# Business Environment and Enterprises' Greenwashing Behavior：

# Evidence from China

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**Abstract:** Optimizing the "soft" business environment is in unlocking the core drivers of enterprise growth and promoting sustainable, green development. This study examines the impact of provincial business environments on enterprises' greenwashing behavior utilizing firm-level data from Chinese A-share listed companies between 2015 and 2022. Employing a difference-in-differences (DID) methodology, we estimate the policy effects of China's business environment reforms. The results indicate that an improved business environment significantly reduces the enterprises' greenwashing behavior by supporting green innovation, decreasing information asymmetry and promote financial performance. Additionally, heterogeneity analysis reveals that this effect is more pronounced in capital-intensive, high-tech industries and private enterprises. This research advances our understanding of how optimizing the business environment can deter greenwashing and offers new strategies for fostering healthy competition and sustainable market development.

**Keywords:** Greenwashing Behavior; Business Environment; Difference-in-Differences Method

# 1 Introduction

As global environmental challenges intensify and sustainable development becomes a defining priority, environmental concerns now significantly constrain economic growth and social progress. In response, China has made green development a central pillar of its national strategy, implementing stringent environmental laws, incentive policies, energy transition measures, and fostering international cooperation. Enterprises, as key drivers of economic activity, are vital to advancing this green transformation (Kwilinski et al., 2024). "Green" has become a critical standard for assessing corporate performance, therefore, ESG reflecting investor demands for corporate transparency and sustainability have gained widespread recognition. (Chopra et al., 2019).

However, while some companies have embraced meaningful environmental practices, due to various pressure others engage in greenwashing—exaggerating their environmental credentials to mislead stakeholders (de et al., 2020; Lublóy et al, 2025). Lublóy, Á., Keresztúri, J. L., & Berlinger, E. (2025). Quantifying firm-level greenwashing: A systematic literature review. Journal of Environmental Management, 373, 123399. Information asymmetry makes it hard for investors to judge the truth of environmental claims, leading to greenwashing negative externality, which is not conducive to enterprises' long-term development and the healthy operation of the market (Chen & Duan, 2023; Pimonenko et al., 2020). Greenwashing has been the concern of more and more scholars. Regarding the influencing factors of corporate greenwashing behavior, the researchers mainly study the moderating effect of natural and anthropogenic factors on firms' greenwashing behavior, for example, artificial intelligence (Li et al., 2024), green bond issuance (Wang & Shen, 2024) and institutional pressure (Li et al., 2024; Zhang et al, 2025).

The business environment, defined as "the comprehensive external ecosystem in which enterprises operate", encompasses economic reforms, market liberalization, and a host of other factors. The quality of this environment plays a decisive role in shaping the flow and aggregation of resources, which ultimately determines a region's long-term development potential (Jiang et al, 2025). But, as a market subject, enterprise is often impacted by its complex and changing business environment (Yuan & Cao, 2022).

Based on above, a significant body of research has focused on the effect of the business environment. The literature mainly focuses on business environment in the ways of industrial structure upgrading (He & Yao, 2022), labor income (Lai et al., 2024), industrial upgrading (Liu & Li, 2024), OFDI (Xie & Yin, 2024), and FDI (Li & Xiao, 2024). Some researchers found that the measures to promote the business environment have significantly influenced corporate green development (Huang et al., 2022). A fair competitive environment and robust business credit system can strengthen corporate confidence in pursuing sustainable growth (Lian et al., 2022), while improved regulation and legal frameworks can steer firms toward more socially responsible behaviors. However, Li and Song (2022) found that an optimized business environment may have disputes with industrial green transformation, which needs sound regulation to coordinate. The subjects of recent research are almost the finance and development status of the enterprises themselves, but few link the optimization of the business environment with the policy orientation of environmental protection and corporate social responsibility. The present study examines whether business environment improvements can effectively mitigate corporate greenwashing and guide firms toward sustainable, high-quality development.

Taking China's A-share listed companies as the research object, this paper investigates the impact of provincial-level business environments on corporate greenwashing behavior. Additionally, we explore the policy effects brought about by China's business environment reforms using a DID approach. We found that a favorable business environment helps curb corporate greenwashing behavior, primarily by encourage green innovation, reducing information asymmetry in the market, and enhancing firms' financial performance.

The main contributions of this research will be as follows. First, this study constructed an innovative theoretical framework from capital improvement and external management optimization that systematically integrates business Environment with corporate greenwashing. Second, providing policy evidence, the paper investigates the impact of China's 2021 pilot business

environment innovation policy on corporate greenwashing.

The remaining sections of this paper is as follows. Section 2 provides four hypotheses through theoretical analysis. Section 3 outlines the research methodology, variables, and sample selection. Section 4 includes empirical procedures. Section 5 analyses the impact of the pilot business environment innovation policies. Section 6 includes conclusions and policy recommendations based on the research findings.

## 2 Theoretical Analysis and Research Hypotheses

A sound business environment can promote the smooth and orderly development of the market (Steinhauser, 2019). It can effectively reduce the financial risk, credit risk and other unfavorable factors in the region (Su et al., 2024) as well as enhance the attractiveness of investment (Zhang et al., 2024). Meanwhile, it allows more investors in the market to convey positive information, reducing the difficulty of enterprise finance (Yin et al., 2023; Luo et al., 2023), so that enterprises do not need to attract funds to the market through greenwashing and other fraudulent behavior. A sound business environment can establish a complete law system and more authoritative public service institutions. Those institutions work as a bridge between enterprises and investors to reduce the information asymmetry in the process of investment and financing and give a way for firms to provide green investors with more high-quality information disclosure; at the same time, optimizing business environment motivates firms＇confidence (Lian et al., 2022) by developing their professional strength and providing support product quality, which can effectively improve their competitiveness. In this environment, companies are more willing to use the real ability to build a brand image, than to gain the long-term trust of investors and the market.

**H1:** Optimizing the business environment helps to reduce enterprises' greenwashing behavior.

To Optimize business environment, the government will strengthen law enforcement and establish more supervision institutions, which improve the quality and quantity of the environmental information disclosure of enterprises can also be a medium of information exchange between the supply and demand of capital (Jiang et al., 2021; Li et al., 2024). Business environment optimization is a comprehensive enhancement of all elements in the construction (Yuan & Cao, 2022). Thus, strengthening the protection of intellectual property rights is included, which controls infringements and improves social trust. So enterprises, especially high-tech enterprises that hold advanced knowledge and need more capital for development, will be more willing to disclose information (Chen et al., 2014; Yu, 2025). Intellectual property protection being improved can effectively relieve information asymmetry and be conducive to establishing a fair market environment. A high-quality information transfer can significantly optimize the allocation of funds in the region, reducing policy discrimination, strengthening the ability of enterprises to obtain resources, and finally, effectively improving the future total return of enterprises (Hamilton & Stekelberg, 2017; Wang et al, 2025).

**H2:** A favorable business environment can inhibit corporate greenwashing by reducing information asymmetry.

Green innovation is a powerful impetus for achieving quality development (Sun et al, 2025).Sun, Y., Belgacem, S. B., Khatoon, G., & Nazir, F. (2025). Impact of environmental taxation, green innovation, economic growth, and renewable energy on green total factor productivity. Gondwana Research, 145, 218-227.Green management innovation enhances the reputation and green image of firms by helping them to achieve resource conservation and establish a good stakeholder network, and attracts more consumers and green investors who are sensitive to the actual environmental behavior and 'greenwashing' behavior of firms (Li et al., 2024). Green technological innovation increases the use of modern digital technologies by enterprises, leading to digital technology diffusion, which in turn makes the information provided by enterprises to the outside world richer and more accurate (Xie et al., 2023). These two aspects work together to increase the risk and cost of greenwashing, and in a more open and transparent information environment, if firms continue to greenwash, they will face a large number of consumer disengagement and investors withdrawing their funds at the same time (Xie et al., 2021). A favorable business environment tends to be accompanied by an easing of financing constraints, meaning that firms in the region are relatively well capitalized (Niu et al., 2022). Green innovation, a type of R&D that takes a long time and requires high investment but contributes to the high quality of firms, can flourish. At the same time, optimizing the business environment will also enhance

local people's pursuit of a high quality of life and increase the demand for green and innovative products and services, forcing enterprises to put green innovation on the agenda (Sulaiman, 2025). A favorable business environment will help to motivate businesses from both a supply and demand perspective, replacing 'greenwashing' behaviors that deceive society with substantive green innovation.

**H3:** A favorable business environment can inhibit corporate greenwashing by stimulating green innovation.

Enterprise performance is the most realistic and powerful embodiment of the enterprise's business condition and strength over a period of time (Hao et al., 2022). On the one hand, the improvement of enterprise performance directly alleviates the capital shortage of the enterprise, and on the other hand, the improvement of performance as a positive signal can attract investment to the enterprise, which indirectly reduces the financing pressure of the enterprise and weakens the "greenwash" caused by the pressure of high market competition (Liu et al., 2022). At the same time, the improvement of enterprise performance allows enterprises to have more spare funds to spend on substantive environmental protection projects and effectively assume social responsibility. A good business environment, as a breeding ground for enterprise growth, can effectively reduce the operating costs of enterprises and accelerate the allocation efficiency of productive capital, providing a fairer, more orderly and stable market economy for the healthy development of enterprises, which is conducive to the improvement of enterprise performance (Han et al., 2023). The optimization of the business environment contributes to the improvement of enterprise performance and inhibits greenwashing in both direct and indirect dimensions.

**H4:** A favorable business environment can inhibit corporate greenwashing by enhancing financial performance.

## 3 Research method

### 3.1 Data

This paper examines a sample of China's A-share listed firms from 2015 to 2022. The ESG data utilized in this study are sourced from Bloomberg and the China Securities Index (CSI), while the data for constructing the business environment are obtained from the National Bureau of Statistics of China. Additional variables are drawn from the CSMAR and CNRDS databases. To address issues related to sample assessment and quality, the following selection criteria are applied:

(1) Data associated with abnormal financial conditions are excluded, specifically ST, *ST, and PT firms, as they may impact empirical results;

(2) The profitability models and greenwashing behaviors of firms in the financial industry differ significantly from those in other sectors, leading to their exclusion;

(3) To mitigate the influence of extreme values on the study's outcomes, data below the 1st percentile and above the 99th percentile are trimmed.

### 3.2 Model construction

We investigate the impact of the business environment on the greenwashing behavior of enterprises using the two-way fixed-effects model, which we constructed to identify our hypothesis:

$$GW_{i,t} = \beta_0 + \beta_1 Score_{i,t} + \delta_i Controls_{i,t} + YearFE + IndustryFE + \varepsilon_{i,t} \tag{1}$$

where the subscripts i, $t$ denote firm and time, respectively; $GW_{i,t}$ denotes the degree of firm greenwashing; $Score_{i,t}$ reflects the Doing Business index, whose coefficient $\beta_1$ is the focus of this paper; $Controls_{i,t}$ represents a series of control variables. We also control for time and effects in our empirical estimations, and $\varepsilon_{i,t}$ is the error term.

According to the theoretical analysis above, this paper expects that the coefficient $\beta_1$ of the business environment score is significantly smaller than zero, indicating that the optimization of the business environment can effectively inhibit greenwashing.

### 3.3 Variable description

**(1) Explained variable: Degree of greenwashing (GW)**

The construction of greenwashing indicators has not yet been standardized. Following Zhang (2022) and Birindelli et al.

(2024), we define greenwashing as firms seeking to create an image of sustainable performance by disclosing select ESG data but performing poorly in real ESG terms. The ESG performance does not meet the publicized standards, which is a kind of overstatement behavior. Based on this definition, a company's greenwashing index is measured by the gap between its ESG disclosure score and its true ESG performance score.

$$GW_{i,t} = \left( \frac{ESG_{dis\,i,t} - \overline{ESG_{dis}}}{\sigma_{dis}} \right) - \left( \frac{ESG_{per\,i,t} - \overline{ESG_{per}}}{\sigma_{per}} \right)$$

(2)

This paper refers to Chen et al (2024) who used the Bloomberg ESG disclosure score to measure the degree of ESG disclosure of a firm, which is the ESG data disclosed by that firm to the public. Bloomberg ESG score focuses more on the amount of disclosed information and therefore serves as the disclosure score. The Bloomberg ESG score ranges from 0 to 100, and the higher the value the better the ESG disclosure of a firm. ESG disclosure is better.

We use the CSI ESG composite score to measure a company's true ESG performance. Compared to Bloomberg, this score places greater emphasis on assessing real performance, making it a more accurate measure of true ESG performance. The CSI ESG score also ranges from 0 to 100, with higher scores indicating better performance.

**(2) Explanatory variables: Business Environment Index (Score)**

Based on the approach of Yang & Wei (2021), we first constructed a preliminary business environment evaluation index system, which includes 4 primary-level indexes and 15 secondary-level indexes. These cover the macroeconomic environment, market environment, infrastructure, and policy environment. We then applied the entropy method to determine the index weights, ensuring an accurate and objective measurement of the specific business environment index for each city. The details are presented in Table 1.

Table 1. Business Environment Index

| First-level | Second-level | Explanation | Property |
|---|---|---|---|
| Macroeconomic Environment | Per capita GDP | Per capita GDP | Positive |
| | Average wage | The average wage of employed persons in urban units | Positive |
| | Consumption rate | total retail sales of consumer goods /GDP | Positive |
| | Per capita investment in fixed assets | fixed investments / Permanent population at the end of the year | Positive |
| | GDP growth rate | GDP growth rate | Positive |
| | Foreign trade dependence | total export-import volume /GDP | Positive |
| Market Environment | Total factor productivity | total factor productivity （TFE) | Positive |
| | Employment figure | Number of employees at the end of the year | Positive |
| | Financial constraints | Banking financial institution loans /GDP | Positive |
| infrastructure | Per capita urban road area | Urban road area / Permanent population at the end of the year | Positive |
| | Number of beds in health institutions | Number of beds in health institutions | Positive |
| | Power supply capacity | Total electricity consumption | Positive |
| | Freight volume | Freight volume | Positive |
| Policy Environment | Government intervention | Government expenditure /GDP | Positive |
| | Enterprise tax revenue | Tax revenue /GDP | Negative |

**(3) Control Variables**

Building on existing literature, we incorporate share proportion of the largest shareholder (Shareholder), independent director (Indep), enterprise scale (Size), regulatory gender structure (Female) and growth potential (Tobin) as control variables. The specific definitions of these variables are provided in Table 2, and the descriptive statistics of the variables are shown in Table 3.

Table 2. Definitions of main variables

| Genre | Name | Abbreviation | Description |
|---|---|---|---|
| Explained variable | Greenwashing index | GW | Show in Equation (1) and (2) |
| Explanatory variables | Business environment index | Score | Show in Table1 |
| Control Variables | Share proportion of the largest | Shareholder | The ratio of the number of shares held by the largest shareholder |

| | | | |
|---|---|---|---|
| shareholder | | | to the total number of shares of the company |
| Independent director | Indep | | Number of independent directors plus one then taking the logarithm |
| Enterprise scale | Size | | Take the logarithm of total assets |
| Regulatory gender structure | Female | | The proportion of women in supervisory positions |
| Growth potential | Tobin | | The ratio of the market value of a company to the replacement cost of its assets |

Table 3. Descriptive statistics

| Variable | N | Mean | SD | p50 | Max | Min |
|---|---|---|---|---|---|---|
| GW | 8104 | -0.280 | 1.150 | -0.390 | 5.930 | -4.020 |
| Score | 8104 | 0.380 | 0.0900 | 0.360 | 0.560 | 0.200 |
| Shareholder | 8104 | 36.26 | 15.86 | 34.57 | 73.66 | 8.420 |
| Indep | 8104 | 1.450 | 0.140 | 1.390 | 1.790 | 1.100 |
| Size | 8104 | 23.38 | 1.260 | 23.26 | 26.36 | 20 |
| Female | 8104 | 0.150 | 0.160 | 0.140 | 0.670 | 0 |
| Tobin | 8104 | 2.060 | 1.560 | 1.510 | 9.350 | 0.830 |

## 4 Empirical results and discussions

### 4.1 Baseline result

We employ a two-way fixed effects model to examine the impact of business environment optimization on enterprises' greenwashing behavior. The results are presented in Table 4. Column (1) controls for industry and year effects, while Column (2) adds control variables to the baseline model in Column (1). The regression coefficients of the business environment index are significantly negative at the 10% and 5% levels, respectively. This indicates that business environment optimization can effectively reduce corporate greenwashing, supporting the H1 hypothesis of this paper.

To control for potential bias caused by measurement errors in key variables, and following the approach of Chen et al. (2024), we redefined the explanatory variable for the business environment index. Using the median as a threshold, values above the median are assigned a value of 1, and those below the median are assigned a value of 0, constructing the Score_N indicator. The regression results are presented in Table 5, columns 1-2. At the 1% significance level, the redefined business environment index still exhibits a negative impact on corporate greenwashing, consistent with the previous findings and reaffirming the robustness of the results.

Table 4. Main regression results

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | GW | GW | GW | GW |
| Score | -0.688*** | -0.689*** | | |
| | (0.145) | (0.142) | | |
| Score_N | | | -0.151*** | -0.132*** |
| | | | (0.0268) | (0.0264) |
| Shareholder | | -0.000719 | | -0.000700 |
| | | (0.000843) | | (0.000843) |
| Indep | | 0.0138 | | 0.0172 |
| | | (0.0963) | | (0.0963) |
| Size | | 0.213*** | | 0.210*** |
| | | (0.0123) | | (0.0123) |
| Female | | 0.0172 | | 0.00982 |
| | | (0.0825) | | (0.0824) |
| Tobin | | 0.00852 | | 0.00776 |
| | | (0.00941) | | (0.00940) |
| Constant | -0.105 | -4.873*** | -0.287** | -5.000*** |

|  | (0.120) | (0.308) | (0.112) | (0.306) |
|---|---|---|---|---|
| Year | yes | yes | yes | yes |
| Ind | yes | yes | yes | yes |
| Observations | 8,104 | 8,104 | 8,104 | 8,104 |

Notes: ***p<0.001, **p<0.01, *p<0.05

## 4.2 Endogeneity and robustness tests

### (1) Replacing the explanatory variables

To test the robustness of the above results, this paper draws on Li et al. (2024), as shown in Equation (3), where each of the two scores is normalized by subtracting the minimum value and then dividing by the difference between the maximum value and the minimum value, finally making the difference. A replacement variable for the explanatory variables was constructed, denoted as GW2. The regression was performed on GW2 with and without control variables whose results are shown in Table 5. Column (1) shows the regression results without control variables and column (2) shows the regression results with control variables, the results show that the coefficients of Score for both regressions are still significantly negative at the 1% level and the hypotheses are still valid.

$$GW2_{i,t} = \frac{\left[ESG_{disi,t} - \min\left(ESG_{disi,t}\right)\right]}{\left[\max\left(ESG_{disi,t}\right) - \min\left(ESG_{disi,t}\right)\right]} - \frac{\left[ESG_{peri,t} - \min\left(ESG_{peri,t}\right)\right]}{\left[\max\left(ESG_{peri,t}\right) - \min\left(ESG_{peri,t}\right)\right]} \tag{3}$$

### (2) Narrowing the sample space

Compared to other provinces, there are obvious differences in the economic development environment of the four municipalities of Beijing, Shanghai, Tianjin and Chongqing. Therefore, to test the robustness of the above conclusions, the sample firms in these four municipalities are excluded and the regressions are re-run, and the results are shown in columns 3-4 of Table 5. Where column (3) is the regression result without control variables and column (4) is the regression result with control variables. As can be seen from the results, the impact of the business environment index on the greenwashing behavior of enterprises is significantly negative at the 1% levels, indicating that the study's conclusions are robust.

### (3) Dual cluster analysis of year enterprises

Since we use panel data, there may be time-series correlation problems. So this paper uses the company-year double cluster adjustment method to control the individual level of intergroup correlation and the existence of panel data time-series correlation problems. As can be seen from the regression results in columns 5-6 of Table 5, the regression coefficients with and without control variables are significantly negative at the 1% level, indicating that the conclusions of this paper have not changed substantially.

Table 5. Robustness test

| VARIABLES | (1) GW2 | (2) GW2 | (3) GW | (4) GW | (5) GW | (6) GW |
|---|---|---|---|---|---|---|
| Score | -0.105*** | -0.109*** | -0.714*** | -0.778*** | -0.688*** | -0.689*** |
|  | (0.0328) | (0.0322) | (0.155) | (0.153) | (0.145) | (0.142) |
| Shareholder |  | -0.000356* |  | -0.000973 |  | -0.000719 |
|  |  | (0.000190) |  | (0.000977) |  | (0.000843) |
| Indep |  | 0.000614 |  | -0.0521 |  | 0.0138 |
|  |  | (0.0218) |  | (0.113) |  | (0.0963) |
| Size |  | 0.0532*** |  | 0.212*** |  | 0.213*** |
|  |  | (0.00278) |  | (0.0146) |  | (0.0123) |
| Female |  | 0.0257 |  | 0.00552 |  | 0.0172 |
|  |  | (0.0186) |  | (0.0973) |  | (0.0825) |
| Tobin |  | 0.00574*** |  | 0.00577 |  | 0.00852 |
|  |  | (0.00213) |  | (0.0106) |  | (0.00941) |
| Constant | -0.198*** | -1.390*** | -0.172 | -4.777*** | -0.0185 | -5.010*** |
|  | (0.0271) | (0.0696) | (0.123) | (0.362) | (0.0559) | (0.299) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Year | yes | yes | yes | yes | yes | yes |
| Ind | yes | yes | yes | yes | yes | yes |
| Observations | 8,104 | 8,104 | 6,128 | 6,128 | 8,104 | 8,104 |
| R-squared | | | | | 0.007 | 0.049 |

Notes: ***p<0.001, **p<0.01, *p<0.05

## (4) Instrumental variables approach

In order to address the potential endogeneity between the business environment and firms' "greenwashing," this paper employs a two-period lagged business environment indicator (lag2score) as an instrumental variable. As demonstrated in column (1) of Table 5, the coefficient of the business environment remains significantly positive at the 1% level following the introduction of a two-period lagged business environment as an instrumental variable. This indicates that the business environment can still exert a considerable influence on the extent of 'greenwashing' by firms, even after addressing the issue of endogeneity. This serves to validate Hypothesis 1 once more. Furthermore, the coefficients of the Anderson canon. corr. The LM statistic p-value is less than 0.01, indicating that the original hypothesis of insufficient identification of instrumental variables should be rejected. Similarly, the Cragg-Donald Wald F statistic is 132.756, which is greater than the critical value at the 10% level, suggesting that the original hypothesis of the existence of weak instrumental variables should also be rejected. These test results therefore indicate that the instrumental variables selected in this paper are valid and reasonable.

Table 6. Instrumental variable method regression results

| VARIABLES | (1)  firsts Score | (2) second GW |
|---|---|---|
| lag2score | 0.145*** | |
| | (11.39) | |
| Score | | -2.570** |
| | | (-2.28) |
| Shareholder | -0.000 | -0.000 |
| | (-1.46) | (-0.38) |
| Indep | -0.050*** | 0.018 |
| | (-5.42) | (0.13) |
| Size | 0.001 | 0.218*** |
| | (1.05) | (14.30) |
| Female | 0.030*** | 0.064 |
| | (3.98) | (0.61) |
| Tobin | 0.001 | 0.009 |
| | (1.60) | (0.82) |
| Constant | 0.267*** | -4.365*** |
| | (8.94) | (-8.32) |
| Year | yes | yes |
| Ind | yes | yes |
| Observations | 5,639 | 5,639 |
| R-squared | | 0.032 |

Notes: ***p<0.001, **p<0.01, *p<0.05

## 4.3 Analysis of the functioning mechanism

### (1) Information asymmetry

Degree of information asymmetry (ASY). Considering the serious lack of data on high-frequency trading in China's securities market, we refer to the study of Yu et al (2020) to construct the ASY information asymmetry index. The higher the degree of information asymmetry, the larger the value of ASY, while other conditions remain unchanged.

To prove hypothesis H3, this paper adopts a three-step method to regress the enterprise "greenwash" index (GW), the above information asymmetry degree (ASY) and the business environment index (Score) separately. The results are shown in Table 7 columns 1-2, which show the regression results of the enterprise greenwash index and the above degree of information

asymmetry (ASY) on the business environment index (Score). It is clear to see that at the 10% level, the coefficient between information asymmetry and enterprise greenwashing is positive, while the coefficient between the business environment index and the degree of information misalignment is negative. It indicates that the optimization of business environment reduces greenwashing by suppressing the degree of information asymmetry between enterprises and investors, which verifies the correctness of hypothesis H2.

**(2) Green innovation**

Following the means using by Hu et al (2022), this paper obtains the patent classification number information of invention patents and utility model patents of all A-share listed companies from the China Research Data Service Platform (CNRDS), and matches it with the "Green List of International Patent Classification" issued by the World Intellectual Property Organization (WIPO) in 2010; according to the matching results, the number of green patents obtained by the enterprises is obtained. Number of green patents obtained by enterprises. Then, we measure the level of firm's green innovation by calculating the logarithm of the number of green patents obtained by the firm plus one. The result is shown in the Table 7 Columns 3-4. It can be easily seen that the coefficient of green innovation (lnGP) in Column (1) is significantly positive at 5% level, and the coefficients of green innovation and business environment index in Column (1) is significant at 1% level, and the positive and negative signs are consistent with the overall hypothesis. The above regression results verify that optimizing the business environment can support enterprises' green innovation, high-quality development while reducing the greenwashing behavior of enterprises.

**(3) Financial Performance**

Referring to existing studies, this paper uses return on assets as a measure of corporate financial performance. And regression was conducted on the degree of corporate greenwashing, corporate performance and business environment index, the regression results are shown in Table 7 columns 5-6, the regression coefficient between corporate performance and business environment index is significantly negative at 1% level, at the same time, the regression coefficient with the business environment index is significantly positive at 1% level. It confirms the hypothesis H4 that Doing Business can reduce the bleaching green behavior of enterprises by improving their financial performance and relieving their financial pressure from inside.

Table 7. Results of the test of the mechanism of action

| VARIABLES | (1)<br>GW | (2)<br>ASY | (3)<br>GW | (4)<br>lnGP | (5)<br>GW | (6)<br>Roa |
|---|---|---|---|---|---|---|
| ASY | 0.0645* | | | | | |
| | (0.0339) | | | | | |
| lnGP | | | -0.0342** | | | |
| | | | (0.0161) | | | |
| Roa | | | | | -1.136*** | |
| | | | | | (0.188) | |
| Score | -0.683*** | -0.0808* | -0.658*** | 0.887*** | -0.615*** | 0.0644*** |
| | (0.142) | (0.0468) | (0.143) | (0.0986) | (0.143) | (0.00842) |
| Shareholder | -0.00111 | 0.00605*** | -0.000703 | 0.000445 | -8.01e-05 | 0.000562*** |
| | (0.000868) | (0.000277) | (0.000843) | (0.000584) | (0.000848) | (4.98e-05) |
| Indep | 0.0165 | -0.0422 | 0.0183 | 0.133** | 0.00939 | -0.00385 |
| | (0.0963) | (0.0316) | (0.0963) | (0.0667) | (0.0961) | (0.00569) |
| Size | 0.234*** | -0.327*** | 0.220*** | 0.215*** | 0.220*** | 0.00598*** |
| | (0.0166) | (0.00404) | (0.0128) | (0.00852) | (0.0123) | (0.000727) |
| Female | 0.0219 | -0.0734*** | 0.0119 | -0.155*** | 0.0408 | 0.0208*** |
| | (0.0825) | (0.0271) | (0.0825) | (0.0571) | (0.0824) | (0.00488) |
| Tobin | 0.0199* | -0.176*** | 0.00844 | -0.00244 | 0.0269*** | 0.0162*** |
| | (0.0111) | (0.00309) | (0.00940) | (0.00651) | (0.00987) | (0.000556) |
| Constant | -5.320*** | 6.927*** | -5.045*** | -5.028*** | -5.092*** | -0.193*** |
| | (0.387) | (0.101) | (0.319) | (0.213) | (0.310) | (0.0182) |
| Year | yes | yes | yes | yes | yes | yes |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ind | yes | yes | yes | yes | yes | yes |
| Observations | 8,104 | 8,104 | 8,104 | 8,104 | 8,104 | 8,104 |

Notes: ***p<0.001, **p<0.01, *p<0.05

## 4.4 Heterogeneity analysis

### (1) Heterogeneity effect on factor input

Capital-intensive enterprises are more dependent on capital than labor-intensive enterprises. The optimization of business environment promotes the rapid inflow of a large amount of capital., and compared with the time needed to attract labor to enter a region with a good business environment, the time lag of capital inflow is shorter, which can effectively improve the production and operation of capital-intensive industries, and reduce the greenwashing behavior of capital-intensive enterprises due to the lack of capital. Moreover, a sound business environment is a sign of high-quality development, which will guide the regional economy from labor-intensive to capital-intensive development, and capital-intensive industries are more suitable for the requirements of regional industrial upgrading, so the optimization of the business environment may squeeze the living space of labor-intensive industries, and instead of easing the negative impacts of the labor-intensive industries, the optimization of the business environment may even intensify the greenwashing of their enterprises to get the government's support for environmental protection. The optimization of business environment may squeeze the living space of labor-intensive industries, instead of alleviating the negative impact of labor-intensive industries, and may even cause them to intensify the degree of greenwashing to obtain government support for environmental protection.

In this paper, the sample is divided into two groups: capital-intensive industry enterprises and labor-intensive industry enterprises. The test results are shown in Table 8. The inhibitory effect of business environment optimization on greenwashing in the sample enterprises belonging to capital-intensive industries is significantly more significant than that of the sample enterprises in non-high-pollution industries, which fully verifies the above speculation.

Table 8. Heterogeneity analysis: production factor inputs

| VARIABLES | (1) Capital intensive GW | (2) GW | (3) Labor intensive GW | (4) GW |
|---|---|---|---|---|
| Score | -0.840*** | -0.935*** | -0.280 | -0.296 |
| | (0.190) | (0.185) | (0.226) | (0.226) |
| Shareholder | | -0.00106 | | 0.000462 |
| | | (0.00110) | | (0.00131) |
| Indep | | -0.107 | | 0.167 |
| | | (0.127) | | (0.149) |
| Size | | 0.264*** | | 0.123*** |
| | | (0.0165) | | (0.0189) |
| Female | | -0.212* | | 0.300** |
| | | (0.111) | | (0.123) |
| Tobin | | 0.0241* | | -0.00407 |
| | | (0.0144) | | (0.0124) |
| Constant | 0.0160 | -5.696*** | -1.635*** | -4.564*** |
| | (0.133) | (0.404) | (0.424) | (0.593) |
| Year | yes | yes | yes | yes |
| Ind | yes | yes | yes | yes |
| Observations | 4,680 | 4,680 | 3,424 | 3,424 |

Notes: ***p<0.001, **p<0.01, *p<0.05

### (2) Heterogeneity effect on high-tech industry

High-tech enterprises as an important force promoting the progress of social science and technology, at the same time, also shoulder more responsibility for promoting the green development of society. Firstly, nowadays, which highly emphasizes the harmony between man and nature, the research and application of green technology will attract the attention of the market,

and strive for high-tech enterprises to get the government's preferential policies in the field of green technology. Secondly, compared with non-high-tech enterprises, high-tech enterprises have a greater need to create a green corporate image, to consolidate their high-end image, but when some companies are not willing to spend money on the combination of green technology and their industries, companies will tend to cover up through the lower cost of greenwashing behavior. Therefore, it is necessary to test whether the improvement of business environment can help reduce the degree of greenwashing of high-tech industry enterprises.

In this paper, the variable tech is divided into two groups, tech=0 for non-high-tech enterprises and tech=1 for high-tech enterprises. The two groups of enterprises' greenwashing degree index (GW) and the business environment index (Score) were regressed separately. The regression results are Table 9. It can be easily seen that the degree of greenwashing of high-tech enterprises is significant at the 5% and 1% levels, respectively, which verifies the above inference.

Table 9. Heterogeneity analysis: non-high-tech - high-tech industries

| VARIABLES | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Non-high-tech | | High-tech | |
| | GW | GW | GW | GW |
| Score | -0.255 | -0.320 | -0.965*** | -0.802*** |
| | (0.206) | (0.203) | (0.204) | (0.201) |
| Shareholder | | -0.00444*** | | 0.00306** |
| | | (0.00113) | | (0.00124) |
| First | | 0.0258 | | -0.00464 |
| | | (0.128) | | (0.143) |
| Size | | 0.176*** | | 0.247*** |
| | | (0.0162) | | (0.0185) |
| Female | | -0.0222 | | 0.0155 |
| | | (0.116) | | (0.117) |
| Tobin | | 0.0256* | | 0.0108 |
| | | (0.0153) | | (0.0123) |
| Constant | -0.199 | -4.062*** | 0.0372 | |
| | (0.125) | (0.395) | (0.184) | |
| Year | yes | yes | yes | yes |
| Ind | yes | yes | yes | yes |
| Observations | 3,779 | 3,779 | 4,325 | 4,325 |

Notes: ***$p<0.001$, **$p<0.01$, *$p<0.05$

**(3) Heterogeneity effect on nature of property right**

The inhibitory effect of business environment optimization on firms' greenwashing behavior is particularly significant in the case of private firms, where the problem of "financing difficulties" is more pronounced. This is because a favorable business environment not only significantly ameliorates the financing constraints caused by property rights discrimination, but also provides a financial market with a more robust integrity system (Chowdhury & Masum, 2025). State-owned enterprises (SOEs) can gradually focus on important industries and key sectors related to the national economic lifeline through various methods, such as organizing, merging, and restructuring, with reduced market competitiveness and strong strengths reinforced by government subsidies (Zhang & Chen, 2017). In contrast, the lack of state-owned equity buffer makes private enterprises directly exposed to the business environment and more vulnerable to external shocks such as changes in the business environment. At the same time, characteristics such as the proportion of short-term debt leading to more financing discrimination against private enterprises (Wei et al., 2014; Chen et al., 2024). Optimizing the business environment can help private firms achieve their performance goals and attract more investment by taking advantage of the upward trend of the economy, thus reducing the "greenwashing" behavior of firms due to lack of capital.

The sample enterprises are divided into two groups according to its nature property right. And construct enterprise attribute variable (owner), when the listed company is a state-owned company, owner is assigned the value of 1; when the listed company

is a non-state-owned company, owner is assigned the value of 0. The results of the test are shown in Table 10. It can be easily seen that the inhibitory effect of business environment optimization on the greenwashing behavior of enterprises in the private enterprises is significantly more significant than that of the state-owned enterprises, which fully verifies the above speculation.

Table 10. Heterogeneity analysis: non-state-owned – state-owned

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Non-state-owned | | State-owned | |
| VARIABLES | GW | GW | GW | GW |
| Score | -1.177*** | -1.235*** | 0.298 | 0.191 |
| | (0.213) | (0.210) | (0.212) | (0.208) |
| Shareholder | | -0.00375*** | | 0.00277** |
| | | (0.00130) | | (0.00122) |
| Indep | | 0.0165 | | 0.167 |
| | | (0.163) | | (0.126) |
| Size | | 0.231*** | | 0.193*** |
| | | (0.0200) | | (0.0163) |
| Female | | -0.139 | | 0.227* |
| | | (0.113) | | (0.127) |
| Tobin | | 0.0146 | | 0.00375 |
| | | (0.0121) | | (0.0166) |
| Constant | -0.132 | -5.132*** | -0.0678 | -4.762*** |
| | (0.157) | (0.512) | (0.191) | (0.418) |
| Year | yes | yes | yes | yes |
| Ind | yes | yes | yes | yes |
| Observations | 3,874 | 3,874 | 4,000 | 4,000 |

Notes: ***p<0.001, **p<0.01, *p<0.05

## 5 Further analysis of policy impact

Considering the geographic advantages, industrial systems, market size, and existing reform foundations of various cities, the first batch of China's pilot cities for business environment innovation in 2021 were identified as Beijing, Shanghai, Chongqing, Hangzhou, Guangzhou, and Shenzhen. As a policy initiative aimed at optimizing the business environment, these pilot cities offer valuable practical insights for this study.

In this paper, we utilize panel data related to the pilot business environment innovation policies and enterprises' greenwashing behavior. Using a DID method, we analyze the impact of these policies on corporate greenwashing and construct the following Equation (5).

$$GW_{i,t} = \beta_0 + \beta_1 Treat_i \times Time_t + \delta_i Controls_{i,t} + IndustryFE + \varepsilon_{i,t} \qquad (5)$$

Among them, the firm's "greenwash" indicator $GW_{i,t}$ is the explanatory variable, the pilot policy $Treat_i \times Time_t$ is the explanatory variable, $Controls_{i,t}$ is the control variable, which is heterogeneous with the control variables in Table 2, we fix the industry, $\varepsilon_{i,t}$ is the random disturbance term. Since the time horizon of the data is 2015 to 2022 compared to the industry, the number is small and is cross-sectional. Therefore, only industry-fixed effects are taken and not year-fixed effects.

### 5.1 Parallel trend test and benchmark regression results

In this paper, the parallel trend test is conducted on the explanatory variable GW. Figure 1 exhibits the dynamic trend of the coefficient of GW under the 90% confidence interval. It can be seen that before the implementation of the pilot business environment innovation policy, there was a common trend in the degree of enterprise greenwashing in the treatment group and the control group, while the implementation of the pilot business environment innovation policy on greenwashing inhibition effect in the year. In conclusion, there was no significant difference between the treatment group and the control group before the implementation of the pilot policy of the Investment Service Center, which satisfies the parallel trend assumption.
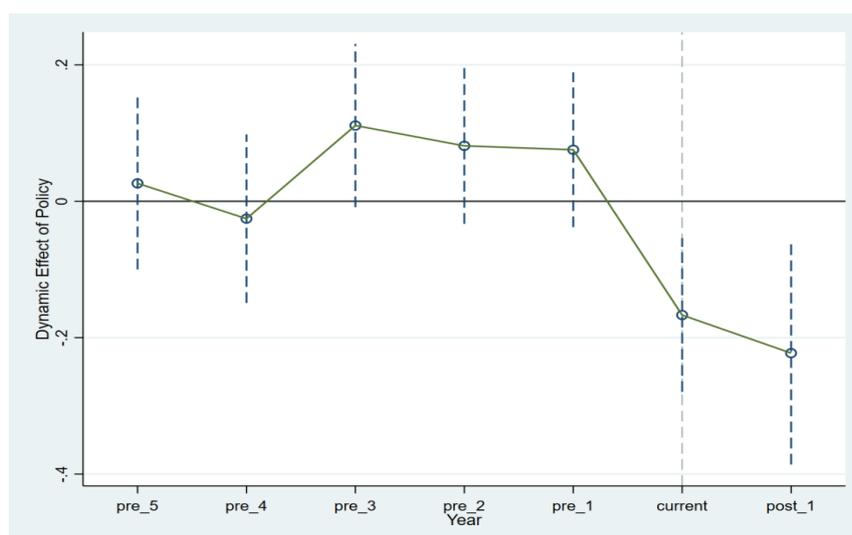
Figure 1. Parallel trend test for DID model

After the parallel trend test, columns 1-2 of Table 11 show the baseline results of the implementation of business environment policies affecting enterprises' greenwashing, and it can be seen that the implementation of the pilot policy on business environment innovation has a significant negative. The results show that the implementation of the pilot business environment innovation policy has a significant negative effect on greenwashing. Column (1) shows the regression results without control variables, and column (2) shows the regression results after adding control variables. The regression coefficients both pass the significance test at 1% level, indicating that the better the business environment is, the lower the degree of greenwashing, which again confirms hypothesis H1.

Table 11. Double Difference Regression Results

| VARIABLES | (1)  GW | (2)  GW |
|---|---|---|
| DID | -0.160*** | -0.198*** |
| | (0.0575) | (0.0564) |
| First | | -0.000502 |
| | | (0.000844) |
| Direct | | 0.0481 |
| | | (0.0961) |
| Size | | 0.212*** |
| | | (0.0123) |
| Female | | 0.0233 |
| | | (0.0827) |
| Tobin | | 0.00717 |
| | | (0.00941) |
| Constant | -0.309*** | -5.121*** |
| | (0.113) | (0.306) |
| Year | yes | yes |
| Ind | yes | yes |
| Observations | 8,104 | 8,104 |

Notes: ***p<0.001, **p<0.01, *p<0.05

## 5.2 Robustness test

Through the previous study, it was found that the Doing Business Innovation Pilot Policy has a dampening effect on enterprises' greenwashing behavior, but this may be the result of other policies or reasons. To further demonstrate the robustness of the random effects results, this paper adopts a counterfactual test to examine whether the core explanatory variables are still significant in the absence of the Doing Business Innovation Pilot Policy. If significant, it means that other unobserved factors

inhibit enterprises' greenwashing, and if not significant, it means that the inhibitory effect of the pilot business environment innovation on the greenwashing behavior of enterprises is robust and reliable. In this paper, the implementation year of the pilot business environment innovation policy is advanced by two years and then the regression is re-run, and the results are shown in Table 12. Columns 1-2 of Table 12 show the regression results of postponing the policy by two years. The cross-multiplier term is not significant in either regression, so the model can be judged to be largely consistent with the counterfactual assumptions.

Table 12. Time placebo test

| VARIABLES | (1) GW | (2) GW |
|---|---|---|
| DID_2 | -0.00852 | -0.0485 |
| | (0.0382) | (0.0376) |
| Shareholder | | -0.000542 |
| | | (0.000845) |
| Indep | | 0.0471 |
| | | (0.0962) |
| Size | | 0.212*** |
| | | (0.0123) |
| Female | | 0.0124 |
| | | (0.0828) |
| Tobin | | 0.00751 |
| | | (0.00942) |
| Constant | -0.301*** | -5.102*** |
| | (0.113) | (0.307) |
| Year | yes | yes |
| Ind | yes | yes |
| Observations | 8,104 | 8,104 |

Notes: ***p<0.001, **p<0.01, *p<0.05

To exclude that the findings of the article are a result of randomness, this paper conducts a placebo test by randomly repeating the firms in the sample 500 times. The results show that the regression coefficients obtained from the random model are distributed around 0. As shown in Figure 2, it is different from the regression coefficient of the benchmark regression of this paper(-0.198). These results indicate that the results of the benchmark regression of this paper are not random and have good robustness.
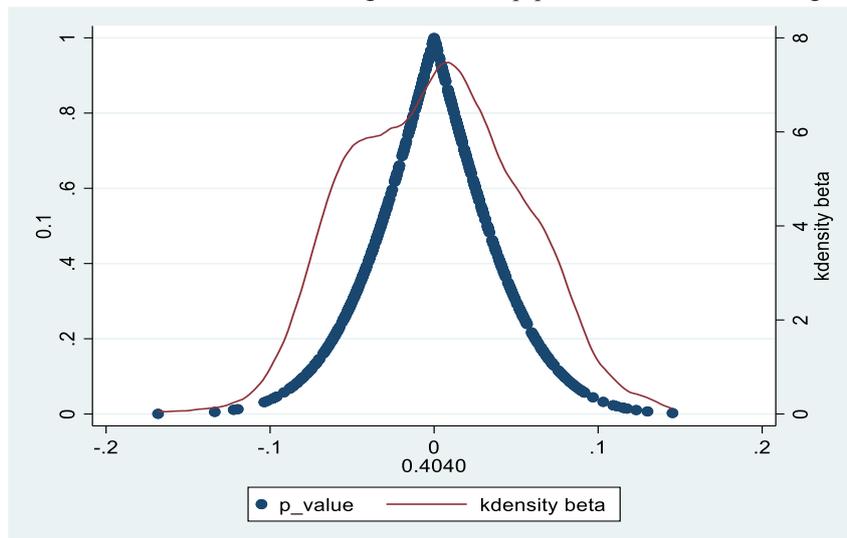


Figure 2. Placebo test

## 6 Conclusion

Based on the data of China's A-share non-financial listed companies from 2015 to 2022, we empirically analyze the impact of business environment on the degree of greenwashing of enterprises, and give the following conclusions: firstly, optimizing

the business environment can indeed inhibit greenwashing, and this conclusion still holds after a series of robustness tests. To a certain extent, optimizing the business environment reduces the investment and financing costs of enterprises, reduces the financing constraints of enterprises, and gives them more capital and advantages. It also effectively develops technology and services, enhances the competitiveness of enterprises, and attracts capital, which in turn reduces enterprises' greenwashing. Secondly, the heterogeneity analysis found that the effect of business environment on firms' greenwashing is more obvious in capital-intensive, high-tech and high-pollution enterprises. Finally, through the difference-in-difference model, we found that the pilot policy has a significant negative effect on the degree of greenwashing of enterprises in the pilot cities, which once again confirms that a good business environment has a significant negative effect on the degree of greenwashing. This again confirms the negative moderating effect of a good business environment on enterprises' greenwashing behavior.

Based on this, we give the following policy recommendations:

Government departments, firstly, should correctly recognize that a sound business environment has great potential value and a long-lasting positive regulatory effect on the development of enterprises in the region. They should constantly improve the various indicators of business environment, through financial support, policy guidance and high-quality development through propaganda methods, and optimize the business environment in each region, to create good economic development for enterprises. The governments need to grasp the successful experience of the pilot business environment innovation policy and apply the successful pilot experience to other regions to improve China's overall business environment and competitiveness. Secondly, while optimizing the business environment, the department should actively explore enterprise policies and regulatory measures to curb greenwashing. Moreover, they also need to increase the supervision and management of corporate greenwashing behavior, improve the ESG evaluation system, unify and refine the environmental information disclosure standards, make the evaluation indexes more scientific, and establish a penalty mechanism for enterprises' greenwashing behavior in ESG reports or environmental reports. The government can formulate corresponding policies to encourage enterprises to disclose information related to real green development and social responsibility, enhance the transparency of their operations, motivate enterprises to proactively build up an image of integrity, and enhance the trust between enterprises and investors. Actively mobilizing the news media, small and medium-sized shareholders and other sectors of society is also a good means the government to monitor the business activities of enterprises in greenwashing.

For enterprises, they should enhance the development of confidence and consciously assume social responsibility. Firms should correctly sort out the business environment optimization and green development of enterprises between the logical chain, and grasp the opportunities and challenges in business environment optimization. Through the financing facilitation, risk reduction, profitability, and other advantages brought by a sound business environment, to vigorously develop their own technology and service levels, to enhance their strength. Actively responding to the market requirements of high-quality development and the policy guidance of harmonious coexistence of man and nature, through the optimization of the green governance mechanism, to effectively improve the level of green development of enterprises to establish a true and credible image of green enterprises. Enterprises can set up a green supervision department and quantify the pollution of the enterprise activities and then add it to the evaluation of the manager's salary payment, which may remind managers to pay attention to the firm's green development while pursuing profitability.

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