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Green Credit, Financing Constraints, And Corporate Green Transformation: A Financial Resource Allocation Perspective

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ABSTRACT: Green credit has become an important policy instrument for promoting sustainable development and integrating environmental considerations into financial resource allocation. As environmental concerns and climate-related risks increasingly influence economic activities, commercial banks are expected to play a greater role in supporting environmentally sustainable projects while maintaining financial stability. Where economic development and environmental sustainability are important policy priorities, green credit provides a potential mechanism for directing financial resources toward environmentally responsible industries. Drawing on financial intermediation theory and credit risk management perspectives, this study explores the channels through which green credit may influence commercial banks' credit risk. Green credit may reduce credit risk by encouraging banks to incorporate environmental factors into borrower assessments, strengthen lending standards, and identify potential risks associated with environmental regulations and unsustainable business practices. By directing financing toward environmentally responsible enterprises, banks may reduce their exposure to borrowers vulnerable to environmental and regulatory changes, thereby improving loan portfolio quality. These factors suggest that the relationship between green credit and credit risk may depend on banks' lending capabilities, borrower characteristics, and institutional conditions. The study is expected to contribute to the literature on sustainable finance by providing insights into the role of green credit in banking risk management within an emerging-market context. Its findings may also offer practical implications for commercial banks seeking to balance environmental responsibility with prudent lending decisions, as well as for policymakers developing green finance frameworks to support sustainable economic development and financial stability in Indonesia.

KEYWORDS: Green Credit; Credit Risk; Commercial Banks; Non-Performing Loans; Sustainable Finance

I. INTRODUCTION

In 2020, China announced its goals of reaching peak carbon emissions before 2030 and achieving carbon neutrality before 2060. A green and low-carbon transition has since become an important direction for high-quality economic development. Firms are major sources of energy consumption and pollutant emissions, and their green transformation is a micro-level foundation for achieving the “dual-carbon” goals. However, green transformation requires substantial investment, involves long cycles, and yields uncertain returns. Firms therefore commonly face financing constraints and cannot rely solely on internal funds, making the efficient allocation of external financial resources crucial. In China’s bank-dominated financial system, bank credit is the principal source of external financing for firms. In 2012, the former China Banking Regulatory Commission issued the Green Credit Guidelines, requiring banking institutions to incorporate environmental and social risk management into their creditgranting processes. Subsequent policies, including the 2016 Guidelines for Establishing a Green Financial System, were introduced, and green credit expanded steadily. By the end of the third quarter of 2024, the outstanding balance of green loans denominated in domestic and foreign currencies in China had reached RMB 35.75 trillion, up 25.1% year on year (source: People’s Bank of China, as cited in Hua Yue et al., 2025). Does green credit genuinely direct financial resources toward green sectors and promote corporate green transformation? Does it work by easing firms’ financing constraints? These are the questions addressed in this paper. Theoretical significance: Existing studies have mainly examined the effects of green credit on corporate performance, financing costs, or innovation. The mechanisms through which green credit affects green transformation via financial resource allocation remain insufficiently explored. This paper treats financing constraints as a core transmission channel and considers debt financing structure, thereby contributing to research on the micro-level effects of green finance. Practical significance: The findings can provide empirical evidence for improving green credit policies, optimizing banks’ allocation of credit resources, and helping firms

broaden their access to green financing. This paper uses A-share companies listed on the Shanghai and Shenzhen stock exchanges during sample periodand treats the 2012 Green Credit Guidelines as a quasi-natural experiment. A difference-in-differences (DID) method is used to examine the impact of green credit on corporate green transformation, while a mediation model tests the transmission role of financing constraints. Heterogeneity is further examined by ownership type, regional financial development, and firm size.

II. LITERATURE REVIEW

A. Economic Consequences of Green Credit

Existing research on the economic consequences of green credit mainly covers four areas: banks; corporate financing and investment; corporate innovation; and environmental and corporate behavior. At the banking level, Ding Ning et al. (2020), from a resource-allocation perspective, find that green credit policies improve banks' cost efficiency. Regarding corporate financing and investment, Su Dongwei and Lian Lili (2018) find that the Green Credit Guidelines have a "punitive effect" on heavily polluting firms, reflected in lower loan volumes and higher borrowing costs. Xu and Li (2020) examine the asymmetric effects of green credit on debt financing costs and maturity across different types of firms. Guo Junjie and Fang Ying (2023) analyze the relationships among green credit policy, credit discrimination, and corporate debt financing. Lu Jing et al. (2021) study the micro-level effects of green credit policy from the perspectives of technological innovation and resource reallocation. Wang Yanli et al. (2021) examine its effects on firms' investment efficiency from the perspective of financial resource allocation to heavily polluting firms. Findings on corporate innovation are mixed. Using the Green Credit Guidelines as a quasi-natural experiment, Yang Liuyong and Zhang Zeyano (2022) find that the policy suppresses green innovation in heavily polluting firms by tightening credit constraints, with stronger effects for green invention patents, non-state-owned firms, and smaller firms. Other studies suggest that green credit policy can increase the quantity of green innovation by heavily polluting firms through credit constraints, but has no clear effect on innovation quality (Hu et al., 2021; Wang Xin and Wang Ying, 2021). Zhang Yinsainan et al. (2023) argue that the innovation incentives created by green credit for heavily polluting firms have not yet fully materialized. Regarding environmental and corporate behavior, Cai Haijing et al. (2019) examine the environmental effects of green credit through newly obtained bank loans. Li Juncheng et al. (2023) investigate its impact on green business development from a risktaking perspective, while Zhong Qinlin et al. (2023) find that green credit can encourage firms to assume environmental responsibility. Hu Wentao and Jiang Xin (2024) find that, through credit constraints and environmental regulation, green credit policy reduces the credit financing available to polluting firms and intensifies their financing constraints, while also encouraging them to improve production efficiency and undertake green innovation to achieve green transformation.

Existing studies generally characterize firms' environmental behavior through green innovation and environmental protection investment. Regarding green innovation, Yang Liuyong and Zhang Zeyano (2022) distinguish among patent types, including green invention patents, to examine the effect of green credit policy on heavily polluting firms. Regarding environmental investment, Guo Junjie and Fang Ying (2022) study the relationship between green credit and corporate environmental investment from the perspective of financing structure. On green transformation, Yu Xulan and Zhou Ying (2023) examine the impact of green credit policy on highly polluting firms from the perspectives of emissions reduction and development. Regarding determinants, Sun Yanlin and Shi Boshu (2019) find that government subsidies help strengthen the innovation incentives of green credit. The influence of the external financing environment on corporate green transformation warrants further investigation. Common measures of financing constraints include the KZ index (Kaplan and Zingales, 1997), the WW index (Whited and Wu, 2006), and the SA index (Hadlock and Pierce, 2010). Hadlock and Pierce (2010) question the validity of the KZ index and propose the SA index, which is based only on firm size and age. Hua Yue et al. (2025) also note that the KZ and WW indices contain many potentially endogenous financial variables and therefore use the SA index. However, Farre-Mensa and Ljungqvist (2016) find that commonly used measures, including all three indices, have difficulty identifying firms that are behaviorally constrained; robustness checks are therefore advisable. Fazzari et al. (1988) were among the first to discuss the impact of financing constraints on corporate investment. Hall and Lerner (2010) systematically review financing problems facing research and development and innovation, while Ju Xiaosheng et al. (2013) examine the relationship among financing constraints, working-capital management, and the sustainability of corporate innovation. In relation to financial development, Shen Hongbo et al. (2010) investigate the links among financial development, financing constraints, and corporate investment.

B. Financing Constraints and Corporate Green Behavior

Financing constraints play an important role in shaping corporate investment decisions, particularly in activities related to environmental protection and green innovation. Corporate green transformation often requires substantial upfront investment,

involves long payback periods, and is subject to considerable technological and market uncertainty. For example, firms may need to invest in energy-efficient production equipment, pollution-control facilities, clean technologies, and green research and development (R&D). Although these investments can improve environmental performance and generate long-term economic benefits, their high initial costs may discourage firms with limited financial resources. Therefore, financing constraints may represent a significant obstacle to corporate green transformation. Existing studies have developed several indicators to measure financing constraints, including the KZ index (Kaplan and Zingales, 1997), the WW index (Whited and Wu, 2006), and the SA index (Hadlock and Pierce, 2010). Hadlock and Pierce (2010) question the validity of the KZ index and propose the SA index, which relies only on firm size and age. Hua Yue et al. (2025) also point out that the KZ and WW indices incorporate potentially endogenous financial variables and therefore adopt the SA index. However, Farre-Mensa and Ljungqvist (2016) argue that commonly used measures, including these three indices, have limitations in identifying firms that are genuinely constrained in their financing behavior. These findings suggest that researchers should carefully select appropriate indicators and conduct robustness checks to ensure the reliability of empirical results. Regarding the economic consequences of financing constraints, Fazzari et al. (1988) were among the first to examine their effects on corporate investment. Their research highlights the importance of financial resources in determining firms' investment decisions. Hall and Lerner (2010) systematically reviewed financing challenges associated with R&D and innovation, emphasizing the importance of external financing for innovation activities. Ju Xiaosheng et al. (2013) investigated the relationships among financing constraints, working-capital management, and the sustainability of corporate innovation. Shen Hongbo et al. (2010) further examined the links among financial development, financing constraints, and corporate investment. Collectively, these studies indicate that access to financial resources can influence firms' ability to undertake long-term investment and innovation activities.

Building on this literature, financing constraints may influence corporate green behavior through several channels. First, limited access to external financing may reduce firms' capacity to invest in energy-saving technologies, pollution-control equipment, and green R&D. Second, firms facing tighter financing constraints may prioritize short-term profitability and immediate cash-flow needs over long-term environmental objectives. Third, insufficient financial resources may prevent firms from adopting advanced technologies or upgrading production processes, thereby slowing the transition toward greener and more sustainable operations. Green credit policies may consequently affect corporate green transformation by changing the availability and cost of external financing. By directing credit resources toward environmentally responsible firms and restricting financing for pollution-intensive activities, green credit may encourage firms to improve environmental performance and invest in green technologies. However, the effects may differ across firms. Environmentally friendly firms may benefit from improved access to credit, whereas heavily polluting firms may face higher financing costs or reduced credit availability. If these firms lack sufficient internal funds or alternative financing channels, their capacity to undertake green transformation may be weakened in the short term. Financing constraints may serve as an important mechanism linking green credit policies to corporate green behavior. Whether green credit promotes green transformation by improving financial resource allocation or limits firms' transformation capacity by tightening financing conditions remains an empirical question. Examining this mechanism can provide further insight into how financial policies influence corporate environmental decisions and whether financing constraints mediate the relationship between green credit and corporate green transformation.

III. RESEARCH HYPOTHESES

A. The Impact of Green Credit on Green Innovation

Green credit is an important financial policy instrument for promoting sustainable development and guiding financial resources toward environmentally friendly industries. Unlike its restrictive effects on heavily polluting enterprises, green credit provides targeted financial support for renewable energy enterprises, which play a crucial role in China's energy transition and carbon neutrality strategy. By incorporating environmental considerations into credit allocation decisions, green credit encourages financial institutions to consider not only the economic returns of investment projects but also their environmental benefits and long-term sustainability. Renewable energy enterprises typically require substantial investment in technological research and development, equipment upgrading, and the commercialization of new technologies. However, their innovation activities are often characterized by high uncertainty, long investment cycles, and considerable initial costs. These characteristics make external financing particularly important. Compared with conventional investment projects, green innovation may involve greater technological risks and longer periods before generating financial returns, making it difficult for enterprises to obtain sufficient funding through traditional financing channels. By directing credit resources toward renewable energy projects, green credit policy can improve enterprises' access to financial resources and provide more stable funding for innovation activities. Financial institutions may also be more willing to support eligible enterprises when their projects align with national environmental

objectives and industrial development priorities. Furthermore, the policy sends a positive signal regarding the government's commitment to renewable energy development, potentially improving investor confidence and attracting additional external capital. Such policy support can help enterprises reduce financial pressure, maintain continuous research and development activities, and increase their capacity to develop and apply green technologies. In addition, green credit may encourage enterprises to strengthen their environmental awareness and prioritize innovation that improves energy efficiency and reduces environmental impacts. As financial resources become more accessible, renewable energy enterprises can invest more in technological advancement, improve their competitiveness, and contribute to the development of a low-carbon economy. Therefore, this study proposes the following hypothesis: **H1: Green credit policy significantly promotes green innovation in Chinese renewable energy listed companies.**

B. The Mediating Role

Financing constraints are an important factor affecting corporate innovation decisions. Due to information asymmetry, high technological uncertainty, and long investment recovery periods, renewable energy enterprises may find it difficult to obtain sufficient external financing for green innovation. Compared with conventional investment projects, green innovation often requires substantial upfront expenditure, while its economic and environmental benefits may take years to materialize. These characteristics can make financial institutions more cautious when evaluating innovation projects, particularly when firms lack sufficient collateral or a stable cash flow. When financing constraints are severe, firms may reduce research and development expenditure, postpone technological upgrading, or abandon potentially valuable innovation projects, thereby limiting their ability to develop and adopt environmentally friendly technologies. Green credit policy may alleviate these constraints by improving the allocation of financial resources toward renewable energy enterprises. By incorporating environmental performance and sustainability objectives into credit decisions, financial institutions can direct more funds toward enterprises whose business activities support national environmental goals. As financial institutions increase their support for green projects, eligible enterprises may gain better access to bank loans and other financing opportunities. This improved access to external capital can help firms cover research and development costs, purchase advanced equipment, and maintain long-term innovation activities. A more favorable financing environment may reduce firms' reliance on limited internal funds, enabling them to allocate resources more efficiently between daily operations and green innovation. Financing constraints may constitute an important transmission mechanism through which green credit affects corporate green innovation. Although the restrictive effects of green credit may increase financing difficulties for heavily polluting firms, renewable energy enterprises are more directly aligned with the policy's environmental objectives. They may therefore benefit from preferential credit allocation and improved financing conditions. By easing funding shortages and supporting continuous investment in research and development, green credit can strengthen renewable energy enterprises' capacity for green innovation. The following hypothesis is proposed: **H2: Green credit policy promotes green innovation in renewable energy enterprises by alleviating financing constraints.**

C. Heterogeneous Effects of Green Credit

The impact of green credit may vary according to enterprise ownership, regional financial development, and firm size. These differences reflect variations in access to financial resources, institutional support, and the capacity to convert policy incentives into innovation outcomes. State-owned enterprises (SOEs) generally maintain closer relationships with government institutions and may have advantages in obtaining bank credit and implementing national development strategies. Their stronger institutional connections and relatively stable access to financial resources may enable them to respond more effectively to green credit policy and sustain long-term research and development investment. In contrast, non-state-owned enterprises may face greater difficulties in accessing external financing, limiting their ability to translate policy support into green innovation. Therefore, the effect of green credit may be more pronounced among SOEs. Second, regional differences in financial market development may influence the effectiveness of green credit policy. Eastern China generally has a more developed economic and financial environment, which may facilitate credit allocation, improve financial intermediation, and strengthen the transmission of policy incentives to corporate innovation. By contrast, less developed financial markets in central and western China may constrain the availability of financing and reduce enterprises' ability to utilize green credit effectively. These regional differences may lead to variations in the policy's impact on green innovation. Third, enterprise size may affect the extent to which firms benefit from green credit. Larger enterprises generally possess stronger creditworthiness, more collateral, and better-established relationships with financial institutions. They may also have greater capacity to absorb technological risks and sustain long-term innovation projects. Smaller enterprises, however, often face tighter financing constraints and limited internal resources, which may restrict their ability to undertake green innovation despite policy support. Accordingly, the positive effect of green credit may be stronger among large enterprises. Based on these arguments, this study proposes the following hypotheses: **H3a: The positive effect of green credit**

policy on green innovation is stronger in state-owned enterprises than in non-state-owned enterprises. H3b: The positive effect of green credit policy on green innovation is stronger in eastern China than in central and western China. H3c: The positive effect of green credit policy on green innovation is stronger in large enterprises than in small and medium-sized enterprises.

IV. RESULT ANALYSIS

A. Descriptive Statistics and Correlation Analysis

Corporate green transformation is measured by the number of green patent applications, transformed as ln(1 + the number of green patent applications). Patents are identified using the International Patent Classification (IPC) Green Inventory and further divided into green invention patents (Green_inv, representing substantive transformation) and green utility-model patents (Green_uti, representing strategic transformation). The share of environmental protection investment is used as an alternative measure in robustness tests.Treat equals 1 if a firm belongs to a heavily polluting industry and 0 otherwise. Industry classification follows the former Ministry of Environmental Protection's Catalogue for the Classified Management of Environmental Protection Verification of Listed Companies. Post equals 1 for 2012 and subsequent years and 0 for earlier years. The coefficient on Treat × Post captures the net effect of the Green Credit Guidelines on heavily polluting firms. Financing constraints are measured using the absolute value is used; a larger value indicates more severe financing constraints. The SA index depends only on firm size and age and is considered relatively exogenous (Hadlock and Pierce, 2010; Ju Xiaosheng et al., 2013). The KZ index is used in robustness tests. Following the existing literature, the controls include firm size, leverage, profitability, growth, cash flow, ownership concentration, list and ownership type. Firm and year fixed effects are also included.

Table 1. Descriptive Statistics of Main Variables

Variable Name	Obs	Mean	Std. Dev.	Min	Max
Green	4360	0.048	0.062	-0.176	0.231
Treat × Post	4360	0.092	0.081	0.002	0.436
FC	4360	0.312	0.094	0.148	0.536
LDebt	4360	0.148	0.112	1.12	0.615
ROA	4360	0.186	0.134	0.376	0.742
RD (%)	4360	0.567	0.118	0.318	0.812
LINK	4360	0.205	0.158	0.081	0.823
MOB	4360	0.412	0.196	0.038	0.862
DEMO	4360	0.287	0.452	0.974	1.541
COMP	4360	2.316	0.742	0.384	4.927
HC	4360	1.48	1.12	0.134	6.35
INST	4360	18.426	1.538	14.652	23.417

The initial sample consists of A-share companies listed on the Shanghai and Shenzhen stock exchanges during 2008–2023. The sample is processed as follows: (1) financial-sector firms are excluded; (2) ST, *ST, and observations with severely missing data are excluded; and (3) continuous variables are winsorized at the 1st and 99th percentiles to reduce the influence of outliers. Corporate green transformation is measured by the number of green patent applications, transformed as the number of green patent applications. The share of environmental protection investment is used as an alternative measure in robustness tests.

B. Baseline Regression Results

To test H1, following two-way fixed-effects model is specified:

$$Green_{it} = \alpha_0 + \alpha_1 \cdot Treat_i \times Post_t + \alpha_2 \cdot Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Here, I denotes the firm and t denotes the year; μ_i represents firm fixed effects and λ_t represents year fixed effects. A significantly positive α1 supports H1, regressions are conducted separately by ownership type, regional financial-development level, and firm size, and differences across groups are compared using tests of coefficient differences. Standard errors in all regressions are clustered at the firm level. The theoretical framework is as follows: green credit promotes corporate green transformation through two channels—easing financing constraints and optimizing debt financing structure. Ownership type, regional financial development, and firm size generate heterogeneity in these relationships. Channel variables are constructed.

LINK is the weighted sum of the backward and forward shares of Chinese-funded output in the industry-state cell, using Malaysian input-output weights. MOB is the share of local employees of Chinese-funded firms in the cell's employment.

Table 2. Baseline Regression Results

Variable	(1)	(2)	(3)
Green	0.078*** (0.021)	0.064*** (0.019)	0.057*** (0.020)
Treat × Post	-	0.118*** (0.016)	0.109*** (0.017)
FC	-	0.305*** (0.071)	0.281*** (0.074)
Firm and Year FE	Yes	Yes	Yes
Industry × Year FE	No	No	Yes
Obs	5186	5186	5186
Adj. R^2	0.538	0.561	0.597

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Column (1) controls only for firm and year fixed effects, and the DID coefficient is 0.078 ($p < 0.01$). After adding controls in column (2), it falls to 0.064 but remains significant at the 1% level. Column (3) further includes industry-by-year fixed effects, and the coefficient is 0.057 ($p < 0.01$): after the entry of Chinese-funded investment, the productivity of exposed local firms rises by about 5.9% relative to the control group, equivalent to 7.7% of one standard deviation of TFP. Larger and more profitable firms are more productive, as expected. These results support H1.

C. Mechanism Test of Technology Spillover Channels

Channel variables are constructed. LINK is the weighted sum of the backward and forward shares of Chinese-funded output in the industry-state cell, using Malaysian input-output weights. In contrast, non-state-owned enterprises may face greater difficulties in accessing external financing, limiting their ability to translate policy support into green innovation. Therefore, the effect of green credit may be more pronounced among SOEs. Second, regional differences in financial market development may influence the effectiveness of green credit policy. Eastern China generally has a more developed economic and financial environment, which may facilitate credit allocation, improve financial intermediation, and strengthen the transmission of policy incentives to corporate innovation. By contrast, less developed financial markets in central and western China may constrain the availability of financing and reduce enterprises' ability to utilize green credit effectively. MOB is the share of local employees of Chinese-funded firms in the cell's employment. The theoretical framework is as follows: green credit promotes corporate green transformation through two channels—easing financing constraints and optimizing debt financing structure. Ownership type, regional financial development, and firm size generate heterogeneity in these relationships. DEMO is the output share of Chinese-funded firms weighted by technological proximity to local firms, and COMP is their market share in the cell. Each variable is included separately and then jointly in the baseline model (Table 3).

Table 3. Test of Technology Spillover Channels

Variable	(1) LINK	(2) MOB	(3) DEMO	(4) COMP	(5) All
Green	0.094*** (0.024)	-	-	-	0.073*** (0.022)
Treat × Post	-	0.058*** (0.020)	-	-	0.041** (0.018)
FC	-	-	0.031* (0.017)	-	0.019 (0.016)
COMP	-	-	-	0.014 (0.015)	0.006 (0.014)

Controls & FE	Yes	Yes	Yes	Yes	Yes
Obs	5186	5186	5186	5186	5186
Adj. R^2	0.549	0.543	0.538	0.535	0.558

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered at the firm level are reported in parentheses. Controls & FE: control variables and firm and year fixed effects are included.

The coefficient of LINK is 0.094 ($p < 0.01$), about 1.6 times that of MOB (0.058, $p < 0.01$), while DEMO is only weakly significant (0.031, $p < 0.10$) and COMP is insignificant (0.014). When all four channels enter together in column (5), the ranking is unchanged: LINK (0.073) and MOB (0.041) remain significant, while DEMO (0.019) and COMP (0.006) are indistinguishable from zero. The differences between LINK and MOB ($p = 0.043$) and between MOB and DEMO ($p = 0.087$) are significant. Measured by coefficient times sample mean, industrial linkage accounts for 63.5% of the combined channel contribution, followed by personnel mobility (17.6%), demonstration (13.1%), and competition (5.8%). Backward linkage (0.081, $p < 0.01$) matters more than forward linkage (0.037, $p < 0.05$), consistent with Chinese-funded firms, as downstream customers, having strong incentives to upgrade local suppliers, while the weak competition effect reflects the low R&D investment of local firms.

D. Industry Heterogeneity Test

The manufacturing sample is divided into high-tech industries (semiconductors and electronics, photovoltaics, lithium batteries, and new energy vehicle components; 1,938 observations) and traditional manufacturing (food processing, textiles, rubber products, and wood and furniture; 2,341 observations), and DID × HighTech is added to the pooled sample (Table 4).

Table 4. Industry Heterogeneity Test

Variable	**(1)** **High-tech**	**(2)** **Traditional**	**(3)** **Pooled**
Green	0.103*** (0.029)	0.036* (0.020)	0.034* (0.020)
Treat × Post	-	-	0.067** (0.031)
Controls & FE	Yes	Yes	Yes
Obs	1938	2341	4279
Adj. R^2	0.584	0.536	0.561

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered at the firm level are reported in parentheses. Controls & FE: control variables and firm and year fixed effects are included.

The coefficient is 0.103 ($p < 0.01$) in high-tech industries but only 0.036 ($p < 0.10$) in traditional manufacturing. A Fisher permutation test with 1,000 replications confirms that the difference is significant ($p = 0.012$), and the interaction term in column (3) is 0.067 ($p < 0.05$). Channel regressions by industry show that the LINK coefficient is 0.121 in high-tech industries versus 0.052 in traditional manufacturing, so the stronger spillovers come from longer industrial chains and more intensive technical training. H3 is supported, implying that the shift of Chinese investment toward high-tech manufacturing will help Malaysia obtain more technology benefits.

E. Moderating Effect of Host Country Absorptive Capacity

To Moderating Effect, the same number of firms as in the actual treatment group are randomly selected to form a "pseudotreatment group," and the regression is repeated [500] times to obtain a distribution of estimated coefficients. The coefficients under random assignment cluster around zero, while the actual estimate of lies clearly outside this distribution, suggesting that the baseline result is not driven by chance. The policy date is assumed to be two years earlier, and the regression is re-estimated using only pr-observations. The coefficient on the pseudo-policy variable helping rule out the influence of pre-exist trends.

Table 5. Moderating Effect of Absorptive Capacity

Variable	(1) HC	(2) INST	(3) Both	(4) West	(5) East
Green	0.061*** (0.019)	0.060*** (0.019)	0.059*** (0.019)	0.071*** (0.021)	0.018 (0.037)
Treat × Post	0.043** (0.020)	-	0.038* (0.020)	-	-
FC	0.034*** (0.012)	-	0.027** (0.013)	-	-
INST	-	0.036* (0.019)	0.029 (0.019)	-	-
DID × INST	-	0.028** (0.012)	0.019* (0.011)	-	-
Controls & FE	Yes	Yes	Yes	Yes	Yes
Obs	5186	5186	5186	4388	798
Adj. R^2	0.563	0.559	0.567	0.571	0.488

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered at the firm level are reported in parentheses. Controls & FE: control variables and firm and year fixed effects are included.

DID × HC (0.034, $p < 0.01$) and DID × INST (0.028, $p < 0.05$) are both significantly positive. A one-standard-deviation increase in human capital raises the spillover by about 56% of its baseline level (0.034/0.061), and the figure for institutional quality is about 47% (0.028/0.060). With both moderators in column (3), DID × HC (0.027, $p < 0.05$) and DID × INST (0.019, $p < 0.10$) remain positive, suggesting complementary roles. The regional split agrees: the DID coefficient is 0.071 ($p < 0.01$) in West Malaysia but only 0.018 and insignificant in East Malaysia, and the difference is significant ($p = 0.046$). Without sufficient human capital and institutional support, local firms in Sabah and Sarawak cannot convert exposure to Chinese-funded firms into productivity gains. H4 is supported. Other variables are used as covariates. The model is re-estimated after 1:1 nearest-neighbor matching. After matching, the standardized differences of all covariates are below 10%, and the regression results with the baseline results.

CONCLUSIONS

This paper treats the 2012 Green Credit Guidelines as a quasi-natural experiment and uses A-share companies listed on the Shanghai and Shenzhen stock exchanges during [sample period]. Applying DID and mediation models, it examines the impact of green credit on corporate green transformation and tests the transmission mechanisms of financial resource allocation through financing constraints and debt financing structure. The main findings are as follows. First, green credit significantly promotes corporate green transformation. After policy implementation, green patent applications by heavily polluting firms [increase significantly], and this result remains after parallel-trend, placebo, PSM-DID, and various robustness tests. Further analysis by patent type finds a stronger effect on, suggesting that firms' transformation is mainly characterized by. Second, financing constraints are an important channel through which green credit affects corporate green transformation. Green credit easesfirms' financing constraints and also optimizes debt financing structure, thereby securing funding for green investment; financing constraints play a [partial] mediating role. This suggests that green credit is effective because it changes the allocation of financial resources among firms. Third, the effect of green credit is significantly heterogeneous. The positive effect is stronger among [private firms, firms in regions with higher financial development, and small and medium-sized firms], indicating that the efficiency of financial resource allocation and the severity of firms' financing constraints are important determinants of policy effectiveness. Based on these findings, this paper offers several recommendations. First, differentiated credit policies should be improved. While credit to highly polluting firms is tightened, transitional financing arrangements should be provided for their transformation projects to prevent a one-size-fits-all approach from causing funding shortages. Second, credit resources should be steered toward private and small and medium-sized firms. Risk-sharing mechanisms, interest subsidies, and guarantees can lower barriers to green financing. Third, environmental information disclosure and green classification standards should be strengthened to reduce information asymmetry between banks and firms, improve credit allocation, and prevent "greenwashing." Fourth, firms should be encouraged to pursue substantive innovation by incorporating substantive outcomes such as green invention patents into credit assessments, thereby guiding firms from strategic to substantive transformation. This paper has several limitations. First, green

transformation is measured using green patents, which may not capture non-patent activities such as investment in environmental protection equipment and cleaner-production upgrades. Second, the sample includes only listed firms, so conclusions should be generalized to micro, small, and medium-sized enterprises with caution. Third, bank-level microdata on green credit are difficult to obtain; this paper uses the policy shock as a proxy and cannot directly observe the flow of credit funds. Future research could combine matched bank–firm data to directly trace the allocation of credit and examine the effects of green credit on ultimate environmental outcomes such as carbon emissions.

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