

A study on the impact of green credit policies on the financing behavior of small and medium-sized industrial enterprises-- Based on data from a sample of 284 companies from 2011-2021

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Abstract. In order to achieve the "Double Carbon" goal of "Carbon Peaking" and "Carbon Neutral", the government has introduced a whole set of green finance-related policies. This paper investigates changes in the investment and financing behavior of small and medium-sized industrial enterprises after the introduction of "Guidance on Building a Green Financial System" using a DID model and a fixed-effect model, drawing the conclusions that policies are effective.

Keywords: Green Finance, Small and Medium-sized Enterprises, Investment and Financing Behavior, Green Policy.

1. Introduction

As the global population growth and rapid economic development, global energy consumption has increased significantly. At the same time, how to achieve green growth has become the primary issue of the current world economic development.

In August 2016, the Central Bank, the Ministry of Finance and other seven ministries jointly issued *the Guidance on Building a Green Financial System* (Guidance in short) to promote the building of a green financial system among the government and industries companies. This paper observes the greening process of heavy polluting enterprises after the policy, which analyzes whether the green credit incentive policy plays a positive role in environmental protection. Besides, it gives some suggestions on the future policy direction to promote the future green development of China's economy and achieve the "double carbon" goal as soon as possible.

The remainder of the article is divided into three parts: the first part summarizes the existing literature on green finance; the second part completes the data processing and model construction, applying a DID model to examine changes in the investment and financing of small and medium-sized industrial enterprises after the promulgation of the Guidance, and the third part provides suggestions for future policy proposals.

2. Literature Review

In recent years, scholars in various fields have focused their research on green finance mostly from the perspective of economic utility, focusing on theoretical studies such as the feasibility of green finance itself in China, the prospects for the development of green finance in China and its empirical studies on the impact on environmental pollution indicators such as carbon emissions.

In the section of theoretical studies on the concept of green finance, scholars have provided an in-depth interpretation. Ma Jun (2015) discusses the necessity of constructing a green financial system in China and proposes for the first time that green finance plays a dual role of stabilizing growth and adjusting structure at the same time; the "Greening China's Financial System" group of the Development Research Center of the State Council (2016) summarizes the practice and experience of foreign green finance and digs deeper into the top-level design flaws facing the development of

green finance in China. In the section of empirical research and quantitative analysis, Dongwei Su and Lili Lian (2018) constructed a quasi-natural experiment using the official implementation of the Green Credit Guidelines in 2012 as an event, using the DID method for the first time and found that both interest-bearing debt financing and long-term debt of heavily polluting enterprises decreased significantly.

Taking the Guidance on Building Green Financial System issued in 2016 as the time point, this paper applies a difference-in-difference model to study changes in the financing behavior of small and medium-sized industrial enterprises before and after the issuance of the Guidance. In the research object, we focuses on small and medium-sized industrial enterprises creatively. Through sexual analysis, we make suggestions for the government to subsequently launch more targeted and feasible green financial policies for small and medium-sized companies to push them to take part in the environmental protection.

3. Research Design

3.1 Samples and data

The paper takes Chinese A-share listed companies from 2011 to 2021 as the original sample, and generates the experimental group and control group by calculating the industry pollution emission intensity index. The operation of each step is as follows:

First, according to the national industrial classification standard, corporations in four industries (mining, manufacturing, electricity, gas and water production, and construction) are classified as secondary industry. The selected enterprises are sorted according to the total assets, and the last 40% of enterprises are defined as small and medium-sized enterprises.

Secondly, pick out the enterprises whose establishment is less than 10 years, retain the samples (with more than 10 years of valid financial data). The samples were divided into heavy pollution (experimental group) and non-heavy pollution (control group). All companies with PT*, companies with missing financial data and companies with asset-liability ratio greater than 1 are excluded.

After the above treatment, the sample contains 284 listed companies finally, including 108 in the experimental group and 176 in the control group, with a measured value of 3134.

3.2 Difference model

This paper separates listed companies into four representative industries with serious pollution as the experimental group, and uses the following fixed-effect differential model to investigate the impact of the Guidance on the investment and financing behavior of heavy pollution companies after the politics.

The model can be signified below:

$$Y_{it} = \beta_0 + \beta_1 treated_i + \beta_2 after_t + \beta_3 treated_i \times after_t + \gamma X_{it-1} + \delta_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where Y_{it} is the enterprise investment and financing index; $treated_i$ is a group dummy variable, the value of the experimental group is 1, while the control group is 0; $after_t$ is an event dummy variable, which is 1 in 2016 and later, otherwise it is 0; $treated_i \times after_t$ denotes the difference-in-difference variable; X_{it} includes a series of enterprise control variables; δ_i denotes the individual fixed effect; λ_t is the time fixed effect. It can be seen that β_3 is the difference-in-difference coefficient, which measures the dynamic effect of green credit policy.

The definition and measurement of variables are showed in Table.1.

Table.1. Definition and measurement of variables

Type of variable	variable name	Definition of variable
Explained Variable	Debt financing with interest (DR)	Debt financing with interest/Total assets
	Liquid Liabilities (FR)	Liquid Liabilities/Total assets at the start

Explanatory Variable	Total liabilities (FS)	Total liabilities
	Enterprise investment (INV)	Net cash flow from investment activities /Total assets
Control Variable	Difference-in-difference Variable	treated * after
	Size	Natural logarithm of total assets of the enterprise
Stability Test Variable	Return on Assets (ROA)	Net profit / Average total assets
	Profit fluctuation (Std)	Standard deviation of ROA from the year of T-1 to the year of T
	Cash Holdings (Cash)	Total cash and cash equivalents / Total assets at the end of the period
	Age	Years of establishment by 2022
	Proportion of tangible assets	Proportion of tangible assets/Total assets
	Proportion of intangible assets	Proportion of intangible assets/Total assets
	Ownership concentration (Largest)	Share Concentration of the largest shareholder
	Asset-liability ratio (Lev)	Total liabilities / Total assets
	Earnings Per Share (EPS)	Earnings per share of corporate stock
	Actual M2 growth rate(M2r)	Actual M2 increase/Actual M2 at the start
	GDP growth index (gdpr)	GDP index (100 in the same period last year)
	Entrepreneur confidence exponent (Confi)	Entrepreneur confidence exponent

In order to alleviate the influence of extreme values on empirical results, the paper carried out Winscribe method to dextramer values for continuous variables and filtered out extreme values exceeding three times the standard deviation. In order to alleviate endogenous problems, the analysis was performed on indicators related to corporate financing (except enterprise age and corporate social responsibility). Meanwhile, the standard deviation of the test results was adjusted by clustering at the enterprise level. Table.2 shows the changes of investment and financing indexes of the experimental group before and after the promulgation of the policy.

From the results in Table.2, first, the average and median liquidity liabilities of the pre-promulgation experimental group were 0.354 and 0.313. After the promulgation of the policy, the mean and median changes of liquidity liabilities were 0.374 and 0.352, and the difference between the median Wilcoxon rank and test z was 6.436 and significantly positive at the 1% level, indicating a significant decline in liquidity debt financing for heavy pollution enterprises after the promulgation of policies.

Table.2. T-test Table (0=Before 1=After)

Var	Before				After			
	obs	mean	median	mean-diff	obs	mean	median	medi-diff
M2R	542	13.908	13.917	-0.559***	676	14.467	14.502	842.173***
gdpr	542	7.864	7.800	1.752***	676	6.112	6.650	482.964***
confi	542	16.643	17.100	-4.885***	676	21.527	23.280	273.957***
DR	519	0.185	0.151	-0.009	639	0.193	0.167	1.261
FR	542	0.354	0.313	-0.020	676	0.374	0.352	6.436**
FS	479	9.846	4.514	-2.396**	562	12.242	6.135	13.252***
INV	542	0.064	0.047	0.008	676	0.056	0.050	0.213

Secondly, the total average difference of the experimental group's liabilities and the median Wilcoxon rank and test z were significantly positive at the 1% level, indicating that the total financing of heavy polluting enterprises through liabilities also decreased significantly after the promulgation

of the policy. At the same time, the average spread of enterprise financing is positive, but it is not significant, indicating that the investment of heavily polluting enterprises has declined after the promulgation of policies, but the statistical significance is not high.

4. Empirical Results

4.1 Time trend chart of enterprise investment and financing

Figure 1 plots the parallel trend test results of the mean value of enterprise investment and financing indicators from 2011 to 2021. Among them, the most significant liquid debt index is selected, which is reflected in the parallel trend test chart as the coefficient before D0 period fluctuates around 0, and the 95% confidence interval of the coefficient contains 0, indicating that the coefficient is insignificant, that is, it meets the parallel trend test. After the bond announcement, the coefficient of parameter estimate value is significantly positive, indicating that the issuance of green bonds has a positive impact on the company's performance, that is, the issuance of green bonds is beneficial to shareholders.

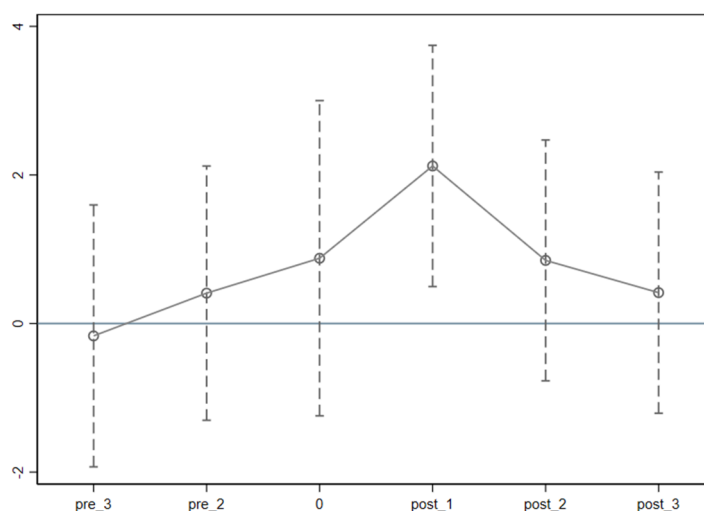


Figure 1. The parallel trend test of investment and financing index mean

4.2 Influence of green policies on enterprise financing behavior

Table 3 provides the fixed effects regression results of green credit affecting corporate financing behavior (controlling for individual and time fixed effects). As can be seen from the results in the third column of Table III, the coefficient of the interaction term TREATED * AFTER was estimated at 1.556 and statistically significant at the 1% level, indicating that the total debt financing level of heavily polluting enterprises was significantly higher than that of non-heavily polluting enterprises after the implementation of the policy. Columns 1 and 2 in Table.3. provide the results of the fixed-effects regression of green credit affecting interest-bearing debt (controlling for individual and time fixed effects). As can be seen from the results in the first and second columns, the coefficient estimates of the interaction term Treated * After were negative but insignificant (-0.003 and -0.029), indicating that the green credit policy did not significantly reduce the liquidity liabilities of heavily polluting enterprises.

The liquidity liabilities and interest-bearing debt financing of heavily polluting enterprises have not been significantly reduced. For example, to quickly respond to national policies in a short time, some heavily polluting enterprises need to purchase a large number of environmental protection equipment, in other words, green credit has no influence on the commercial credit of heavily polluting enterprises, which leads to the substitution effect of commercial credit on short-term loans of enterprises.

Table.3. The fixed effect regression of green credit on corporate financing

	m1	m2	m3	m4
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Variables	FS	FR	FS	INV
	(1)	(2)	(3)	(4)
d	-0.003 (0.019)	-0.029 (0.033)	1.556*** (0.512)	0.004 (0.026)
treat	0.006 (0.015)	0.023 (0.026)	-0.844 (0.631)	-0.005 (0.020)
after	0.013	0.160***	1.084	0.063
IND FE	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES
Observations	2,271	2,400	2,400	2,400
Number of id	274	274	274	274
R-Squared	0.0265	0.0378	0.604	0.0183

Standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

4.3 Dynamic effect of green credit on enterprise investment and financing

In order to test the dynamic effect of green credit on enterprise investment and financing behavior, this paper uses two-way fixed effect method to estimate the model. According to the results provided in Table 4, when the dependent variable is total liabilities, the estimated values of DID2016, DID2018 and DID2019 are not significant. The estimated values of DID2017 and DID2020 coefficients are both significantly positive at the 5% level, and the absolute values of the estimated difference coefficients show an upward trend and a significant increase in the second year of the policy implementation (2017), indicating that the total debt financing is more sensitive to the green credit policy.

Therefore, we can also find the influence of other control variables in the dynamic effect on corporate debt comprehensive financing. First, operating scale and the enterprise financing was significantly positively related to the level of index at 1% to 8.84, reflecting the more large-scale enterprises tend to have the ability to respond faster green financial policy obviously, due to the strict supervision by public Guidance are stricter.

Table.4. Year and Multi-index dynamic effect test

dynamic		dynamic		dynamic		dynamic	
Variables	FS	Variables	FS	Variables	FS	Variables	FS
	(1)		(1)		(1)		(1)
did2016	1.308 (1.086)	posty201 6	1.308 (1.086)	Size	8.840*** (0.241)	ratio_I	-2.051 (3.351)
did2017	2.520*** (0.827)	posty201 7	2.520*** (0.827)	ROA	3.937*** (0.935)	ratio_T	5.706** (1.134)
did2018	1.256 (0.827)	posty201 8	1.256 (0.827)	Std	-0.405 (0.347)	Largest	-2.232 (2.355)
did2019	0.833 (0.830)	posty201 9	0.833 (0.830)	Cash	-8.139*** (1.172)	Lev	15.386* (1.152)
did2020	1.650**	posty202 0	1.650**	age	-3.725***		

	(0.828)		(0.828)		(0.804)
did2021	1.350	posty2021	1.350		
	(1.286)		(1.286)		
treat	-0.830	treat			
	(0.633)				
IND FE	YES	IND FE	YES		
Observations	2,380	Observations	2,380		
Number of id	271	Number of id	271		
R_squared	0.604	R_squared	0.604		

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

At the same time, the cash flow of enterprises also shows a highly significant negative correlation at the 1% level, reflecting the fact that heavily polluting enterprises suffered a serious setback in cash income after the policy was announced and paid the price of environmental pollution.

The age of enterprises also shows a highly significant negative correlation at the 1% level, reflecting that some enterprises newly established in the last ten year don't have sufficient cash flow to adapt to the requirements of the current environment.

The tangible asset ratio of firms also shows significantly negative correlation at the 1% level. The enterprises (especially in some industries such as metal smelting and manufacturing) is affected by the high cost of renewal due to the large proportion of tangible assets.

4.4 Heterogeneity Analysis

The heterogeneity analysis of the geographical location of enterprises is carried out. The provinces where the above companies are located are sorted out and divided into central, eastern and western provinces for heterogeneity analysis. The results in Table.5. show that only the eastern enterprises have higher significance. Therefore, the eastern provinces with relatively large influence are selected for further analysis to determine whether they are state-owned holding enterprises. As for state-owned holding enterprises, they have assumed certain social responsibilities and the state has certain decision-making power, so the response effect of the policy is more obvious.

Since enterprises in eastern provinces are more significant, we can infer that enterprises in more developed regions (eastern provinces such as Zhejiang, Jiangsu, Guangdong, etc.) are more active in responding to the policy, so the indicators of investment and financing change more. Therefore, we extracted the index of "whether it is a municipality (MCP) directly under the Central Government" for the next step of heterogeneity analysis. It is visible from the table. The extent of response was greater in non-municipalities than in municipalities.

Table.5. Heterogeneity analysis

	(1)	(2)	(3)	(1)	(2)
VARIABLES	east FS	central FS	west FS	MCP FS	Non MCP FS
d	1.663*** (0.598)	0.826 (1.799)	1.418 (1.178)	0.593 (0.844)	0.995* (0.595)
treat	-1.415** (0.630)	1.383 (2.259)	-0.641 (1.568)	0.235 (0.889)	0.272 (0.754)
after	1.202 (1.026)	-1.554 (4.031)	-2.002 (2.338)	0.687 (1.385)	0.568 (1.127)
Size	8.177*** (0.259)	10.781*** (1.026)	7.272*** (0.557)	7.985*** (0.322)	8.787*** (0.306)
ROA	2.504	2.611*	12.959***	4.160*	2.665***

	(1.612)	(1.555)	(3.602)	(2.452)	(1.001)
Cash	-9.410***	-5.083	1.874	-11.624***	1.490
	(1.275)	(4.640)	(3.191)	(1.485)	(1.584)
age	-2.628***	-1.440	-0.612	-3.615***	-2.222**
	(0.701)	(4.553)	(2.299)	(1.032)	(0.940)
ratio_T	7.733***	-5.700	-0.793	9.421***	4.117***
	(1.296)	(3.493)	(2.825)	(1.720)	(1.335)
Largest	-3.266*	6.165	8.373	-1.945	-1.988
	(1.968)	(12.598)	(9.163)	(3.109)	(2.735)
Lev	15.752***	21.543***	22.992***	13.891***	28.629***
	(1.119)	(3.535)	(3.124)	(1.408)	(1.470)
Constant	-164.321***	-217.749***	-154.055***	-158.340***	-183.871***
	(5.331)	(19.704)	(12.788)	(6.667)	(6.251)
IND FE	YES	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES	YES
Observation	1,827	272	301	638	1,762
Number of id	211	31	32	73	201
R squared	0.607	0.735	0.708	0.711	0.661

5. Conclusions

In this paper, we will look at the introduction of Guidance on Building a Green Financial System (Guidance in short) in 2016, as the focus was centered in creating a quasi-natural experiment. The changes in the investment and financing behavior of small and medium-sized industrial enterprises before and after the policy were quantitatively studied using a difference-in-difference model. We see that :

(1)Before the introduction of “Guidance”, the liquidity debt financing and indicators of relevant enterprises decreased significantly. Guidance had a relatively obvious financing penalty effect on polluting enterprises, but the investment effect was not clearly reflected.

(2)After releasing that policy, the cash income of heavily polluting enterprises suffered a serious setback, and their production and operation performance continued to decline. Their growth weakened and their development prospects were limited, which indicate that their production and operation were negatively affected after the introduction.

(3)The severity of enterprises’ punishments depends on their pollution degree, location, and largest statement. Within enterprises in the eastern region, the state-owned holding enterprises and those located in non-municipalities directly under the central government, have clearer responses to the policy.

The investment and financing status of enterprises can be related to the economic status of the year. The economic situation of the year can be judged by analyzing the average growth index of manufacturing industry in each year (for example, the price of crude oil and natural gas can judge the economic status of fossil fuel supply). The endogenous can be reduced by adding control variables to the model.

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