Average total assets for the year
Proportion of Independent Directors	Indep	Number of independent directors / Total number of directors
Tobin's Q	TobinQ	(Market value of circulating shares + Non-circulating shares × Book value per share + Liabilities) / Total assets
Capital Intensity	CAP	Total assets / Operating income
Debt-to-Equity Ratio	Lev	Total liabilities at year-end / Total assets at year-end
CashFlow Ratio	Cashflow	Net cash flow from operating activities / Total assets
Proportion of the Largest Shareholder	Top1	Number of shares held by the largest shareholder / Total number of shares
Proportion of Tangible Assets	Tangible	(Total assets - Net intangible assets - Net goodwill) / Total assets

Table 2: Descriptive Statistics

VarName	Obs	Mean	SD	Min	Median	Max
gin	22,156	0.350	0.785	0.000	0.000	6.848
ginq	22,156	0.238	0.638	0.000	0.000	6.328
fm	22,156	1.271	28.652	0.000	0.481	3527.476
Size	22,156	22.275	1.309	19.585	22.086	26.452
ROA	22,156	0.038	0.065	-0.373	0.037	0.247
Indep	22,156	37.642	5.380	28.570	36.360	60.000
TobinQ	22,156	1.994	1.313	0.802	1.582	15.607
CAP	22,156	2.502	2.081	0.378	1.916	18.942
Lev	22,156	0.426	0.202	0.032	0.419	0.908
Cashflow	22,156	0.047	0.068	-0.199	0.046	0.267
Top1	22,156	34.076	14.833	8.020	31.923	75.779

4.3 Benchmark Model Setting

This empirical study focuses on examining the impact of financial mismatch on corporate green innovation performance. After conducting a Hausman test on the panel data, the results indicate that the P-value rejects the null hypothesis, confirming that the fixed-effects model is more appropriate than the random-effects model for this research. Moreover, compared to the random-effects model, the core advantage of the fixed-effects model lies in its assumption that individual effects are correlated with the explanatory variables in the model. This effectively controls for individual heterogeneity that does not change over time in panel data, addressing estimation bias caused by omitting such unobservable variables. Moreover, this model does not require imposing the stringent assumption that "individual effects are independent of explanatory variables", which is difficult to satisfy in most empirical settings. Consequently, its estimation results exhibit greater robustness and reliability.

Therefore, this paper specifies the following two-way fixed effects model:

$$gin_{it} = \beta_0 + \beta_1 fm_{it} + \Sigma\eta_j X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (1)$$

$$ginq_{it} = \varphi_0 + \varphi_1 fm_{it} + \Sigma\eta_j X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (2)$$

In the model, gin_{it} and ginq_{it} represent the quantity and quality of firms' green innovation, where I and t denote the firm and the year, respectively. gm_{it} the core explanatory variable, financial misallocation. X_{it} represents the control variables that affect the dependent variables. $\mu_i$and $\delta_t$represent the individual and time fixed effects, respectively. The inclusion of both individual and time fixed effects helps mitigate endogeneity issues inherent in traditional regression models. $\varepsilon_{it}$is the random disturbance term.

4.4 Mediation Effect Model

In addition to directly impacting firms' green innovation performance, financial misallocation also exerts an indirect effect through intermediate mechanisms. Therefore, following the approach of Jiang Ting (2022), this study constructs a mediation analysis model to explore these effects in detail. The model is specified as follows:

$$Y_{it} = \alpha_0 + \alpha_1 D_{it} + \Sigma\eta_j X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (3)$$

$$mediator_{it} = \theta_0 + \theta_1 D_{it} + \Sigma\eta_j X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (4)$$

In the formula, mediator is the mediator variable, and the other variables are the same as above.

5.0 Experiments

5.1 Benchmark Regression Results

The benchmark regression results are shown in Table 3. As indicated in columns (2) and (4), after controlling for time and firm fixed effects and including control variables, the coefficients of fm_{it} are-0.003 and-0.002, respectively, and are statistically significant at the 1% level. The economic interpretation of these findings is that, after accounting for other influencing factors, financial misallocation negatively impacts both the quantity and quality of firms' green innovation. This suggests that financial misallocation inhibits the development of green innovation in firms. In theory, financial mismatch can inhibit corporate green innovation performance by affecting capital access, resource allocation efficiency, risk management, and triggering rent-seeking behavior. Therefore, Hypothesis 1 is validated.

Table 3: Benchmark Regression

	(1)	(2)	(3)	(4)
Variable Name	gin	gin	ginq	ginq
fm	-0.001**	-0.003***	-0.001**	-0.002***
	(2.27)	(-26.31)	(0.71)	(-26.53)
Constant	0.239***	-1.338***	0.144***	-1.119***
	(21.83)	(-3.61)	(15.80)	(-3.91)
Observations	22,156	22,156	22,156	22,156
R-squared	0.014	0.019	0.013	0.018
Number of Firms	2,911	2,911	2,911	2,911
Control Variables	NO	YES	NO	YES
Individual Effects	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES

Note: *** p<0.01, ** p<0.05, * p<0.1. Z-statistic values are shown in parentheses. The same applies to the table below.

5.2 Robustness Test

5.2.1 Replace The Explained Variable

This study conducts a robustness check by replacing the dependent variables. Specifically, the ratio of firms' green patent applications to total patent applications in a given year (Ratio gin) and the ratio of firms' green invention patents to total patent applications in the same year (Ratio ginq) are used as proxies for the quantity and quality of green innovation, respectively. The results are presented in Table 4. As shown in columns (1) and (2), the regression results are significantly negative at the 1% level. Therefore, even when the dependent variables are substituted, the inhibitory effect of financial misallocation on firms' innovation performance remains significant, confirming that the baseline regression results are robust.

5.2.2 Tail Trimming

The regression results after applying 1% double trimming to the data are presented in columns (3) and (4) of Table 4. The findings indicate that financial mismatch continues to suppress corporate green innovation performance even after trimming, confirming the robustness of the benchmark regression results.

Table 4: Robustness Test

	(1)	(2)	(3)	(4)
Variable Name	Ratio gin	Ratio ginq	Ratio gin	Ratio ginq
fm	-0.001***	-0.001***	-0.001***	-0.001***
	(-33.30)	(-35.40)	(-41.67)	(-35.00)
Constant	0.008	-0.022	-0.015	-0.011**
	(0.13)	(-0.52)	(-0.93)	(-2.16)
Observations	22,156	22,156	20,223	20,126
R-squared	0.002	0.002	0.004	0.004
Number of Firms	2,911	2,911	2,850	2,860
Control Variables	YES	YES	YES	YES
Individual Effects	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES

5.3 Mediating Effect of Financing Constraints

As shown in Table 5(1), the regression coefficient for financial mismatch on the "quantity" of corporate green innovation is -0.003, significant at the 1% level, consistent with previous findings. This indicates that financial mismatch inhibits the "quantity" of corporate green innovation. Next, we regress financial mismatch as the explanatory variable on financing constraints (SA) as the dependent variable. The results are presented in Column (2) of Table 5. Here, the regression coefficient for financial mismatch on financing constraints is 0.001, significant at the 1% level, indicating that financial mismatch promotes financing constraints. Thus, financing constraints mediate the effect of financial mismatch on the "quantity" of corporate green innovation. Similarly, Tables 5(3) and (4) show that financing constraints also mediate the effect of financial mismatch on the "quality" of corporate green innovation.

The impact of financial misallocation on firms' green innovation "quantity" and "quality" through financing constraints manifests in the following ways: On the one hand, financial misallocation prevents firms from obtaining financing that aligns with their needs, particularly long-term capital. This shortage of funds results in insufficient investment in green innovation projects, hindering RD and technological innovation activities, which directly affects

the firms' innovation capacity and project scale, thereby limiting both the quantity and quality of green innovation projects. On the other hand, due to financial misallocation, firms may face higher financing costs. Financial institutions, in an attempt to mitigate risks, may demand higher interest rates or impose stricter financing conditions. The increased financing costs place additional financial pressure on firms, causing them to be more cautious in their investment in green innovation projects. Consequently, firms may reduce their RD budgets and opt for lower-risk, less innovative projects, ultimately leading to a decline in green innovation performance. Therefore, Hypothesis 2 is supported.

Table 5: The Mediating Effect of Financing Constraints

	(1)	(2)	(3)	(4)
Variable Name	gin	SA	ginq	SA
fm	-0.003***	0.001***	-0.002***	0.001***
	(-27.39)	(15.22)	(-26.53)	(15.22)
Intercept Term	-0.057	-4.084***	-1.119***	-4.084***
	(-0.11)	(-34.39)	(-3.91)	(-34.39)
Observations	22,148	22,148	22,156	22,148
R-squared	0.020	0.843	0.018	0.843
Number of Firms	2,911	2,911	2,911	2,911
Control Variables	YES	YES	YES	YES
Individual Effects	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES
Variable Name	YES	YES	YES	YES

5.4 Heterogeneity Analysis

5.4.1 Regional Heterogeneity Analysis

Currently, China still faces significant regional development imbalances, with noticeable disparities in human, material, and financial resources between the eastern, central, and western regions. Moreover, the green innovation performance of firms varies across these regions, which may influence the impact of financial misallocation. To explore the differential effect of financial misallocation on firms' green innovation performance across regions, this study divides the total sample data into three sub-samples: Eastern, Central, and Western regions, and performs separate regressions for each sub-sample. The results are shown in Table 6 below. As seen in columns (1) to (6) of Table 6, financial misallocation suppresses the development of firms' green innovation "quantity" and "quality" in both the Eastern and Western regions, with a more pronounced suppression effect in the Western region. However, the coefficient for financial misallocation in the Central region is not significant, indicating that its effect on suppressing firms' green innovation "quantity" and "quality" is not significant in the Central region. This may be because, although the eastern region possesses abundant financial resources

overall, these resources tend to be concentrated among a few large enterprises and specific industries. This concentration makes it difficult for small and medium-sized enterprises (SMEs) and emerging industries to secure sufficient financial support. Such uneven resource allocation exacerbates financial mismatches, limiting many enterprises' investments in green innovation. Simultaneously, despite the eastern region's economic advancement, enterprises still face relatively high financing costs. Financial institutions like banks tend to channel funds into low-risk projects, while green innovation initiatives—characterized by higher risks and longer return cycles—often struggle to secure low-cost financing, thereby dampening corporate enthusiasm for green innovation. In contrast, the western region suffers from relatively underdeveloped financial markets, with a limited number and variety of financial institutions, making it difficult to provide diversified financing channels. When pursuing green innovation, enterprises face limited financing options, leading to insufficient capital and consequently stifling green innovation efforts. Although the Western Development Strategy has brought some policy support to the region, targeted support policies and incentive measures for green innovation remain inadequate. Without robust policy backing, enterprises encounter heightened uncertainty and financial pressure during green innovation. Central China, however, may experience negligible impact from financial mismatch on green innovation due to a reasonable allocation of financial resources across enterprises of varying sizes and a relatively mature financial market. Therefore, Hypothesis 3 holds.

Table 6: Regional Heterogeneity Analysis

	(1) East	(2) West	(3) Middle	(4) East	(5) West	(6) Middle
Variable Name	gin	gin	gin	ginq	ginq	ginq
fm	-0.003***	-10.089**	3.281	-0.002***	-8.818**	-0.354
	(-20.13)	(-2.39)	(0.74)	(-19.86)	(-2.45)	(-0.11)
Intercept Term	-1.349***	-1.407*	-1.477	-1.132***	-1.796***	-0.538
	(-2.99)	(-1.68)	(-1.35)	(-3.19)	(-2.92)	(-0.65)
Observations	15,807	3,479	2,867	15,807	3,479	2,867
R-squared	0.022	0.022	0.018	0.021	0.029	0.012
Number of Firms	2,086	462	395	2,086	462	395
Control Variables	YES	YES	YES	YES	YES	YES
ID Effects	YES	YES	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES	YES	YES

5.4.2 Analysis of Enterprise Heterogeneity

As shown in columns (1) to (3) of Table 7 below, the financial mismatch coefficient for technology-intensive enterprises is -0.002 and significant at the 1% level. while the coefficients for labor-intensive and asset-intensive enterprises are not significant. This indicates that financial mismatch in technology-intensive enterprises inhibits the "quantity" of green innovation, whereas the lack of significance in labor-intensive and asset-intensive enterprises suggests its suppression effect on green innovation quantity is negligible. The reasons may be as follows: Technology-intensive enterprises face high risks and uncertainties, capital-intensive demands, information asymmetry, limited financing channels, insufficient policy support, and high technological barriers and patent barriers. These factors make it difficult for enterprises to obtain sufficient and well-matched financial resources. Addressing these challenges requires collaborative efforts from financial institutions, governments, and enterprises. By optimizing financial support policies, improving financing channels, enhancing information communication, and providing targeted incentives, we can promote green innovation in technology-intensive enterprises and advance sustainable development.

As shown in columns (4) to (6) of Table 7 below, the financial mismatch coefficient for technology-intensive enterprises is -0.002 and significant at the 1% level, while the coefficient for asset-intensive enterprises is 0.007 and significant at the 1% level. The coefficient for labor-intensive enterprises is not significant. This indicates that financial mismatch in technology-intensive enterprises inhibits the development of green innovation "quality", while financial mismatch in asset-intensive enterprises promotes the development of green innovation "quality." For labor-intensive enterprises, the impact is insignificant. The reasons may be as follows: Technology-intensive enterprises often pursue high-quality outcomes in green innovation, but financial mismatch severely impacts the quality of their green innovation. This is because financial mismatch in technology-intensive enterprises creates conflicts between short-term financing and long-term projects, high financing costs, and insufficient capital scale, thereby limiting the "quality" development of their green innovation. In asset-intensive enterprises, companies possess substantial fixed assets and long-term investments that require effective management and utilization. When facing financial mismatch, companies may need to allocate and utilize existing resources more cautiously to ensure the smooth progress of their green innovation projects. This optimized resource allocation encourages enterprises to focus on high-quality green innovation projects, avoiding resource wastage and enhancing the quality of innovation outcomes. Moreover, asset-intensive enterprises' propensity for long-term investments, effective utilization of internal financing and equity capital, along with technological integration and innovation, enable them to enhance the quality of green innovation projects through multiple avenues when

confronting financial mismatch, thereby achieving sustainable development goals. In conclusion, Hypothesis 4 holds.

Table 7: Analysis of Heterogeneity in Enterprise Types

	(1) Labor	(2) Technology	(3) Asset-	(4) Labor-	(5) Technology	(6) Asset
Variable Name	gin	gin	gin	ginq	ginq	ginq
fm	-0.169	-0.002***	0.006	-0.221	-0.002***	0.007**
	(-1.39)	(-12.17)	(1.33)	(-1.31)	(-11.52)	(2.00)
Intercept Term	-0.760*	-3.267***	-1.280	-0.246	-2.708***	-1.108
	(-1.75)	(-3.90)	(-1.58)	(-0.99)	(-4.11)	(-1.45)
Observations	7,784	10,030	3,976	7,784	10,030	3,976
R-squared	0.018	0.034	0.012	0.012	0.036	0.010
Number of Firms	1,158	1,470	590	1,158	1,470	590
Control Variables	YES	YES	YES	YES	YES	YES
ID Effects	YES	YES	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES	YES	YES

6.0 Conclusion and Policy Implication

6.1 Conclusion

This study, grounded in relevant theoretical frame works, utilizes panel data from listed companies over the period 2011 to 2022 to construct a two-way fixed effects econometric model, analyzing the mechanism by which financial misallocation impacts corporate green innovation performance. The key findings are as follows:

Full sample regression analysis: The analysis of the entire sample reveals that financial misallocation suppresses both the “quantity” and “quality” of corporate green innovation. This conclusion remains robust after conducting various robustness checks.

Geographic heterogeneity: When analyzing regional heterogeneity, the results show that financial misallocation negatively affects the “quantity” and “quality” of green innovation in both the eastern and western regions, with the effect being more pronounced in the western region. In contrast, the effect in the central region is not statistically significant.

Firm-TypeHeterogeneity: In terms of firm-type heterogeneity, financial misallocation significantly suppresses the “quantity” and “quality” of green innovation in technology-intensive firms. However, the impact on

labor-intensive firms' green innovation "quantity" and "quality" is insignificant. For asset-intensive firms, financial misallocation does not significantly affect the "quantity" of green innovation but has appositive impact on its "quality" .

Role of Financing Constraints: Financing constraints play an intermediary role in the relationship between financial misallocation and corporate green innovation performance. Specifically, financial misallocation exacerbates financing constraints, which in turn suppresses the development of corporate green innovation.

6.2 Policy Implication

Based on the findings of this study, the following recommendations and insights are provided:

Establish an Institutional Safeguard System to Enhance Targeted Guidance Effectiveness. Regulatory authorities should build a standardized green finance institutional framework centered on resolving information asymmetry. This includes establishing a quantitative credit rating system covering green innovation achievements and environmental compliance records, while standardizing information disclosure requirements. Implement differentiated regulation based on regional and corporate heterogeneity to channel eastern financial resources toward green innovation in SMEs, strengthen financial infrastructure and policy support in central and western regions, improve risk compensation mechanisms for technology-intensive enterprises, and optimize financing systems for green assets in asset-intensive enterprises. Conduct regular assessments of financial resource allocation efficiency, using differentiated tools to guide resources toward green innovation clusters, expand carbon market coverage, and facilitate the conversion pathways between carbon assets and financial resources.

Innovate service delivery models to enhance resource allocation efficiency. Financial institutions should focus on green innovation financing needs, develop tailored instruments such as medium-to-long-term loans and equity-debt combinations, promote financing methods integrating intellectual property pledges with green credit, and optimize repayment and collateral arrangements; Establish dedicated green innovation credit lines, assemble specialized teams, and strengthen targeted support for key regions and enterprises. Create a credit cooperation mechanism among eastern, central, and western regions to promote balanced resource allocation. Develop multidimensional risk assessment models, utilize big data to monitor capital flows, and mitigate risks through diversified lending and syndicated loans to achieve a balance between returns and security.

Strengthen endogenous development capabilities and proactively connect with

external resources. Enterprises should optimize internal management based on their specific type: technology-intensive enterprises should standardize capital accounting and accumulate collateral assets; asset-intensive enterprises should revitalize existing green assets and focus on innovation quality; labor-intensive enterprises should reduce R&D risks through industry-academia-research collaboration. Proactively engage with policy and financial resources by establishing policy tracking mechanisms, participating in green credit ratings, disclosing project information truthfully, and building long-term partnerships with financial institutions. Focus on enhancing core quality in green innovation while balancing quantity and quality to strengthen core competitiveness.

References

Aghion, P., Askenazy, P., Berman, N., Cette, G., & Eymard, L. (2012). Credit constraints and the cyclicality of R&D investment: Evidence from France. *Journal of the European Economic Association, 10*(5), 1001-1024. https://doi.org/10.1111/j.1542-4774.2012.01093.x

Aoki, S. (2012). A simple accounting framework for the effect of resource misallocation on aggregate productivity. *Journal of the Japanese and International Economies, 26*(4), 473-494. https://doi.org/10.1016/j.jjie.2012.08.001

Brandt L., Tombe T., & Zhu, X. (2013). Factor market distortions across time, space and sectors in China. *Review of Economic Dynamics, 16*(1), 39-58. https://doi.org/10.1016/j.red.2012.10.002

Fungáčová, Z., Kochanova, A., & Weill, L. (2015). Does money buy credit? Firm-level evidence on bribery and bank debt. *World Development, 68*, 308-322. https://doi.org/10.1016/j.worlddev.2014.12.009

Ji, X., Zhang, L., & Cao, W. (2025). Innovative policies, financial mismatch, and corporate innovation performance: A quasi-natural experiment based on the national innovative city pilot policy. *Finance Research Letters, 2025*, 107525. https://doi.org/10.1016/j.frl.2025.107525

Jiang, T. (2022). Mediating effects and moderating effects in causal inference. *China Industrial Economics, 5*(5), 100-120.

Kablan, S. (2009). Banking efficiency and financial development in Sub-saharan Africa (SSA). *African Finance Journal, 11*(2), 28-50. https://doi.org/10.5089/9781455201198.001

Li, C., Tang, W., Liang, F., & Wang, Z. (2024). The impact of climate change on corporate ESG performance: The role of resource misallocation in enterprises. *Journal of Cleaner Production, 445*, 141263. https://doi.org/10.1016/j.jclepro.2024.141263

Li, C., Wang, Y., Zhou, Z., Wang, Z., & Mardani, A. (2023). Digital finance and enterprise financing constraints: Structural characteristics and mechanism identification. *Journal of Business Research, 165*, 114074. https://doi.org/10.1016/j.jbusres.2023.114074

Li, T., Liang, L., & Han, D. (2018). Research on the efficiency of green technology innovation in China's provincial high-end manufacturing industry based on the RAGA-PP-SFA model. *Mathematical Problems in Engineering, 2018*(1), 9463707. https://doi.org/10.1155/2018/9463707

Li, W., & Pang, W. (2023). Digital inclusive finance, financial mismatch and the innovation capacity of small and medium-sized enterprises: Evidence

From Chinese listed companies. *Heliyon, 9*(2). https://doi.org/10.1016/j.heliyon.2023.e13792

Li, X., & Zhao, Z. (2022). Corporate internal control, financial mismatch mitigation and innovation performance. *Plos One, 17*(12), e0278633. https://doi.org/10.1371/journal.pone.0278633

Liao, G., Yao, D., & Hu, Z. (2020). The spatial effect of the efficiency of regional financial resource allocation from the perspective of internet finance: Evidence from Chinese provinces. *Emerging Markets Finance and Trade, 56*(6), 1211-1223. https://doi.org/10.1080/1540496X.2018.1564658

Rauf, F., Wanqiu, W., Naveed, K., & Zhang, Y. (2024). Green R&D investment, ESG reporting, and corporate green innovation performance. *Plos One, 19*(3), e0299707. https://doi.org/10.1371/journal.pone.0299707

Wang, S., Yong, Y., Liu, X., & Wang, Y. (2024). How fintech mitigates credit mismatches to promote green innovation: Evidence from Chinese listed enterprises. *International Review of Financial Analysis, 96*, 103740. https://doi.org/10.1016/j.irfa.2024.103740

Whited, M T., & Zhao, J. (2021). The misallocation of finance. *The Journal of Finance, 76*(5), 2359-2407. https://doi.org/10.1111/jofi.13031

Wurgler, J. (2000). Financial markets and the allocation of capital. *Journal of Financial Economics, 58*(1-2), 187-214. https://doi.org/10.1016/S0304-405X(00)00070-2

Yang, Y., Wang, X., & Sun. Y. (2019). Evolution of allocation efficiency of financial resource, TFP growth and China's economy development——based on Panel Data PVAR Model. *Management Review, 31*(6), 36.

Yin, L., & Wang, Z. (2025). How does digital finance affect financial mismatch?. *Applied Economics, 57*(22), 2869-2886. https://doi.org/10.1080/00036846.2024.2331429

Zhou, W. (2013). Political connections and entrepreneurial investment: Evidence From China's transition economy. *Journal of Business Venturing, 28*(2), 299-315. https://doi.org/10.1016/j.jbusvent.2012.05.0