Green Credit Policy and Short-Term Financing for Long-Term Investment: Evidence from China’s Heavily Polluting Enterprises

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Abstract: In 2012, China issued the “Green Credit Guidelines” policy to guide the green transformation of companies, and at the same time, the investment and financing behaviors of heavy polluters during the green transition have received widespread attention. In the view of the investment and financing maturity structure, we take China’s A-share listed enterprises from 2009 to 2021 as samples, and construct a difference-in-differences (DID) model to examine the implication of the green credit policy on the short-term financing for long-term investment (SFLI) of heavy polluters. We found that: (1) green credit policy can reduce the level of SFLI of heavy polluters; (2) the size of short-term debt and the level of over-investment can play a mediating effect, and government subsidies can weaken the relationship between green credit policy and SFLI; (3) this effect is more significant when directors, supervisors, or senior executives have a financial institution background. (4) this effect is not significant in enterprises with bank-firm shareholding relationships and a stronger innovation intensity; (5) the effect is more significant in areas with stronger environmental regulations. This paper argues that heavily polluting enterprises should reduce short-term debt financing and over-investment, so, to solve the problem of investment and financing term mismatch under the credit risk; banks should prevent the credit rent-seeking problem caused by the equity association between banks and enterprises, and promote the consistency of green credit standards. The government can provide subsidies to enterprises in green transformation and strengthen the construction of regional environmental regulations in order to guide the smooth innovation and upgrading of heavy polluters. Our research expands the study of the micro-economic consequences of green credit policy, providing references for how to reduce maturity mismatch risk and guide the smooth transformation of heavy polluters from the multi-perspective of the government, banks, and enterprises, thus helping to promote companies’ smooth transit.

Keywords: green credit policy; short-term debts; over-investment; short-term financing for long-term investment; government subsidies

1. Introduction

In recent years, in the face of the challenges posed by climate risk, more and more financial institutions are becoming concerned about the environmental risks during financial resource allocation, and have vigorously developed green credit in response. In 2002, the International Finance Corporation (IFC), together with internationally recognized banks, proposed that environmental risks should be integrated into the credit assessment criteria. In 2003, the world’s leading banks signed the Equator Principles, in line with the proposal made in 2002, which proposed to introduce enterprises environmental performance into credit criteria. Currently, the Equator Principles have become one of the gold standards for international green credit [1], and have contributed to the practice of green credit. While the Equator Principles and green financial products continue to be enriched, green credits are also booming in China. For the past few years, China has issued policies to optimise
the delivery of green credit, achieving a high-quality development approach premised on environmental protection and resource conservation, and now China ranks first in terms of its green credit scale.

In 2012, China introduced the Green Credit Guidelines policy, requiring banks to take environmental risks as a reference for credit issuance, in order to guide the flow of financial resources to energy-saving and environmentally friendly enterprises. Specifically, the green credit policy advocates environmental risk reviews during loan pricing, loan disbursement, and credit ratings, as well as the implementation of whole-process credit supervision of high-environmental-risk enterprises. Through the differentiated loan pricing and risk management measures mentioned above, the green credit policy can force heavy polluters to develop in a green way. At the end of the third quarter of 2023, China’s green loan balance has reached 28.58 trillion yuan, becoming an important driving force leading industrial upgrading and green transform of enterprises.

Maturity mismatch has been widely studied in banks and usually refers to the mismatch in the maturity structure of banks’ assets and liabilities [2,3]. As for enterprises, it usually refers to the maturity misbalance between financing and investment, and is mainly manifested in short-term financing for long-term investment (SFLI) [4]. However, SFLI usually uses long-term investment returns to repay short-term financing costs, which may result in the corporate not having sufficient cash to repay its debts falling due, thus, increasing the firm’s debt service risks [5], exacerbating cash flow volatility [6], raising banks non-performing loan ratios, and even triggering systemic financial risks [7]. Previous studies have found that when a firm’s long-term financial resources cannot meet its long-term investment needs, the firm is prone to make up for long-term financing constraints through continuous short-term financing [8,9]. At the same time, imperfect corporate governance, such as irrational and opportunistic behavior of management, can also increase the extent of investment and financing maturity mismatches [10]. Given that appropriate debt maturity structure can reduce the likelihood of corporate maturity mismatches, many scholars have studied the causes and governance mechanisms of debt maturity structure. Information asymmetry and agency costs are indispensable factors influencing the corporate debt maturity structure [11,12]. However, regulatory quality and banking developments can reduce the tendency for short debts [13]; meanwhile, corporate profitability and the debt leverage can also exert positive governance effects on the debt maturity structure [14,15]. In view of the high short-term debt ratios of Chinese listed companies, exploring multiple governance mechanisms to reduce the misbalance of investment and financing terms is an important task to reduce systemic financial risks in the process of high development.

Previous studies have proposed that, under the pressure of financial constraints and long-term R&D investments, heavily polluting firms may choose alternative financing approaches such as commercial credit financing or be forced to scale down their investments [8,16,17]. In this regard, with the enactment of the green credit policy, do heavy polluters actively choose prudent strategies to cope with the expected cash flow pressure? Or do they passively choose maturity mismatch to compensate for the long-term financing constraints imposed by credit tilts? To address the above questions, we firstly construct a DID model to evaluate the implication of green credit policy on the degree of SFLI of heavy polluters, finding that the green credit policy significantly suppresses the maturity mismatch of heavy polluters. Secondly, we not only examine the mediating mechanisms, including the degree of short-term debt and over-investment, but also test the moderating role of government subsidies. Thirdly, through the heterogeneity test, we examine the heterogeneity of regional environmental regulations, bank-business shareholding relationships, firm innovation intensity, and the financial institution backgrounds of insiders.

Our study makes several contributions: firstly, this paper not only tests the implications on the single investment or financing behavior of heavy polluters following the enactment of the green credit policy, but also explores the impact on the overall maturity structure mismatch, thus enriching the study of the micro-economic consequences of green
credit policy. Secondly, this paper assesses the mediating role of over-investment and short-term debt, thus expanding the theoretical research framework of maturity mismatch, and enriching the study on the perspective of free cash flow pressure and risk management. Meanwhile, this paper explores the regulatory function of government subsidies, as well as tests the heterogeneity of bank-enterprise equity affiliation and financial institutions’ practitioner experience in the heterogeneity test, thus helping to promote the synergy of government, banks and enterprises. The above research provides a reference for optimizing the economic implication of green credit policy, and explores how to reduce the financial risk during green transformation of heavy polluters.

2. Theoretical Analysis and Research Hypothesis

In 2012, China enacted the Green Credit Guidelines policy, advocating that banks implement differentiated loan pricing and risk management policies to incentivize the green transformation of heavy polluters. Given that the green credit policy has raised up credit requirements and lending rates for heavy polluters, corporate investment and financing decisions are subject to the double constraints of external credit supervision and internal risk management to address the challenges posed by financing risks, such as debt service risks and cash flow risks.

In the view of credit supervision and governance, after the promulgation of Green Credit Guidelines, banks have strengthened their scrutiny and supervision of the environmental risks of heavy polluters, while at the same time raising the thresholds of credit-granting and lending rates for heavy polluters. Under strong credit regulation and constraints, in order to obtain more credit resources, the financial reports of heavy polluters are of higher quality and more informative [18,19]. For example, companies tend to increase the transparency of their ESG information in order to secure external financing [20]. Meanwhile, the regulatory pressure and public monitoring pressure brought about by green credit policy can also contribute to greater transparency of corporate information [21]. Furthermore, the mitigation of information asymmetry can strengthen the internal and external governance of companies, which helps to reduce the opportunistic behavior of management. On the other hand, strong regulation and high interest rates expose heavily polluting firms to more credit constraints and rigid payment pressure. Under the expected pressure, firms strengthen idle capital management, thereby reducing the capital structure agency problem caused by excess cash flow. At the same time, banks can improve corporate governance by effectively controlling management’s opportunistic behavior through creditor oversight mechanisms [20]. Existing studies have found that mitigating internal governance issues such as agent conflicts and speculative arbitrage can reduce the term misbalance of financing and investment [10,22].

Particularly in terms of risk management, the aggressive strategy of continuous debt to disbursement long-term investments may increase bond default risks, and may even lead to insolvency or bankruptcy due to financial liquidity difficulties [23,24]. Based on the principles of risk aversion and risk hedging [25], management perceiving future operational risk and uncertainty can be more inclined to adopt robust or even conservative strategies, thus reducing the firm’s extreme cash flow risk [26]. Therefore, considering credit constraints and strategic risk management, heavy polluters tend to choose low-risk strategies, thus reducing maturity mismatch risks as well as ensuring financial sustainability. Thus, we propose the following hypothesis:

**Hypothesis 1.** *The Green credit policy can significantly reduce the level of SFLI of heavy polluters.*

In the view of risk management, firms with more short-term debt face greater refinancing and debt rollover pressures [27]. Both tightening credit markets and firms in operational distress will increase the risk of firms defaulting on their debt and the volatility of their value [28]. It has been found that enterprises with more short-term debt ratios are prone to fall into the trap of raising new debts to repay old ones if short-term cash inflows
are unable to repay maturing debts; in particular, once credit is tightened or debt rollover is difficult, imbalances between income and expenditure are likely to occur, resulting in financial crises such as insolvency [29]. At the same time, over-confident management tends to over-estimate investment returns and under-estimate investment risks, favoring short-term debt financing with high liquidity and low nominal interest rates [30,31]. However, with the Green Credit Guidelines in place, credit constraints and the pressure of rigid payment can attenuate the psychological bias of over-confidence of the management. Especially when faced with financing risks, management’s incentives for short-term debt financing are weakened for the purpose of safeguarding the company’s sustainable operating [32]. Meanwhile, under the dual constraints of external credit supervision and internal risk management, heavily polluting enterprises tend to make risk-averse financing decisions, reducing the pressure of debt rollover and debt services brought about by short-term liabilities [33], thus avoiding the imbalance between revenues and expenditures. Therefore, we propose the following hypothesis:

**Hypothesis 2.** Short-term debt can play a mediating role; the green credit policy can reduce the scale of short-term debt in heavy polluters and therefore reduce the level of SFLI.

After the enactment of the green credit guidelines, under the pressure from free cash flow constraints and risk management, heavily polluting enterprises reduce the maturity mismatch caused by blind expansion. On the one hand, free cash flow theory suggests that excess free cash flow exacerbates firms’ agency conflicts [34], especially over-investment. Under the differentiated credit and pricing methodologies, heavy polluters face greater financial resource constraints and environmental constraints, and in the meantime, bear greater pressure for green transformation and technological upgrading. Credit constraints and green transformation compress idle funds and reduce irrational behaviors such as abuse of free cash flow. Debt service and rigid payment pressure can also reduce management opportunistic behavior under discretionary authority [35], thus, reducing the excessive investment of heavily polluting enterprises caused by blind expansion [36]. On the other hand, it has been found that companies with an explorer strategy have higher levels of over-investment than companies with a defender strategy [37]. However, based on the principles of risk avoidance and risk hedging [25], in order to hedge the cash flow risk, heavy polluters decrease the sensitivity of investment opportunities and prudently grasp the direction of funds, so as to effectively inhibit the level of over-investment [38]. Reducing corporate over-investment not only reduces the imbalance of investment and financing structure caused by blind expansion as well as insufficient endogenous financing, but also avoids the negative effect of corporate prospector type strategies on credit ratings [39], which reduces high-risk behaviors such as continuous short-term loans in favor of long-term payment. Therefore, we propose the following hypothesis:

**Hypothesis 3.** Over-investment can play a mediating role; the green credit policy can reduce the level of over-investment of heavy polluters, and therefore reduce the level of SFLI.

Government subsidies can provide non-reimbursable financial assistance and implicit reputational certification for heavily polluting firms, thus affecting the inhibition impact of green credit policy on SFLI. Firstly, government subsidies provide financial support for firms’ innovative activities [40], which can alleviate the financing constraints during green transformation and upgrading, thus reducing the expected cash flow pressures caused by the tightening of credits to heavily polluting firms. Secondly, government subsidies can exert an implicit reputational guarantee and government certification effect, by sending positive signals to financial institutions [41], boosting the confidence of the capital market in subsidized firms, which not only reduces the difficulty of credit financing of heavy polluters, but also reduces debt financing costs [42], lengthens debt maturity structure [43], and helps firms to attract more risky investments [44,45]. Therefore, government subsidies can alleviate the financing pressure of enterprises in various ways [42], thus weakening...
the financing risk and expected cash flow pressure brought by strict credit regulation. At the same time, government subsidies, as an implicit guarantee mechanism, can play the role of risk mitigation, which can reduce the environmental uncertainty of enterprises and improve enterprises risk-bearing capacity [46]; thus weakening the risk-aversion and risk-smoothing motives of heavily polluting firms under credit constraints. Given that the green credit policy can suppress SFLI by increasing the expected cash flow pressure and risk management incentives of heavily polluting firms, government subsidies can weaken the inhibitory effect by providing financial support as well as reputational or risk guarantees. Therefore, we propose the following hypothesis:

**Hypothesis 4.** Government subsidies can weaken the inhibitory effect of the green credit policy on the level of SFLI of heavy polluters.

### 3. Research Design

#### 3.1. Sample Selection and Data Source

Referring to Fan et al. [47], this paper takes the “Listed Companies’ Environmental Protection Verification Industry Classification Management Catalogue” released by China’s Ministry of Environmental Protection (MEP) in 2008 as the main basis for the heavy polluting industries, and matches the 16 industries therein with the industry classification codes in the revised version of the Securities and Futures Commission (SFC) in 2012, thereby initially identifying the range of heavy polluting industries. Secondly, after the preliminary screening, we manually excluded heavily polluting enterprises whose main business do not involve any of the 16 businesses listed in the Industry Classification Catalog. Finally, based on the information of environmental protection concept stocks in the iFinD database, environmentally friendly enterprises were removed from all samples to ensure the purity and reliability of our experiments. We selected companies in A-share market from 2009 to 2021, and collected data through the iFinD and CSMAR database. After screening out the heavy and non-heavy polluters in each year through the above operation, we carried out the following treatments for the sample annual observations: (1) we deleted the financial companies; (2) we deleted abnormal operating companies whose balance sheet ratio was larger than 1; (3) we deleted the companies with data deficiencies; (4) we shrunk continuous variables at the upper and lower 1% levels. After the above procedures, our paper finally contains 12,076 “firm-year” observations.

#### 3.2. Variable Definition

Explained variable: Short-term Financing for Long-term Investment (SFLI). There are now two main ways to measure this variable. Some studies measure the level of mismatch by the gap between the proportion of short-term liabilities to total liabilities and the proportion of short-term assets to total assets [48]. Some studies measure the extent of mismatch by the gap between long-term capital expenditure and long-term capital inflows [49]. We adopted the second method, which firstly calculates the capital gap, and then removes the scale effect with the size of assets, so as to construct the metric of explained variable. The greater the metric, the larger the level of SFLI.

Explaining variable: DID (Time × Treat). In this paper, we used the cross-multiplier term of the time and group variable as the explanatory variable (Time × Treat). In 2012, China promulgated the Green Credit Guidelines policy, therefore 2012 was taken as the base year. For 2012 and later years, the time variable takes 1, otherwise it takes 0. Meanwhile, we selected the heavy polluters as the experimental group, and selected non-heavy polluters excluding environmental protection companies as the control group. If the company belongs to heavy polluters, the group variable equals to 1, otherwise it equals to 0.

Mediating variables: Firstly, for the over-investment indicator, we referred to the research of Richardson [50] to calculate the degree of over-investment by the residual measure model; if the residual is larger than 0, the degree of over-investment is the value of the residual; if the residual is less than or equals to 0, the level of over-investment is 0.
Secondly, we calculated the size of short-term debt by the ratio of current liabilities to total assets at year-end [11,51].

Moderating variable: Government subsidies. We measured the level of government subsidies with the proportion of annual government subsidies to annual revenues from operations [52].

Control variables: According to the previous research [53], we chose the proportion of tangible assets, operating cash flow, return on equity, asset growth capacity, board size, percentage of independent directors, institutional investor shareholding proportion, two concurrent positions, Tobin Q, and SOE, as the control variables at the firm level. Meanwhile, considering the implication of local financial development on policy effects, the level of regional financial development was also included as one of the control variables. Specific variables are defined as shown in Table 1.

Table 1. Variable Definition Table.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Variable Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Explained variable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFLI</td>
<td>Short-term financing for long-term investment</td>
<td>[Cash paid for buying fixed assets, intangible assets and other long-term assets – (The increase in long term loans + Increase in owners’ equity + Net cash flow from operating activities + Net cash flow from disposing fixed assets, intangible assets and other long-term assets)]/Total assets at the beginning of the year.</td>
</tr>
<tr>
<td><strong>Explaining variable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DID</td>
<td>Interaction term</td>
<td>Time × Treat.</td>
</tr>
<tr>
<td>Time</td>
<td>Time dummy variable</td>
<td>Takes the value of 1 for 2012 and onwards, 0 for before.</td>
</tr>
<tr>
<td>Treated</td>
<td>Group dummy variable</td>
<td>Heavily polluting companies equal to 1, otherwise equal to 0.</td>
</tr>
<tr>
<td><strong>Mediating variable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ove-inv</td>
<td>Over-investment</td>
<td>Takes the value of residual if the residual is larger than 0, Otherwise the value is 0.</td>
</tr>
<tr>
<td>SD</td>
<td>Short-term Debt</td>
<td>Current liabilities/Asset size at year-end.</td>
</tr>
<tr>
<td><strong>Moderating variable</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub</td>
<td>Government subsidies</td>
<td>Total government subsidies/total operating income for the year.</td>
</tr>
<tr>
<td>Tasset</td>
<td>Ratio of tangible assets</td>
<td>(Total assets-net intangible assets-net goodwill)/Total assets at end of year.</td>
</tr>
<tr>
<td>Cash</td>
<td>Operating cash flow</td>
<td>Net cash flows from operating activities/total assets at end of year.</td>
</tr>
<tr>
<td>Roa</td>
<td>Return on net assets</td>
<td>Net profit/shareholders’ equity.</td>
</tr>
<tr>
<td>Growth</td>
<td>Total asset growth rate</td>
<td>Increase in assets for the year/total assets at year-beginning.</td>
</tr>
<tr>
<td>Bo</td>
<td>Board size</td>
<td>Measured by the number of board members.</td>
</tr>
<tr>
<td>Bi</td>
<td>Independent directors</td>
<td>The proportion of independent directors.</td>
</tr>
<tr>
<td>Ins</td>
<td>Shareholding of Institutional investors</td>
<td>The proportion of shares held by institutional investors.</td>
</tr>
<tr>
<td>Duality</td>
<td>CEO Duality</td>
<td>If the general manager is also the chairman of the board, the value is 1, otherwise it is 0.</td>
</tr>
<tr>
<td>Soe</td>
<td>State-owned enterprise</td>
<td>State-owned enterprises equals to 1, otherwise equals to 0.</td>
</tr>
<tr>
<td>TQ</td>
<td>Tobin Q</td>
<td>Market value/book value of assets</td>
</tr>
<tr>
<td>Fin</td>
<td>Regional financial development</td>
<td>(local deposits + local loans)/local GDP.</td>
</tr>
</tbody>
</table>
3.3. Model Design

Firstly, with reference to the previous study [54], we constructed a difference-in-differences model to assess the influence of the Green Credit Guidelines on SFLI of heavy polluters, as shown in Equation (1).

\[
SFLI_{i,t} = \alpha_0 + \alpha_1 \text{Treat}_{i,t} \times \text{Time}_{i,t} + \sum_j \varphi_j \text{Control}_{i,t} + \sum \text{Firm} + \sum \text{Year} + \epsilon_{i,t}
\]  

(1)

where \(Treat_{i,t} \times \text{Time}_{i,t}\) is the intermodal term (DID). If the coefficient of intermodal term is significantly less than 0, it means that the green credit policy can significantly curb the level of SFLI of heavy polluters. If the coefficient of intermodal term is significantly larger than 0, it means that the policy can significantly increase the level of SFLI of heavy polluters.

Secondly, we adopted the causal steps approach to test whether the intermediation role of over-investment and short-term debts are valid, as shown in Equations (2) and (3).

\[
M_{i,t} = \phi_0 + \phi_1 \text{Treat}_{i,t} \times \text{Time}_{i,t} + \sum_j \psi_j \text{Control}_{i,t} + \sum \text{Firm} + \sum \text{Year} + \epsilon_{i,t}
\]

(2)

\[
SFLI_{i,t} = \gamma_0 + \gamma_1 \text{Treat}_{i,t} \times \text{Time}_{i,t} + \gamma_2 \text{M}_{i,t} + \sum_j \gamma_j \text{Control}_{i,t} + \sum \text{Firm} + \sum \text{Year} + \epsilon_{i,t}
\]

(3)

where \(M_{i,t}\) represents the mediating variables, corresponding to over-investment (Overinv) or short-term debt (SD). If the coefficients of \(\alpha_1\), \(\varphi_1\), \(\gamma_1\) and \(\gamma_2\) are all significant and the coefficient of \(\gamma_1\) is less than \(\alpha_1\), it indicates that over-investment or short-term debt plays a partially mediating role between green credit policy and SFLI of heavy polluters.

Thirdly, according to the previous research [55], we built a triple difference model to examine the moderating role of government subsidies, as shown in Equation (4).

\[
SFLI_{i,t} = \delta_0 + \delta_1 \text{Treat}_{i,t} \times \text{Time}_{i,t} \times \text{Bank}_{i,t} + \delta_2 \text{Treat}_{i,t} \times \text{Time}_{i,t} \times \text{Bank}_{i,t} + \delta_3 \text{Bank}_{i,t} + \sum_j \delta_j \text{Control}_{i,t} + \sum \text{Firm} + \sum \text{Year} + \epsilon_{i,t}
\]

(4)

where \(\text{Treat}_{i,t} \times \text{Time}_{i,t} \times \text{Bank}_{i,t}\) is the triple difference interaction term (DDD); if the coefficient of \(\text{Treat}_{i,t} \times \text{Time}_{i,t} \times \text{Bank}_{i,t}\) is significantly larger than 0 and the coefficient of \(\text{Treat}_{i,t} \times \text{Time}_{i,t}\) is significantly less than 0, it indicates that government subsidies can diminish the negative impact of green credit policy on SFLI of heavy polluters.

4. Results of Empirical Tests

4.1. Descriptive Statistics

Table 2 demonstrates the results of descriptive statistics of relevant variables. The number of all variables in Table 2 is 12,076.

The standard deviation of SFLI equals to 0.3182, the minimum value equals to -2.2351, and its maximum value equals to 0.2998, which indicates that the degree of SFLI varies widely among different enterprises; the upper quartile is 0.0212, which indicates that more than one-fourth of the companies have the problem of SFLI. The average value of short-term debt (SD) equals to 0.3795, and its minimum value is 0.0478 while maximum value equals 0.8307, which shows a large extreme variance and that there is a big difference in the debt maturity structure of some companies. The average value of over-investment (Overinv) equals to 0.0178, the median equals to 0.0000, while the upper quartile equals to 0.1117, and the lower quartile is 0.0015, which means that more than three-fourths of the companies have the problem of SFLI. The average value of institutional investor shareholding (Ins) and board size (Bo) have large standard deviations. The average value of institutional investor shareholding is 0.4928, suggesting that the average shareholding reaches 49.28%, and the average value of board size equals to 9.5489, which means that the average board member is more than nine. The median value of the nature of ownership (Soe) is 0 and the upper quartile is 1, indicating that more than a quarter of the...
companies are state-owned enterprises. Other control variables have been shown through Table 2.

Table 2. Table of descriptive statistics.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>P25</th>
<th>P50</th>
<th>P75</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFLI</td>
<td>-0.1157</td>
<td>0.3182</td>
<td>-2.2351</td>
<td>-0.1491</td>
<td>-0.0529</td>
<td>0.0212</td>
<td>0.2998</td>
</tr>
<tr>
<td>SD</td>
<td>0.3795</td>
<td>0.1820</td>
<td>0.0478</td>
<td>0.2381</td>
<td>0.3652</td>
<td>0.5055</td>
<td>0.8307</td>
</tr>
<tr>
<td>Overinv</td>
<td>0.0178</td>
<td>0.0365</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0181</td>
<td>0.1870</td>
</tr>
<tr>
<td>Sub</td>
<td>0.0113</td>
<td>0.0182</td>
<td>0.0000</td>
<td>0.0015</td>
<td>0.0048</td>
<td>0.0125</td>
<td>0.1117</td>
</tr>
<tr>
<td>Tasset</td>
<td>0.9219</td>
<td>0.0966</td>
<td>0.4775</td>
<td>0.9063</td>
<td>0.9543</td>
<td>0.9802</td>
<td>1.0000</td>
</tr>
<tr>
<td>Cash</td>
<td>0.0422</td>
<td>0.0731</td>
<td>-0.1830</td>
<td>0.0024</td>
<td>0.0408</td>
<td>0.0841</td>
<td>0.2434</td>
</tr>
<tr>
<td>Roa</td>
<td>0.0633</td>
<td>0.1316</td>
<td>-0.6259</td>
<td>0.0245</td>
<td>0.0694</td>
<td>0.1216</td>
<td>0.3743</td>
</tr>
<tr>
<td>Growth</td>
<td>0.2160</td>
<td>0.4852</td>
<td>-0.2908</td>
<td>0.0164</td>
<td>0.1072</td>
<td>0.2564</td>
<td>0.6728</td>
</tr>
<tr>
<td>Bo</td>
<td>9.5489</td>
<td>2.2901</td>
<td>5.0000</td>
<td>8.0000</td>
<td>9.0000</td>
<td>11.0000</td>
<td>17.0000</td>
</tr>
<tr>
<td>Bi</td>
<td>0.3753</td>
<td>0.0622</td>
<td>0.2500</td>
<td>0.3333</td>
<td>0.3656</td>
<td>0.4826</td>
<td>0.5833</td>
</tr>
<tr>
<td>Ins</td>
<td>49.2761</td>
<td>23.3630</td>
<td>0.9741</td>
<td>32.5130</td>
<td>50.6608</td>
<td>66.9919</td>
<td>97.0067</td>
</tr>
<tr>
<td>Duality</td>
<td>0.2213</td>
<td>0.4151</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Soe</td>
<td>0.4670</td>
<td>0.4989</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>TQ</td>
<td>2.2475</td>
<td>1.5241</td>
<td>0.9024</td>
<td>1.2945</td>
<td>1.7504</td>
<td>2.5834</td>
<td>9.7122</td>
</tr>
<tr>
<td>Fin</td>
<td>3.4938</td>
<td>1.3736</td>
<td>1.7937</td>
<td>2.5584</td>
<td>3.1215</td>
<td>3.8331</td>
<td>7.5520</td>
</tr>
</tbody>
</table>

4.2. Basic Test Results

Table 3 demonstrates the results of basic regression. After controlling for a year and individual fixed effects, the DID coefficient equals to -0.0161, corresponding to a p-value of 1% and a t-value of -2.57. This indicates that we can accept hypothesis 1 at the 99% level, which implies that the green credit policy significantly declines the level of SFLI of heavy polluters. The R-square reflects the fit of the regression and the larger the value, the better the fit. As seen in Table 3, the value of R-squared equals to 0.7961, proving a good fit.

Table 3. Baseline regression results.

<table>
<thead>
<tr>
<th>Variables</th>
<th>SFLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DID</td>
<td>-0.0161 *** (−2.57)</td>
</tr>
<tr>
<td>Tasset</td>
<td>0.1707 *** (6.64)</td>
</tr>
<tr>
<td>Cash</td>
<td>-1.1961 *** (−50.11)</td>
</tr>
<tr>
<td>Roa</td>
<td>-0.1407 *** (−10.49)</td>
</tr>
<tr>
<td>Growth</td>
<td>-0.5419 *** (−166.98)</td>
</tr>
<tr>
<td>Bo</td>
<td>-0.0017 ** (−2.03)</td>
</tr>
<tr>
<td>Bi</td>
<td>0.0874 *** (2.83)</td>
</tr>
<tr>
<td>Ins</td>
<td>-0.0005 *** (−3.60)</td>
</tr>
<tr>
<td>Duality</td>
<td>0.0044 (0.80)</td>
</tr>
<tr>
<td>Soe</td>
<td>0.0091 (0.76)</td>
</tr>
<tr>
<td>TQ</td>
<td>-0.0105 *** (−6.78)</td>
</tr>
<tr>
<td>Fin</td>
<td>0.0081 (1.52)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.0939 *** (−2.73)</td>
</tr>
</tbody>
</table>

Year FE YES
Firm FE YES
R² 0.7961
N 12,076

Note: *** p < 0.01, ** p < 0.05.
The above results indicate that hypothesis 1 is confirmed. According to our analysis, after the issuance of the green credit policy, heavy polluters facing credit constraints, strict credit supervision and environmental risk review are more inclined to adopt prudent strategic decision-making. For the purpose of reducing expected cash flow pressure and financial risk, heavy polluters may decrease the level of short-term financing and blind investment, thus reducing the level of SFLI.

4.3. Mediation Test Results for Short-Term Debt and Over-Investment

Table 4 demonstrates the results of the mediation tests. Firstly, columns (1) and (2) present the mediating effect of short-term debt (SD). It can be seen that when DID serves as the independent variable and short-term debt (SD) serves as the dependent variable, DID is negative and has a significant level of 5%, suggesting that green credit policy significantly decreases the scale of short-term debt of heavy polluters. When both DID and short-term debt (SD) serve as independent variables and SFLI serves as the dependent variable, the coefficient of DID is negative with a level of 10%, while short-term debt (SD) is significantly positive with a level of 1%, which proves that the green credit policy can decrease the level of SFLI of heavy polluters through decreasing their short-term debt. Therefore, short-term debt plays an intermediary role, proving that hypothesis 2 is valid.

Table 4. Results of intermediation effects tests.

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) SD</th>
<th>(2) SFLI</th>
<th>(3) Overinv</th>
<th>(4) SFLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DID</td>
<td>−0.0095 **</td>
<td>−0.0113 *</td>
<td>−0.0027 **</td>
<td>−0.0125 **</td>
</tr>
<tr>
<td></td>
<td>(−2.32)</td>
<td>(−1.91)</td>
<td>(−1.96)</td>
<td>(−2.09)</td>
</tr>
<tr>
<td>Overinv</td>
<td></td>
<td></td>
<td></td>
<td>1.3024 ***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(30.04)</td>
</tr>
<tr>
<td>SD</td>
<td>0.1135 ***</td>
<td>0.1128 ***</td>
<td>−0.0948 ***</td>
<td>0.2942 ***</td>
</tr>
<tr>
<td></td>
<td>(6.78)</td>
<td>(4.64)</td>
<td>(−16.60)</td>
<td>(11.79)</td>
</tr>
<tr>
<td>Tasset</td>
<td>0.0618 ***</td>
<td>−1.2276 ***</td>
<td>0.0086</td>
<td>−1.2073 ***</td>
</tr>
<tr>
<td></td>
<td>(3.97)</td>
<td>(−54.48)</td>
<td>(1.63)</td>
<td>(−52.83)</td>
</tr>
<tr>
<td>Cash</td>
<td>−0.1488 ***</td>
<td>−0.0648 ***</td>
<td>0.0082 ***</td>
<td>−0.1514 ***</td>
</tr>
<tr>
<td></td>
<td>(−17.03)</td>
<td>(−5.05)</td>
<td>(2.74)</td>
<td>(−11.78)</td>
</tr>
<tr>
<td>Roa</td>
<td>0.0074 ***</td>
<td>−0.5457 ***</td>
<td>0.0138 ***</td>
<td>−0.5599 ***</td>
</tr>
<tr>
<td></td>
<td>(3.52)</td>
<td>(−178.14)</td>
<td>(19.16)</td>
<td>(−176.95)</td>
</tr>
<tr>
<td>Growth</td>
<td>0.0003</td>
<td>−0.0019 **</td>
<td>−0.0004 **</td>
<td>−0.0012</td>
</tr>
<tr>
<td></td>
<td>(0.45)</td>
<td>(−2.31)</td>
<td>(−2.30)</td>
<td>(−1.43)</td>
</tr>
<tr>
<td>Bo</td>
<td>−0.0076</td>
<td>0.0913 ***</td>
<td>0.0060</td>
<td>0.0795 ***</td>
</tr>
<tr>
<td></td>
<td>(−0.38)</td>
<td>(3.14)</td>
<td>(0.88)</td>
<td>(2.69)</td>
</tr>
<tr>
<td>Bi</td>
<td>−0.0004 ***</td>
<td>−0.0003 **</td>
<td>0.0001 ***</td>
<td>−0.0007 ***</td>
</tr>
<tr>
<td>Ins</td>
<td>(−4.32)</td>
<td>(−2.29)</td>
<td>(4.47)</td>
<td>(−5.10)</td>
</tr>
<tr>
<td>Duality</td>
<td>0.0013</td>
<td>0.0037</td>
<td>0.0017</td>
<td>0.0021</td>
</tr>
<tr>
<td>Soe</td>
<td>0.0096</td>
<td>0.0042</td>
<td>−0.0006</td>
<td>0.0098</td>
</tr>
<tr>
<td>TQ</td>
<td>0.0002</td>
<td>−0.0106 ***</td>
<td>−0.0001</td>
<td>−0.0105 ***</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(−7.25)</td>
<td>(−0.08)</td>
<td>(−7.06)</td>
</tr>
<tr>
<td>Fin</td>
<td>0.0088</td>
<td>0.0036</td>
<td>0.0001</td>
<td>0.0080</td>
</tr>
<tr>
<td>Constant</td>
<td>0.2662</td>
<td>−0.2298 ***</td>
<td>0.0966 ***</td>
<td>−0.2198 ***</td>
</tr>
<tr>
<td></td>
<td>(11.87)</td>
<td>(−7.02)</td>
<td>(12.63)</td>
<td>(−6.61)</td>
</tr>
<tr>
<td>Year FE</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Firm FE</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>R²</td>
<td>0.0389</td>
<td>0.8186</td>
<td>0.0919</td>
<td>0.8131</td>
</tr>
<tr>
<td>N</td>
<td>12,076</td>
<td>12,076</td>
<td>12,076</td>
<td>12,076</td>
</tr>
</tbody>
</table>

Note: ***p < 0.01, **p < 0.05, *p < 0.1.
Secondly, columns (3) and (4) present the mediating effect of over-investment (Over-inv). It can be seen that when over-investment (Overinv) serves as the dependent variable, the independent variable (DID) exhibits less than 0 with a significant level of 5%, suggesting that the green credit policy can significantly inhibit over-investment in heavy polluters. When both DID and over-investment (Overinv) are used as independent variables and SFLI is used as the dependent variable, the coefficient of DID exhibits negative with a significant level of 5% and Overinv exhibits significantly positive at a 1% level, which indicates that the green credit policy can reduce the degree of SFLI of heavy polluters by reducing their investment pressure caused by over-investment. Therefore, over-investment plays an intermediary role, proving that hypothesis 3 is valid.

4.4. Moderating Test Results for Government Subsidies

Table 5 demonstrates the results of the moderated test. After the introduction of the moderating variable (Sub) and the triple difference term (DDD), DID is still significantly negative, and the coefficient of DDD equals to 0.5185, which is larger than 0 with a significant level of 5%, proving that government subsidies weaken the inhibitory effect of the green credit policy on SFLI of heavy polluters. Therefore, hypothesis 4 is valid. According to our analysis, government subsidies can send positive messages to banks, weakening the financing constraints and expected cash flow pressures caused by credit tightening and whole-process credit supervision of heavy polluters, thus weakening the influence of green credit policy on the degree of SFLI of heavy polluters.

Table 5. Results of Moderating effects test.

<table>
<thead>
<tr>
<th>Variables</th>
<th>SFLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDD</td>
<td>0.5185 **</td>
</tr>
<tr>
<td></td>
<td>(2.24)</td>
</tr>
<tr>
<td>DID</td>
<td>−0.0219 ***</td>
</tr>
<tr>
<td></td>
<td>(−3.23)</td>
</tr>
<tr>
<td>Sub</td>
<td>−0.2248 *</td>
</tr>
<tr>
<td></td>
<td>(−1.82)</td>
</tr>
<tr>
<td>Tasset</td>
<td>0.1713 ***</td>
</tr>
<tr>
<td></td>
<td>(6.66)</td>
</tr>
<tr>
<td>Cash</td>
<td>−1.1962 ***</td>
</tr>
<tr>
<td></td>
<td>(−50.12)</td>
</tr>
<tr>
<td>Roa</td>
<td>−0.1412 ***</td>
</tr>
<tr>
<td></td>
<td>(−10.49)</td>
</tr>
<tr>
<td>Growth</td>
<td>−0.5419 ***</td>
</tr>
<tr>
<td></td>
<td>(−167.00)</td>
</tr>
<tr>
<td>Bo</td>
<td>−0.0017 **</td>
</tr>
<tr>
<td></td>
<td>(−2.01)</td>
</tr>
<tr>
<td>Bi</td>
<td>0.0880 ***</td>
</tr>
<tr>
<td></td>
<td>(2.85)</td>
</tr>
<tr>
<td>Ins</td>
<td>−0.0005 ***</td>
</tr>
<tr>
<td></td>
<td>(−3.60)</td>
</tr>
<tr>
<td>Duality</td>
<td>0.0045 (0.83)</td>
</tr>
<tr>
<td>Soe</td>
<td>0.0092 (0.77)</td>
</tr>
<tr>
<td>TQ</td>
<td>−0.0106 ***</td>
</tr>
<tr>
<td></td>
<td>(−6.80)</td>
</tr>
<tr>
<td>Fin</td>
<td>0.0081 (1.50)</td>
</tr>
<tr>
<td>Constant</td>
<td>−0.0920 ***</td>
</tr>
<tr>
<td></td>
<td>(−2.67)</td>
</tr>
</tbody>
</table>

Year FE | YES |
Firm FE | YES |
R²     | 0.7962 |
N      | 12,076 |

Note: *** p < 0.01, ** p < 0.05, * p < 0.1.
5. Robustness Tests

5.1. Parallel Trend Test

For the purpose of testing whether the parallel trend assumption is valid, we measured the dynamic effects according to the estimated coefficients under different treatment time points and plotted the parallel trend test, which can be seen in Figure 1. We divided the sample interval into 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016 to 2021; meanwhile, to exclude the interference of multicollinearity, we excluded the year 2012. We then examined whether the parallel trend assumption can be valid by assessing the policy effects at different time points. As shown in Figure 1, before the promulgation of the policy, the effect is either positive or negative, and none of them are significant; however, after the introduction of policy, the negative influence is gradually significant and persistent. Therefore, the DID model passed the parallel trend test.

![Figure 1. Parallel trend test.](image)

5.2. PSM-DID

For the purposes of excluding the interference of sample selection deviations on the experimental test, we used the PSM method to re-screen both the experimental and control group. First, we selected 11 characteristic variables for 1:3 nearest neighbor matching, then screened out the two groups of samples with similar traits, and finally re-run the regression analysis.

Table 6 shows the changes in the means and standard deviations before and after matching. After matching, the standard biases of the feature covariates were all declined, meanwhile, the significance levels of the t-tests were all larger than 5%, indicating that the balance test was passed. As shown in Table 7, the coefficient of DID exhibits less than 0 at a significant level of 5%, proving that the inhibitory impact is still significant, which again proves the soundness of our previous regression.

![Table 6. Balance test.](image)

5.3. Placebo Test

For the purpose of excluding omitted variables as well as random factors from interfering with the experimental results, we constructed randomized trials at the time and group levels and then regressed the main regression. We reproduced the above process 500 times and observed the distributional characteristics of the regression coefficients. Through Figure 2, we discovered that the spurious estimated coefficients are concentrated around the zero line, indicating that the problems of random factors and omitted variables can be excluded, thus, passing the placebo test.
Table 6. Balance test.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unmatched(U) Matched(M)</th>
<th>Mean</th>
<th>Bias</th>
<th>Reduct</th>
<th>T-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treated</td>
<td>Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tasset</td>
<td>U</td>
<td>0.9223</td>
<td>0.9210</td>
<td>0.01</td>
<td>−0.35</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>0.9223</td>
<td>0.9206</td>
<td>0.02</td>
<td>0.33</td>
</tr>
<tr>
<td>Cash</td>
<td>U</td>
<td>0.0547</td>
<td>0.0361</td>
<td>0.26</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>0.0547</td>
<td>0.0564</td>
<td>−0.02</td>
<td>−1.10</td>
</tr>
<tr>
<td>Roa</td>
<td>U</td>
<td>0.0549</td>
<td>0.0675</td>
<td>−0.09</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>0.0549</td>
<td>0.0605</td>
<td>−0.04</td>
<td>0.56</td>
</tr>
<tr>
<td>Growth</td>
<td>M</td>
<td>0.1896</td>
<td>0.2310</td>
<td>−0.09</td>
<td>0.92</td>
</tr>
<tr>
<td>Bo</td>
<td>M</td>
<td>9.7645</td>
<td>9.4267</td>
<td>0.15</td>
<td>0.99</td>
</tr>
<tr>
<td>Bi</td>
<td>M</td>
<td>0.3722</td>
<td>0.3773</td>
<td>−0.08</td>
<td>0.72</td>
</tr>
<tr>
<td>Ins</td>
<td>M</td>
<td>50.5800</td>
<td>48.4950</td>
<td>0.09</td>
<td>0.99</td>
</tr>
<tr>
<td>Duality</td>
<td>M</td>
<td>0.1972</td>
<td>0.2363</td>
<td>−0.10</td>
<td>0.97</td>
</tr>
<tr>
<td>Soe</td>
<td>M</td>
<td>0.5043</td>
<td>0.4410</td>
<td>0.13</td>
<td>0.96</td>
</tr>
<tr>
<td>TQ</td>
<td>M</td>
<td>2.2186</td>
<td>2.2121</td>
<td>−0.03</td>
<td>0.88</td>
</tr>
<tr>
<td>Fin</td>
<td>M</td>
<td>3.2458</td>
<td>3.2493</td>
<td>−0.00</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Table 7. PSM-DID test results.

<table>
<thead>
<tr>
<th>Variables</th>
<th>SFLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DID</td>
<td>−0.0147 **</td>
</tr>
<tr>
<td>Tasset</td>
<td>0.1659 ***</td>
</tr>
<tr>
<td>Cash</td>
<td>−1.1847 ***</td>
</tr>
<tr>
<td>Roa</td>
<td>−0.1468 ***</td>
</tr>
<tr>
<td>Growth</td>
<td>−0.5453 ***</td>
</tr>
<tr>
<td>Bo</td>
<td>−0.0017 **</td>
</tr>
<tr>
<td>Bi</td>
<td>0.0071 ***</td>
</tr>
<tr>
<td>Ins</td>
<td>−0.0004 ***</td>
</tr>
<tr>
<td>Duality</td>
<td>0.0047</td>
</tr>
<tr>
<td>Soe</td>
<td>0.0117</td>
</tr>
<tr>
<td>TQ</td>
<td>−0.0109 ***</td>
</tr>
<tr>
<td>Fin</td>
<td>0.0098 *</td>
</tr>
<tr>
<td>Constant</td>
<td>−0.0983 ***</td>
</tr>
</tbody>
</table>

Note: *** p < 0.01, ** p < 0.05, * p < 0.1.
6. Heterogeneity Analysis

6.1. Analysis of Heterogeneity of Environmental Regulatory Intensity

We tested the heterogeneity of environmental regulation intensity by grouping regression. The division is according to the amount of provincial investment in industrial pollution control (IIPC), so firms in areas with high level of IIPC are divided into a strong environmental regulation group, and firms in areas with low level of IIPC are divided into a low environmental regulation group. As shown in Table 8, the coefficient of DID equals to $-0.0258$, which is less than 0 with a level of 10% among areas with a high level of IIPC; and the coefficient of DID is not significant among areas with a low level of IIPC. Our analysis suggests that in regions with strong environmental regulation, the green credit policy generates stronger credit constraints and stricter environmental risk scrutiny of heavy polluters. As a result, heavy polluters are more inclined to take prudent investment and financing decisions to cope with financing risks, and meanwhile heavy polluters reduce over-investment caused by blind expansion to a greater extent, so the degree of SFLI in the group with strong environmental regulation is lower.

Table 8. Heterogeneity test of environmental regulatory intensity.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Strong Regional Environmental Regulation</th>
<th>Weak Regional Environmental Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SFLI</td>
<td>SFLI</td>
</tr>
<tr>
<td>DID</td>
<td>$-0.0258^*$</td>
<td>$-0.0119$</td>
</tr>
<tr>
<td></td>
<td>($-1.72$)</td>
<td>($-1.58$)</td>
</tr>
<tr>
<td>Controls</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Year FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Firm FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.7705</td>
<td>0.8130</td>
</tr>
<tr>
<td>N</td>
<td>4341</td>
<td>7325</td>
</tr>
</tbody>
</table>

Note: * $p < 0.1$.

6.2. Analysis of Heterogeneity of Bank-Enterprise Shareholding Linkages

We tested the heterogeneity of bank-enterprise shareholding linkages through grouping regressions. There are two types of bank-enterprise shareholding linkages, one of which refers to companies holding shares in banks and the other to banks holding shares in companies. We collected data on bank-enterprise shareholding linkages from the CSMAR database. As shown in Table 9, the coefficient of DID for the group without bank-enterprise...
shareholding linkages equals to \(-0.0186\), which is less than 0 with a significant level of 5%; while the regression result for the group with bank-enterprise shareholding linkages is not significant. Our analysis suggests that the bank-enterprise shareholding linkages, as a long-term contractual relationship may weaken the financing uncertainty and debt servicing pressure of heavy polluters; meanwhile, the existence of this additional relationship may create opportunities for rent-seeking and out-of-rule cooperation between banks and enterprises, weakening the high-environmental-risk review as well as the whole-process credit supervision of heavy polluting enterprises; ultimately, it weakens the inhibitory effect on the blind expansion and high-risk strategic decisions of heavy polluters. Therefore, the effect is more significant in the group where there is no bank-enterprise shareholding linkage.

Table 9. Heterogeneity test of bank-enterprise shareholding linkages.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Existence of Bank-Enterprise Shareholding Links</th>
<th>No Bank-Enterprise Shareholding Links</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SFLI</td>
<td>SFLI</td>
</tr>
<tr>
<td>DID</td>
<td>(-0.0137)</td>
<td>(-0.0186^{**})</td>
</tr>
<tr>
<td></td>
<td>((-1.15))</td>
<td>((-2.48))</td>
</tr>
<tr>
<td>Controls</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Year FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Firm FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.7858</td>
<td>0.7953</td>
</tr>
<tr>
<td>N</td>
<td>1944</td>
<td>9870</td>
</tr>
</tbody>
</table>

Note: ** \(p < 0.05\).

6.3. Analysis of Heterogeneity of Experience in Financial Institutions

We used group regression to test the impact difference according to whether the directors, supervisors or executives possess experience in financial institutions or not. As shown in Table 10, the DID coefficient exhibits \(-0.0196\) with a significant level of 5% among firms whose directors, supervisors, or executives have a financial institution background; and its regression results are not significant in firms where their insiders have no financial institution background. The analysis suggests that under expected cash flow pressure and high environmental risks, directors, supervisors, or executives with experience in financial institutions can make sound investment and financing decisions to cope with the expected cash flow pressure and liquidity constraints brought by credit constraints, so as to ensure the ability of the enterprise to continue operation and prevent the enterprise from falling into a more serious financial crisis, such as insolvency.

Table 10. Heterogeneity test of experience in financial institutions.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Have a Background in Financial Institutions</th>
<th>Have no Background in Financial Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SFLI</td>
<td>SFLI</td>
</tr>
<tr>
<td>DID</td>
<td>(-0.0196^{**})</td>
<td>(-0.0197)</td>
</tr>
<tr>
<td></td>
<td>((-2.49))</td>
<td>((-1.42))</td>
</tr>
<tr>
<td>Controls</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Year FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Firm FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.8065</td>
<td>0.7392</td>
</tr>
<tr>
<td>N</td>
<td>8296</td>
<td>3149</td>
</tr>
</tbody>
</table>

Note: ** \(p < 0.05\).
6.4. Analysis of Heterogeneity of Innovation Intensity

We used group regression to test for differences in impact based on innovation intensity. We referred to the previous study [48], and calculated innovation intensity by the ratio of R&D investment to operating income. As shown in Table 11, the coefficient of DID is less than 0 in group with low investment in innovation; in group with high levels of innovation intensity, the coefficient of DID is not significant. It is possible that enterprises with a high innovation intensity face a greater green transition pressure and are more likely to adopt high-risk strategies; and at the same time, with high and long-term R&D investment, enterprises can be more prone to maturity mismatches such as SFLI.

Table 11. Heterogeneity test of innovation intensity.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Low Innovation Intensity</th>
<th>High Innovation Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DID</td>
<td>-0.0163 **</td>
<td>-0.0069</td>
</tr>
<tr>
<td></td>
<td>(-2.43)</td>
<td>(-0.38)</td>
</tr>
<tr>
<td>Controls</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Year FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Firm FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>R²</td>
<td>0.7334</td>
<td>0.8349</td>
</tr>
<tr>
<td>N</td>
<td>8638</td>
<td>2587</td>
</tr>
</tbody>
</table>

Note: ** p < 0.05.

7. Conclusions and Policy Implications

We took China’s A-share listed enterprises from 2009 to 2021 as samples, and constructed a difference-in-differences (DID) model to examine the implication of green credit policy on the level of SFLI of heavy polluters. We found that the green credit policy can reduce the level of SFLI of heavy polluters. The green credit policy can reduce the size of short-term liabilities and the level of over-investment of heavy polluters, thus diminishing the maturity mismatch. Government subsidies provide resource support for heavy polluters and deliver positive messages to the banks, which can weaken the negative impact of the green credit policy on the level of SFLI, as well as moderate the relationship between the green credit policy and SFLI. Through heterogeneity tests, firstly we found that the impact was more significant when directors, supervisors, or senior executives of enterprises have a financial institution background. Secondly, we found that the effect becomes not significant in enterprises with bank-firm shareholding relationships and stronger innovation intensity. Thirdly, it can be found that the effect is more significant in areas with stronger environmental regulations.

In view of the findings, we propose the following suggestions: firstly, heavy polluters are expected to standardize their investment and financing behaviors in green transition. Heavy polluters should adopt sound financial strategies, especially reducing high-risk financial decisions such as SFLI, so as to avoid financial crises caused by over-estimating returns or under-estimating risks. On the other hand, heavy polluters should control over-investment and blind expansion behaviors, thus alleviating cash flow risks under credit constraints. Secondly, banks are advised to refrain from the ‘one-size-fits-all’ phenomenon and provide appropriate credit support to heavy polluters in green transition, preventing them from adopting maturity mismatches and high-risk strategies due to the pressures of green transformation and credit constraints, so as to guide the smooth transformation of heavy polluters. Meanwhile, banks should improve the quality of credit supervision, avoid credit rent-seeking, and ensure the uniformity of credit-granting standards. Thirdly, governments should establish a sound environmental regulatory system considering both environmental and economic benefits, promoting the governance synergy between credit limits and innovation incentives, so as to guide the smooth transform of heavy polluters. Meanwhile, governments should improve the allocation of financial resources, enhance
the micro-economic consequences of credit policy, reduce the term mismatch and capital structural imbalance during the transform of heavy polluters, so as to avoid systemic financial risks caused by irregular financial strategies.

In addition, our research may have the following contributions and limitations: firstly, previous research has mostly explored the unilateral affect of the green credit policy on companies investment or financing, but this research investigates the impact on maturity mismatch from the perspective of the overall maturity structure, expanding the study on the microeconomic consequence of green credit policies. Secondly, this research takes the perspective of risk management optimization under credit constraints to study the mediating role of short-term debt and over-investment, providing a decision-making reference for heavily polluting companies to reduce financial risks and systematic financial risks caused by maturity mismatches, and at the same time enriching the research on the mechanism of SFLI. Thirdly, this research further explores the matching problem of maturity structure under the synergy of multiple subjects, and explores the impacts of government subsidies, bank-corporate affiliation, and personnel’s financial experience on the relationship between the green credit policy and SFLI of heavy polluters, so as to provide a reference for avoiding the risk of maturity mismatch due to the pressure of innovation, rent-seeking of credit, and high-risk strategic decisions. At the same time, there is still room for further research. Firstly, this research has considered the intermediary role of over-investment and short-term liabilities, but has not yet launched a mechanism test of corporate risk-taking capacity, therefore we will deepen our research from this perspective in the future. Secondly, the aim of the green credit policy is guiding the green development of companies. Therefore, in the future, we will further explore whether the green credit policy can elevate the total factor productivity of companies by reducing their degree of SFLI, and explore how to improve the green and efficient allocation of credit funds.

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