Green Finance Reform and Innovation Pilot Zone Policy and Market Value of High-Pollution Enterprises: A Quasi-Natural Experiment Based on the DID Model

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ABSTRACT

Driven by the strategic goals of "carbon peak and carbon neutrality," green finance has become a key instrument for facilitating the green transition of high-emission enterprises and improving market-based environmental governance. This study takes the 2017 Green Finance Reform and Innovation Pilot Zones policy as a natural experiment. Using a sample of China's A-share listed high-emission firms from the first quarter of 2012 to the fourth quarter of 2018, it employs a two-way fixed-effects difference-in-differences model to examine the impact of green finance policies on the market value of these firms and the dynamic pattern of this impact. The results show that in the short term, the pilot zone policy significantly reduced the market valuation of high-emission enterprises in the pilot regions. This negative effect exhibits a clear time pattern: as the market gradually absorbs relevant information and adjusts expectations, the negative impact first intensifies and then weakens. Robustness checks, including parallel trends tests, placebo tests with random policy timing, and tests with randomly selected treatment groups, confirm the reliability of the findings. This study contributes to the literature on the microeconomic consequences of green finance policies and corporate asset pricing, while also providing empirical insights for governments aiming to refine green finance policies, for high-emission firms seeking to mitigate policy shocks, and for capital markets intending to foster green investment concepts.

Keywords: Green finance policy; Pilot zone of green finance reform and innovation; Enterprises with a high emission rate; The value of a company in the market; Difference-in-differences model

1. INTRODUCTION

Governance of the global climate is gradually advancing, and the transition towards a green, low-carbon economy is also becoming a characteristic of high quality development across the world. Facing increasing ecological strains and the necessity to change its growth pattern, China has stated clear targets to peak carbon emissions and carbon neutrality. It drives traditional energy-intensive and high-emission industries out of their old intensive growth trajectories. As a result, environmental governance and green industrial upgrading have become core concerns in macroeconomic regulation.

High-emission industries have been part of China industrial economy and at the same time they are the largest contributors to carbon emissions and environmental pollution over the last several decades. The traditional modes of production and operation of the enterprises are in stark contrast to the green development trend that is necessary to achieve the goals of the dual carbon. Traditional environmental regulation, based largely on administrative orders, tends to be characterized by high enforcement costs, poor incentive effects, and low market responsiveness. Therefore, it cannot effectively promote a high-emission company to reform itself voluntarily. In such a situation, mechanisms of market-based environmental governance that focus on green finance have slowly entered the scene. [1] These mechanisms reorganize the investment and financing environment by allocating financial resources among companies differently. This has made them an important instrument in controlling the conduct of high-polluting companies, developing green industrialization, and attaining balanced ecological and economic growth. [2]

In order to develop a holistic green financial governance structure, China has released and developed its green finance regulations in a stepwise, piloted fashion. The release of the Green Credit Guidelines in 2012 is the starting point in the institutionalization of green finance in China. It was the first time that credit resources allocation was directly linked to corporate environmental performance, which put early financial constraints on companies with high emissions. Later in 2017, China also created the first set of Green Finance Reform and Innovation Pilots and simultaneously integrated green credit into the macroprudential assessment framework of financial institutions. [3][4] That change transformed green finance

policies as flexible recommendations into obligatory regulations, establishing an environment that is quite appropriate to research an exogenous policy shock. Due to the phased introduction of the policies, their restriction to specific areas, and their implementation in waves, they easily fit into the controlled natural experiment logic behind the difference-in-differences (DID) methodology. It creates a strong foundation to correctly determine the micro-level governance outcomes of green finance policies.

The market value of a company indicates the way capital markets evaluate its business performance, susceptibility to policy risks, and future growth potential. It is therefore an indication that is sensitive to the microeconomic consequences of external policy shocks. [5] High-emission firms are affected by green finance policies through two major mechanisms, namely, the provision of funds and changes in market expectations. [6] On the other hand, most of the current researches have been devoted to the issue of how green finance affects corporate green innovation, emission reduction, as well as the performance of operations and they tend to agree on the positive governance impact of such policies. Conversely, the powerful regulatory messages inherent within these policies could alter the perception of risk by investors. This could cause a capital flow out of risk-averse investors, thus increasing the volatility of the market between high-emission companies. The sensitivity of high-emitting companies to green finance policies and their higher policy impacts than low-carbon green companies are compared. [7] Hence, fluctuations in their market value represent a straightforward and reliable indicator of effectiveness of these policies.[8]

Up to now, green finance policies have been extensively studied in scholarly sources. The majority of the available works are devoted to the influence of these policies on regional green economic transformation, industrial restructuring, [9] corporate green innovation, anti-pollution efforts, and real-life business performance. On balance, they indicate positive government outcomes of green finance. [10] However, there are significant lacunae. Recent studies are inclined towards focusing on the operational issues of companies with very little consideration given to the implications of policies on the capital market value.[11]Specifically, research that directly investigates the connection between green finance policies and the value of high emission companies is not abundant.[12] Furthermore, most of the current literature is unable to properly address the confounding factors including macroeconomic patterns, industry cycles or firm-level heterogeneity. It complicates the identification of the real treatment effect of green finance policies and restricts the accuracy of the results obtained.

Due to the gaps in literature identified earlier, the present research may be considered as a quasi-natural experiment since it uses the 2017 Green Finance Reform and Innovation Pilot Zones policy in China. A difference-in-differences (DID) model is applied to a sample of A-share listed high-emission firms to investigate what impact green finance policies have on their market value. Our analysis also includes heterogeneity analysis by ownership size, industry type and regional features, which allows us to determine how policy impacts vary across different settings.

This piece of writing builds upon the existing body of work on the microeconomic effects of green finance and corporate asset pricing, filling a gap in capital-market-focused research. We have some practical implications of our empirical results to various parties. Policy makers use it as a foundation to enhance green finance policies and increase accuracy in regulating environmental factors. In terms of high-emission companies, the results indicate methods of proactive response to policy changes and implementation of steady, sustainable change. And to capital market investors, they provide directions on dealing with risks associated with policy and promoting green investment behavior.

2. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESES

Based on the efficient market hypothesis and signal transmission theory, it is considered in the present paper how green finance policies impact the market value of high emitters dynamically. The paper also explains the mechanics behind the short-term volatility and long-term rebound to policy shocks.

(1) Initial Policy Phase: The Mechanism Behind the Formation of Short-Term Negative Effects

According to the efficient market hypothesis, capital markets react promptly to any new policy information. The effect of regulatory signals can be observed in corporate valuations shortly after being published. The Green Finance Reform and Innovation Pilot Zone policies were used as an exogenous regulatory shock in 2017. This was an obvious indication that the government had a strict interest in regulating high-polluting industries more closely and tightening green credit terms.

There was still significant information asymmetry at the beginning of implementation. It was challenging to investors to estimate the real financing limits that the various high-emission companies faced. The consequence was that a pessimistic sentiment spread out - the view that companies with high pollution levels were about to experience a shortage of funds,

increased compliance expenditures, and a steep decline in future cash flow. Such an abrupt change in expectations triggered risk-averse investment to exit high-pollution industries. The corporate risk premium increased significantly and during the first phase of the policy the market value of the high-emitting companies decreased markedly. [13]

Therefore, based on the above analysis, the following hypothesis is proposed:

H1:The measures of the Green Finance Reform and Innovation Pilot Zone are likely to decrease the value of extremely polluting companies in the pilot zones by a great extent within a relatively short period.

After policies have been in existence over a period of time, the initial overreaction of the market is likely to subside. The degree of information asymmetry reduces and the policy effects exhibit significant signs of attenuation.

On the other hand, investors have been able to watch how firms react upon policy shocks using the subsequent financial reports and environmental disclosures. A few high-emission firms, however, find it possible to alleviate the short term financing pressures by employing trade credit, reallocating internal funds or getting transitional subsidies offered by local government. They are not as bad off as they were originally expected to be. [14]

Conversely, market sentiment slowly becomes reasonable as it was before due to a previous panic-induced negativity. The prices of assets which had been undervalued due to the turmoil will start to recover. When the market finally takes all the negative policy messages into account, the valuation of companies will depend on actual fundamentals once again. The extra negative impact of green finance policies on the market value of high-emission companies disappears very fast, reaching zero.

Therefore, based on the above analysis, the following hypothesis is proposed:

H2: As the information asymmetry in the market decreases and all expectations are factored into pricing, the negative effect of green finance policies on the value of a high-pollution corporation is significantly time sensitive and its impact is highly perishable with time.

3. EMPIRICAL RESEARCH DESIGN

3.1 Sample Selection and Data Sources

We use the period between the first quarter of 2012 and the fourth quarter of 2018 as our sample that includes China's A-share listed companies that are considered highly polluting. We rely on the official documentation to find such businesses, i.e., we refer to two official documents: the Guidelines on Environmental Information Disclosure of Listed Companies and the Industry Classification Guidelines of Listed Companies (2012 Revision) published by the China Securities Regulatory Commission. Industries that are considered heavily polluting include mining, high-polluting manufacturing, and production and supply of power, heat, gas, and water. The final sample consists of listed companies engaged in these industries.

The present research adopts the following screening measures to the original sample in order to guarantee the validity and reliability of the sample data: The first step is to remove the enterprises that were registered after the year 2012 so that the data could be continuously observed before and after the policy implementation; The second step is to delete the samples that had anomalous debt-to-asset ratio or other serious missing financial indicators; Third, the listed companies that were named as ST, *ST, or PT throughout the period of the research were removed to prevent the effect of the extreme values of financially distressed companies; Fourth, observation samples that had extreme missingness of core variables and financial data were deleted. Further, in order to reduce the influence of outliers on empirical outcomes, all continuous variables were trimmed to the 1st and 99th percentile. Finances, corporate governance and industry / region information was obtained through Guotai An (CSMAR) database and empirical analysis of quarterly panel data.

3.2 Variable Selection

3.2.1 Dependent Variable

The dependent variable will be the corporate market capitalization and in this research the proxy variable is the TobinQ ratio (TobinQ). TobinQ is an overall indicator of the way capital markets evaluate the intrinsic value of a company, its projected future earnings, and its growth prospects, and is thus the main measure of the market value of listed companies. [15] The formula is calculated as follows: (Market capitalization of tradeable shares + Book value of non-tradeable shares + Total liabilities) / Book value of total assets. In comparison with single financial indicators, TobinQ allows capturing

the dynamics of change in the market capitalization of high-emission enterprises more comprehensively and sensitively during policy shocks.

3.2.2 Core Explanatory Variable

The difference-in-differences model is used in this paper to build the main explanatory variable interaction term Did, which is the product of the grouping dummy variable Treat and the time dummy variable Post.

The green finance reform and innovation pilot zone set up in 2017 is used as the natural experimental environment and enterprises under this zone are assigned to the treatment group (Treat = 1) and others, who are not in this zone are assigned to the control group (Treat = 0).

The time dummy variable (Post): The adoption of the policy officially came into effect in 2017, after which all quarterly samples that were taken since 2017 are coded as 1 in the Post category and all those before 2017 are coded as 0 in the same category.

The interaction term is defined to be Treated Post and its regression coefficient measures the net treatment effect of green finance policies on the market values of high-emission firms.

3.2.3 Control Variables

In order to reduce the influence of individual corporate attributes on market value and based on previous studies about the connection between green finance and business value, the research chooses corporate size (Size), debt-to-asset ratio (Lev), years listed (ListAge), revenue growth rate (Growth), intangible asset ratio (IR), price-to-earnings ratio (PE), and price-to-book ratio (PB) as control variables.

The specific definitions of each variable are shown in the table below:

Table 1. Relevant Information on Research Variables

variable classes	Variable Name	variable symbol	variable-definition
explained variable	enterprise value	TobinQ	Total market value of the company / Cost of capital replacement
explanatory variable	Dual-Difference Variable	Treat×Post	The samples that are found in the pilot zone and those after 2017 are given the value of 1, whereas the rest are given the value of 0.
controlled variable	Company Size	Size	The natural logarithm of the enterprise's total assets at the end of the period
	asset-liability ratio	Lev	Total Liabilities / Total Assets
	listing age	ListAge	Subtract the listing year from the original year and then take the natural logarithm.
	increase rate of business revenue	Growth	(Current period operating revenue-Previous period operating revenue) / Previous period operating revenue
	Intangible Assets Ratio	IR	Net intangible assets / Total assets
	Price-to-Earnings Ratio	PE	Stock Price / Earnings Per Share
	Price-to-Book Ratio	PB	Stock Price / Net Assets Per Share

3.3 Model Construction

In order to empirically investigate the effect of green finance policies on market value of high-emission companies, this paper builds a two-way fixed-effects difference-in-differences (DDIM) benchmark model:

$$\mathrm{TobinQ}_{i,t} = \alpha + \beta\,\mathrm{Did}_{i,t} + \gamma\,\mathrm{Controls}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

The formula: is the market capitalization of the i-th company in the t-th quarter; is the interaction between the dual difference in policy; denotes a collection of enterprise-level control variables; the firm-specific fixed effect regulates the inherent characteristics of the firm which are constant in time.; time fixed effects are used to control time shocks including macroeconomic conditions and industry cycles at the quarterly level.the random disturbance term. The coefficient β is the main parameter of interest within this paper that will be used to determine the general orientation and the size of the effect of green financial policy on the market capitalization of high-emitting companies.

3.4 Descriptive Statistical Analysis

This is the reported descriptive statistics of the major variables. The dependent variable Tobin s Q (CSMAR code F100901A) has 21,431 valid observations. It has an average of 2.0266 and a standard deviation of 1.2789. The lowest value is 0.8773 and the highest is 8.1538. The mean is greater than 1, which implies that, on average, the value of the market of the sample firms is greater than the cost of capital replacement of the sample firms, which is a sensible result. A fairly high standard deviation indicates significant heterogeneity in market valuation across the companies, which provides a sufficiently strong empirical foundation to investigate how policy shocks impact market value.

The table below shows summary statistics on the most important dummy variables. Interaction term did has a mean of 0.0114, which indicates that 1.14 percent of all sample observations are in the pilot regions after the introduction of the policy. The treatment indicator treat averages 0.0475 or approximately 4.75 percent of the sample companies are located in pilot areas. The post-policy dummy post has a mean of 0.2460, implying that 24.60% of the observations belong to the post-policy period. It indicates that the distribution of samples is fairly well-balanced before and during the policy intervention.

The results of the statistical analysis of control variables are as follows: The mean enterprise size (Size) is 22.3792 and its standard deviation is 1.2617, which means that the total distribution is highly concentrated; the mean value of debt to assets ratio (Lev) is 0.4332 with the standard deviation of 0.2062, which implies that the debt levels are in acceptable limits; the mean listing age (ListAge) is 2.3918 with a standard deviation of 0.6332, which indicates little variation in the maturity of the sample enterprises; the mean revenue growth rate (Growth) is 0.0241 and the standard deviation is 0.1121, which means that there is some variability in the growth potential; the mean value of intangible asset ratio (IR) is 0.0574 and the standard deviation is 0.0566, which indicates that the total share of intangible assets is relatively low; the mean price-to-earnings ratio (PE) is 87.1168 with a standard deviation of 149.2095 and the mean price-to-book ratio (PB) is 3.3053 with a standard deviation of 3.0103 and it indicates that there are considerable differences in the market values of the sample enterprises and this is consistent with the nature of the A-share market.

The application of tail-trimming to all continuous variables at the 1st and 99th quantiles was used in this study which minimized the effect of outliers on the data and made it reliable.

Table 2. Descriptive Statistical Analysis

	observed value	mean	standard deviation	least value	25th percentile	median	75th percentile	crest value
TobinQ	21431	2.0266	1.2789	0.8773	1.2161	1.5943	2.3432	8.1538
did	21431	0.0114	0.1063	0.0000	0.0000	0.0000	0.0000	1.0000
treat	21431	0.0475	0.2126	0.0000	0.0000	0.0000	0.0000	1.0000
post	21431	0.2460	0.4307	0.0000	0.0000	0.0000	0.0000	1.0000
Size	21431	22.3792	1.2617	20.0002	21.4853	22.1920	23.1303	26.1709
Lev	21431	0.4332	0.2062	0.0482	0.2673	0.4282	0.5912	0.9024
ListAge	21431	2.3918	0.6332	0.6931	1.9459	2.5649	2.8904	3.2189
Growth	21431	0.0241	0.1121	-0.2931	-0.0000	0.0000	0.0000	0.5759
IR	21411	0.0574	0.0566	0.0000	0.0247	0.0420	0.0667	0.3219

Table 2. (continued) Descriptive Statistical Analysis

	observed value	mean	standard deviation	least value	25th percentile	median	75th percentile	crest value
PE	19029	87.1168	149.2095	5.3586	21.7356	37.1806	76.8151	935.4215
PB	21430	3.3053	3.0103	0.5345	1.6137	2.4532	3.8709	21.3371
N	21431							

3.5 Correlation Analysis

Table 3 shows the results of the Pearson correlation analysis of the main variables. Initially, the correlation coefficient between the dependent variable TobinQ and the core explanatory variable did is -0.043, which is statistically significant at 10%. This initial result shows that green finance policies are negatively correlated with the market value of high-pollution enterprises as predicted by theory.

Further, the relationship between the dependent variable and the control variables is consistent with economic theory: Size of the enterprise (Size), debt to asset ratio (Lev), and Tobin's Q all demonstrate strong negative correlations (1%), which means that bigger companies with more debt have less market value; the price/earnings ratio (PE) and price/book ratio (PB) both have strong positive correlations with Tobin's Q (1%) and it can be concluded that market valuation measures behave in the same direction as the market capitalization of a company; but the correlations between listing age (listage), revenue growth rate (growth), and intangible asset ratio (ir) and Tobin's Q were not statistically significant, and they should be validated further by regression models.

To sum up, the correlation coefficients of control variables are within the acceptable limit, and the largest correlation coefficient between Size and Lev is 0.447, which is much lower than the multicollinearity level of 0.7. Such a result suggests that there are no serious problems of multicollinearity and that they can be considered as reliable in further regression analyses.

Table 3. Correlation Analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) TobinQ	1.000								
(2) did	-0.043*	1.000							
(3) Size	-0.439*	0.022*	1.000						
(4) Lev	-0.277*	-0.006	0.447*	1.000					
(5) ListAge	0.002	0.043*	0.369*	0.341*	1.000				
(6) Growth	0.002	-0.006	0.016*	-0.036*	-0.056*	1.000			
(7) IR	-0.001	0.004	0.012	0.025*	0.068*	-0.003	1.000		
(8) PE	0.260*	-0.036*	-0.213*	0.070*	0.052*	-0.073*	0.006	1.000	
(9) PB	0.788*	-0.045*	-0.393*	0.048*	0.004	-0.010	0.018*	0.318*	1.000

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

3.6 Benchmark Regression

In order to determine the overall effect of the Green Finance Reform and Innovation Pilot Zone policies on the market value of very polluting companies, this paper will perform a benchmark regression with a two-way fixed-effects difference-in-differences (DDIM) model and the findings are shown in Table 4. The regression results without control variables and control variables are shown in columns (1) and (2), respectively. The columns contain both firm-specific fixed effects as well as quarterly time fixed effects and use robust standard errors to correct heteroscedasticity.

Regression outcomes show that the coefficient of the core explanatory variable in column (1) is-0.2200, which was found to be significantly negative at the 10 percent level, implying that green finance policies have had a significant reduction of the market value of high-polluting enterprises in the pilot regions. Once control variables are added, the coefficient of did in column (2) is -0.1746, which continues to be significantly negative at the 1 percent level and the adjusted R 2 increases by 0.2468 to 0.7261, which indicates a significant increase in the model fit and increased credibility of the findings. It shows that even after taking into account the characteristics of firms as well as time trends, green finance policies had a significant negative net impact on the market value of high-polluting companies in the pilot regions, hence confirming Hypothesis H1 of this research.

The findings regarding the control variables are mostly in accordance with the expectations. The coefficient on the variable of firm size (Size) is -0.2173 and it is statistically significant at the 1 percent level which means that the larger the enterprise, the more limited the growth opportunities and the smaller the market values are. There is also a negative coefficient on the debt-to-asset ratio (Lev) (-1.5186, significant at 1%) which indicates that increased financial risk, i.e. higher leverage, goes hand in hand with reduced market value. On the contrary, listing age (ListAge) has a positive coefficient of 0.7349 (significant at 1%), which means that companies with a longer history of trading have a more favourable reputation and therefore more valuable.

The price-to-earnings ratio (PE) and price-to-book ratio (PB) have both been positively related to market capitalization with correlations of 0.0001 ($p < .10$) and 0.3775 ($p < .01$), respectively. It shows that there exists a strong positive correlation between the often used valuation measures in the market and the company market value. At the same time, revenue growth rate (Growth) and intangible assets ratio (IR) do not demonstrate statistically significant impact on the market capitalization of highly polluting companies.

Table 4. Benchmark Regression Results

	(1) No control variables included	(2) Including control variables
did	-0.2200*	-0.1746***
	(0.1129)	(0.0526)
Size		-0.2173***
		(0.0446)
Lev		-1.5186***
		(0.1336)
ListAge		0.7349***
		(0.0630)
Growth		-0.0297
		(0.0341)
IR		-0.5134
		(0.3698)
PE		0.0001*
		(0.0001)
PB		0.3775***
		(0.0188)
_cons	1.7075***	4.6604***
	(0.0245)	(0.9578)

Table 4. (continued) Benchmark Regression Results

	(1) No control variables included	(2) Including control variables
N	21431	19017
r2_w	0.2468	0.7261

Standard errors in parentheses

Note: (The numbers in the parenthesis are the robust standard errors). The symbols ***-, ** and * stand for the level of significance at 1, 5 and 10 percent respectively.

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

3.7 Parallel Trend Test and Dynamic Effect Analysis

To effectively implement the difference-in-differences model, it requires an assumption of parallel trends, i.e., trends in the dependent variable should be similar between the treatment and control groups prior to the policy implementation. In order to examine this assumption and its dynamic effects, the current research uses the event study approach to develop the following model:

$$TobinQi,t = \alpha + \sum\sum_{-4}^{4} k\,\beta kTreati \times Eventk,t + \gamma Controlsi,t + \mu i + \lambda t + \varepsilon i,t \quad (2)$$

In the present case, the policy time dummy variable takes the current policy implementation period (Q2 2017) as the reference point. k is the relative duration in terms of quarters (k = -4 means the quarter four periods prior to the policy implementation, and k=4 means the quarter four periods after the policy implementation). Quarter prior to policy implementation (k = -1) is chosen as baseline group of this research and no dummy variable related to the baseline period is added into the model. The dynamic effect coefficient of each period is denoted by 0k which shows the change in the policy effect on corporate market capitalization at various time points.

Figure 5 shows the results of the parallel trends test, which presents an estimated coefficient per period together with a 95 percent confidence interval. The confidence intervals are all zero in all pre-policy periods (k = -4,-3,-2,-1). It implies that prior to the implementation of the policy, there were no meaningful changes in the market values trends among the control and treatment groups. The parallel trends assumption is thus met and our model specification is justified.

The analysis of the dynamics after the introduction of the policy shows that the coefficients of the current period (k=0) and future periods (k=1 to 4) are highly significant and negative suggesting the presence of a significant reduction in the market value of high-pollution enterprises in the pilot areas as a direct result of the green finance policy. Moreover, the absolute magnitudes of these coefficients initially rose and later fell, reaching their peak in the second quarter post-policy introduction and slowly decreasing. The trend indicates both the specific time sensitivity of the negative effect of the policy on the market value of high-pollution enterprises, whereby the policy effect dissipates over the course of time as market information is absorbed and corporate fundamentals recover, thus confirming Hypothesis H2 of this paper.

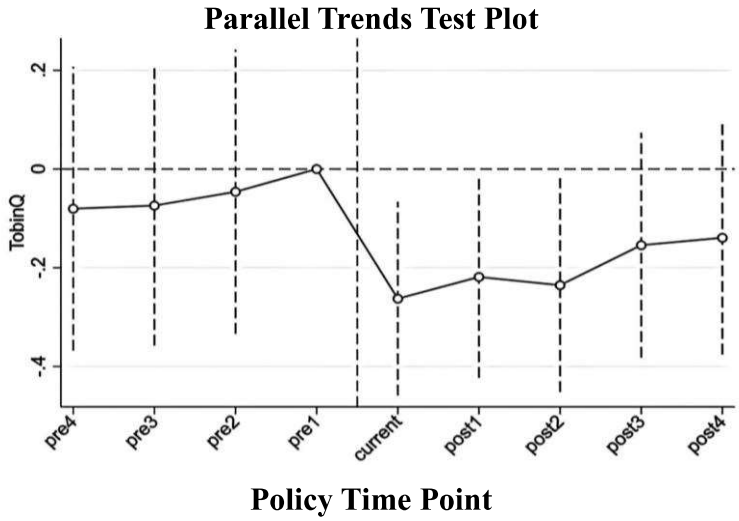

Figure 1. Parallel Trend Test

3.8 Robustness Test

To ensure that the regression results of the benchmark are reliable, the present paper uses these two methods of robustness testing:

3.8.1 The test of false policy timelines

In order to remove any contamination of other unobserved time trends or policy shocks, a placebo test to artificial policy time is used in this study where the policy implementation date is moved forward to the second quarter of 2015. The difference-in-differences model is re-estimated with a dummy variable post_fake. In case the baseline results are caused by green finance policies, the artificial policy interaction term coefficient did_fake must be insignificant.

Table 4-5 shows the test results. The false policy interaction term, did_fake, has a coefficient of -0.0257 which is not statistically significant. It implies that when the false policy was implemented, the change in market values of the treatment and control groups were not significantly different. Such outcomes eliminate the possibility of other time trends or policy shocks interfering with the results and validate the validity of the baseline regression results.

Table 5. Placebo test: False policy period (Q2 2015)

	(1)
	Tobbin Q
did_fake	-0.0257
	(0.0661)
Size	-0.4313***
	(0.0572)
Lev	-1.7008***
	(0.1583)
ListAge	1.0720***
	(0.0954)
Growth	0.0474
	(0.0368)

Table 5. (continued) Placebo test: False policy period (Q2 2015)

	(1)
	Tobbin Q
IR	-0.7007
	(0.4589)
PE	0.0002**
	(0.0001)
PB	0.3751***
	(0.0202)
_cons	8.7795***
	(1.2259)
N	14276
r2_w	0.7384

Standard errors in parentheses

Please note that the value in brackets is the robust standard error. The stars ***-, **, and * denote significance levels of 1 per cent, 5 per cent and 10 per cent respectively.

* p<0.1， ** p<0.05， *** p<0.01

3.8.2 Random Permutation Test for the Treatment Group

As a means to further reduce the influence of omitted variables or random factors, this paper uses the placebo test approach to randomized treatment groups: the random selection of an equal number of enterprises into a total sample in order to constitute the so-called pseudo-treatment group and then repeat the difference-in-differences regression 500 times to get the distribution of coefficients estimate of the randomized treatment group.

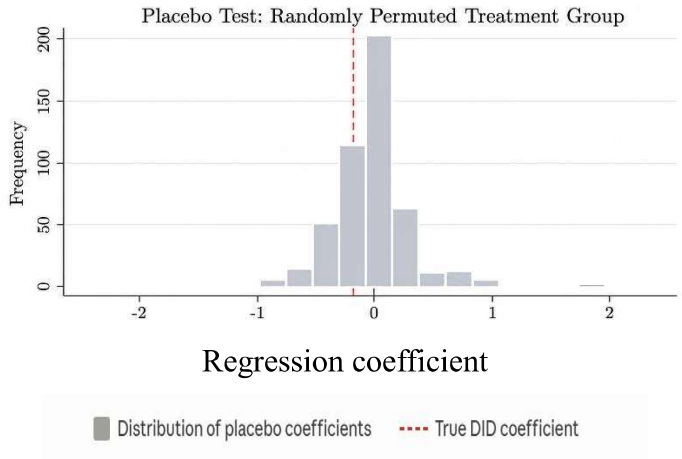

Figure 2. Placebo Test: Randomized Permutation Treatment Group

The estimates of the coefficients in 500 random regressions tend to be close to zero and normally distributed. In contrast, our observed regression coefficient (−0.1746) is situated in the left tail of the distribution and is significantly different than the random coefficients. It implies that the baseline results do not depend on the randomness or missed variables, and also indicates that the negative effect of green finance measures on the market capital of the most polluting companies is strong.

3.8.3 PSM-DID

The study performs a quality check on the matching process to guarantee the validity of the results of the PSM matching. Propensity score matching assumes that the post-matched treatment group and post-matched control group should not have any systematic differences in observable characteristics, which means that the covariate balance condition should be met. Standardized deviation test and t-test are used in this study to compare the mean differences of the control variable before and after matching and report in detail the measures of matching quality such as pseudo-R2, LR chi-square test and B-R scores. Tables 8 and 9 present the findings.

Table 6. Matching Quality Inspection Results

Variable	Unmatched Matched	Mean		%reduct		t-test		V(T)/ V
		Treated	Control	%bias	|bias|	t	p>|t|	(C)
Size	U	22.682	22.392	25.7		3.41	0.001	0.60*
	M	22.682	22.827	-12.8	50.1	-1.30	0.194	0.54*
Lev	U	.41269	.41414	-0.8		-0.11	0.913	0.71*
	M	.41269	.40816	2.5	-211.2	0.26	0.793	0.74*
ListAge	U	2.6514	2.3631	52.2		6.57	0.000	0.45*
	M	2.6514	2.6629	-2.1	96.0	-0.25	0.803	0.69*
Growth	U	.02202	.02884	-6.6		-0.90	0.369	0.70*
	M	.02202	.03841	-15.9	-140.3	-1.43	0.154	0.43*
IR	U	.05842	.05682	2.5		0.42	0.674	1.56*
	M	.05842	.05573	4.2	-67.2	0.44	0.660	1.52*
PE	U	37.792	87.612	-44.9		-4.93	0.000	0.10*
	M	37.792	36.329	1.3	97.1	0.37	0.710	1.71*
PB	U	2.0438	3.1804	-55.0		-6.34	0.000	0.21*
	M	2.0438	2.0018	2.0	96.3	0.37	0.708	1.18

* if variance ratio outside [0.77； 1.30] for U and [0.77； 1.30] for M

Sample	Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%Var
Unmatched	0.064	154.27	0.000	26.8	25.7	77.7*	0.23*	100
Matched	0.008	4.95	0.666	5.8	2.5	21.1	0.56	86

* if B>25%， R outside [0.5； 2]

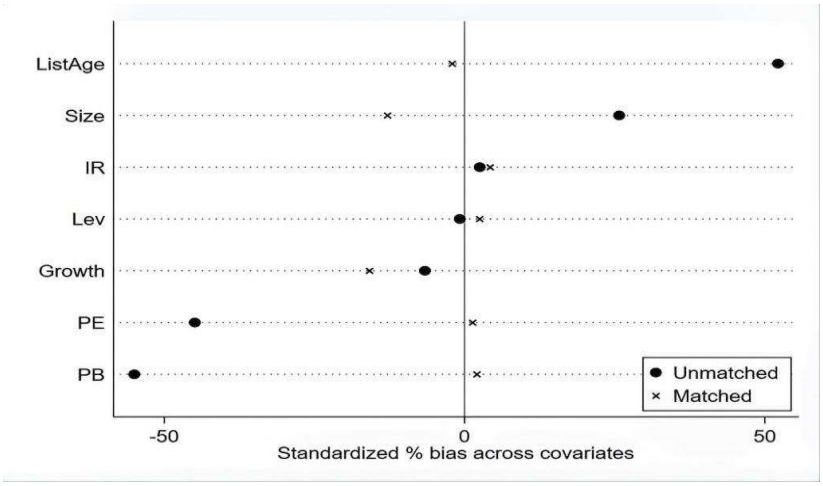

Figure 3. Matching Quality Inspection Chart

By analyzing the standardized bias (%bias), it can be reported that a number of control variables had significant imbalances prior to the matching process. The deviation of PE was found to be 44.9, PB 55.0, ListAge 52.2 and Size 25.7 - which are all above the acceptable level of 10. Following the implementation of 1:2 nearest neighbor matching, the standardized biases of all variables reduced significantly and were under 15 percent. In particular, the biases after matching were 12.8% by Size, 2.5% by Lev, 2.1% by ListAge, 4.2% by IR, 1.3% by PE, and 2.0% by PB. The rate of reduction (%reduct) was over 50 percent in each instance with the highest reduction rate being 97.1 percent, which means that the matching has been effective.

We considered the outcomes of the t-test. Prior to matching, some of the variables in which the treatment and control groups differed greatly were found to be Size (t=3.41, p=0.001), ListAge (t=6.57, p=0.000), PE (t=-4.93, p=0.000) and PB (t=-6.34, p=0.000). After matching, the p values of all the variables were greater than 0.1, implying that the mean differences between the two groups were not statistically significant. This meets the balance requirement of matching.

The post-match pseudo-R-square (Ps R 2) reduced significantly in terms of global matching quality by 0.064 to 0.008, the LR chi 2 value decreased by 154.27 to 4.95 and the associated p-value rose by 0.000 to 0.666, which means that there were no systematic differences between the matched treatment group and control group with respect to observable characteristics. MeanBias has decreased to 5.8% compared to 26.8, MedBias to 2.5% compared to 25.7, B-value decreased to 21.1% (lower than 25%) and the R-value is 0.56 (which is within the [0.5,2]) and %Var decreased to 86%. All these indicators indicate that the covariate distribution in the post-PSM matched samples have reached the optimal balance, which is the necessary quality of the propensity score matching to guarantee that the results of the subsequent DID estimation are reliable.

4. CONCLUSION AND POLICY RECOMMENDATIONS

4.1 Research Findings

The paper employs as an experimental design the 2017 policies of the Green Finance Reform and Innovation Pilot Zones, with the research sample being A-share listed high-pollution companies. It examines in a structured manner the influence of green finance policies on the market capitalization of high-pollution enterprises with the help of a two-way fixed-effects difference-in-differences model, and comes up with the following main findings.

To begin with, green finance policies decreased the market valuation of highly polluting companies in the pilot areas by a great margin. Controlling other variables, the benchmark regression coefficients indicate that the policy interaction term did has a coefficient of -0.1746 and this is statistically significant at 1%. It implies that the green finance policies had a strong negative influence on the market value of high-polluting companies because they tightened financing conditions and increased compliance pressures, so confirming Hypothesis H1.

The negative impact of green finance policies on the high market value of highly polluting companies is also very sensitive to the time. As shown by the parallel trend tests and their dynamic effects analysis, the market value trends of the treatment

group and the control group were the same prior to the policy, which meets the parallel trend assumption. Following the implementation of the policy, the negative effect initially increased and then decreased. It reached its peak in the second quarter and slowly declined since then. This phenomenon indicates a dynamic behavior in which the market will initially respond to the policy shock excessively and subsequently adjust its expectations, thus corroborating Hypothesis H2.

Finally, the robustness tests are supportive of the conclusions provided above. The false policy time test and the random treatment substitution test also indicate that the baseline results are unaffected by time trends and random factors, meaning that the results are very credible.

4.2 Policy Recommendations

Another suggestion is to improve the transmission process of green finance policies. The regulators may enhance the clarity of policy information and offer more straightforward forward-looking advice. It will also enable decreasing overreactions in the market due to the information asymmetries at the initial stage of implementation, constraining unreasonable fluctuations in evaluation of highly polluting companies, and enhancing the effectiveness of policy transmission.

One of the measures towards this goal is establishing a differentiated support system within green transformation. Policymakers ought to provide transitional financing aid as well as tax relief in addition to green finance constraints to all the high-polluting companies that are making efforts to become greener in their operations. It would keep the companies from experiencing significant financial challenges because of the strict regulations, and it would also be able to balance the environmental objectives with the sustainability of corporations.

Another suggestion would be to promote the green investment attitude among the capital market through a long term view. The regulators might enhance the green investment education among institutional investors, encourage ESG reporting, direct the market to evaluate the green transformation potential of highly polluting companies more reasonably. By doing that, they are able to reduce the excessive influence of short-term risk-averse capital flows on corporate market valuations.

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