Shifting Costs, Shifting Strategies: How China's Environmental Fee-to-Tax Reform Drives Financialization in Listed Companies

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Abstract. This study investigates the impact of China's 2018 environmental fee-to-tax reform on corporate financialization among A-share listed firms. By using a Difference-in-Differences (DID) model, we find that the reform significantly reduces financialization, especially for non-state-owned enterprises (non-SOE), firms without financially experienced managers, and those located in eastern regions (developed areas). Our findings suggest that higher regulatory costs and stricter environmental requirements shift firms' financial resources from financial investments to production and operating activities. This research contributes to illustrate how environmental policies can influence financial strategies in different corporation, providing insights for policymakers to balance environmental governance with economic development in the future.

Keywords: Environmental protection law, Corporate financialization, Fee to tax reform, Difference-in-difference, Policy impact analysis.

1 Introduction

1.1 Global Environmental Policies and Corporate Behavior

Global environmental policies have significantly influenced corporate behavior and driven corporate investments in pollution control and sustainable practices while potentially affecting corporate financial strategies (Porter & van der Linde, 1995)[1]. Stricter regulations and policies often foster innovation and competitiveness but can also encourage firms to reallocate resources as a response to regulatory costs (Davis, 2016) [2].

1.2 China's Fee-to-Tax Reform

China introduced the "Pollution Levy System" in 1979 to charge firms for pollutant emissions. However, low fee rates, weak enforcement, and insufficient transparency weakened its effectiveness. To address these issues, the Environmental Protection Law was introduced in 2015, setting a stricter standard for pollutant emissions. In 2018,

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Environmental Protection Tax Law was implemented, replacing the traditional pollutant fee system with a tax to strengthen environmental governance.

1.3 Research Objectives and Contributions

This study employs a DID approach to analyze how the fee-to-tax reform affects the allocation of corporate financial resources between daily production and investments in financial assets. The research contributes to the understanding of how environmental regulations impact corporate financialization, while also offering policy insights to check whether environmental governance fosters excessive financialization, which may hinder long-term economic growth. This paper's findings go beyond existing research and show that companies' responses differ depending on ownership structures, managers' backgrounds, and regional differences. For example, the more pronounced reduction in financialization observed in eastern firms, driven by higher environmental taxes and stricter standards, illuminates a previously underexplored dimension of regional heterogeneity. Such regional specificity not only refines theoretical models of corporate decision-making under environmental constraints but also provides clearer guidance for policymakers. For instance, efforts could focus on stimulating environmentally responsible investment through structured incentives for green technology adoption, enhancing firm-level environmental disclosure requirements to guide more informed shareholder and investor evaluations. Integrating these dimensions—ownership structure, managerial expertise, and regional differences—into a coherent analytical and policy framework not only refines theoretical conceptions of how firms balance regulatory pressures against financialization strategies but also offers a practical foundation for future environmental policies that can simultaneously support economic efficiency, environmental sustainability, and long-term corporate resilience.

2 Literature Review

2.1 Societal Impact of the Fee-to-Tax Reform

The reform aimed to enhance environmental governance by imposing stricter penalties for pollution through taxation. It encouraged firms to reduce emissions and invest in cleaner technologies (Zhang et al., 2019) [3]. Studies report measurable reductions in pollutant emissions and improved air and water quality, with corresponding health benefits such as reduced respiratory illnesses (Chen, Song, & Xue, 2019) [4]. However, increased regulatory costs may also encourage financialization as firms seek to hedge risks, sustain profitability and speculate for profit (Xie et al., 2022) [10].

2.2 Corporate Financialization

Corporate financialization refers to the shift of non-financial firms toward financial activities, including deriving profits from asset trading and financial operations (Krippner, 2005; Epstein, 2005) [5] [6]. Indicators like the ratio of financial assets to total

assets and the share of financial income to total income capture the degree of financialization (Orhangazi, 2008) [7]. These investments can provide liquidity and hedge against uncertainties but may divert resources from productive investments.

2.3 The Impact of Environmental Fee-to-Tax Reform on Financialization

Environmental regulations internalize pollution costs, encouraging firms to adopt cleaner technologies but imposing financial burdens that influence investment decisions (Porter & van der Linde, 1995; Gray & Shadbegian, 1998) [1] [8]. Research indicates that firms facing regulatory costs may increase financialization to hedge risks or maintain liquidity (Campbell, Sefcik, & Soderstrom, 1998) [9]. Xie et al. (2022) [10] found that the fee-to-tax reform heightened financialization, especially in non-state-owned enterprises and highly polluting industries. Firms in competitive markets or with high fixed assets were more likely to increase financial asset investments as a risk-hedging strategy.

3 Research Hypotheses and Data Description

3.1 Research Hypotheses

The 2018 environmental fee-to-tax reform in China presents a critical turning point in environmental policy enforcement. While certain studies argue that increased compliance costs drive firms toward greater financialization, such effects are not necessarily uniform and require further analysis. In recent years, the Chinese government has emphasized the importance of preventing a shift "from the real economy to the virtual economy," underscoring the need to control excessive reliance on financial markets at the expense of productive activities.

The policy aims not only to enforce stricter environmental governance but also to motivate firms to redirect resources toward environmental improvements instead of speculative financial investments. Thus, the following research hypotheses are proposed:

Hypothesis 1 (Ha): The environmental fee-to-tax reform reduces excessive corporate financialization among Chinese firms.

Hypothesis 2 (Hb): The environmental fee-to-tax reform stimulates corporate financialization due to rising compliance costs.

Rationale: The reform increases the financial burden of pollution control while promoting stricter regulatory compliance. On one hand, firms may be incentivized to allocate more resources toward sustainable operations and environmental governance, reducing excessive financialization. On the other hand, the short-term pressures of higher compliance costs may drive firms to increase financial investments as a hedge against risks. Firms that successfully balance environmental performance and operational efficiency, however, are better positioned for long-term sustainability and profitability.

3.2 Model Specification

To investigate the impact of China's 2018 environmental fee-to-tax reform on corporate financialization, we utilize a Difference-in-Differences (DID) model. This model allows for the comparison between firms affected by the reform (treatment group) and those that were not directly impacted (control group), before and after the reform's implementation. The DID model is ideal for identifying causal effects in policy analysis by controlling for unobserved factors that might affect both groups similarly over time. The model is specified as follows:

$$Financialization_{it} = \alpha + \beta_1 Post_t + \beta_2 Treat_i + \beta_3 (Post_t \times Treat_i) + \gamma X_{it} + \epsilon_{it} \quad (1)$$

$Financialization_{it}$: The degree of financialization for firm i in year t, measured as the ratio of financial assets to total assets.

$Post_t$: a binary variable that takes the value 1 for the years after the reform (i.e., 2018 and later), and 0 for the years before the reform.

$Treat_i$: a dummy variable equal to 1 for firms in industries heavily affected by the environmental fee-to-tax reform (e.g., highly polluting industries), and 0 for firms in other industries.

$Post_t \times Treat_i$: The interaction term, which identifies the causal effect of the environmental fee-to-tax reform on treated firms.

X_{it}: A vector of time-varying control variables, including firm size (log of total assets), return on assets (ROA), leverage (asset-to-liability ratio), ownership concentration, firm age, etc.

ϵ_{it}: The error term.

The coefficient β_3 represents the effect of the environmental fee-to-tax reform on financialization after controlling for firm-level and year-specific unobserved factors. A significant negative β_3 indicates that the reform reduces financialization, whereas a positive coefficient suggests increased financialization.

3.3 Data Description

The dataset comprises firm-level panel data for Chinese A-share listed non-financial companies over the period 2013–2023. Data were sourced from the China Stock Market & Accounting Research Database (CSMAR), providing comprehensive firm-level information on financial metrics, firm characteristics, and operational details. The sample includes non-financial firms across various industries, excluding firms from the financial sector (Banking, insurance and real estate) due to their inherently high levels of financialization. Additionally, firms listed after 2018 are excluded because we want to compare the behavior of company before and after the fee-to-tax reform. The dataset includes firms from all major regions in China, ensuring geographic representation.

To classify polluting firms, we referred to the Notice on the Classification Management Catalog for Environmental Verification of Listed Companies (Ministry of Ecology and Environment, 2009) [11] and the 2012 Guidelines for Industry Classification of Listed Companies (China Securities Regulatory Commission, 2012) [12]. Based on these

guidelines, we identified polluting firms as those operating in industries with the following codes: "B06" "B07" "B08" "B09" "B10" "C15" "C17" "C18" "C19" "C22" "C25" "C26" "C27" "C28" "C29" "C30" "C31" "C32" "D44" "D45".

Following prior studies (Du et al., 2017; Jiao, 2024; Xie, G et al., 2022) [13] [14] [15], we redefine financial assets by excluding monetary funds. Monetary funds are highly liquid and primarily retained to support firms' daily operational needs rather than long-term investments. As our focus is on financial assets acquired for speculative or return-seeking purposes, we define financial assets as the sum of trading assets, derivative assets, net loans, available-for-sale assets, held-to-maturity assets, long-term investments, and investment real estate. The degree of financialization is measured as the ratio of financial assets to total assets.

The selection of control variables follows established literature (Xu & Xuan, 2021; Bai et al., 2023; Wang et al., 2023) [16] [17] [18] and considers factors that could influence corporate financialization. As shown in Table 1, these include firm size (Measured as the natural logarithm of total assets), profitability (ROA), leverage (asset-to-liability ratio), ownership concentration, capital expenditures, Tobin's Q, total assets turnover, firm age and concurrent position (whether the Chairman and the CEO are held by the same individual). These variables collectively account for firm-specific characteristics, operational performance, and financial structure, ensuring a robust estimation of the reform's effect on financialization.

Table 1. Variables Explanation

Variables	Name	Explanation
Dependent variable	FinR	Financialization = (trading assets + derivative assets + net loans +available for sale assets + held to maturity assets + long-term investments +investment real estate) / total assets
Key variables	Post	Time effect: post = 1 for years after the policy Post = 0 for years before the policy
	Treat	Firm effect: treat = 1 for firms impacted by the policy Treat = 0 for firms not impacted by the policy
	posttreat	Post* treat: it equals 1 for firms in the treatment group during the post-policy period. It equals 0 otherwise.
Control variables	ATL	Asset-to-Liability Ratio = total liabilities / total assets
	AssetT	Total assets turnover
	Roa	Return on assets = net income / average total assets
	Tobinq	Tobin's Q = (market value) / (total assets – net intangible assets – net goodwill)
	Capex	Capital expenditure: Cash Paid for the Acquisition of Fixed Assets, Intangible Assets, and Other Long-term Assets
	Size	Firm Size: Measured as the natural logarithm of total assets

OwnCon	Ownership Concentration: the shareholding percentage of the largest shareholder
Age	Firm Age = reporting year – founded year + 1
Dual	Concurrent Position: whether the Chairman and the CEO are held by the same individual

The formula and explanation are directly extracted from CSMAR database.

Descriptive Statistics:

The descriptive statistics highlight key variables relevant to the analysis. As shown in Table 2, after removing missing and abnormal samples, we obtained a total of 30,871 valid observations. To avoid the influence of extreme value, we winsorized all continuous variables at the 2nd and 98th percentiles. Approximately 37.1% of firms are state-owned enterprises (SOEs), providing a balanced representation for comparative analysis. The financialization measure has a mean of 0.071, with financial assets accounting for up to 41.8% of total assets in some firms, indicating significant variation. Firm age averages 21 years, ranging from 4 to 68, reflecting a mix of new and established firms. The policy-related variables show that 60.8% of observations are from the post-policy period, 25.9% of firms belong to the treatment group, and 15.4% are in the treatment group during the post-policy period. These statistics provide a robust foundation for analyzing the reform's impact on financialization and exploring heterogeneity across firm characteristics.

Table 2. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
OwnCon w	30871	32.966	14.381	9.556	67.483
ATL w	30871	.426	.2	.079	.875
AssetT w	30871	.633	.388	.106	1.979
roa w	30871	.036	.065	-.184	.184
tobinq w	30871	2.315	1.471	.926	8.258
ln Revenue	30871	21.592	1.448	18.859	25.248
ln capex w	30871	18.682	1.775	14.27	22.615
soe	30871	.371	.483	0	1
ln TA w	30871	22.274	1.266	20.093	25.655
FinR w	30871	.071	.094	0	.418
OwnCon w	30871	32.966	14.381	9.556	67.483
age	30871	20.997	6.046	4	68
Dual	30871	.285	.452	0	1
FinBack	30871	.643	.479	0	1
post	30871	.608	.488	0	1
treat	30871	.259	.438	0	1
posttreat	30871	.154	.361	0	1

*w represents winsorized data (at the 2% and 98% levels)

ln represents variables that are log-transformed for scale adjustment

4 Results and Discussion

4.1 Baseline Regressions

The baseline regression results utilize both Ordinary Least Squares (OLS) and Fixed Effects (FE) models to estimate the impact of China's environmental fee-to-tax reform on corporate financialization. Across all models, the interaction term posttreat is negative and statistically significant at the 1% level, highlighting the causal effect of the policy on reducing financialization.

In the OLS models (columns 1 and 2 in Table 3), the coefficient for posttreat is -0.0086 and -0.0096, respectively. These results indicate that, on average, firms in the treatment group experienced an 0.86 to 0.96 percentage reduction in financialization relative to the control group after the reform. The inclusion of control variables in column 2 enhances the model's explanatory power, confirming that the reform has a negative impact on corporate financialization.

In the FE models (columns 3 and 4 in Table 3), the coefficient for posttreat is further strengthened, with values of -0.0112 and -0.0101, respectively. These results suggest a larger policy effect when accounting for unobserved firm-specific and year-specific factors, which are controlled in the FE framework. The negative coefficient implies that firms in highly regulated industries (treatment group) shifted resources away from financial assets investments, likely to comply with stricter environmental standards or manage increased regulatory costs. The stability of the posttreat coefficient across different specifications confirms the robustness of the policy's impact.

Table 3. Baseline Regression Results

	OLS	OLS	FE	FE
	Financialization	Financialization	Financialization	Financialization
posttreat	-0.0086***	-0.0096***	-0.0112***	-0.0101***
	(0.0031)	(0.0030)	(0.0029)	(0.0029)
post	0.0216***	0.0108***		
	(0.0017)	(0.0022)		
treat	-0.0074**	-0.0038		
	(0.0035)	(0.0034)		
ATL_w		-0.0950***		-0.0415***
		(0.0072)		(0.0074)
AssetT_w		-0.0301***		-0.0241***
		(0.0032)		(0.0037)
roa_w		0.0022		-0.0320***
		(0.0160)		(0.0114)
tobinq_w		0.0010		0.0021***
		(0.0008)		(0.0007)
ln_capex_w		-0.0145***		-0.0057***
		(0.0011)		(0.0007)
ln_TA_w		0.0240***		0.0010
		(0.0017)		(0.0022)

OwnCon_w		-0.0000		-0.0003**
		(0.0001)		(0.0001)
age		0.0019***		0.0032***
		(0.0002)		(0.0003)
Dual		-0.0015		-0.0025
		(0.0022)		(0.0019)
_cons	0.0612***	-0.1805***	0.0487***	0.1240***
	(0.0019)	(0.0248)	(0.0015)	(0.0430)
Firm FE	NO	NO	YES	YES
Year FE	NO	NO	YES	YES
r2_a	0.0140	0.1111	0.0498	0.0718
F	66.0443	54.3125	31.4269	27.9200
N	30871	30871	30871	30871

Standard errors in parentheses

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

4.2 Parallel Trend Test

The parallel trend test is a critical assumption for the validity of the Difference-in-Differences (DID) methodology. It ensures that prior to the policy intervention, the treatment and control groups exhibit similar trends in the dependent variable, enabling the observed post-policy differences to be attributed to the policy rather than pre-existing differences. To formally assess the parallel trend assumption, the following regression model is estimated:

$$Fin_{it} = \alpha + \sum_{k=-5}^{-2} \beta_k (Pre_k \times Treat_i) + \beta_0 (Current \times Treat_i) + \sum_{j=1}^{5} \gamma_j \big(Post_j \times Treat_i\big) + \delta X_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (2)$$

Where Pre_k is a dummy variable for k years before the policy implementation. $Post_j$ is a dummy variable for j years after the policy implementation. $Current$ is a dummy variable for the year of policy implementation. μ_i and λ_t represent firm effects and year effects.

The regression results are visualized in the Figure 1, which plots the coefficients for the interaction terms. We use the year immediately before policy implementation as the baseline. Under 99% confidence level, in the pre-policy period, the coefficients Pre_5 Pre_4 Pre_3 Pre_2 are close to zero and statistically insignificant, confirming that the treatment and control groups followed parallel trends before the policy was implemented. This supports the validity of the parallel trend assumption. In the year of policy implementation, the coefficient for Current is slightly negative but insignificant, suggesting that the immediate impact of the reform was not drastic. In the post-policy period, the coefficient $Post_2$ are negative and statistically significant, indicating that the policy led to a reduction in financialization in the treatment group relative to the control group. This is consistent with the main DID results, which demonstrate a significant decrease in financialization following the reform.

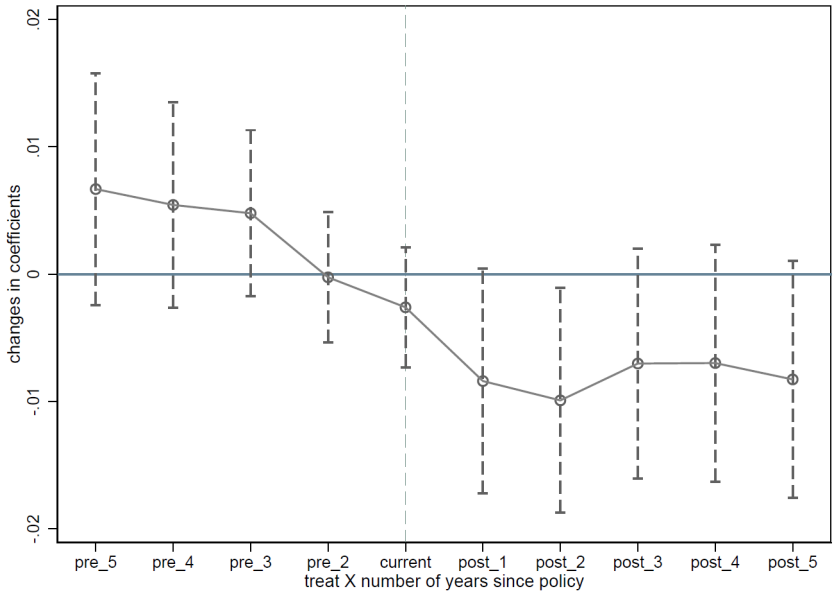

Fig. 1. Parallel Trend Test

4.3 Heterogeneity Analysis

To better understand how the environmental fee-to-tax reform impacts corporate financialization, a heterogeneity analysis was conducted along three dimensions: ownership structure, management's financial background, and regional location (shown in Table 4). The results reveal significant differences in the policy's effects across these groups, highlighting the varying ability of firms to respond to increased regulatory costs.

Table 4. Heterogeneity Analysis Results

	Ownership Type		Management Background		Enterprise Region			
	SOE	NonSOE	Financial	Non Financial	East	Northeast	Mid	West
	Fin	Fin	Fin	Fin	Fin	Fin	Fin	Fin
posttreat	-0.0047	-0.0105***	-0.0052	-0.0195***	-0.0096***	-0.0065	-0.0103*	-0.0091
	(0.0042)	(0.0039)	(0.0035)	(0.0045)	(0.0037)	(0.0096)	(0.0062)	(0.0074)
ATL_w	-0.0399***	-0.0496***	-0.0438***	-0.0363***	-0.0487***	-0.0135	-0.0283	-0.0368**
	(0.0120)	(0.0094)	(0.0089)	(0.0125)	(0.0092)	(0.0308)	(0.0187)	(0.0179)
AssetT_w	-0.0190***	-0.0276***	-0.0202***	-0.0261***	-0.0212***	-0.0446***	-0.0242***	-0.0254**
	(0.0054)	(0.0051)	(0.0045)	(0.0061)	(0.0047)	(0.0134)	(0.0083)	(0.0102)
roa_w	-0.0521***	-0.0116	-0.0351**	-0.0095	-0.0533***	0.0785**	0.0308	-0.0329
	(0.0199)	(0.0142)	(0.0144)	(0.0180)	(0.0141)	(0.0350)	(0.0262)	(0.0330)
tobinq_w	0.0010	0.0020**	0.0010	0.0035***	0.0030***	-0.0027	0.0025	-0.0004

	(0.0011)	(0.0009)	(0.0009)	(0.0012)	(0.0009)	(0.0033)	(0.0021)	(0.0015)
ln_capex_w	-0.0052***	-0.0056***	-0.0061***	-0.0049***	-0.0068***	-0.0043*	-0.0028*	-0.0046***
	(0.0011)	(0.0010)	(0.0009)	(0.0012)	(0.0010)	(0.0024)	(0.0016)	(0.0015)
ln_TA_w	-0.0055	0.0011	0.0000	0.0008	0.0009	-0.0124*	0.0017	0.0023
	(0.0036)	(0.0029)	(0.0028)	(0.0033)	(0.0028)	(0.0074)	(0.0049)	(0.0058)
OwnCon_w	0.0001	-0.0003	-0.0003**	-0.0002	-0.0002	-0.0009*	-0.0001	-0.0006**
	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0005)	(0.0004)	(0.0003)
age	0.0021***	0.0047***	0.0035***	0.0038***	0.0037***	0.0011	0.0036***	0.0023***
	(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0012)	(0.0007)	(0.0008)
Dual	-0.0001	-0.0040*	-0.0019	-0.0033	-0.0010	-0.0141*	-0.0076*	-0.0030
	(0.0032)	(0.0024)	(0.0024)	(0.0029)	(0.0024)	(0.0076)	(0.0045)	(0.0042)
_cons	0.2770***	0.0915	0.1555***	0.0906	0.1379**	0.4776***	0.0214	0.1026
	(0.0695)	(0.0562)	(0.0550)	(0.0633)	(0.0550)	(0.1637)	(0.1011)	(0.1087)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
r2_a	0.0417	0.1001	0.0632	0.0801	0.0796	0.0735	0.0785	0.0505
F	6.3881	25.5143	17.2930	10.6389	22.5007	1.9145	5.6882	2.8378
N	11438	19433	19838	11033	20890	1302	4459	4220

Standard errors in parentheses

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

Ownership Structure: State-Owned Enterprises (SOEs) vs. Non-SOEs: The heterogeneity analysis based on ownership nature shows a significant difference in policy impact between SOEs and non-SOEs. For non-SOEs, the posttreat coefficient is -0.0105 ($p < 0.01$), indicating a significant reduction in financialization following the policy reform. This suggests that the reform directly increased the operational costs of non-SOEs, such as pollution fees and environmental governance expenditures, compelling them to reallocate resources from financial investments to core business activities. Additionally, non-SOEs generally face higher financing costs, which likely exacerbated the need to prioritize productive investments over financialization.

In contrast, for SOEs, the posttreat coefficient is -0.0047 and statistically insignificant. This may be attributed to the advantages enjoyed by SOEs, such as lower financing costs, access to government subsidies, and preferential policy support. These advantages likely mitigated the financial pressure from the reform, allowing SOEs to maintain their existing financial strategies without significant adjustments.

Management's Financial Background: The second dimension of heterogeneity considers whether a firm's management team has a financial background. For firms with non-financial-background management, the posttreat coefficient is -0.0195 ($p < 0.01$), indicating a strong and significant reduction in financialization after the reform. Managers without a financial background may be less inclined to invest in financial assets and more focused on core business operations. When faced with increased regulatory costs, these firms appear to reallocate financial resources toward environmental compliance and productive investments, thereby reducing financialization.

Conversely, for firms with financial-background management, the posttreat coefficient is smaller (-0.0052) and statistically insignificant. This suggests that managers with financial expertise may view financial investments as an integral part of the firm's strategic planning and remain committed to financialization despite the added costs from the reform. Their familiarity with financial markets may also enable them to mitigate the financial pressures of the reform through more sophisticated financial strategies.

Regional Differences: East, Northeast, Mid, and West: The region allocation is derived from How are economic zones divided from The National Bureau of Statistics of China (2021) [19]. The heterogeneity analysis across regions reveals that the impact of the reform is most pronounced in eastern China, where the posttreat coefficient is -0.0096 ($p < 0.01$). This reflects the higher environmental standards and stricter enforcement of the environmental fee-to-tax reform in this economically developed region. Firms in the east, especially those in high-pollution industries, likely faced substantial regulatory costs, prompting them to reduce financialization and reallocate resources toward environmental compliance and technology upgrades.

Notably, provincial-level data on environmental tax standards further supports these findings: in Beijing, upper-limit tax rates (e.g., 12 yuan per pollution equivalent for air pollutants, 14 yuan for water pollutants, which is 10 times of the lowest standards) are enforced, while Tianjin, only slightly lower, adopts 10 yuan and 12 yuan respectively, and certain counties in Hebei—particularly those adjacent to Beijing— also impose a higher-than-average rates (data sourced from E20 Environment Platform) [20]. These significantly elevated tax rates align closely with our empirical evidence, wherein the eastern region shows the strongest statistical significance ($p<0.01$), demonstrating that firms under stricter environmental financial burdens more readily adjust their investment portfolios away from financialization.

Conversely, the analysis indicates that the reform's impact is far less pronounced in the mid ($p<0.1$), west, and northeast regions (both insignificant). Such variations mirror the underlying economic realities: mid-level provinces, though not as affluent as the east, enforce moderately higher tax rates than the national minimum, leading to some observable but weaker pressures on corporate financialization. In contrast, western and northeast regions largely apply the lowest permissible tax rates (e.g., in Xinjiang, Qinghai, Gansu, Heilongjiang, Jilin), reflecting more constrained economic conditions and limited enforcement capacities. Firms operating in these less developed regions may find it challenging to shoulder substantial environmental tax burdens and thus local authorities often opt for minimal tax regimes, resulting in negligible effects on firms' strategic reallocation of resources.

These regional differences underscore the importance of recognizing that the reform's efficiency depends heavily on local economic environments, enforcement rigor, and the capacity of firms to absorb compliance costs. Future research might expand this analysis by considering additional factors such as inter-provincial competition, sector-specific pollution intensity, or local government fiscal dependency on polluting industries.

5 Robustness Tests

Robustness tests were conducted to ensure the reliability of the results and to validate that the observed impact of the environmental fee-to-tax reform on corporate financialization is not dependent on specific model assumptions or variable definitions. As shown in Table 5, these checks included redefining the financialization measure, excluding specific industries, and adjusting the time period of observations to exclude the impact of special event (e.g., COVID-19, 2015 stock crash and the anticipation effect of environmental law in 2015).

Table 5. Robustness Tests

	Redefine Dependent Variable	Refine Treatment Group	Exclude COVID-19 Impact	Exclude 2015 Stock Crash Impact	Exclude Environmental Law Anticipation Effect
	Fin	Fin	Fin	Fin	Fin
posttreat	-0.0059**	-0.0101***	-0.0083***	-0.0097***	-0.0092***
	(0.0026)	(0.0029)	(0.0025)	(0.0029)	(0.0028)
ATL_w	-0.0416***	-0.0415***	-0.0070	-0.0447***	-0.0497***
	(0.0063)	(0.0074)	(0.0085)	(0.0074)	(0.0076)
AssetT_w	-0.0174***	-0.0241***	-0.0195***	-0.0244***	-0.0266***
	(0.0033)	(0.0037)	(0.0046)	(0.0038)	(0.0039)
roa_w	-0.0286***	-0.0320***	-0.0351***	-0.0336***	-0.0198*
	(0.0101)	(0.0114)	(0.0135)	(0.0113)	(0.0117)
tobinq_w	0.0020***	0.0021***	0.0020**	0.0026***	0.0018**
	(0.0006)	(0.0007)	(0.0008)	(0.0008)	(0.0008)
ln_capex_w	-0.0040***	-0.0057***	-0.0032***	-0.0058***	-0.0053***
	(0.0006)	(0.0007)	(0.0008)	(0.0008)	(0.0008)
ln_TA_w	0.0057***	0.0010	-0.0055**	0.0018	0.0004
	(0.0018)	(0.0022)	(0.0024)	(0.0022)	(0.0025)
OwnCon_w	-0.0002**	-0.0003**	-0.0002	-0.0003**	-0.0002
	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
age	0.0020***	0.0032***	0.0071***	0.0031***	0.0039***
	(0.0003)	(0.0003)	(0.0005)	(0.0003)	(0.0004)
Dual	-0.0016	-0.0025	0.0003	-0.0027	-0.0044**
	(0.0017)	(0.0019)	(0.0021)	(0.0019)	(0.0020)
_cons	-0.0067	0.1240***	0.1347***	0.1130***	0.1143**
	(0.0353)	(0.0430)	(0.0505)	(0.0437)	(0.0490)
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
r2_a	0.0530	0.0718	0.0736	0.0707	0.0598
F	23.7639	27.9200	33.3972	28.4293	23.6999
N	30871	30871	18409	28557	26627

Standard errors in parentheses

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

5.1 Redefining the Financialization Measure

To assess whether the results are sensitive to how financialization is measured, we excluded investment in real estate in financial assets, which was an important part of financial assets investments, and the posttreat coefficient remains significant (-0.0059, $p < 0.05$). This indicates that the policy's impact is robust to changes in the financialization definition. This finding indicates that the reform's effect on financialization is not tied to a specific measure but is most pronounced in reducing firms' reliance on speculative and high-risk financial assets.

Real estate investment often differs fundamentally from other financial assets due to its relatively illiquid nature, longer investment horizons, and stronger ties to the real economy. In our sample of 30,871 observations, real estate investment accounts for an average of 17.48% of total financial assets, making it the most significant component. By excluding real estate, we isolate the more liquid and speculative portions of firms' financial portfolios, ensuring that observed effects are not driven by one particular asset category. This enhances the transparency of our approach, as it demonstrates that the core results hold even when we refine the definition of financialization to exclude certain asset classes with potentially distinct risk-return profiles.

5.2 Refining Treatment Group

The robustness of the results was further tested by excluding the pharmaceutical manufacturing industry (C27) because this sector contains a significant proportion of sales and service-oriented companies, such as pharmaceutical distribution, logistics, and research-focused firms, rather than production-heavy enterprises. Even after excluding this industry, the posttreat coefficient remains significant (-0.0101, $p < 0.01$). This demonstrates that the policy's impact is not driven by industry composition or the inclusion of firms with minimal environmental regulatory exposure.

In addition, the classification of polluting industries by the Ministry of Ecology and Environment (2009) includes various pharmaceutical manufacturing activities (chemical drug production, chemical drug preparation, biochemicals, and traditional Chinese medicine manufacturing). However, the China Securities Regulatory Commission's (2012) industry classification does not differentiate these activities with equal precision. Consequently, C27 in the CSRC classification is a broad category that encompasses firms engaged in both manufacturing and substantial sales services. Prior studies illustrate these inconsistencies: for instance, Pan, et al. (2019) [21] exclude C27 from their definition of polluting industries, while Li, et al. (2021) [22] include C27. Given such scholarly debates over whether pharmaceutical manufacturing should be considered a polluting industry, excluding C27 tests the robustness and generalizability of our treatment definition. This approach improves the transparency of our methodology by acknowledging and addressing alternative industry classifications, ultimately enhancing the reliability of our conclusions. By showing that the results persist despite this redefinition of treatment groups, we demonstrate that the observed policy effects are

not artifacts of one particular industry classification scheme but rather reflect a consistent underlying relationship between environmental taxation and firm-level financialization strategies.

5.3 Excluding the Impact of Special Events

To ensure that the observed effects of the environmental fee-to-tax reform are not influenced by specific external events, we conduct robustness tests by systematically removing samples corresponding to these events:

COVID-19 Pandemic: We exclude data after 2020 to eliminate any distortions caused by the economic disruptions during the pandemic.

2015 Stock Market Crash: We remove observations of the year 2015 to mitigate any bias stemming from the stock market crisis in China, which could influence firms' financial behavior.

Anticipation Effect of the 2015 Environmental Protection Law: To account for firms potentially adjusting their behavior in anticipation of stricter environmental regulations, we exclude observations from years prior to 2015.

The results of these tests reveal that the posttreat coefficients remain negative and statistically significant across all three scenarios: excluding COVID-19 impact (-0.0083, p-value<0.01), excluding 2015 stock crash impact (-0.0097, p-value<0.01), and excluding environmental law anticipation effect (-0.0092, p-value<0.01). These findings confirm the robustness of the results, as the policy's impact on reducing corporate financialization persists even after controlling for the potential influence of these major events. By removing these confounding time periods, we ensure that the observed effect is not driven by unrelated economic shocks or anticipatory behaviors but rather reflects the true causal impact of the environmental fee-to-tax reform.

6 Conclusion

Our findings indicate that China's 2018 environmental fee-to-tax reform successfully redirected corporate resources away from speculative financial investments toward productive and environmentally sustainable activities, effectively aligning with the policy's intended objectives. Robustness checks confirm that the results are consistent across alternative definitions of financialization, industry exclusions, and different time period, highlighting the reliability of the conclusions.

The results offer significant insights for policymakers aiming to strike a balance between environmental governance and economic development. First, stricter environmental regulations can serve as effective tools not only to improve environmental performance but also to control excessive financialization, promoting a more sustainable and productive allocation of corporate resources. Second, the findings underscore the importance of targeting policies toward firms with greater exposure to environmental risks, such as highly polluting industries, to maximize regulatory effectiveness. Finally, policymakers should complement environmental regulations with supportive measures,

such as financial incentives for green investments and technological innovation, to further encourage firms to transfer to sustainable growth strategies. However, these strategies must be adapted to the economic geographies of China, where disparities in industrial development, infrastructure, and technological capacity exist between eastern and western regions. For instance, while firms in the east readily leverage fiscal incentives and green subsidies to upgrade their production technologies, firms in the west and northeast may require a different approach. In less developed areas, additional incentives could involve direct financial support for capacity-building initiatives, the provision of low-interest loans or grants to offset initial compliance costs, and closer cooperation with local governments and environmental agencies to streamline technical assistance. These measures would help alleviate the financial pressures of firms in economically constrained regions from embracing cleaner technologies and more sustainable business models. Furthermore, policies that facilitate inter-regional information exchange and knowledge transfer could foster a more uniform advancement in environmental capabilities across diverse corporate landscapes.

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