

Research on the Impact of Environmental Regulation on Corporate Financing Constraints: Evidence from Heavily Polluting A-share Listed Enterprises

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Abstract

Amid China's pursuit of Dual-Carbon targets and ecological-oriented economic growth, the present paper regards the strict enforcement of the revised Environmental Protection Law as a quasi-natural-experimental setting. Adopting the difference-in-differences (DID) model, this research analyzes the inner causal link between tightened environmental governance and financing obstacles confronting high-polluting corporations. Empirical findings suggest that nationwide enforcement of the new-version Environmental Protection Law greatly improves external financing conditions for heavy-pollution firms and relieves their capital-raising predicament. A further mechanism test validates that this environmental policy lowers agency expenses and pushes enterprises to standardize information disclosure practices. Such changes reduce information asymmetry between firm insiders and outside investors, and ultimately ease corporate financing limits. This study extends existing theories about environmental governance and micro-level corporate decisions. It also supplies practical empirical evidence to coordinate ecological administration and sustainable high-quality economic expansion.

Keywords

New Environmental Protection Law; Environmental Regulation; Financing Constraints; Heavily Polluting Enterprises.

1. Introduction

Nowadays, global environmental regulations are tightening and continuing to change the business mode of enterprises, and financing constraints hinder the green development of enterprises. The supervision and discipline of the new Environmental Protection Law, which was implemented in 2015, has been greatly improved. The policy focusses on restricting heavily polluted industries and is suitable as a quasi-natural experiment to alleviate endogenous deviations. This article constructs a double differential research framework to test the role and transmission path of environmental regulations on enterprise financing constraints, enrich the relevant theories of environmental economy, and provide an empirical basis for improving environmental protection policies and alleviating the pressure of enterprise green financing.

2. Literature Review and Research Hypotheses

Existing studies demonstrate that environmental regulations have a U-shaped threshold relationship with corporate environmental investment[1]. Regulatory tools such as cleaner production requirements and environmental quality standards can force enterprises to upgrade production processes and accelerate green transformation[2]. Market-incentive environmental regulations effectively drive corporate green innovation, yet the incentive effect

of environmental taxes is lagged[3]. Some stringent regulations also raise corporate operating costs and restrain enterprise development[4].

The new Environmental Protection Law implemented in 2015 is a rigid command-and-control policy. Academic debates have emerged around the Porter Hypothesis (Porter & Linde, 1995)[5]. Some scholars argue that the law generates an innovation offset effect and facilitates corporate green upgrading[6]. Other research points out that the new law raises compliance costs, inhibits corporate green innovation, and forces firms to cut production passively to meet emission standards (Cui & Jiang, 2019)[7].

Most existing literature on financing constraints explores mitigation channels from the perspectives of policy, market and corporate governance. R&D subsidies, bank-tax interaction, tax reform, corporate digital transformation and equity balance mechanisms can all effectively ease corporate financing difficulties[8]. Nevertheless, systematic research on the internal transmission mechanisms through which environmental regulations affect corporate financing constraints remains insufficient.

Given the contradictory conclusions in prior literature, this paper sorts out the dual impact channels of the new law and puts forward competing hypotheses. On the one hand, stricter environmental supervision under the new law restrains managers' short-term self-interested behaviors and mitigates principal-agent conflicts (Cui et al., 2019)[9]. On the other hand, the policy tightens mandatory environmental information disclosure rules, pushes enterprises to improve information transparency and breaks down information barriers in capital markets (Zhao et al., 2019)[10]. Prior literature confirms that agency conflicts aggravate financing pressure, while high information transparency improves firms' access to financing (Jensen & Meckling, 1979; Jiang et al., 2016)[11][12]. However, the new law also increases enterprises' environmental compliance costs and operational uncertainty, which may exacerbate financing constraints (Gu et al., 2020)[13]. Accordingly, this paper proposes two competing hypotheses: Hypothesis 1: The implementation of the new Environmental Protection Law significantly alleviates financing constraints of heavily polluting enterprises.

Hypothesis 2: The implementation of the new Environmental Protection Law intensifies financing constraints of heavily polluting enterprises.

3. Model Design and Variable Definition

3.1. Sample Selection and Data Sources

In accordance with the Guidelines for Environmental Information Disclosure of Listed Companies issued by the Ministry of Ecology and Environment, this study categorizes 16 specific industrial sectors as heavily polluting industries, with all other manufacturing sectors defined as non-heavily polluting industries. Given that the regulatory intensity of the revised Environmental Protection Law primarily targets high-pollution sectors, non-polluting industries are barely impacted by this policy shock.

Following the empirical framework proposed by Cui and Jiang (2019) [7], the current study selects Chinese A-share manufacturing firms as the primary research sample. Enterprises belonging to heavily polluting industries are classified into the treatment group, while the remaining manufacturing firms constitute the control group.

To ensure data accuracy and research robustness, this study excludes samples listed after 2015, ST-labeled firms, and observations with severe missing values. Additionally, all continuous variables are winsorized at the 1% bilateral level to eliminate the interference of extreme outliers. After a series of data screening procedures, a final sample of 14,852 firm-year panel observations is retained. All research data utilized in this analysis are sourced from the CSMAR and WIND financial databases.

3.2. Model Specification

This paper studies the impact of the new Environmental Protection Law on the financing constraints of heavily polluted enterprises through the double differential model. The model is as follows:

$$KZ_{i,t} = \beta_0 + \beta_1 \text{Treat}_i \times \text{Post}_t + \beta_2 \text{Controls}_{i,t} + \text{Firm}_i + \text{Year}_t + \varepsilon \quad (1)$$

In the model, KZ is the explained variable, which measures the degree of corporate financing constraints. The interaction term $\text{Treat} \times \text{Post}$ serves as the core explanatory variable, capturing the net policy effect of environmental regulation. Controls represent a series of control variables. Firm and Year are individual fixed effects and year fixed effects, which are used to control for enterprise heterogeneity and time-varying trends, respectively. i denotes the individual enterprise, and t denotes the year.

3.3. Variable Definition

3.3.1. Explained Variable

The existing financing constraint indicators have their own advantages and disadvantages. This article refers to the research of Jiang et al. (2019) [14], and selects the KZ index with wider applicability and stronger comprehensiveness to measure enterprise financing constraints. The study selects four core financial indicators to measure the initial KZ0, and obtains the final KZ index through Ordered Logit regression fitting. The larger the index value, the higher the degree of enterprise financing constraints.

3.3.2. Explanatory Variable

This article sets $\text{Treat} \times \text{Post}$ as the core interpretation variable. Among them, Treat is a group virtual variable, with the value assigned to enterprises in heavy pollution industries and 0 to enterprises in non-heavy pollution industries; Post is a time virtual variable, with the implementation of the new law in 2015 as the node, the value is 1 in 2015 and later, and the value is 0 in 2014 and before. The interaction between the two can accurately identify the differentiated policy effects of environmental regulation on enterprises in different industries.

3.3.3. Control Variables

Based on existing studies, this article selects the following control variables: enterprise size (Size), firm age (Age), asset-liability ratio (Lev), operating cash flow (Cf), corporate accounting performance (Roe), fixed asset ratio (Fixed), growth opportunity (Growth), shareholding ratio of the largest shareholder (Top1), board size (Bs), and enterprise property rights (Soe). Furthermore, individual fixed effects (Firm) and year fixed effects (Year) are controlled in the regression model. The detailed definitions of control variables are presented in Table 1.

Table 1. Variable Definitions

Variable Type	Variable Symbol	Variable Name	Indicator Construction
Explained Variable	KZ	KZ Index	$KZ = a_1D/A + a_2Cash/A + a_3CF/A + a_4Lev$. A higher value of the KZ index indicates severer corporate financing constraints. The coefficient a refers to the regression coefficients obtained from Ordered Logit regression.
Explanatory Variable	Treat	Group Dummy Variable	Assigned 1 if the enterprise belongs to the treatment group; otherwise assigned 0 for the control group.
	Post	Time Dummy Variable	Assigned 1 if the sample observation year is 2015 or later; otherwise assigned 0.
Control Variable	Size	Asset Size	Natural logarithm of the enterprise's annual total assets.
	Age	Firm Age	The duration since the enterprise's establishment.
	Lev	Asset-Liability Ratio	Ratio of total liabilities to total assets.
	Cf	Operating Cash Flow	Ratio of net cash flow from operating activities to total assets.
	Roe	Return on Equity	Ratio of net profit to shareholders' equity.
	Growth	Operating Revenue Growth Rate	$(\text{Year-end main business revenue} - \text{year-beginning main business revenue}) / \text{Year-beginning main business revenue}$.
	Fixed	Fixed Asset Ratio	Ratio of net fixed assets to total assets.
	Top1	Largest Shareholder Holding Ratio	Ratio of total shares held by the largest shareholder to total outstanding shares at the end of the period.
	Bs	Board Size	Total number of board members.
	Soe	Property Right Nature	Assigned 1 for state-owned enterprises; otherwise assigned 0.
	Firm	Individual Fixed Effect	Firm-level fixed effect.
	Year	Year Fixed Effect	Annual fixed effect.

4. Empirical Result Analysis

4.1. Descriptive Statistics

This section conducts descriptive statistics on the main variables of the research model, and the corresponding results are presented in Table 2.

Table 2. Descriptive Statistical Results

Variable	Mean	SD	Min	p50	Max
KZ	0.59	2.40	-11.34	0.88	13.66
Treat	0.35	0.48	0.00	0.00	1.00
Post	0.74	0.44	0.00	1.00	1.00
Size	22.18	1.17	17.78	22.04	27.55
Age	10.21	6.92	2.00	8.00	31.00
Lev	0.40	0.19	0.01	0.39	1.00
Cf	0.15	0.12	0.00	0.12	0.92
Roe	0.04	0.88	-66.54	0.07	1.12
Growth	0.39	5.76	-4.64	0.12	434.60
Fixed	0.23	0.14	0.00	0.20	0.87
Top1	34.01	14.12	2.43	31.99	89.99
Bs	9.25	2.29	4.00	9.00	27.00
Soe	0.27	0.45	0.00	0.00	1.00

The descriptive statistical results show that sample enterprises generally face financing constraints with obvious individual heterogeneity. The treatment group accounts for 35% of the total samples, and the samples after policy implementation account for 74%. All other control variables are within a reasonable value range.

4.2. Empirical Result Analysis

Benchmark Regression Results Analysis

Table 3 shows the running results of the benchmark regression model. The core explanatory variable is Treat*Post, and the interpreted variable is the KZ index. Models (1) to (4) gradually improve the explanatory power of the model by gradually adding control variables and fixed effects. The specific analysis is as follows:

(1) The impact of the policy interaction term

When only the core explanatory variable is included, the Treat*Post coefficient is -0.528, which is significantly negative at the level of 1%. After the gradual introduction of the fixed effect of control variables and individual and year, the coefficient fluctuates slightly but is still significantly negative, indicating that the new Environmental Protection Law can significantly alleviate the financing constraints of heavily polluted enterprises.

Table 3. Benchmark Regression Results

Variable	(1)	(2)	(3)	(4)
	KZ	KZ	KZ	KZ
Treat*Post	-0.528***	-0.415***	-0.470***	-0.364***
Size		-0.682***	-0.690***	-0.704***
		(-31.38)	(-18.76)	(-20.34)
Age		0.0391***	0.0397***	0.0393***
		(10.24)	(5.62)	(8.68)
Lev		6.819***	6.330***	6.243***
		(61.88)	(45.76)	(48.04)
Cf		-7.674***	-7.719***	-8.326***
		(-56.60)	(-49.96)	(-56.50)
Roe		-0.0312*	-0.0211	-0.0182
		(-2.43)	(-1.60)	(-1.47)
Growth		-0.00551**	-0.00592**	-0.00493**
		(-2.83)	(-2.91)	(-2.59)
Fixed		0.444**	1.332***	1.796***
		(3.21)	(7.17)	(10.27)
Top1		-0.00992***	-0.00823***	-0.00854***
		(-7.15)	(-3.84)	(-4.25)
Bs		-0.000381	-0.00520	0.00466
		(-0.06)	(-0.78)	(0.75)
Soe		0.568***	0.506***	0.369***
		(9.92)	(4.90)	(3.81)
_cons	0.623***	13.98**	14.19**	14.87***
Firm	Not contorlled	Not contorlled	Contorlled	Contorlled
Year	Not contorlled	Not contorlled	Not contorlled	Contorlled
Adjusted R ²	0.0021	0.5636	0.5937	0.7575
N	14825	14825	14825	14532

Taking Model (4) as the benchmark, the coefficient of Treat×Post is -0.364. This indicates that after the policy implementation, the KZ index of enterprises in the treatment group decreases by an average of 0.364 units compared with the control group, which demonstrates that the financing constraints of heavily polluting enterprises are significantly alleviated.

(2) Influence of Control Variables

It can be seen from Table 3 that the scale, operating cash flow, and ownership concentration can significantly alleviate corporate financing constraints, while firm age and asset-liability ratio aggravate corporate financing pressure. The number of board members has no significant impact on financing constraints. State-owned enterprise nature exerts a positive effect on financing constraints, which can be partially explained by firm individual characteristics. After incorporating all control variables and two-way fixed effects, the adjusted R² of the model increases from 0.0021 to 0.7575, which greatly improves the explanatory power of the model. The results confirm that both enterprise individual heterogeneity and macro environmental factors have significant impacts on corporate financing constraints.

4.3. Parallel Trend Test

As a fundamental precondition for reliable policy identification via the difference-in-differences framework, the parallel trend assumption demands that treatment and control groups exhibit identical evolutionary tendencies prior to policy intervention. To verify the validity of the

empirical estimation, this study performs a formal parallel trend test, with the detailed regression results presented in Table 4.

Table 4. Parallel Trend Test Results

Variable	(1)
	KZ
pre_2	-0.126
pre_1	-0.221
current	0.719***
las_1	0.525***
las_2	0.437***
las_3	0.245**
las_4	0.431***
las_5	0.382***
_cons	14.85***
N	14825

The results of the parallel trend test show that the advance coefficients of each period before the implementation of the policy are not significant, and there is no obvious difference in the trend between groups. The parallel trend hypothesis is established. The coefficients of the current period and the lag period of the policy are significantly positive, and the effect shows the characteristics of first decline and then stabilisation, indicating that the financing constraint mitigation effect of the new method is gradually released over time, and the benchmark regression results are reliable.

5. Robustness Tests

5.1. Placebo Test

To ensure the reliability of the baseline regression results, this article carries out 500 random sampling simulation placebo tests, and the probability density distribution of the corresponding results is shown in Figure 1. The results show that the virtual policy coefficient mostly fluctuates around zero value, and there is a significant difference from the core coefficient of the benchmark regression. It indicates that random interference factors do not affect the research conclusions, confirming that the alleviation of financing constraints among heavily polluting enterprises is indeed caused by policy changes.

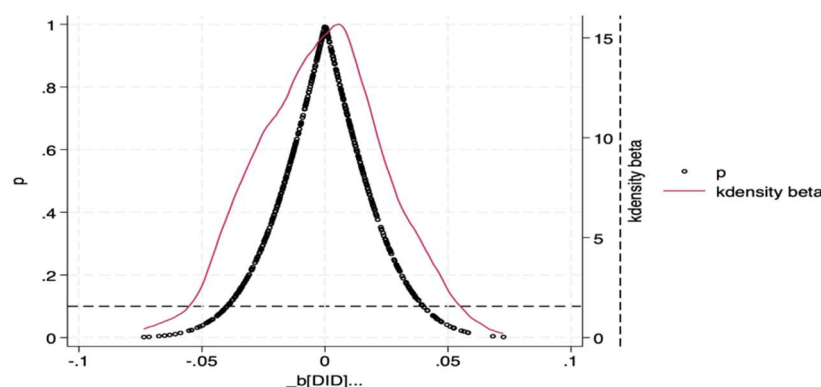


Figure 1. Results of Placebo Test

5.2. Alteration of Sample Time Interval

The global COVID-19 pandemic starting in 2019 constitutes a severe external economic shock that is likely to disturb the accuracy and stability of baseline regression outcomes. To rule out the disruptive impact of this public health crisis on empirical analysis, this study removes firm-year observations covering the 2019–2021 period and re-runs the baseline econometric model. As illustrated in Column (1) of Table 5, the interaction coefficient between policy implementation and group dummy variables remains statistically negative at the 1% significance level. The re-estimated outcomes firmly confirm the credibility and robustness of the core research conclusion, demonstrating that the primary empirical findings are not driven or biased by the COVID-19 outbreak.

Table 5. Regression Results of Robustness Tests

Variable	(1)	(2)
	Altered Time Interval	Excluding Interfering Samples
	KZ	KZ
Treat*Post	-0.348*** (-7.02)	-0.314*** (-5.48)
Control Variables	Controlled	Controlled
Firm	Controlled	Controlled
Year	Controlled	Controlled
_cons	17.10*** (19.78)	14.93*** (16.92)
Adjusted R ²	0.7728	0.7573
N	11623	11305

5.3. Exclusion of Potential Interfering Samples

To avoid the policy interference brought by the central environmental inspection campaign, this study excludes samples from nine provinces (autonomous regions) covered by the first round of central environmental inspections, including Hebei, Inner Mongolia, Heilongjiang, Jiangsu, Jiangxi, Henan, Guangxi, Yunnan, and Ningxia. The remaining samples are used for re-regression analysis, and the results are displayed in Column (2) of Table 5. The regression outcomes show that the core research conclusion remains highly robust after excluding the interfering samples.

6. Mechanism Tests

This study will also conduct a mechanism test from the two key dimensions of agency cost and information asymmetry.

6.1. Agency Cost Channel

Before the policy changes, the supervision was relaxed and the cost of illegality was low. In order to pursue short-term interests, the management of heavily polluting enterprises passively treated pollution and misappropriated environmental protection funds, which aggravated proxy conflicts and information asymmetry. After the implementation of the new law, the supervision and punishment of environmental protection have been greatly enhanced, forcing the management to increase investment in pollution control, rely on long-term operation, and effectively reduce the agency cost of enterprises. Since there is no direct observation data on the agency cost, it is necessary to carry out empirical testing with the help

of agent indicators. This article draws on the method of Shi et al. (2022) [15] to measure the agent cost by the management cost rate and group regression. The results show that the interaction coefficient is significantly negative, which confirms that the bailout effect of the new method on high agent costs and heavily polluted enterprises is more significant, and financing constraints can be alleviated by reducing agency costs.

Table 6. Mechanism Test - Agency Cost

Variable	(1)	(2)
	Mc=0	Mc=1
	KZ	KZ
Treat*Post	-0.093 (-1.15)	-0.511*** (-5.48)
Control Variables	Contorlled	Contorlled
Firm	Contorlled	Contorlled
Year	Contorlled	Contorlled
_cons	22.07*** (19.78)	11.36*** (16.92)
Adjusted R ²	0.7810	0.7694
N	5054	9090

6.2. Information Asymmetry Channel

Table 7. Mechanism Test - Information Asymmetry

Variable	(1)	(2)
	Kv=0	Kv=1
	KZ	KZ
Treat*Post	-0.125 (-1.35)	-0.384*** (-5.94)
Control Variables	Contorlled	Contorlled
Firm	Contorlled	Contorlled
Year	Contorlled	Contorlled
_cons	13.58*** (9.78)	16.79*** (15.42)
Adjusted R ²	0.7402	0.7711
N	6881	6941

Before the policy changes, there were no mandatory standards for corporate environmental information disclosure, and non-heavily polluting enterprises generally had higher disclosure quality. After the implementation of the new Law, heavily polluting enterprises are subject to strict governmental supervision and market monitoring. These enterprises are required to standardize the disclosure of pollutant emission data and actively disclose in-depth information such as environmental protection strategies and governance plans, which significantly improves corporate information transparency. This practice effectively alleviates market information asymmetry, reduces investors' decision-making risks, and optimizes the external financing environment of enterprises. Referring to Zhou et al. (2011)[16], this paper adopts the KV index, which is negatively correlated with information disclosure quality, to

measure corporate information transparency. The full sample is divided into a low-KV group (high information disclosure quality) and a high-KV group (low information disclosure quality) for grouped regression. The results indicate that the coefficient of $Treat \times Post$ is significantly negative only in the high-KV group. It demonstrates that the new Environmental Protection Law exerts a stronger mitigating effect on financing constraints for heavily polluting enterprises with low information disclosure quality, which verifies that the policy can alleviate corporate financing constraints by reducing information asymmetry.

7. Conclusion and Suggestions

This article takes the implementation of the new Environmental Protection Law as a quasi-natural experiment, and explores the impact of environmental regulations on the financing constraints of heavily polluted enterprises with the help of dual differential models. Research shows that strict environmental regulations can significantly alleviate the constraints of enterprise financing. There are two major mechanisms of reducing agency costs and alleviating information asymmetry: policies can strengthen external supervision, standardize management behavior, optimize corporate governance, and at the same time force enterprises to improve the transparency of environmental information and boost capital market confidence. At the same time, parallel trend, placebo and other robustness tests confirmed the reliability of the research conclusions. Based on this, this article puts forward optimization suggestions from the four dimensions of policy, finance, enterprise and academic research: strengthen environmental protection law enforcement and information disclosure supervision, improve the green financial evaluation and product system, and promote enterprises to integrate environmental governance into development strategies. At the same time, it can deepen the regulatory tools, long-term effectiveness of policies and enterprise heterogeneity in the future. Research to provide support for green governance and financial policy optimization.

References

- [1] Tang, G. P., Li, L. H., & Wu, D. J. (2013). Environmental regulation, industrial attributes and corporate environmental investment. *Accounting Research*, (06), 83–89.
- [2] Zhang, Q., Zheng, Y., & Kong, D. M. (2019). Regional environmental governance pressure, executive experience and corporate environmental investment: A quasi-natural experiment based on ambient air quality standards (2012). *Economic Research Journal*, 54(06), 183–198.
- [3] Ambec, S., Cohen, M. A., Elgie, S., & Lanoie, P. (2013). The porter hypothesis at 20: Can environmental regulation enhance innovation and competitiveness? *Review of Environmental Economics and Policy*, 7(1), 2–22.
- [4] Shi, X., & Xu, Z. (2018). Environmental regulation and firm exports: Evidence from the eleventh five-year plan in China. *Journal of Environmental Economics and Management*, 89, 187–200.
- [5] Porter, M. E., & van der Linde, C. (1995). Toward a new conception of the environment competitiveness relationship. *Journal of Economic Perspectives*, 9(4), 97–118.
- [6] Liu, Y. Y., Huang, Z. Y., & Liu, X. X. (2021). Environmental regulation, executive compensation incentives and corporate environmental investment: Evidence from the implementation of the environmental protection law of 2015. *Accounting Research*, (5), 175–192.
- [7] Cui, G. H., & Jiang, Y. B. (2019). The impact of environmental regulation on firms' environmental governance behaviors: A quasi-natural experiment based on the new environmental protection law. *Economic Management Journal*, 41(10), 54–72.
- [8] Lai, F. H., Li, S. M., & Wang, D. Z. (2021). Mechanism design of government R&D subsidies under corporate financing constraints. *Economic Research Journal*, 56(11), 48–66.

- [9] Cui, G. H., & Jiang, Y. B. (2019). The impact of environmental regulation on firms' environmental governance behaviors: A quasi-natural experiment based on the new environmental protection law. *Economic Management Journal*, 41(10), 54–72.
- [10] Zhao, Y., Shen, H. T., & Zhou, Y. K. (2019). Environmental information asymmetry, institutional investors' site visits and corporate environmental governance. *Statistical Research*, (7), 104–118.
- [11] Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs, and ownership structure. *Journal of Financial Economics*, 3(4), 305–360.
- [12] Jiang, F. X., Shi, B. B., & Ma, Y. B. (2016). Financial experience of information disclosers and corporate financing constraints. *Economic Research Journal*, (6), 83–97.
- [13] Gu, L. L., Guo, J. L., & Wang, H. Y. (2020). Corporate social responsibility, financing constraints and corporate financialization. *Journal of Financial Research*, (2), 109–127.
- [14] Jiang, F. X., Cai, W. J., Cai, X. N., & Li, X. T. (2019). Microeconomic effects of bank competition: Empirical evidence from financing constraints. *Economic Research Journal*, (6), 72–88.
- [15] Shi, Y. D., Chen, H. L., & Song, M. Y. (2022). Does environmental regulation affect corporate financing constraints? A quasi-natural experiment based on the new environmental protection law. *Securities Market Herald*, (08), 8–19.
- [16] Zhou, K. G., Li, T., & Zhang, Y. (2011). Company secretaries and information disclosure quality. *Journal of Financial Research*, (7), 167–181.