Does the Green Credit Policy Affect the Debt Maturity Structure and Growth of Enterprises: Evidence from China's Heavily Polluting Enterprises

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ABSTRACT: Owing to the Green Credit Policy (GCP), financial institutions have strengthened their social and environmental responsibilities, guided the flow of social resources to the green development field, and increased the adverse externality costs of enterprises as a result of corporate credit debt financing. Taking China's Shanghai and Shenzhen A-share listed companies from 2008 to 2020 as samples, this paper constructs a quasi-natural experiment using a double difference model, empirically analyzes the changes in the debt maturity structure (DMS) of heavily polluting enterprises (HPE) after the Green Credit Guidelines (GCG) was issued, and further investigates the change trend of the relationship between DMS and growth of HPE before and after the policy was issued. The results show that after the introduction of the policy, DMS of HPE is significantly and negatively constrained by debt, the positive impact of DMS on enterprise growth (EG) is weakened, while the DMS of state-owned heavily polluting enterprises (SOHPE) is more constrained; however, the positive effect of DMS on EG is weakened, which helps reduce the negative impact of policies on EG. Moreover, the DMS of private heavily polluting enterprises (PHPE) has a significant and positive impact on EG, which increases the negative impact on businesses. The level of regional financial development (LRFD) is conducive to strengthening the policy to HPE.

Keywords: Green credit, Debt maturity structure of enterprises, Enterprise growth, Double difference model, Quasi natural experiment

1. INTRODUCTION

In the past, China's "extensive and speed seeking" economic development model laid the groundwork for modernization, but the environmental problems that subsequently emerged have grown increasingly serious. In 2020, the double carbon target was put forward. As a result, China's economic development model will have changed from seeking speed to seeking quality and considering environmental and ecological benefits. In the process of implementing innovative production methods, enterprises cannot do without the support of green capital. In the context of the widening gap in green finance, green finance has gradually become an important driving force for high-quality and sustainable development of the economy, and plays a pivotal role in promoting innovation, transformation, and upgrading of enterprises and enhancing enterprise social responsibility. From the perspective of the development status of domestic green finance, green credit accounts for the largest proportion, among which banking and financial institutions are important participants. By the end of 2021, the balance between

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domestic and foreign currency green credit reached 15.9 trillion yuan. In order to check the blind expansion of HPE and promote their energy conservation, relevant departments have released a series of green credit policies, including the Opinions on Implementing Environmental Protection Policies and Regulations to Prevent Credit Risk issued in 2007, the Green Credit Guidelines issued in 2012, and the Green Finance Evaluation Scheme for Banking Financial Institutions formulated in 2021. This approach is intended to accomplish the strategic goal of our financial institutions in implementing environmental protection policies and advancing the green finance system.

These green credit policies have strengthened the social and environmental responsibilities of financial institutions, played an important role in optimizing the allocation of financial resources, guided the flow of social funds to promote the innovation, transformation, and upgrading of "two high and one surplus" enterprises, and increased the external costs of enterprises from the source of enterprise credit debt financing. Additionally, signal transmission plays a role in the implementation of these policies. The existing literature has confirmed that the issuance of green credit policies has a financing penalty effect on HPE. In addition, debt financing of enterprises with different maturities has different requirements for corporate cash flow, which will have an impact on corporate valuation. Therefore, studying the changes in DMS of HPE after the promulgation of the green credit policy can more specifically reveal the impact of policies on enterprise financing, and further explain whether the relationship between DMS and growth of HPE has changed after the promulgation of the policy and whether the changes among different types of HPE are the same. By examining the changes in DMS and growth of enterprises after the implementation of the green credit policy from the perspective of the policy object, we can offer more helpful suggestions for future policy formulation, help enterprises to effectively carry out their environmental protection responsibilities, reduce the stock externalizes caused by heavy energy consumption and production by HPE, and contribute to China's strength in coping with global climate change.

2. LITERATURE REVIEW

From the perspective of the relationship between green credit policy and corporate DMS, scholars have done relevant research on the source and scale of corporate financing. The policy has a "punishment" effect on HPE. Su and Lian (2018) [17] believe that this "punishment" is mainly reflected in the financing costs and the amount of long-term debt funds of HPE, and the implementation of the policy further inhibits the investment behavior of HPE. Chai et al. (2022) [5] also found that after the implementation of the policy, the proportion of non liquid financing of HPE decreased. Love et al.(2007)[14] found that in the event of a crisis, bank credit contracted, which would lead to a corresponding reduction in the supply of trade credit for enterprises with a high proportion of short-term debt. Wang et al. (2021)[19] built a moderated mediation effect model and concluded that although HPE reduced their long-term debt after being affected by policies, they turned to seek more commercial credit. These two financing methods played a partial intermediary role in the process of promoting the investment efficiency of HPE through policies. From the perspective of the relationship between the maturity structure of corporate debt and growth, there is no conclusion. Jalilvand and Harris (1984)[9] believe that an increase in long-term debt can promote the expansion and development of enterprises, and large companies are more inclined to extend debt maturity.

Brick and Ravid (1991)[4] pointed out that when there is a liquidity premium, the longer the debt maturity of an enterprise, the stronger the role of the tax shield, and the more conducive it is to EG. Sogorb-Mira (2005) [16] also found that the maturity structure of corporate debt is positively related to growth in Spanish SMEs. However, Barclay and Smith (1995)[1] believe that the term corporate debt is inversely proportional to growth and that corporate taxation does not affect the term structure of corporate debt. Ozkan (2000) [15] later confirmed this view. At present, the specific relationship between corporate DMS and growth cannot be found in the relevant literature, and few scholars have explored this relationship in the "two high" industries.

By reviewing the existing literature, it can be seen that scholars have investigated the relationship between green credit, the corporate DMS, and growth from different entry points, which has made important contributions to future research, but there are still some imperfections. First, scholars have found through empirical studies that as HPE are constrained by the government's green credit policy, their debt financing costs will further increase, while environmentally friendly enterprises will find it relatively easy to obtain green credit funds at a lower cost and longer term. However, most existing research starts from the absolute scale of debt financing and does not carefully investigate the changes in the internal term structure of debt financing. Second, the relationship between the term structure of corporate debt and its growth has not yet been determined. Therefore, it is necessary to investigate the change in the term structure and growth of corporate debt based on the external impact of the green credit policy and explore the timeliness of the green credit policy.

This study has the following possible innovations: First, by combining the existing literature and related theories, we build an empirical model to deeply investigate the changes in DMS of HPE and the changes in the relationship between DMS and growth after the promulgation of the green credit policy, and enrich the perspective of relevant literature research. Second, the data of A-share listed companies in Shanghai and Shenzhen from 2008 to 2020 are selected for empirical research to analyze the impact of COVID-19 on the policy implementation effect. Finally, we examine the path and effect of policy implementation from the perspective of heterogeneity and make suggestions for improving targeted policies in the future based on our analysis of enterprise property rights and regional financial developments.

3. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

3.1 Green credit and corporate DMS

Agency costs, information asymmetry, tax shields, and other factors affect the debt term structure of enterprises. Agency costs can be divided into principal-agent costs between owners and managers and principal-agent costs between owners and creditors. From the point of view of the principal-agent cost between owners and managers, Jensen (1999) [10] believes that an increase in the corporate debt scale can effectively restrict managers' use of free cash flow, thus reducing the principal-agent cost between them. As the implementation subject of green credit and the creditor of enterprise credit financing, banks mainly face the principal-agent cost problem between the owner and creditor. Barnea et al. (1991)[2] pointed out that in order to reduce the asset substitution behavior of credit-granting enterprises, creditors can restrain the enterprise's risk investment tendency by shortening the debt term and adding more

restrictive conditions about enterprise behavior in relevant contract documents. From the perspective of information asymmetry, enterprise information owned by enterprise managers and creditors are asymmetric. This is because creditors have an information disadvantage, resulting in adverse selection and moral hazard. Diamond (1991)[7] pointed out that enterprises with a favorable reputation and positive public image are more likely to finance through bonds, while enterprises with lower reputations usually directly use bank loans. Lemma et al. (2021)[13] also concluded that a company's commitment to climate change control will significantly increase debt maturity, and the positive correlation between the two is conducive to encouraging enterprises to assume more environmental and social responsibilities. After the promulgation of the green credit policy, there have been higher requirements for the environmental performance and social responsibility of HPE. Enterprises with poor environmental performance are often the key verification objects of local environmental protection regulatory authorities, often subject to rectification and punishment; their reputation will be affected, and the bank's credit threshold for enterprises will be raised and refused to extend the loan. Based on the above analysis, hypothesis H1 is proposed.

H1: DMS of HPE is negatively constrained by the green credit policy.

From the perspective of enterprise property rights, state-owned enterprises can obtain bank lending facilities and establish stable business relationships by virtue of their relationships with the government. Brandt and Li (2002)[3] point out that private enterprises are often discriminated against by bank loans, with a high loan threshold, high financing costs, and difficult access to bank credit. Companies that pollute heavily can only obtain commercial credit, which increases their financing costs. As a consequence, after the implementation of the green credit policy, heavily polluting state-owned enterprises that have significant credit capital connections to the policy implementation subject will be subject to stricter regulations. Therefore, this study proposes the following hypothesis:

H1a: The debt maturity of SOHPE is significantly constrained by the green credit policy.

China is a vast country, and the financial development levels of different regions are quite different; therefore, the evaluation of the implementation effect of an economic policy cannot be uniform. Provinces with a higher level of financial development will more comprehensively regulate the disclosure and supervision of environmental protection information by enterprises. This will improve the availability of external financing, reduce the agency cost between enterprise owners and creditors to a certain extent, and alleviate the problem of information asymmetry. Therefore, if the level of financial development of the province where the heavily polluted enterprise is located is relatively high, it will be more directly affected by the policy and the policy effect will be more effective. Based on this, the following hypothesis is proposed:

H1b: The difference in LRFD leads to a difference in the effect of policy constraints. If the financial development level of the province to which the heavily polluted enterprise belongs is high, the enterprise's debt maturity will be subject to greater negative constraints.

3.2 Enterprise DMS and EG

Karpavičius and Yu (2019)[12] believed that EG could be exogenous or endogenous, and found that when other variables were controlled, the financial leverage of high growth enterprise was

lower. The EG refers to in this paper is an endogenous phenomenon. EG refers to an enterprise's ability to continuously increase its own value and added value, including the continuous growth of its asset scale and operating performance. The long- and short-term debts of enterprises play different roles in internal governance and agency costs, and affect the internal resource allocation and production efficiency of enterprises to varying degrees, thus promoting the growth and development of enterprises.

Short-term debt requires a high level of free cash flow. On the one hand, it exerts great pressure on an enterprise's liquidity. On the other hand, it can effectively supervise and constrain management behavior, prevent excessive investment and asset substitution, and reduce enterprise risk. However, due to the short term nature of short-term debt, creditors' supervision and restrictions on enterprises are limited, which has a minimal effect on long-term corporate governance, industrial technology upgrading, and technological innovation. In addition, if the enterprise could not repay its debts in time or refinance at maturity, it could lead to the enterprise's bankruptcy.

Compared to short-term debt, long-term debt exerts less liquidity pressure on enterprises, which improves their financial freedom and risk-bearing levels. Enterprises can make full use of debt financing for innovative investments, allocate resources more reasonably, and provide favorable development opportunities for enterprises. Some innovative R&D investment projects have a long cycle, high cost, large investment, and high risk, and need to raise capital investment and ensure long-term stability of capital. The above characteristics indicate that enterprises investing in these projects need to have a high level of risk, seek new growth opportunities through research and development, and enhance the company's future competitiveness. Kane et al. (1984)[11] pointed out that the extension of debt maturity can guarantee a tax offset effect; thus, long-term debt can have a more significant tax shield effect than short-term debt, effectively save the cost of the company, and further promote the growth and development of enterprises. Highfield (2011) [8] also pointed out that long-term debt can promote the growth of enterprises and send a positive signal of enterprise operating conditions and future development prospects. For creditors, Chen et al. (2008)[6] believe that long-term debt has long-term and concentrated risk, which requires strict constraints on enterprises. Creditors have strong enthusiasm for supervising the use of funds and the ineffective expansion of enterprises, which can improve the investment efficiency of enterprises and promote their growth.

The assumption that H1 is proven, leads to heavily polluted enterprises being constrained by debt financing after the policy; debt maturity decreases, and the proportion of long-term debt decreases. Therefore, the role of long-term debt in corporate internal governance and agency costs will be weakened, as will the role of corporate debt maturity in boosting the future growth and development of enterprises. Based on the above analysis, the following hypothesis was proposed:

H2: Under certain other conditions, there is a positive correlation between DMS of enterprises and their growth, and the promotion of the debt maturity of HPE on growth is reduced after the green credit policy is issued.

Tsang (1998) [18] pointed out that state-run enterprises have more political relations with the government than private enterprises do. Compared with private enterprises, state-owned enterprises can obtain loans from financial institutions at a lower cost with the additional

support of the government, and that their default penalties are lower. Compared with PHPE, SOHPE have more business contacts with financial institutions and are more likely to obtain long-term loans. Before the implementation of the green credit policy, the long-term debt of enterprises played a more significant role in promoting EG. However, after the implementation of the policy, these state-owned enterprises are more directly constrained by long-term debt financing and are more likely to seek additional support; therefore, the promotion effect of long-term corporate debt on corporate growth has declined more than that of PHPE. In PHPE, the ratio of long-term debt to total debt fell after being constrained by policies, which increased the ratio of short-term debt to total debt. In addition, PHPE face loan discrimination and increased liquidity pressure. As a result of external financing and public opinion supervision, long-term debt is needed to relieve liquidity pressure and change enterprise production modes. Therefore, the promotion of enterprise debt maturity in terms of EG has strengthened. Therefore, this study proposes the following hypotheses:

H2a: After the implementation of the green credit policy, the promotion of the debt maturity of SOHPE on growth declines, while the promotion of the debt maturity of PHPE on growth increases.

The financial development level of the province where the enterprise is located also directly affects the relationship between the growth of HPE and DMS of enterprises after the implementation of the policy. Regional financial development can help improve the financing difficulties of enterprises, promote the development of enterprises, and promote the technological progress of enterprises. The improvement in LRFD will also enrich the financing methods of enterprises to a certain extent and also make it easier to obtain other financing facilities. Having implemented the policy, HPE located in the highlands are now more strictly monitored and are directly affected by public opinion. The degree of information asymmetry among enterprises in these regions is relatively low. Enterprises face increased pressure from creditors and shareholders to withdraw from financing, which puts forward higher liquidity requirements. Long-term stable funds are critical for the transformation and upgrading of enterprises and continued sound operations. However, due to the high degree of information asymmetry, low availability of financing, and other reasons, the signal transmitting effect of long-term debt financing and the role of corporate internal governance of HPE in provinces with low LRFD have decreased after the implementation of the policy, and so the role of corporate debt maturity in promoting corporate growth has decreased. Based on this, the following assumptions are proposed:

H2b: After the implementation of the green credit policy, the debt maturity of HPE in provinces with higher LRFD has increased its role in promoting EG, whereas the debt maturity of HPE in provinces with lower LRFD has decreased its role in promoting EG.

4. RESEARCH DESIGN

4.1 Sample selection

This study selected the annual data of Shanghai and Shenzhen A-share listed companies from 2008 to 2020. Compared with the Opinions on Implementing Environmental Protection Policies and Regulations to Prevent Credit Risk issued on July 12, 2007, GCG issued by the

CBRC on February 24, 2012, standardized the responsibilities of financial institutions more in promoting energy conservation, emission reduction, and environmental protection built a green credit management system from the green credit process, environmental risk management, and control, social responsibility, etc., and promoted the transformation of production mode. At the same time, GCG propose that qualified green credit assets should be included in the scope of mortgages and pledges of monetary policy instruments, such as refinancing, which is a positive incentive for financial institutions to implement green credit. Therefore, this study constructs a quasi-natural experiment based on the implementation of these guidelines.

Drawing on the classification methods of existing scholars for HPE, referring to the Classified Management Directory of Environmental Protection Verification Industries of Listed Companies (CMD) issued by the Ministry of Environmental Protection in 2008, and combining the industry reference directory of "two high and one surplus" in the Key Evaluation Indicators for the Implementation of Green Credit (KEI) issued by the CBRC in 2014, we divided the experimental group and the control group. The listed companies in the industry-related industries indicated in the CMD and KEI are the experimental group of this quasi-natural experiment, and other listed companies are the control group.

4.2 Data preprocessing

Pre-process the obtained data and eliminate the following company data: financial companies, companies with abnormal financial conditions, delisting warning companies, and companies listed on the Shanghai Stock Exchange and Shenzhen Stock Exchange in 2012 and later. Further, all continuous variables were winsorized to eliminate the extreme value of 1 percent. The data used in this empirical study are from wind energy terminals, financial reports of listed companies, and provincial statistical bulletins. Stata 16.0 was used for data processing.

4.3 Model setting and variable selection

To test whether DMS of heavily polluted enterprises is significantly constrained compared to non-heavily polluted enterprises after the implementation of the green credit policy, this study constructs the following difference-in-difference (DID) model:

$$ld_{it} = a_0 + a_1 treated_i + a_2 post_t + a_3 treated_i \acute{} \ post_t + a_4 controls + e_{it} \quad (1)$$

where i represents the enterprise, t represents the year, and ldis the term structure of corporate debt, which is measured by the proportion of long-term debt in all corporate liabilities; treated is a policy dummy variable. If the ith enterprise belongs to the experimental group, the value is 1; otherwise, the value is 0; post is a dummy variable for time. Taking 2012 as the node, the value of post is 1 from 2012 to 2020, the value of post in other years is 0, and the double difference variable is determined by treated× post; Controls are control variables, which include return on assets(roa), cash flow(cash), shareholder holding(hold), and age of the enterprise(age). The t-1 values were obtained. See Table 1 for the meaning and calculation method of the specific variables; it is a random interference term.

Further, under the condition that the pre-coefficient of the double difference sub-item in Model 1 is significant, we explore the changes in the relationship between DMS and EG of

HPE and non-heavily polluted enterprises before and after the implementation of the policy, and construct Model 2:

$$agr_{it} = b_0 + b_1 ld_{it} + b_2 controls + e_{it} \quad (2)$$

Here, agr represents the growth of enterprises. And the growth rate of total assets is adopted. Controls represent control variables, all of which are t-1 period values, including enterprise scale(scale),return on assets(roa), cash flow(cash), shareholders' holding(hold), asset liability ratio(dar), enterprise structure(fixass), and material capital intensity(ci).

Table 1. Variable definition.

Variable	Symbol	Measurement
The term structure of corporate debt	*ld*	Long-term debt/all corporate liabilities
Enterprise growth	*agr*	(Total assets of period t-Total assets of period t-1)/Total assets of period t-1
Policy dummy variable	*treated*	If the *ith* enterprise belongs to the experimental group, the value is 1; otherwise, the value is 0
Dummy variable for time	*post*	The value of *post* is 1 from 2012 to 2020, the value of *post* in other years is 0
Double difference variable	*treated*×*post*	Policy dummy variable×dummy variable for time
Return on assets	*roa*	Net profit/total assets
Cash flow	*cash*	Enterprise free cash flow/total assets at the end of the period
Shareholder holding	*hold*	Total shares held by the top ten shareholders
Age of the enterprise	*age*	Ln(Establishment period of the enterprise in year t)
Enterprise scale	*scale*	Ln(total assets)
Asset liability ratio	*dar*	Total liabilities/total assets
Enterprise structure	*fixass*	Fixed assets/total assets
Material capital intensity	*ci*	Ln(fixed assets/Number of employees)

5. EMPIRICAL RESULTS AND ANALYSIS

5.1 Data descriptive statistics

Table 2 shows that the average value of the enterprise debt maturity structure variable ld is 0.1640. Long-term debt accounts for 16.40 percent of total debt, and the proportion of long-term debt among most enterprises is not high. The EG variable *agr* is a percentage variable, with the minimum value of - 29.20 percent, the maximum value of 258.10 percent, and the standard deviation of 0.3500. It can be seen that there are large differences in the growth of different enterprises.

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std	Min	Max
ld	14625	0.1640	0.1840	0.0000	0.7280
agr	14625	0.1540	0.3500	-0.2920	2.5810
roa	14625	0.0380	0.0545	-0.1540	0.2180
cash	14625	0.0002	0.0974	-0.3010	0.2690
hold	14625	0.5440	0.1540	0.2180	0.8990
age	14625	2.8740	0.3210	1.9460	3.5260
scale	14625	22.4800	1.3800	19.7500	26.3700
dar	14625	0.4960	0.1960	0.0723	0.8920
fixass	14625	0.2510	0.1860	0.0019	0.7600
ci	14625	12.7200	1.1740	9.7310	15.9900

5.2 Correlation analysis

As shown in Table 3, the absolute values of the correlation coefficients between the main variables are all less than 0.638. There is a significant correlation between the maturity structure of corporate debt and the double-difference items and corporate growth. The correlation between the two variables, positive and negative, had no practical economic causal significance. The following text specifically tests the hypotheses proposed in this study.

Table 3. Correlation analysis.

Variable	*ld*	*agr*	*did*	*roa*	*cash*	*hold*	*age*	*scale*	*dar*	*fixass*	*ci*
ld	1										
agr	0.065***	1									
treated×post	0.101***	-0.059***	1								
roa	-0.090***	0.251***	-0.060***	1							
cash	-0.130***	-0.124***	0.075***	0.195***	1						
hold	0.144***	0.191***	0.037***	0.197***	0.057***	1					
age	-0.003	-0.067***	0.141***	-0.056***	0.063***	-0.140***	1				
scale	0.369***	0.107***	0.144***	0.045***	0.029***	0.338***	0.194***	1			
dar	0.272	0.07	0.011	-	-	0.052	0.004	0.407	1		

	***	3***		0.343 ***	0.072 ***	***		***			
fixass	0.262 ***	-0.104 ***	0.318 ***	-0.102 ***	0.067 ***	0.074 ***	-0.164 ***	0.031 ***	0.013	1	
ci	0.417 ***	-0.039 ***	0.286 ***	-0.084 ***	0.018 **	0.143 ***	0.017 **	0.306 ***	0.077 ***	0.638 ***	1

Note:* , ** , and *** respectively representing 10%, 5% and 1% of the significance level.

5.3 Empirical analysis results

Columns (1), (2), and (3) in Table 4 show the regression results of the green credit policy on the maturity structure of corporate debt. The regression coefficient corresponding to the treated×post item is significantly negative at the level of 0.01. From the regression results, after the promulgation of the Guidelines, heavily polluted enterprises have been significantly affected by the policies. The proportion of long-term liabilities of enterprises in total liabilities has decreased, indicating that after the implementation of the green credit policy, financial institutions have gradually shrunk their long-term loan business to heavily polluted enterprises, curbed the long-term debt financing of heavily polluted enterprises, and increased the liquidity pressure of heavily polluted enterprises. Providing H1 is proven, it has a positive impact on the transformation and upgrading of HPE.

Table 4. Empirical results of model 1.

	(1)	(2)	(3)
Variable	*ld*	*ld*	*ld*
treated×post	-0.0271***	-0.0272***	-0.0270***
	(-3.3719)	(-3.3920)	(-3.8328)
treated	0.0732***	0.0736***	0.0214***
	(10.5136)	(10.5670)	(2.8459)
post	0.0116**	0.0069	0.0238***
	(2.4719)	(0.7756)	(2.9879)
controls	Yes	Yes	Yes
Year	No	Yes	Yes
Industry	No	No	Yes
Constant	0.0364**	0.0086	0.0897***
	(2.1302)	(0.4503)	(4.4060)
N	13500	13500	13500
Adjusted R^2	0.0575	0.0579	0.2721

Note:* , ** , and *** respectively representing 10%, 5% and 1% of the significance level.

Furthermore, we explore the relationship between DMS of HPE and EG before and after the implementation of the green credit policy. See Table 5 for specific results. The sample interval

of column (4) was set to 2008-2020. Column (5) presents the regression analysis for HPE from 2008 to 2020. Column (6) presents the regression results for HPE from 2008 to 2011 before the implementation of the policy. Column (7) presents the regression results for HPE from 2012 to 2020 after policy implementation. It can be seen in Table 5 that there is a significant positive correlation between corporate DMS and growth. However, after the green credit policy was put in place, the impact of DMS on the growth of HPE has diminished. Suppose H2 holds.

Table 5. Empirical results of model 2.

	(4)	(5)	(6)	(7)
Variable	Full sample	Experimental group	Results of the experimental group before policy implementation	Results of the experimental group after the implementation of the policy
ld	0.2485***	0.2810***	0.3694***	0.2529***
	(12.3840)	(7.6528)	(4.5882)	(5.9478)
controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Constant	1.0088***	0.0000	0.0000	0.0000
	(14.6014)	—	—	—
N	6750	1830	915	915
R^2	0.0530	0.0717	0.0902	0.0555

Note:* , ** , and *** respectively representing 10%, 5% and 1% of the significance level.

5.4 Robustness test

5.4.1 Parallel trend test

When using the double-difference method, the control group, as the counterfactual control of the experimental group, needs to ensure that the experimental group and the control group have the same trend before the implementation or promulgation of the policy. Thirteen interactive items were set in a 13-year interval from 2008 to 2020. For example, if the ith enterprise is a heavily polluted enterprise and t is 2008, pre_4 is 1; otherwise, it is 0; if the ith enterprise is a heavily polluted enterprise and t is 2012, the value of current is 1; otherwise, it is 0. According to the regression results in Table 6, the coefficients for pre_4, pre_3, pre_2, and pre_1 are not significant, meeting the parallel trend conditions of the double-difference method. There is no significant difference in the trend of DMS between HPE and non-heavily polluting enterprises before the implementation of the green policy. In addition, under the impact of the COVID-19 pandemic in 2020, the People's Bank of China reduced the reserve ratio three times to release liquidity to speed up the resumption of production, which created favorable conditions for enterprise financing, resulting in no significant effect of policy constraints on DMS of heavily polluted enterprises.

Table 6. Parallel trend test.

Variable	(8) *ld*	Variable	(8) *ld*
pre_4	0.0000	*post_3*	-0.0149
	—		(-1.4364)
pre_3	0.0142	*post_4*	-0.0327****
	(1.3678)		(-3.1505)
pre_2	0.0053	*post_5*	-0.0402***
	(0.5148)		(-3.8701)
pre_1	-0.0082	*post_6*	-0.0301***
	(-0.7885)		(-2.9063)
current	-0.0112	*post_7*	-0.0311***
	(-1.0819)		(-2.9990)
post_1	-0.0163	*post_8*	-0.0111
	(-1.5678)		(-1.0683)
post_2	-0.0033	Constant	-1.0235***
	(-0.3187)		(-36.9139)
controls	Yes		
Industry	Yes	Yes	Yes
N	13500	Adjusted R^2	0.4028

5.4.2 PSM-DID

To solve the endogeneity problem, this study adopts the one-to-one nearest neighbor matching method to further weaken the deviation caused by different types of listed companies due to different ownership structures, profitability, and other factors and reduce the sample selection error. The balance test results obtained after matching are listed in Table 7. After PSM, the absolute deviations after matching are significantly lower than 10 percent, the results are acceptable. The p-value is greater than 0.1, indicating that there is no significant difference between the experimental group and the control group in terms of return on assets, cash flow, shareholders' shareholding, and enterprise age. Next, we used the data after PSM to build a double-difference model to further test the robustness of Model 1. We can see in Table 8 that the coefficient for the double difference is still significantly negative, proving the robustness of the DID results.

Table 7. Propensity score matching result.

Variable	Unmatched matched	Mean		% bias	%reduct |bias|	t-test	
		Treated	Control			t	P>|t|
roa	U	0.0338	0.0395	-10.3	89.5	-5.64	0.000
	M	0.0338	0.0332	1.1		0.48	0.633
cash	U	0.0061	-0.0023	9.2	85.9	4.89	0.000
	M	0.0061	0.0079	-1.3		-0.58	0.561

hold	U	0.5550	0.5397	10.2	82.6	5.49	0.000
	M	0.5550	0.5527	1.8		0.78	0.433
age	U	2.8447	2.8846	-12.5	90.9	-6.68	0.000
	M	2.8447	2.8483	-1.1		-0.49	0.621

Table 8. PSM-DID.

	(9)	(10)	(11)
Variable	*ld*	*ld*	*ld*
treated×post	-0.0323***	-0.0317***	-0.0268***
	(-2.8780)	(-2.8201)	(-2.7166)
treated	0.0740***	0.0739***	0.0124
	(7.5973)	(7.5817)	(1.1030)
post	0.0231***	0.0057	0.0335**
	(2.5928)	(0.3843)	(2.5496)
controls	Yes	Yes	Yes
Year	No	Yes	Yes
Industry	No	No	Yes
Constant	0.0169	-0.0251	0.1172***
	(0.6252)	(-0.8232)	(3.3498)
N	5809	5809	5809
Adjusted R^2	0.0631	0.0638	0.2814

Note:*, **, and *** respectively representing 10%, 5% and 1% of the significance level.

5.4.3 Placebo test

A placebo test was conducted for model 1. The year 2009 was assumed to be the year of policy implementation, and the policy dummy variable post2009 was reset. When t equals 2009–2020, the value is 1; otherwise, it is 0. From the results in Table 9, it can be seen that the coefficients of the double difference sub items are not significant. It is fictitious that the Guidance issued in 2009 has no significant impact on DMS of HPE, indicating that the DID regression results above are reliable.

Table 9. Placebo test.

	(12)
Variable	ld
treated×post2009	0.0011
	(0.2014)
treated	0.0000
	—
post2009	0.0000
	—

controls	Yes
Year	Yes
Industry	Yes
Constant	0.0959***
	(4.7283)
N	13500
Adjusted R^2	0.2713

Note:*, **, and *** respectively representing 10%, 5% and 1% of the significance level.

5.4.4 Shorten time window

To eliminate the interference of subsequent similar policies, the time window was shortened to 2008–2014. The robustness test results in Table 10 can be obtained by narrowing the time window of the regression model in Table 5. It can be seen from the fact that the *ld* coefficient of the enterprise DMS is significantly positive. After reducing the time window to 2008–2014, the regression results of whole sample and experimental group were stable before and after the policy.

Table 10. Shorten time window (model 2).

	(13)	(14)	(15)	(16)
Variable	Full sample	Experimental group	Results of the experimental group before policy implementation	Results of the experimental group after the implementation of the policy
ld	0.2639***	0.3351***	0.3694***	0.3210***
	(9.2463)	(6.6768)	(4.5882)	(4.6213)
controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Constant	1.2202***	1.4295***	0.0000	1.6500***
	(11.7977)	(6.6637)	—	(5.2287)
N	6750	1830	915	915
R^2	0.0544	0.0975	0.0902	0.0896

Note:*, **, and *** respectively representing 10%, 5% and 1% of the significance level.

5.5 Heterogeneity test

5.5.1 Heterogeneity test of the influence of the green credit policy on DMS of enterprises

Different property rights of enterprises and the financial development levels of their regions may lead to differences in investment and financing decisions, corporate governance, and social environmental responsibilities, and the effectiveness of policy transmission and implementation may be different. Therefore, this study examines this using grouping regression. According to the property rights of enterprises, heavily polluted enterprises were

divided into two sub-samples: SOHPE and PHPE. See Table 11 for specific results. The absolute value of the coefficient for the double-difference sub-item of the SOHPE group is greater than that of the PHPE group. SOHPE are more likely to obtain long-term loans from large commercial banks. Compared with PHPE, they are more likely to obtain credit lines from commercial banks before the implementation of the policy. Therefore, after the implementation of the green credit policy, SOHPE are more prone to being affected and constrained by the bank credit policy, assuming that H1a is proven.

In addition, referring to the practice of existing scholars, the ratio of the loan balance of financial institutions at the end of each year in each province to the local GDP of that year is used to measure LRFD. The financial development level in highland areas is defined as greater than or equal to the mean value of this variable, and the financial development level in low-land areas is defined as below the mean value. Heavily polluted enterprises can be divided into two sub-samples. The regression results in Table 11 show that if LRFD is different, the constraint effect of policies on DMS of enterprises will also be different. The higher LRFD, the greater the number of policy banks, commercial banks, large banks, and other financial institutions, the more comprehensive the knowledge of enterprise environmental protection information, the stronger the financial institutions' own supervision and risk perception, the wider the policy transmission channels, and the stronger the effect. After the implementation of the green credit policy, DMS of HPE belonging to provinces with financial development levels in highland areas will be more affected, and the proportion of long-term debt will decrease further, assuming H1b is proved.

Table 11. Heterogeneity test of model 1.

	(17)	(18)	(19)	(20)
Variable	SOHPE	PHPE	Higher LRFD	Lower LRFD
treated×post	-0.0314***	-0.0219**	-0.0285**	-0.0217***
	(-2.9441)	(-2.3869)	(-2.0528)	(-2.5924)
treated	0.0029	0.0310***	0.0290**	0.0087
	(0.2341)	(3.2911)	(2.0303)	(0.9489)
post	0.0577***	0.0028	0.0507***	0.0072
	(4.6397)	(0.2737)	(4.1291)	(0.5781)
controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Constant	0.2126***	0.0175	0.1892***	0.0320
	(6.5084)	(0.6787)	(5.4822)	(1.2527)
N	6336	7164	5713	7787
Adjusted R^2	0.2803	0.2714	0.2535	0.2992

Note:* , ** , and *** respectively representing 10%, 5% and 1% of the significance level.

5.5.2 Heterogeneity Test of the Relationship between DMS and Growth of Heavily Polluted Enterprises

For Model 2, the heterogeneity test is conducted from the perspective of enterprise property rights attributes and LRFD. The regression results (21), (22), (23) and (24) in Table 12 show that after the policy, the impact of DMS of SOHPE on EG is reduced, whereas the change in PHPE is the opposite. Moreover, the change in SOHPE is greater than that in PHPE. Suppose H2a proves. Combined with the empirical results above, although the proportion of long-term debt of SOHPE is reduced more because of the impact of policies, the positive effect of the corporate DMS on growth is weakened, which can reduce the negative impact of policies on corporate growth to a certain extent, while the positive effect of PHPE' DMS on growth is strengthened, which aggravates the negative impact of policies on corporate growth.

Then, it explores the heterogeneous influence of the financial development level in different regions on the relationship between DMS and its growth. It can be seen from the regression results (25) and (27) in Table 12 that, before the implementation of the Guidelines, the higher the financial development level of a province, the less statistically significant the boosting effect of the debt maturity of HPE in the province on their growth. Heavy polluting enterprises in these regions are more likely to receive financial support. In addition to external debt financing, there are other financing methods and profit growth opportunities. From the regression results (26) and (28) in Table 12, it can be seen that after the implementation of the policy, DMS of HPE in provinces with financial development levels in the highlands has a greater role in boosting the growth of enterprises. HPE in the provinces with low financial development levels in the region are affected by the policy, and the corporate DMS has weakened its role in promoting the growth of enterprises. Suppose H2b is proved. According to the empirical data above, heavily polluted enterprises in the provinces of the highland region have a greater long-term debt financing punishment effect. After the promulgation of the Guidelines, DMS of enterprises has a greater role in promoting growth. Therefore, the growth of heavily polluted enterprises in the financial development level provinces in the highland region will be more negatively affected by the implementation of the policies.

Table 12. The heterogeneity test of model 2.

Variable	(21) SOHPE (before policy implementation)	(22) SOHPE (after policy implementation)	(23) PHPE (before policy implementation)	(24) PHPE (after policy implementation)	(25) SOHPE (before policy implementation)	(26) SOHPE (after policy implementation)	(27) PHPE (before policy implementation)	(28) PHPE (after policy implementation)
ld	0.4546***	0.2187***	0.2535*	0.3113***	0.2473	0.3633***	0.3672***	0.2744***
	(4.4828)	(3.7441)	(1.9529)	(4.7651)	(1.1509)	(4.6215)	(4.0837)	(4.4796)
controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Const	1.6225***	1.2169***	0.0000	1.2567***	1.6478**	1.8693***	0.0000	1.6991***

ant								
	(3.7886)	(4.9463)	—	(5.0431)	(2.5093)	(5.0933)	—	(4.2443)
N	447	1341	468	1404	192	1071	723	1674
R^2	0.1334	0.0442	0.1286	0.0865	0.1402	0.0892	0.1011	0.0508

Note:* , ** , and *** respectively representing 10%, 5% and 1% of the significance level.

6. CONCLUSIONS AND POLICY IMPLICATIONS

6.1 Main research conclusions

Based on the Green Credit Guidelines issued in 2012, this study conducts a quasi-natural experiment that is conducive to green innovation and enterprise upgrading. It uses the DID model to empirically analyze the changes in DMS of HPE after the promulgation of the guidelines. On this basis, it further investigates the changes in the relationship between DMS and growth of HPE before and after the promulgation of the policy, which is helpful in promoting HPE to innovate production methods from the perspective of debt financing and enhance corporate socioenvironmental responsibility. Through empirical analysis, we can draw the following conclusions: the green credit policy has a significant negative constraint on DMS of HPE, and the negative constraint is not significant in 2020 due to the COVID-19 pandemic; after the promulgation of the guidelines, the positive effect of DMS of HPE on growth has weakened. From the perspective of the heterogeneity of enterprises' property rights, the change in DMS of SOHPE after being affected by policies is greater than that of PHPE. The positive effect of enterprises' DMS on growth is weakened, which can reduce the negative impact of policies on the growth of enterprises to a certain extent. However, the positive effect of DMS of PHPE on growth is strengthened, which aggravates the negative impact of policies on the growth of enterprises. In addition, the effect of the green credit policy will differ if the financial development level of each province is different. The high LRFD will strengthen the impact of policies on the maturity structure of corporate debt, and the HPE in these regions will face a more serious liquidity crisis and transformation pressure after being subjected to strict environmental protection verification and public opinion supervision. Further, the positive effect of DMS on EG will increase, the effect of long-term debt financing punishment on HPE in regions with low financial development levels is weak, and the positive effect of enterprise debt maturity on EG is reduced, further reducing the negative impact of policies on EG.

6.2 Policy enlightenment

First, for financial institutions that are the subject of policy implementation, improving the credit threshold for heavily polluted enterprises, strengthening the screening of enterprise environmental protection information, and increasing the cost of debt financing can significantly affect DMS of heavily polluted enterprises, and thus have an impact on the growth and development of HPE. Financial institutions should actively fulfill their environmental and social responsibilities, strengthen enterprise information verification, implement differentiated credit policies, raise the credit threshold, achieve prior treatment of environmental pollution, internalize pollution costs, promote energy conservation and environmental protection of enterprises, and help achieve green cycle development and dual

carbon goals. Financial institutions also need to pay attention to the fact that a reduction in debt maturity may cause economic pressure on the production, operation, and transformation of enterprises. They must provide special financial support for the environmental protection and transformation of HPE. Simultaneously, they need to monitor the flow of funds and build a timely exit mechanism.

Second, for policy formulation and relevant regulatory authorities, the scope of green projects and products should be clarified, prudent assessments should be conducted, and China's green financial system should be strengthened. As LRFD affects the effect of corporate governance and green credit policies, the lower LRFD, the weaker the punishment effect on HPE. Therefore, it is necessary to implement a system construction that matches the policies in these regions. This system construction improves the sensitivity and identification ability of enterprise environmental risks, achieves information sharing between regulatory authorities and financial institutions, and minimizes the impact of information asymmetry on relevant policy effects. In addition, the local government should improve the incentive mechanism for financial institutions participating in green credit, promote the sustainable development of policies, and reduce administrative intervention in the loan decision-making of financial institutions. Simultaneously, it should be clear that it is not the ultimate goal of imposing financing constraints on HPE through differentiated credit financing. What is more important is to make each economic sector clear about their social and environmental responsibilities and innovate their mode of production. Therefore, relevant departments should not only implement "front-end punishment," but also focus on "midrange guidance and support" and "back-end supervision and improvement."

Finally, for individual enterprises, corporate environmental performance will affect the duration and cost of corporate financing, and then affect the stable operation and future development prospects of enterprises. Therefore, individual enterprises should strengthen ESG information disclosure, innovate production methods, optimize their DMS, and promote their growth. In daily production and operation, enterprises need to raise the eco-awareness of employees and try to change the original production mode to one of high energy consumption and high pollution. Under the guidance of relevant policies, HPE should actively carry out enterprise transformation and upgrading, practice green cycle development, strengthen internal governance and environmental and social responsibilities, and use the positive incentives of green transformation funds from financial institutions to improve their future development prospects. To improve the coping ability of enterprises in the face of climate and environmental problems, and contribute China's strength to the construction of a community with a shared future for mankind.

REFERENCES

[1] Barclay, M.J., and Smith, C.W., "The maturity structure of corporate debt," The Journal of Finance. 50(2)(1995). https://doi.org/10.2307/2329421 (1997).

[2] Barnea, M., Haugen, R.A., and Senbet, L.W., "An equilibrium analysis of debt financing under costly tax arbitrage and agency problems," The Journal of Finance. 36(3), 569-581(1991). https://doi.org/10.1111/j.1540-6261.1981.tb00645.x

[3] Brandt, L., and Li, H., "Bank discrimination in transition economies: ideology, information or incentives? "William Davidson Institute Working Papers Series. 31(3), 387-413(2002).https://doi.org/10.2139/ssrn.360280

[4] Brick, I.E., and Ravid, S.A., "Interest rate uncertainty and the optimal debt maturity structure," Journal of Financial & Quantitative Analysis. 26(1), 63-81(1991). https://doi.org/10.1111/j.1540-6288.1987.tb01160.x

[5] Chai, S., Zhang, K.,Wei, W., Ma, W., and Zoynul, A.M., "The impact of green credit policy on enterprises' financing behavior: Evidence from Chinese heavily-polluting listed companies," Journal of Cleaner Production(2022). https://doi.org/10.1016/j.jclepro.2022.132458

[6] Chen, X., Wang, X., and Zeng, J., "Governance of creditor's rights evaluation and enterprise growth of SMEs:an empirical study based on listed SMEs in China," Chinese Journal of Management Science. (01), 163-171(2008). https://doi.org/10.16381/j.cnki.issn1003-207x.2008.01.011

[7] Diamond, D.W., "Monitoring and reputation: the choice between bank loans and directly placed debt," Journal of Political Economy. 99(4), 689-721(1991). https://doi.org/10.1086/261775

[8] Highfield, M.J., "On the maturity of incremental corporate debt issues," Quarterly Journal of Finance&Accounting. 47(2), 45-67(2011).

[9] Jalilvand, A., Harris, R.S., "Corporate behavior in adjusting to capital structure and dividend targets: an econometric study," Journal of Finance. 39(1984). https://doi.org/10.1111/j.1540-6261.1984.tb03864.x

[10] Jensen, M., "Agency costs of free cash flow, corporate finance, and takeovers," American Economic Review. 76(2), 323-329(1999). https://doi.org/10.1017/cbo9780511609435.005

[11] Kane, A., Marcus, A.J., and Mcdonald, R.L., "How big is the tax advantage to debt?" Journal of Finance. 39(1999). https://doi.org/10.3386/w1286

[12] Karpavičius, S., and Yu, F., "External growth opportunities and a firm's financing policy," International Review of Economics & Finance. 62(JUL.), 287-308(2019). https://doi.org/10.2139/ssrn.2720007

[13] Lemma, T., Lulseged, A., and Tavakolifar, M., "Corporate commitment to climate change actions, carbon risk exposure and a firm's debt financing policy-accepted version," Business Strategy and the Environment(2021). https://doi.org/10.1002/bse.2849

[14] Love, I., Preve, L.A., Sarria-Allende, V., "Trade credit and bank credit: evidence from recent financial crises," J. Financ. Econ. 83 (2), 453–469(2007). https://doi.org/10.1016/j.jfineco.2005.11.002

[15] Ozkan, A., "An empirical analysis of corporate debt maturity structure," European Financial Management.6(2000). https://doi.org/10.1111/1468-036X.00120

[16] Sogorb-Mira, F., "How SME uniqueness affects capital structure: evidence from a 1994-1998 Spanish data panel," Small Business Economics. 25, 447-457(2005). https://doi.org/10.2139/ssrn.393162

[17] Su, D., and Lian, L., "Does green credit policy affect corporate financing and investment?" Journal of Financial Research. (12), 123-137(2018).

[18] Tsang, E., "Can guan xi be a sourse of sustained competitive advantage for doing business in China," Academy of Management Executive. 12(2), 64-73(1998). https://doi.org/10.5465/ame.1998.650517

[19] Wang, Y., Lei, X., and Long, R., "Can green credit policy promote the corporate investment efficiency?-based on the perspective of high-pollution enterpries' financial resource allocation," China Population,Resources and Environment. 31(01), 123-133(2021).