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Will Green Credit Affect the Cash Flow of Heavily Polluting Enterprises?

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Abstract: As environmental pollution intensifies, China has begun to implement green credit policies to reduce credit allocation to highly polluting enterprises. This research examines the influence of green credit on the cash flow of heavily polluting enterprises, based on the implementation of the "Green Credit Guidelines". The policy creates a quasi-natural experimental setting by giving businesses access to an exogenous occurrence. Consequently, this paper uses data from 494 A-share listed companies in China over a fifteen-year period from 2007 to 2021 and employs a Difference-in-Differences (DID) model to assess the net effect of the policy, positing that green credit scheme will prevent highly polluting businesses from making money. The empirical findings show that the green credit policy significantly reduces the cash flow of businesses that emit a lot of pollutants, especially when it comes to operational cash flow. Heterogeneity analysis reveals that the cash flow of high-emission regions and non-state-owned heavily polluting enterprises is affected even more significantly. Previous research has often overlooked cash flow as a metric; however, cash flow is a critical indicator of an enterprise's operational status. From this angle, this study adds to our knowledge of how green credit schemes affect highly polluting businesses. Additionally, it contributes to the ongoing discussion regarding the relationship between financial constraints and cash flow. China's government ought to keep encouraging the creation of green credit regulations, enhance supervision of state-owned heavily polluting enterprises, and pay attention to low-emission regions by establishing dynamic regulatory indicators to promote ecological civilization construction and the transformation and upgrading of lagging industries.

Keywords: green finance; green credit; cash flow; DID; policy evaluation

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1. Introduction

Environmental issues not only lead to climate change [1,2] and environmental degradation but also impact the economies of nations, including business operations [3–5] and capital structures [6]. These challenges also affect politics and national security, and they even threaten human survival and development [7,8]. Green credit has emerged as an effective tool for addressing these problems by influencing corporate loan conditions and improving both economic and environmental performance [9]. Green credit integrates commercial banks and other financial institutions into a regulatory framework, requiring them to provide preferential interest rates or financial support to enterprises or institutions that promote ecological protection, pollution control, and emission reduction, in accordance with national policies related to the environment and ecology. Conversely, for heavily polluting enterprises that exhibit high levels of emissions and do not meet environmental performance standards, this policy restricts new investments and establishes higher loan interest rates to suppress their financing activities. According to research, green finance regulations in China are particularly effective at enhancing environmental quality [10] and helping highly polluting enterprises make the transition to sustainable practices [9,11]. Moreover, green credit, as a form of green innovation, is essential for achieving sustainable development [12].

The focus of this article is to examine how green credit rules affect the cash flow of businesses that emit a lot of pollutants in China, assessing the dynamic effects of these policies. Existing research suggests that increased financing constraints raise the cost of capital for enterprises, resulting in firms with higher financing constraints exhibiting greater sensitivity to cash flow in terms of cash holdings, investment, and debt financing, which significantly affects the allocation of cash flow [13,14]. First, businesses that pollute a lot will have to pay more for external financing when green credit regulations are implemented. This leads to severe financial limitations and forces these enterprises to enhance their pollution control measures [15]. Second, green credit policies may encourage enterprises to accumulate cash as a buffer against external shocks, thereby reducing risk [16,17]. As a result, enterprises may forgo certain investment opportunities [18]. These factors collectively impact the cash flow of heavily polluting enterprises, leading to a deterioration in their cash flow conditions.

This study primarily examines green credit policies in the context of China. First, the Chinese government places great emphasis on and continuously promotes the development of green credit policies. In 2012, the government implemented the "Green Credit Guidelines" (GCGs), encouraging commercial banks to offer credits to environmentally friendly enterprises through preferential interest rates or financial assistance. Since 2015, as part of the deepening of ecological civilization building and the transformation of the economic structure, China has gradually introduced substantial green credit incentives, such as the "Overall Plan for the Reform of the Ecological Civilization System", the "Guiding Opinions on Constructing a Green Financial System", and the "Overall Plan for the Pilot Zones for Green Finance Reform and Innovation in Five Provinces". These policies include interest rate subsidies, refinancing, rediscounting, guarantees, asset securitization, and a series of green credit incentive measures. Second, green credit's development process is in full swing. China possesses the largest green finance market in the world, providing an ideal environment for studying the economic impact of green credit policies on enterprises' green innovation. China is now the world leader in the green finance sector, with 21 major domestic banks' green credit balances totaling CNY 12.5 trillion as of the end of the first quarter of 2021, according to a study from the China Banking and Insurance Regulatory Commission. According to the research, green finance regulations in China are particularly effective at enhancing environmental quality [10] and helping highly polluting enterprises make the switch to green practices [9,11]. This study focuses on the cash flow of heavily polluting enterprises, as cash flow metrics hold significant value for businesses. Cash flow metrics serve as powerful tools for analysis, forecasting, and valuation applications and are often used as control variables in research [19]. The magnitude of cash flow reflects a firm's ability to allocate and absorb social resources, indicating its payment capacity, cash flow management level, and future value. Therefore, cash flow plays a crucial role in a firm's financial operations and risk management.

GCGs, introduced in China in 2012, serve as an exogenous event for enterprises unaffected by the firms themselves, thus providing a suitable quasi-natural experimental environment [20,21]. Non-heavily polluting enterprises generally exhibit better environmental performance and are, therefore, less affected by the GCGs. However, as the primary target of GCG restrictions, heavily polluting enterprises face reductions in loan availability and increased borrowing costs [18]. This distinction between heavily and non-heavily polluting enterprises creates a "treatment group" and a "control group", respectively, satisfying the pre-assumption of the difference-in-differences (DID) model. In this study, a DID model was established to evaluate the net effect of the GCGs by analyzing the coefficient of the interaction term. The analysis focused on assessing the influence of the GCGs on the cash flow of heavily polluting enterprises. Based on this approach, three research hypotheses are proposed: (1) The GCGs have a suppressive impact on the cash flow of heavily polluting companies; (2) compared to state-owned heavily polluting enterprises, non-state-owned ones experience a greater impact on cash flow from the GCGs; (3) heavily polluting enterprises in high-emission regions are more affected by the GCGs in terms of cash flow compared to those in low-emission regions.

This study aims to offer empirical evidence on the role of green credit in promoting ecological civilization building and supporting the structural transformation of economic development. Due to the punitive effect of the GCGs on the cash flow, these heavily polluting firms face a higher risk of cash shortages or reduced cash flow, often resorting to borrowing to alleviate liquidity constraints [22,23]. However, the GCGs restrict borrowing by heavily polluting enterprises, forcing them to address pollution at its root in order to maintain normal business operations. This ultimately contributes to the promotion of ecological civilization building.

The remaining sections of this work are structured as follows. Section 2 summarizes the available literature on green credit and cash flow. Section 3 provides a theoretical examination of the influence of GCGs on the cash flow of significantly polluting businesses and suggests three assumptions. Section 4 discusses the study design, which includes the sample, data, model, and variables. Section 5 includes the empirical findings and analyses, including dynamic impacts. Section 6 offers the results of the mechanism analysis. Section 7 presents the results of the placebo test, the regression results after including robustness variables, and the results of PSM-DID. Finally, in Section 8, we provide conclusions, discussion, and policy implications.

2. Literature Review

China's most influential green credit policy is the GCGs issued by the China Banking Regulatory Commission in 2012. On the basis of the current regulatory framework, these principles permit banks to participate in environmental monitoring and governance while limiting loans to regulated industries (non-green firms) [24]. They successfully transfer capital from polluting companies to eco-friendly businesses [21], preventing the growth of companies that use significant amounts of energy and produce a lot of pollution. This policy has resulted in a redistribution of financial and energy resources in the context of the microeconomy [25,26]. Enterprises are obliged to pay the opportunity costs of environmental pollution by internalizing the negative externalities of pollution emissions via credit channels. This encourages clean investments and discourages polluting ones. This capital allocation guides industrial transformation toward cleanliness and green development, effectively alleviating issues of environmental information asymmetry [27]. Bank credits are the primary source of financing for enterprises in China because of the country's bank-centered financial structure [28], and the amount of debt financing is significantly larger than that of equity financing [24]. Therefore, Implementing GCGs may greatly improve the green production efficiency of severely polluting companies [29]. According to empirical data, this green credit strategy improves resource allocation structures and increases capital flow efficiency [30].

From the banks' perspective, green credit can reduce the risks they bear and lower the probability of bankruptcy [31–33]. From the enterprises' standpoint, green credit limits their ability to finance loans and raises financing costs for highly polluting businesses [34]. Additionally, green credit reduces the default risk for enterprises [35], promotes green innovation among heavily polluting enterprises [36,37], and enhances enterprises' social responsibility [38]. Lee et al. [39] found that green credit can foster the development of new energy companies through increased R&D expenditure.

From an industrial perspective, green credit policies can drive local industrial upgrades [40,41]. Recently, some scholars have begun to investigate the long-term impacts of green credit policies, revealing that the effect of green credit on green technological innovation is nonlinear [42], with the impact in the later stages of a policy being more pronounced than in the earlier stages.

However, the incentive mechanisms in the Chinese market still face several issues, including insufficient incentives for companies to improve their ESG (environmental, social, and governance) performance [43], as well as the ongoing challenge of inadequate investment for small and medium-sized companies [44]. Because of this, the impact of green financing legislation on green development is still debated and requires further investigation.

This research investigates the influence of green credit policies on the cash flow of significantly polluting firms from the standpoint of the enterprises themselves. Following the GCGs' adoption, highly polluting enterprises experience significant financial outflows as the number of loans accessible to them declines and financing costs rise [45].The growing expenses of pollution control also contribute to financial outflows in an attempt to lower pollution levels and lessen the consequences of the green credit policy. Therefore, the GCGs have a punitive effect on the cash flow of heavily polluting companies.

From the perspective of capital inflows, green credit policies somewhat restrict external financing. Previous research has found that introducing green finance rules affects the financing capability of substantially polluting firms, increases their external financing costs, and significantly decreases the scale of debt financing available to high-pollution enterprises [20,45]. The high cost of debt financing and short repayment terms further exacerbate the challenging environment faced by these firms [46], resulting in severe financing constraints. The existing literature indicates that when enterprises encounter financing constraints, their investments become more sensitive to internal cash flow [13,47–50]. Therefore, it is reasonable to speculate that financing constraints will affect the cash-holding behavior and cash flow of enterprises to some extent. In contrast, the funds provided to heavily polluting enterprises by the government and banks will also decrease, impacting their cash flow. After implementing green credit policies, the Chinese government plans to reduce subsidies to high-pollution enterprises and guide them toward green development through these policies [51]. Meanwhile, banks are likely to reduce credits to heavily polluting companies [20]. These factors will collectively lead to a deterioration in the cash flow of heavily polluting enterprises.

From the perspective of cash outflows, heavily polluting enterprises are compelled to increase their investments in pollution control under the financing constraint pressure brought about by green credit policies, bringing a deterioration in cash flow. However, this situation may also enhance enterprises' innovative capabilities. Porter's hypothesis suggests that effective environmental legislation might encourage technological innovation. Research has also confirmed this, showing that credit-constrained enterprises increase their research and development (R&D) investments, thereby enhancing their R&D intensity and capacity for independent innovation [52–54]. From a long-term perspective, green credit promotes the energy transition of enterprises [15]. Green financing programs may significantly improve the green production efficiency of highly polluting firms, according to studies by Lv et al. [29] and Li et al. [55]. Several studies have also indicated that enterprises pursue green innovation primarily to minimize the negative impact of rising financing costs caused by green credit laws [10,56,57]. These innovations and R&D efforts, aimed at responding to green credit policies, require substantial funding, which further affects the cash flow of heavily polluting enterprises.

The existing literature typically employs the DID model to analyze the influence of the GCGs on enterprises' cash flow while also utilizing placebo tests to assess the robustness of the results [18,58]. This study followed the established methodology in the literature to investigate the operating cash flows of heavily polluting enterprises.

3. Theoretical Analysis and Research Hypotheses

3.1. The Impact of Green Credit Policies on the Cash Flow of Heavily Polluting Enterprises

This study posits that the implementation of the GCGs has primarily led to an increase in financing costs for enterprises by reducing their access to debt financing, ultimately resulting in a deterioration of their cash flow conditions.

First, banks have reduced loans to heavily polluting enterprises, which has increased their financing costs and resulted in significant cash outflows, thereby exacerbating their cash flow situations. Following the implementation of the GCGs, banks aligned their practices with national policy requirements, raising credit standards and making social and environmental performance key criteria for loan approvals [58]. This green credit policy represents a systemic change at the national level in the financing environment for enterprises, making it more difficult for businesses with high pollution levels to obtain bank financing [18]. The existing literature, such as the study by Li et al. [59], demonstrates that the size of debt financing for significantly polluting firms has declined after the GCGs were adopted. Banks not only reduce the number of loans extended to heavily polluting enterprises but also set relatively higher interest rates on these loans. Consequently, heavily polluting enterprises that cannot secure sufficient loans from banks are compelled to seek funding through more costly financing channels. Furthermore, following the introduction of the GCGs, additional financial institutions change their risk evaluations for these highly polluting enterprises, demanding higher risk premiums from them. The implementation of the GCGs has raised these enterprises' external financing costs and diminished their financing capabilities, while the reduction in bank loans and shortening of debt maturities have intensified their severe capital shortages [20,51].

From a long-term perspective, excessively high financing costs and capital shortages exacerbate liquidity risks for enterprises. Capital shortages compel firms to reduce investments, while elevated costs diminish profit margins, ultimately impacting the cash flow conditions of these enterprises. According to financing constraint theory, the implementation of green credit policies imposes higher costs on heavily polluting enterprises when seeking external financing, which may force these firms to reduce investments during periods of capital shortfall, thereby impacting their long-term development. These enterprises may face capital shortages due to heightened refinancing and liquidity risks, leading them to sell critical assets at lower prices [60]. At the same time, funding constraints diminish their capacity to assume risks, forcing them to cut back on investments in projects [61]. These factors can adversely affect the normal operations and profitability of enterprises, ultimately reducing their cash inflows.

Additionally, following the establishment of green credit laws, significantly polluting enterprises require more funding to perform green transformation and improvements [18].

Increased pollution governance and green innovation expenditure also contribute to cash outflow.

In addition to the aforementioned major factors, companies with poor environmental performance also experience a reduction in equity financing, in addition to decreased bank lending. According to modern corporate governance and stakeholder theory, corporations must be accountable not just to shareholders, but also to creditors, workers, suppliers, consumers, governments, communities, and the environment [62]. Investors are paying more attention to the financial and environmental performance of publicly traded enterprises as a result of the increased environmental consciousness in modern society. Green credit regulations have encouraged businesses to make green investments and drawn substantial financial resources to clean sectors [37]. Poor environmental performance can negatively impact a company, weakening its competitiveness and harming shareholder interests [63]. Conversely, increased engagement in corporate social responsibility (CSR) and environmental, social, and governance (ESG) practices can enhance a firm's reputation, leading to more stable evaluation processes and improved goodwill from stakeholders [64–66]. Companies that actively participate in socially responsible investments attract socially responsible investors, thereby reducing their financing difficulties [67].

Furthermore, the operational cash flow of enterprises largely depends on customer behavior. A positive attitude from customers can enhance the predictability of sales [68,69], thereby ensuring future operational income and providing stable cash flow [70]. Consequently, a decline in "customers" in the stock market not only directly results in a decrease in equity financing for enterprises but also increases the volatility of their cash flow. The persistent fluctuations in enterprises' cash flow exacerbate credit risk [71], leading these companies to potentially increase borrowing to alleviate liquidity constraints, further driving up the cost of financing.

Based on the above discussion, this study proposes the first hypothesis:

H1. *The GCGs will suppress the cash flow of heavily polluting enterprises, resulting in a punitive effect.*

3.2. The Heterogeneity of the Impact of Green Credit Policies on the Cash Flow of Heavily Polluting Enterprises

3.2.1. State-Owned and Non-State-Owned Enterprises

In the existing literature, the distortion of credit in China is largely attributed to a preference for lending to state-owned enterprises [72]. Due to the implicit guarantees provided by the government for the debts of state-owned enterprises, these firms often receive more loans from banks [73], while non-state-owned enterprises frequently face credit discrimination. Shailer and Wang [74] found that state-owned enterprises enjoy interest rates that are 12.3% lower than those of non-state-owned enterprises. The International Monetary Fund (IMF) [75] estimated that favorable financing channels and implicit government guarantees enhance the credit ratings of state-owned enterprises by 2 to 3 times, which effectively reduces borrowing costs by 0.5% to 1%. As a result, following the implementation of such policies, commercial banks may prioritize reducing loans to high-risk, non-state-owned enterprises, leading to increased financing costs for these firms. On the contrary, banks may not be able to enforce stringent oversight over local state-owned enterprises [76].

Moreover, the GCGs have certain limitations. They primarily restrict bank loans but do not directly curtail commercial credit for heavily polluting enterprises. These firms can utilize commercial credit to partially substitute for short-term bank loans. State-owned enterprises, with their strong financial foundations and higher commercial credit ratings, are better positioned to obtain funding support at the supply chain level through accounts payable, thereby offsetting the reduction in bank loans. Therefore, the impact of green credit policies on enterprises' cash flow is asymmetric, with non-state-owned, heavily polluting enterprises being more adversely affected than their state-owned counterparts. This research provides the second hypothesis:

H2. *The negative impact of the GCGs on enterprises' cash flow is heterogeneous, with the punitive effect on non-state-owned, heavily polluting enterprises being stronger than that on state-owned, heavily polluting enterprises.*

3.2.2. High- and Low-Emission Areas

Since sulfur dioxide emissions in the atmosphere primarily result from heavy industrial activities such as the combustion of fossil fuels, smelting of sulfur-containing ores and non-ferrous metal, and steel production, this study calculates the median industrial sulfur dioxide emissions for the 31 provinces in China. The locations of listed companies are matched with their respective provinces, allowing the sample to be divided into two subsets: high- and low-emission regions. Building on this, this study examines the regional asymmetry in the influence of the GCGs on the cash flow of heavily polluting enterprises.

In high-emission regions, the coordination between pollution control and economic development presents greater challenges for the government. As a result, there is a likelihood that the implementation of the GCGs will receive more emphasis, thereby accelerating pollution reduction efforts in these areas. Consequently, the punitive impact of the GCGs on the cash flow of heavily polluting enterprises in high-emission regions is expected to be greater than that in low-emission regions. Thus, this research proposes a third hypothesis:

H3. *The punitive effect of the GCGs on enterprises' cash flow will be stronger for enterprises in high-emission regions compared to those in low-emission regions.*

4. Research Design

4.1. Samples and Data

This study recalculated the pollution emission intensity of various industries based on the "Environmental Statistical Yearbook" published by the National Bureau of Statistics of China. It categorized 42 industries into heavily and non-heavily polluting sectors according to the median pollution emission intensity. On this foundation, treatment and control groups were constructed.

This study used A-share listed companies in China from 2007 to 2021 as the raw sample. The selection of A-share companies was motivated by two key factors: the availability and completeness of data and the relative operational stability of these firms, making it easier to reflect the impact of the GCGs. Additionally, A-share companies wield greater influence in China, making them more suitable as a reference for government policy formulation and adjustments.

The experimental and control groups were then created using measures of the intensity of industry pollution emissions. Initially, three types of pollution emissions—wastewater discharge, gas emissions, and solid waste discharge—were selected as pollution indicators. The output emission of pollutants per unit of industrial output was calculated and standardized; then, the standardized output emissions were summed to derive the pollution emission intensity for each industry. The specific steps were as follows:

First, the amount of industry pollutants released per unit of output was determined; that is:

$$UE_{ij} = E_{ij}/O_i,$$

where E_{ij} is the main pollutant *j*'s emissions of industry *i*, and O_i is the total output value of industry *i* (*i* = 1, 2, . . ., m; *j* = 1, 2, . . ., n).

Second, the output value of pollutants per unit of industry output was linearly standardized:

$$UE^{s}_{ij} = \left[UE_{ij} - \min\left(UE_j\right)\right] / \left[\max\left(UE_j\right) - \min\left(UE_j\right)\right]$$

where UE_{ij} is the main pollutant *j* unit output value emissions of industry *i*; max (UE_j) and min (UE_j) are the maximum and minimum values of the main pollutant *j* in the emissions per unit of the output value of all industries, respectively; UE^{s}_{ij} refers to the standardized values.

Third, the emissions per unit output value of various pollutants were added up to obtain the pollution emission intensity of the industry γ_i, as follows:

$$\gamma_i = \sum_{j=1}^{n} UE^{s}_{ij}$$

Furthermore, based on the median pollution emission intensity of 42 industrial sectors, industries with $\gamma_i > 0.1121$ were classified as heavily polluting industries, while industries with $\gamma_i \leq 0.1121$ were classified as non-heavily polluting industries.

Finally, industrial companies listed on the stock market were retained, while other companies were excluded. Based on the previously calculated pollution emission intensities, the sample was divided into a heavily polluting industrial group (treatment group) and a non-heavily polluting industrial group (control group). Additionally, all ST (Special Treatment) and PT (Particular Treatment) companies with abnormal financial conditions during the period from 2007 to 2021, as well as companies with severe missing or abnormal financial data (such as a debt-to-asset ratio greater than 1 or less than 0), were removed from the sample. Following these procedures, the final sample consisted of 494 listed companies, yielding a total of 7410 observations.

4.2. Difference-in-Differences Model

This study employed a fixed effects Difference-in-Differences (DID) model, where individual fixed effects control for time-invariant heterogeneity across entities, and time fixed effects account for time-related heterogeneity that does not vary across entities. This approach enabled a more accurate estimation of the policy effects. Heavily polluting industrial listed companies were designated as the treatment group, while non-heavily polluting listed companies served as the control group. This study investigated the impact of a green credit policy, the GCGs, on the cash flow of heavily polluting enterprises.

$$Y_{it} = \beta_0 + \beta_1 \text{treated}_i \times \text{after}_t + \gamma X_{it} + \delta_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where Y_{it} is the enterprises' cash flow indicator; Treated_i is the dummy variable of the group, where the value of the heavily polluting enterprises in the treatment group is 1, while that of the non-heavily polluting enterprises in the control group is 0; After_t is the event dummy variable, where the value of 2012 and later is 1 and otherwise is 0; $\text{treated}_i \times \text{after}_t$ is a difference-in-differences variable; X_{it} includes a range of enterprise-level control variables; δ_i is an individual fixed effect; λ_t is a time fixed effect; ε_{it} is a random perturbation term; β_1 is a difference-in-differences coefficient that measures the effect of events on the treatment group.

To evaluate the dynamic policy effects after the formal implementation of the GCGs, an extended DID model was constructed by replacing the interaction term $\text{treated}_i \times \text{after}_t$ with cross-sectional variables for group and annual variables after policy issuance. This model was constructed as follows:

$$Y_{it} = \beta_0 + \sum \theta_t \times treated_i \times postYear_t + \gamma X_{it} + \delta_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where $postYear_t$ is a dummy variable for each year after the implementation of the GCGs; $treated_i \times postYear_t$ is a new difference-in-differences variable, denoted as DID_Year_t; θ_t is a difference-in-differences coefficient that measures the dynamic effect of the green credit policy.

4.3. Variables

This study utilized two indicators—operating cash flow (CFO) and investing cash flow (CFI)—as dependent variables, forming a cash flow indicator. The primary focus was on using the CFO to examine the impact of the GCGs on the daily operations and profitability of heavily polluting enterprises. Previous research has indicated that heavily polluting enterprises affected by the GCGs may face insufficient financing, which could lead to reduced investment in projects or even the liquidation of assets [18]. To give a more thorough evaluation of the effect of the GCGs on these businesses' day-to-day operations, this research included the CFI. Both the CFO and CFI were directly extracted from the cash flow statements of enterprises' financial reports, which were prepared in accordance with standardized accounting principles, ensuring consistency and comparability.

For control variables, the following firm-level factors were included in this research to lessen any effects on businesses' cash flow [18]: size (SIZE), return on assets (ROA), age (AGE), proportion of tangible assets (TAR), equity concentration (LARGEST), Tobin's Q (TQ), and gearing ratio (LEV). Additionally, this study controlled for variables related to stock price characteristics, which could affect the implementation effects of the GCGs and enterprises' cash flow, including the degree of profit volatility (STD) and stock yield (RET). Table 1 shows variables' definitions and measurements.

Table 1. Definition and measurement of variables.

	The Variable Name	Variable Measures
Explained variables	Operating cash flow (CFO)	Net operating cash flow/total assets × 100
	Investing cash flow (CFI)	Net investing cash flow/total assets × 100
Explanatory variable	DID variable	Treated × after
Mechanism variable	Financing costs (COST)	Interest expense/liabilities × 100
Control variables	Size (SIZE)	The size of the enterprise's assets (the natural logarithm of total assets).
	Return on assets (ROA)	Net profit/average total assets
	Degree of profit volatility (STD)	The standard deviation of the return on assets from t-2 to t
	Age (AGE)	The number of years the enterprise has been established
	Proportion of tangible assets (TAR)	Total tangible assets/total assets
	Equity concentration (LARGEST)	The shareholding ratio of the largest shareholder
	Tobin's Q(TQ)	Market capitalization/(total assets − net intangible assets − net goodwill).
	Gearing ratio (LEV)	Total liabilities/total assets
	Stock yield (RET)	Annual individual stock returns
Robustness test variables	Real M2 growth rate (M2R)	Actual M2 increase/Actual M2 at the beginning of the period
	GDP Growth Index (GDPR)	GDP index, which stood at 100 in the same period last year

Note: The listed company data and macroeconomic data in the table are from the CSMAR database.

To mitigate the impact of extreme statistics on the empirical results and enhance the robustness and accuracy of the findings, the continuous variables were winsorized. Specifically, values that fell below the first percentile or above the ninety-ninth percentile were adjusted to be set at the first or ninety-ninth percentile, respectively. Additionally, cluster adjustment at the firm level was applied to the standard deviations of the test results.

5. Empirical Results

5.1. Parallel Trends Analysis

In the DID model, the sample was divided into two groups: heavily polluting enterprises and non-heavily polluting enterprises. To verify that the CFO of the two groups of samples exhibited similar trends before the implementation of the GCGs, this study conducted a parallel trend test using data from three years before and after the policy implementation. Figure 1 presents the results of the parallel trend test. PRE_3 and PRE_2 represent the years 2009 and 2010, respectively, CURRENT refers to the policy implementation year 2012, and POST_1, POST_2, and POST_3 correspond to the three years following the policy implementation, from 2013 to 2015, respectively. According to the results, the CFO of enterprises was not significantly affected prior to the policy implementation, but it significantly decreased after the policy was implemented. This finding confirms that the DID model in this study satisfies the precondition assumption, making the conclusion valid.

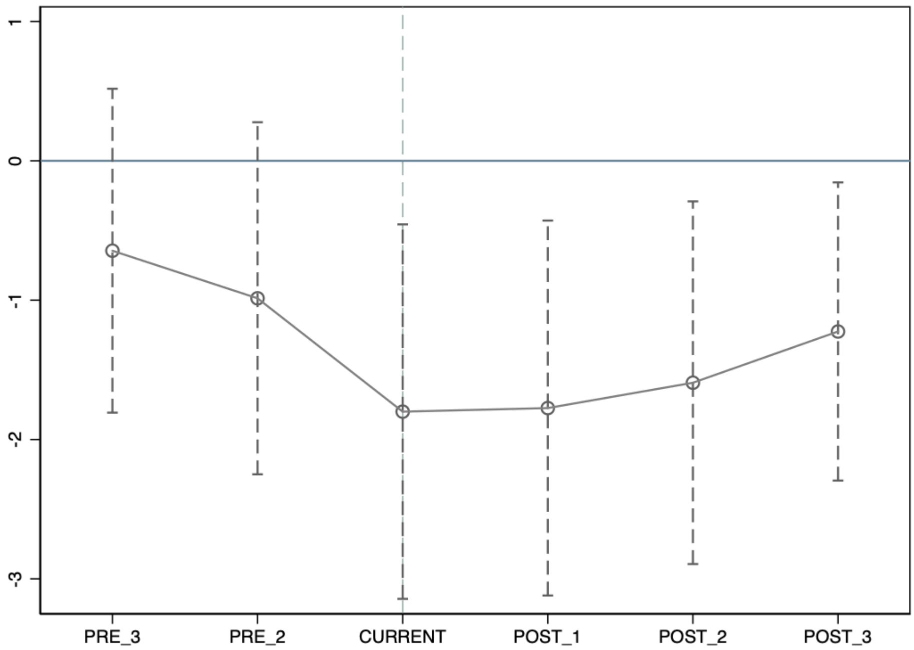

Figure 1. Testing the parallel trends assumption.

5.2. The Temporal Trend of the Enterprises' Cash Flow

From the trend of operating cash flow (Figure 2), it is evident that after the release of the GCGs in 2012, the trends in operating cash flow for the two groups began to diverge. The treatment group exhibited a declining trend in operating cash flow, while the control group showed an upward trend. The gap in operating cash flow between the two groups gradually narrowed. In 2016, the treatment group's operating cash flow halted its decline and showed a significant increase, whereas the control group experienced a notable decline in operating cash flow. This study hypothesizes that within three years following the launch of the GCGs, heavily polluting enterprises increased their investments in pollution control and reduced pollutant emissions to comply with national policies and banking credit standards. Consequently, the rebound in operating cash flow for heavily polluting enterprises in 2016 can be attributed to these efforts.

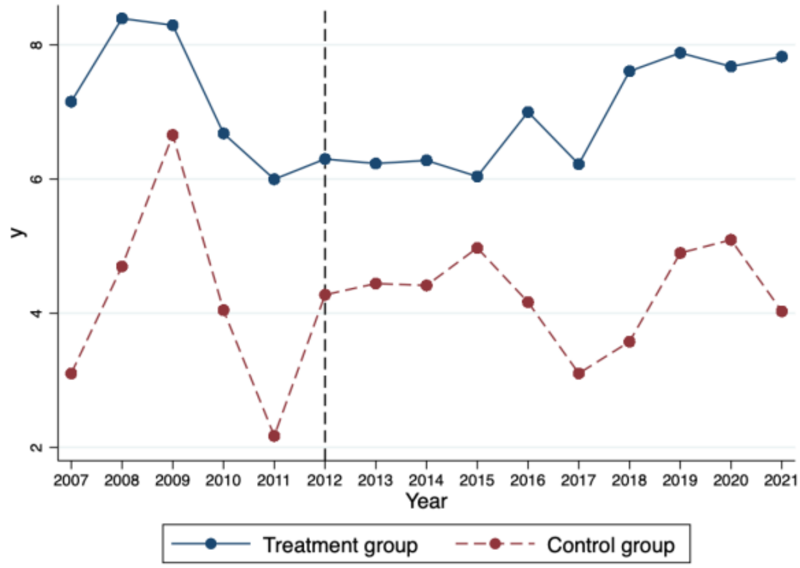

Figure 2. Time trend of CFO.

In terms of investing cash flow (Figure 3), it was observed that post-policy implementation, the treatment group experienced an upward trend in investing cash flow. This study speculates that due to reduced financing, these enterprises scaled back their investments or even liquidated assets to obtain funds. The control group's investing cash flow was in a declining state prior to 2016, but they secured more financing with the support of the GCGs, leading to an expansion in their investment scale. After 2016, both groups' investing cash flows began to rise.

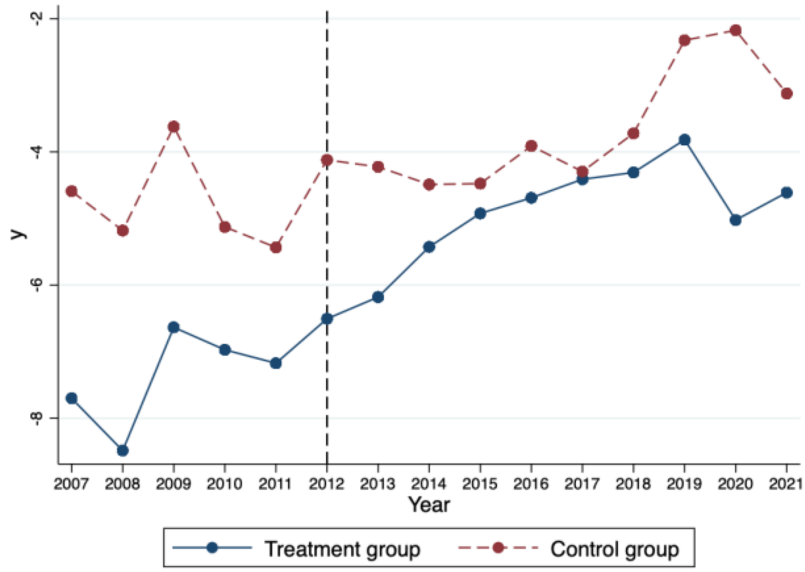

Figure 3. Time trend of CFI.

In summary, Hypothesis 1 is likely correct.

5.3. Descriptive Statistics

Table 2 displays the descriptive statistics for variables. The mean operating cash flow (CFO) is 6.01, with a sample variance of 6.79. The mean investment cash flow (CFI) is −5.15, indicating that the sample is generally in a state of investment expansion, with a sample variance of 6.54.

Table 2. Descriptive statistics.

Variables	N	Mean	SD	Min	Max
CFO	7410	6.01	6.79	−11.78	26.41
CFI	7410	−5.15	6.54	−26.53	13.11
SIZE	7410	22.61	1.32	20.08	26.22
ROA	7410	0.04	0.06	−0.14	0.24
STD	7410	0.02	0.02	0.00	0.13
AGE	7410	18.06	5.56	7.00	32.00
TAR	7410	0.95	0.05	0.70	1.00
LARGEST	7410	35.24	15.01	8.45	75.05
TQ	7410	2.05	1.31	0.88	8.28
LEV	7410	0.49	0.18	0.08	0.88
RET	7410	0.28	0.77	−0.72	3.36
GDPR	7410	108.00	2.50	102.30	114.20
M2R	7410	0.14	0.05	0.08	0.28
COST	7410	2.14	1.57	0.00	6.29

5.4. Regression Analysis of the Impact of the GCGs on Enterprises' Cash Flow

Table 3 provides the fixed effect regression results of the GCGs affecting the operating cash flow of enterprises after controlling for individual and time fixed effects.

Table 3. Impact of GCGs on operating cash flow.

Variables	Full Sample	Stated-Owned	Non-State-Owned	High Emissions	Low Emissions
DID	−0.79 **	−0.58	−1.09 *	−1.43 ***	0.42
	(−2.24)	(−1.33)	(−1.77)	(−3.31)	(−0.70)
SIZE	−0.56 **	−0.75 **	−0.26	−0.66 **	−0.49
	(−2.43)	(−2.54)	(−0.69)	(−2.35)	(−1.20)
ROA	42.75 ***	45.07 ***	39.56 ***	40.88 ***	46.91 ***
	(−16.52)	(−13.42)	(−9.98)	(−13.30)	(−10.04)
STD	9.49 **	9.60 *	10.07	8.15	12.26
	(−2.26)	(−1.68)	(−1.57)	(−1.65)	(−1.51)
AGE	0.49	0.60 *	−0.53	0.70 **	−1.90 ***
	(−1.42)	(−1.82)	(−0.85)	(−2.56)	(−3.29)
TAR	−1.05	−2.89	1.31	−1.01	−1.76
	(−0.43)	(−0.94)	(−0.35)	(−0.33)	(−0.46)
LARGEST	0.02	0.02	0.01	0.02	0.01
	(−1.17)	(−1.21)	(−0.54)	(−1.42)	(−0.34)
TQ	0.24 **	0.03	0.56 ***	0.25 *	0.23
	(−2.03)	(−0.19)	(−3.33)	(−1.73)	(−1.18)
LEV	−0.87	−0.18	−1.57	−0.69	−1.28
	(−0.89)	(−0.14)	(−1.09)	(−0.60)	(−0.70)
RET	0.43 **	0.66 ***	−0.01	0.67 ***	−0.09
	(−2.52)	(−3.22)	(−0.03)	(−3.19)	(−0.32)
Observations	7410	4875	2535	4995	2415
R-squared	0.16	0.15	0.18	0.16	0.18
Number of id	494	325	169	333	161

Note: *t*-statistic is in parentheses; ***, **, and * show 1%, 5%, and 10% significant levels, respectively.

According to Table 3's column (1) regression results for the entire sample, the estimated coefficient for treated × after is −0.79, which is significant at the 5% level. This finding suggests that, in comparison to non-substantially polluting businesses, the CFO of heavily polluting businesses declined dramatically following the introduction of the GCGs. This suggests a decline in operating income and profits for heavily polluting enterprises, indicating that the GCGs have had a negative impact on them. Therefore, Hypothesis 1 cannot be rejected, suggesting that the GCGs lead to a deterioration in cash flow for heavily polluting enterprises. This conclusion also supports the notion that financing constraints affect enterprises' cash flow.

Table 3's columns (2) and (3) provide the results for state-owned and non-state-owned enterprises, respectively. The estimated coefficients for treated × after are −0.58 and −1.09, with the absolute value of the coefficient for non-state-owned enterprises being larger and significant at the 10% level. This suggests that non-state-owned heavily polluting enterprises experienced a more pronounced punitive effect on their cash flow, whereas state-owned enterprises were not significantly affected. Thus, Hypothesis 2 cannot be rejected, demonstrating that the deterioration in enterprises' cash flow caused by the GCGs is heterogeneous, with a stronger punitive effect on non-state-owned heavily polluting enterprises.

Table 3's columns (4) and (5) provide the results for enterprises in high- and low-emission regions, respectively. The estimated coefficients for treated × after are −1.43 and 0.42, with the coefficient for high-emission region enterprises being significant at the 1% level. This result suggests that the impact of the GCGs was more significant on the operating cash flow of heavily polluting enterprises in high-emission regions, while enterprises in low-emission regions did not experience a significant impact. Therefore, Hypothesis 3 cannot be rejected, suggesting that the cash flow of enterprises in high-emission regions is more adversely affected than that of enterprises in low-emission regions.

Table 4 demonstrates the regression results for the impact of the GCGs on investing cash flow after controlling for individual and time fixed effects. From column (1) for the full sample, the estimated coefficient for treated × after is 1.23, which is significant at the 1% level. This suggests that the investing cash flow of heavily polluting enterprises significantly increased compared to that of non-heavily polluting enterprises. When investing cash flow is positive, it indicates that the enterprise is in a contraction phase, potentially generating cash inflows by disposing of fixed assets. Conversely, when investing cash flow is negative, it signifies that the enterprise is in an expansion phase, investing in fixed assets and other expenditures. Therefore, an increase in investing cash flow suggests a reduction in the enterprise's investments, indicating the possibility of liquidating assets to obtain funds. The negative impact of GCGs on heavily polluting enterprises has led to a deterioration in their cash flow conditions, further validating Hypothesis 1.

Columns (2) and (3) of Table 4 provide the results for state-owned and non-state-owned enterprises, respectively. The estimated coefficients for treated × after are 2.01 and −0.34. The positive coefficient for state-owned enterprises is significant at the 1% level, indicating that the GCGs have significantly constrained these enterprises' investment. In contrast, the negative coefficient for non-state-owned enterprises is interpreted as a reflection of the more severe impact of the GCGs on these firms. Thus, non-state-owned enterprises may have to increase their investments in pollution control and green upgrades to mitigate the negative effects of the GCGs, thus not contradicting the assumptions of this study.

Columns (4) and (5) show the regression results for enterprises in high- and low-emission regions, respectively. The estimated coefficients for treated × after are 1.17 and 1.50, both significant at the 5% level. This result indicates that the impact of the GCGs on investing cash flow for heavily polluting enterprises in high- and low-emission regions does not exhibit significant heterogeneity.

Compared to operating cash flow, investing cash flow is more significantly influenced by enterprises' decisions and is subject to more subjective factors; therefore, some deviation in the results is acceptable. The major purpose of this study is to study CFI as a supplement to address the limitations of operating cash flow, thereby providing a more thorough examination of how the GCGs affect the cash flow of enterprises.

Table 4. Impact of green credit on investing cash flow.

Variables	Full Sample	Stated-Owned	Non-State-Owned	High Emissions	Low Emissions
DID	1.23 ***	2.01 ***	−0.34	1.17 **	1.50 **
	(−3.08)	(−4.23)	(−0.51)	(−2.41)	(−2.12)
SIZE	−1.61 ***	−1.25 ***	−2.01 ***	−1.63 ***	−1.89 ***
	(−5.88)	(−3.57)	(−4.67)	(−4.93)	(−3.84)
ROA	−8.53 ***	−9.64 ***	−5.69	−6.46 **	−12.42 ***
	(−3.40)	(−3.05)	(−1.38)	(−2.04)	(−3.34)
STD	27.10 ***	27.73 ***	24.37 ***	28.49 ***	19.70 *
	(−6.04)	(−5.46)	(−3.04)	(−5.85)	(−1.96)
AGE	−0.47	−0.24	−2.38 ***	−0.38	−0.94 *
	(−1.30)	(−0.64)	(−2.64)	(−1.01)	(−1.77)
TAR	8.86 ***	2.56	14.19 ***	5.19	16.97 ***
	(−2.89)	(−0.60)	(−3.50)	(−1.33)	(−3.70)
LARGEST	−0.02	0	−0.06 **	−0.05 **	0.05
	(−1.36)	(0)	(−2.36)	(−2.57)	(−1.47)
TQ	−0.46 ***	−0.45 ***	−0.47 **	−0.56 ***	−0.34
	(−3.69)	(−2.90)	(−2.41)	(−3.59)	(−1.65)
LEV	1.31	1.28	0.27	2.66 *	−2.19
	(−1.21)	(−0.93)	(−0.15)	(−1.96)	(−1.35)
RET	0.32 *	0.43 *	0.08	0.17	0.65 *
	(−1.69)	(−1.91)	(−0.24)	(−0.79)	(−1.72)
Observations	7410	4875	2535	4995	2415
R-squared	0.08	0.10	0.08	0.09	0.08
Number of id	494	325	169	333	161

Note: *t*-statistic is in parentheses; ***, **, and * show 1%, 5%, and 10% significant levels, respectively.

5.5. The Dynamic Effect of the GCGs on the Cash Flow of Enterprises

The expanded DID model (2) was used to analyze the dynamic impact of the green credit policy on the cash flow of highly polluting companies while taking into consideration the GCGs' lag effects. Table 5 provides regression results regarding the influence of the GCGs on the enterprises' cash flow.

According to the column (1) of Table 5, prior to 2016, the coefficients for operational cash flow were notably negative. The coefficients for DID_2013, DID_2014, and DID_2015 are significant at the 5%, 10%, and 1% levels, respectively. After 2016, the coefficients are not significant except for the year 2020. The insignificance of the long-term policy effect of the GCGs may result from the fact that enterprises might have completed their pollution control tasks between 2012 and 2016 and met the environmental and social performance requirements for bank credit. As a result, the GCGs no longer exerted a suppressive effect on these enterprises' operating cash flow. This could also be due to a lack of long-term regulatory oversight, leading banks and enterprises to relax the enforcement of the GCGs.

When the dependent variable is investing cash flow, according to the results in column (2), the coefficients for 2012 and 2013 are not significant. However, after 2014, policy effects begin to manifest, with significant positive coefficients lasting until 2019. Specifically, the coefficients for DID_2014, DID_2015, DID_2016, DID_2017, DID_2018, and DID_2019 are significant at the 5%, 1%, 5%, 1%, 1%, and 10% levels, respectively, indicating that for an extended period, the enterprise's investments have been in a state of contraction. After reaching a peak in 2017, the coefficients gradually decline, which means that the enterprises' investments are starting to return to normal levels.

Table 5. Dynamic effects of green credit policies on enterprise cash flow.

Variables	CFO	CFI
CURRENT	−1.22 **	0.30
	(−2.28)	(0.61)
DID_2013	−1.19 **	0.65
	(−2.20)	(1.10)
DID_2014	−1.01 *	1.56 **
	(−1.85)	(2.50)
DID_2015	−1.59 ***	1.82 ***
	(−2.74)	(2.80)
DID_2016	−0.41	1.54 **
	(−0.78)	(2.30)
DID_2017	−0.56	2.31 ***
	(−0.10)	(3.35)
DID_2018	0.08	2.03 ***
	(0.15)	(3.49)
DID_2019	−0.72	1.16 *
	(−1.29)	(1.88)
DID_2020	−1.09 *	−0.17
	(−1.83)	(−0.27)
DID_2021	−0.18	1.21 *
	(−0.33)	(1.81)
Observations	7410	7410
R-squared	0.16	0.08
Number of id	494	494

Note: *t*-statistic is in parentheses; ***, **, and * show 1%, 5%, and 10% significant levels, respectively.

6. Mechanism Analysis

According to the theoretical analysis section, the GCGs influence the enterprises' cash flow by affecting their financing costs. Therefore, financing costs were used as a mediating variable to verify the impact mechanism of the GCGs [76]. The results are shown in Table 6. Implementing the GCGs greatly raises the financing costs of highly polluting businesses, as seen by the estimates in column (3), where the coefficient is 0.21 and significant at the 5% level.

Table 6. Mechanism analysis.

Variables	CFO	CFI	COST
DID	−0.80 **	1.23 ***	0.21 **
	(−2.24)	(−3.08)	(−2.18)
SIZE	−0.56 **	−1.61 ***	−0.03
	(−2.43)	(−5.88)	(−0.35)
ROA	42.75 ***	−8.53 ***	−2.22 ***
	(−16.52)	(−3.40)	(−4.73)
STD	9.49 **	27.10 ***	1.23
	(−2.26)	(−6.04)	(−1.25)
AGE	0.49	−0.47	−0.17 ***
	(−1.42)	(−1.30)	(−4.31)
TAR	−1.05	8.86 ***	−1.26 *
	(−0.43)	(−2.89)	(−1.76)
LARGEST	0.02	−0.02	−0.00
	(−1.17)	(−1.36)	(−1.08)
TQ	0.24 **	−0.46 ***	−0.03
	(−2.03)	(−3.69)	(−1.21)
LEV	−0.87	1.31	1.37 ***
	(−0.89)	(−1.21)	(−5.37)
RET	0.43 **	0.32 *	0.06 *
	(−2.52)	(−1.69)	(−1.68)
Observations	7410	7410	7410
Number of id	494	494	494
Adjusted R-squared	0.16	0.08	0.14

Note: *t*-statistic is in parentheses; ***, **, and * show 1%, 5%, and 10% significant levels, respectively.

7. Robustness Test

To guarantee the validity of the previously acquired results, this paper conducted placebo tests, controlled for macroeconomic variables, and performed a re-estimation using the PSM-DID model to verify the findings.

7.1. Placebo Test

To eliminate the possibility that the conclusions drawn in this study may be influenced by other events occurring before the issuance of the GCGs, a placebo test was conducted following the approach of Yuan and Gao [18]. This involved advancing the policy implementation event by one period and two periods, selecting 2010 and 2011 as the hypothetical policy implementation years. According to Table 7, the estimated coefficients for FDID and F2DID are −0.52 and −0.58, respectively, which are not significant. This suggests that the hypothetical policy has little effect on the enterprises' operating cash flow. Before the introduction of the GCGs, these enterprises did not exhibit the trends derived from the GCGs' regression; changes in cash flow occurred only after the impact of the GCGs. Therefore, it can be concluded that the event selected for constructing the quasi-natural experiment is ideal, and the estimated results of the coefficients derived earlier possess a high level of credibility.

Table 7. Placebo test.

Variables	Placebo	Placebo
FDID	−0.52	
	(−1.38)	
SIZE	−0.56 **	−0.56 **
	(−2.42)	(−2.42)
ROA	42.72 ***	42.71 ***
	(16.53)	(16.53)
STD	9.32 **	9.27 **
	(2.22)	(2.21)
AGE	0.49	0.49
	(1.40)	(1.39)
TAR	−1.05	−1.08
	(−0.43)	(−0.44)
LARGEST	0.02	0.02
	(1.14)	(1.14)
TQ	0.25 **	0.25 **
	(2.10)	(2.11)
LEV	−0.80	−0.79
	(−0.82)	(−0.81)
RET	0.43 **	0.42 **
	(2.52)	(2.49)
F2DID		−0.58
		(−1.51)
Observations	7410	7410
R-squared	0.16	0.16
Number of id	494	494

Note: *t*-statistic is in parentheses; *** and ** show 1% and 5%, significant levels, respectively.

7.2. Controlling for Macroeconomic Factors

Furthermore, the 2008 global financial crisis had a severe influence on China's economy. For instance, the reduction in external demand due to the crisis led to massive unemployment in the export sector, which is a primary driver of the economy. To mitigate the negative consequences of the crisis, the government enacted expansionary fiscal measures, launching a "4 trillion" economic stimulus plan that triggered the development of cement, steel, and other heavily industries. Meanwhile, the central bank adopted expansionary monetary policies, repeatedly lowering deposit and loan interest rates while injecting substantial liquidity into the market. This may affect the amount and cost of financing for enterprises.

Considering that these economic expansion policies could potentially influence enterprise debt financing and investments, they may also affect enterprises' cash flow, thereby impacting the effectiveness of the GCGs. Therefore, to account for these macroeconomic factors affecting heavily polluting enterprises, this study employed two robust control variables: the real growth rate of M2 (M2R) and the GDP growth index (GDPR). After incorporating these robust variables into the model, the results remained consistent with those obtained earlier, as shown in Table 8. From the results shown in column (1) for the full sample, the estimated coefficient for treated × after is −0.79, which is significant at the 5% level. According to the columns (3) and (4), the coefficient estimates for non-state-owned enterprises and high-emission regions are −1.09 and −1.43, respectively, and are statistically significant at the 1% and 10% levels.

Table 8. Robustness test.

Variables	Full Sample	Stated-Owned	Non-State-Owned	High Emissions	Low Emissions
DID	−0.79 **	−0.58	−1.09 *	−1.43 ***	0.42
	(−2.24)	(−1.33)	(−1.77)	(−3.31)	(−0.70)
SIZE	−0.56 **	−0.75 **	−0.26	−0.66 **	−0.49
	(−2.43)	(−2.54)	(−0.69)	(−2.35)	(−1.20)
ROA	42.75 ***	45.07 ***	39.56 ***	40.88 ***	46.91 ***
	(−16.52)	(−13.42)	(−9.98)	(−13.30)	(−10.04)
STD	9.49 **	9.60 *	10.07	8.15	12.26
	(−2.26)	(−1.68)	(−1.57)	(−1.65)	(−1.51)
AGE	0.49	0.60 *	−0.53	0.69 **	−1.90 ***
	(−1.42)	(−1.82)	(−0.85)	(−2.56)	(−3.29)
TAR	−1.05	−2.89	1.31	−1.01	−1.76
	(−0.43)	(−0.94)	(−0.35)	(−0.33)	(−0.46)
LARGEST	0.02	0.02	0.01	0.02	0.01
	(−1.17)	(−1.21)	(−0.54)	(−1.42)	(−0.34)
TQ	0.24 **	0.03	0.56 ***	0.25 *	0.23
	(−2.03)	(−0.19)	(−3.33)	(−1.73)	(−1.18)
LEV	−0.87	−0.18	−1.57	−0.69	−1.28
	(−0.89)	(−0.14)	(−1.09)	(−0.60)	(−0.70)
RET	0.43 **	0.66 ***	−0.01	0.67 ***	−0.09
	(−2.52)	(−3.22)	(−0.03)	(−3.19)	(−0.32)
GDPR	−0.08	0.01	−0.36 ***	−0.06	−0.41 ***
	(−1.12)	(−0.13)	(−3.16)	(−0.82)	(−3.86)
M2R	49.99	55.49	−96.09	71.43	−330.15 ***
	(−0.86)	(−1.00)	(−0.93)	(−1.57)	(−3.38)
Observations	7410	4875	2535	4995	2415
R-squared	0.16	0.15	0.18	0.16	0.18
Number of id	494	325	169	333	161

Note: *t*-statistic is in parentheses; ***, **, and * show 1%, 5%, and 10% significant levels, respectively.

7.3. PSM-DID

To address concerns regarding selection bias between the treatment group and control group, the DID model was combined with Propensity Score Matching (PSM-DID), and control variables were added to re-estimate the model. The analysis is conducted using a year-by-year matching approach, employing a 1:1 nearest neighbor matching method. It then calculates the propensity scores via a logit model, which are applied to match new control group samples with the treatment group based on the propensity scores. Table 9 shows the regression findings. Column (1) shows the findings without control factors, while column (2) shows the baseline results from Section 5. Column (3) displays the PSM-DID results without macroeconomic variables and column (4) provides the PSM-DID regression results with macroeconomic variables included. The coefficient estimates obtained from the PSM-DID regressions are −0.81 and −0.80, respectively, both significant at the 1% level, consistent with the baseline regression results, indicating a high degree of robustness.

Table 9. PSM-DID.

Variables	DID1	DID2	PSM-DID1	PSM-DID2
DID	−0.56	−0.80 **	−0.81 ***	−0.80 ***
	(0.39)	(0.35)	(0.27)	(0.26)
SIZE		−0.56 **	−0.57 ***	−0.57 ***
		(0.23)	(0.17)	(0.17)
ROA		42.75 ***	43.01 ***	43.02 ***
		(2.59)	(1.57)	(1.57)
STD		9.49 **	9.88 ***	9.76 ***
		(4.21)	(3.12)	(3.12)
AGE		0.49	0.51 **	0.50 **
		(0.35)	(0.22)	(0.22)
TAR		−1.05	−1.35	−1.30
		(2.43)	(1.82)	(1.82)
LARGEST		0.02	0.02	0.02
		(0.01)	(0.01)	(0.01)
TQ		0.24 **	0.23 ***	0.23 ***
		(0.12)	(0.09)	(0.09)
LEV		−0.87	−0.93	−0.88
		(0.97)	(0.70)	(0.70)
RET		0.43 **	0.43 ***	0.43 ***
		(0.17)	(0.15)	(0.15)
M2R				50.63
				(37.51)
GDPR				−0.08
				(0.06)
Observations	7410	7410	7406	7406

Note: *t*-statistic is in parentheses; *** and ** show 1% and 5%, significant levels, respectively.

This study utilizes a placebo test to establish causal linkages and subsequently controls for macroeconomic variables to eliminate any potential effects these factors may have on the impacts of GCGs and the cash flow of enterprises. To reduce disparities between the treatment and control groups, the PSM-DID method is applied. The results indicate that the conclusions presented in Section 5 of this study are both robust and credible.

8. Conclusions and Perspectives

This paper develops a quasi-natural experiment based on GCGs and uses a DID model to examine the impact of the green credit policy on the cash flow of significantly polluting enterprises. The results indicate that the implementation of the GCGs has led to a deterioration in the enterprises' cash flow situation, inhibiting their CFO and affecting their actual operations. Additionally, this impact exhibits heterogeneity, with more pronounced effects on non-state-owned enterprises and those located in high-emission regions.

First, the results suggest that GCGs can lead to a deterioration of heavily polluting enterprises' cash flow, affecting their operational and profitability capacities. This imposes a tangible constraint on corporate behavior and is beneficial for promoting ecological civilization. Enterprises with unstable cash flow or low cash flow levels often face greater liquidity risks and cash shortages. Increasing borrowing to alleviate liquidity constraints can further heighten the default risk for enterprises unable to meet their debt obligations. Firms with persistently fluctuating cash flows are likely to experience an accelerated increase in credit risk [71], leading to a further rise in financing costs. Therefore, cash flow significantly impacts a company's operational flexibility and sustainability. To mitigate the negative effects of GCGs on cash flow, heavily polluting enterprises must standardize their behaviors and actively engage in pollution reduction and control measures. The government and commercial banks should keep pushing for the adoption of green credit by formulating detailed and feasible requirements, establishing a comprehensive and scientific green assessment and evaluation system, and enforcing punitive measures. Optimizing and innovating green credit businesses and products is crucial.

Second, the regression findings for the subsamples show that the impact of GCGs on the cash flow of non-state-owned firms and enterprises in high-emission zones is more substantial. Therefore, the Chinese government is recommended to continually expand the influence of green credit and eliminate heterogeneity in policy effects. On the one hand, green credit policies should be implemented more aggressively in low-emission regions and state-owned businesses, rather than focusing just on high-emission regions and non-state-owned businesses. The government must enhance its regulatory oversight of banks to ensure that the same level of scrutiny is applied to both state-owned and non-state-owned enterprises when issuing loans, thereby minimizing credit discrimination. On the other hand, for regions densely populated with heavily polluting enterprises, the government could establish special management zones for targeted remediation, such as in the Taihu and Huaihe River basins. Due to the differing impacts experienced by high-emission and low-emission regions, local governments and banks should be encouraged to create a set of green indicators and environmental performance evaluation mechanisms tailored to local pollution conditions, enabling effective guidance for heavily polluting industries to control and reduce pollution, facilitate industrial upgrading and transformation, and foster environmentally friendly enterprises.

Third, the current research findings can only confirm the existence of a punitive effect of the GCGs on heavily polluting enterprises; however, whether the intensity of this punishment can be maintained within a reasonable range remains uncertain. The regression results concerning investment cash flow indicate that enterprises have been in a prolonged state of reduced investment, even facing the risk of selling off assets, which is detrimental to their long-term development. Although green credit appears to be a relatively mild policy at present, the government and banks should pay attention to the severity of penalties during its implementation to avoid pushing enterprises into a vicious cycle. Studies show that the adoption of the GCGs causes capital investment structures to change, raises the enterprises' financing costs [20,51], and creates a funding gap for highly polluting businesses. If these negative impacts are not kept within controllable limits, enterprises could face bankruptcy due to cash flow issues, thereby triggering greater chaos. In order to achieve an optimal situation for the economy and the environment, it is crucial to create dynamic, real-time credit criteria and restrictions based on the application of green credit policies. When implementing green credit policies, banks can calculate a coefficient based on the specific circumstances of different enterprises to determine loan amounts and interest rates. This coefficient can be adjusted annually to ensure it aligns with the current operational status of the enterprises. Simultaneously, the government should improve pertinent incentive programs by expanding financial subsidies for businesses that are actively involved in green innovation and provide suitable finance assistance.

Existing research has seldom focused on the impact of GCGs on enterprises' cash flow. Cash flow, as a metric based on the cash basis of accounting, combines both effectiveness and authenticity, reflecting the current operational status of enterprises with high research value. However, previous studies on the relationship between GCGs and cash flow have not paid sufficient attention to the specific cash flow types and their impacts; they have tended to focus more on enterprises' cash-holding behavior [18] and cash flow sensitivity [58]. Operating cash flow, as one of the most important cash flow indicators, intuitively reflects the main business revenue and, consequently, the profitability of an enterprise. Therefore, the dimension of cash flow should be emphasized. This study analyzed the impact of the GCGs on cash flow and the heterogeneity of this impact, thus filling the gap in the existing literature.

The contributions of this research can be summarized in three aspects.

This study contributes to the literature by exploring the impact of Green Credit Guidelines (GCGs) on heavily polluting enterprises from the perspective of cash flow. While existing research has predominantly focused on financing costs and green innovation when examining corporate behavior in the context of green credit, there has been limited attention paid to how GCGs influence the cash flow of highly polluting firms. By utilizing cash flow as the key variable, a factor that has been seldom explored in previous studies, this article provides a more comprehensive analysis of the effects of GCGs from a corporate finance standpoint.

Second, this study also makes a significant contribution to the ongoing academic debate about the impact of financing constraints on corporate cash flow. By examining green credit policies as a specific form of financing constraint, it provides valuable empirical evidence from China to inform this discussion. The findings of this paper demonstrate that financing constraints, in the context of green credit, have a detrimental effect on the cash flow of heavily polluting enterprises.

Third, the findings of this study offer practical implications for both enterprises and policymakers. For businesses, the analysis highlights how cash flow shortages can hinder investment and daily operations, motivating firms to prioritize pollution reduction and green transformation. For policymakers, the research provides a novel perspective on evaluating green credit policies by integrating cash flow considerations into the assessment process. This approach can help develop a more comprehensive and effective green credit framework, fostering sustainable development through continuous innovation in green financial products and services.

Lastly, the research enriches the understanding of the effectiveness and economic consequences of environmental policies, particularly in the context of China's green credit policies. As the world's second-largest economy and a leading emerging market, China's experience offers valuable insights for other developing countries seeking to implement similar environmental policies. The study provides a deeper understanding of how such policies can influence corporate behavior and economic outcomes, offering lessons that can inform the design and implementation of green finance initiatives globally.

Building upon this study, further research could explore enterprises' financing cash flow and financing behavior, as well as the impact of green credit policies on different cash flow sensitivities, such as cash–cash flow sensitivity and investment–cash flow sensitivity, thereby providing deeper insights into how financing constraints affect cash flow. In the section concerning enterprise investment, there remain unresolved issues. While financing constraints and reduced capital may lead to investment contraction, increased investments in pollution control and the replacement of environmentally-friendly equipment could lead to higher enterprise investments. The question of which of these opposing effects carries more weight in the impact of GCG on investing cash flow has yet to be definitively answered. On the other hand, due to limitations in data availability, the sample selected for this study consists of A-share listed companies and does not include non-listed companies, which somewhat reduces the representativeness of the sample. Future research could incorporate non-listed companies into the sample to enhance the generalizability of the results.

In conclusion, the green credit policy is currently not fully developed and faces numerous issues. Future research should be grounded in practical realities, focusing on addressing the challenges encountered during policy implementation, which in turn can guide practice and continually narrow the gap between theory and practice. The green credit policy has the potential to align financial resources with environmental goals by incentivizing financial institutions to support environmentally friendly projects, reducing pollution and carbon emissions, and promoting innovation and economic growth in the green sector. It is essential for tackling climate change issues and easing the shift to a sustainable economy. To make sure that policies continue to be relevant to modern requirements, we must keep pushing for the creation of green credit and carry out ongoing study.

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