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# Do green bonds increase "greenwashing" behavior in corporate green innovation?

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**Abstract：** Amid an increasingly severe environmental backdrop, green innovation has become a crucial direction for our country's development. Green bond policies, as market-based policy tools, play a significant role in alleviating financing pressures for green innovation and promoting environmental enhancement. This paper uses a sample of 4,484 A-share listed companies from 2009 to 2023 to empirically test and deeply analyze the impact and internal mechanisms of the "2021 Financial Institutions Green Finance Evaluation Scheme" on corporate environmental levels. The core innovations of this paper include: First, empirically investigating the impact and mechanism of the Scheme on corporate environment using a difference-in-differences model; Second, based on the baseline regression model, it empirically tests the Scheme's heterogeneous impact on corporate green innovation, and innovatively proposes that corporate R&D will transform into "strategic green innovation"; Third, from the perspective of information barriers, it innovatively proposes and tests the negative moderating role of digital technology in the aforementioned mechanism, indicating that the application of digital technology has enhanced firms' "strategic green innovation" under existing policies, and examined the heterogeneous effects of this mechanism in terms of equity structure and industry characteristics. The core conclusions of this paper indicate: (1) The implementation of the 2021 Scheme significantly enhanced corporate environmental levels; (2) The Scheme significantly reduced the development of corporate green utility patents, with firms more inclined to engage in "strategic green innovation," and the application of digital technology intensified this effect; (3) The aforementioned mechanism has differentiated impacts on firms with different equity structures and industry characteristics. Therefore, to further promote green bond policies, refine the green innovation regulatory framework, and actively eliminate information barriers between government and businesses, this paper provides scientific support for further promoting green bonds, improving the green innovation regulatory system, and eliminating information barriers between government and enterprises.

**Key Words：**

Green Bonds

Corporate Environmental Performance

Strategic Green Innovation

## 1. Introduction

The environmental governance situation is becoming increasingly severe due to long-term use of fossil fuels and the process of industrialization. According to the "Global Climate Status 2023" released by the World Meteorological Organization, by 2023, the global near-surface average temperature was 1.45℃ higher than the pre-industrial baseline. Against this backdrop, "carbon peaking and carbon neutrality" have gradually become a global consensus, making the improvement of environmental performance a key goal of environmental policy. In recent years, China has emphasized the development of sustainable energy technologies as a vital tool for environmental governance, with the core of sustainable energy development being green technology innovation. In 2017, China's State Intellectual Property Office issued the "Patent Priority Examination Management Measures" which emphasized prioritizing the development of green patents related to environmental protection. In 2022, the National Development and Reform Commission issued the "Implementation Plan for Further Improving the Market-Oriented Green Technology Innovation System," detailing initiatives in talent development and evaluation systems to promote green innovation. In 2023, the State Council released "Green Development in the New Era of China," which specifically called for increased investment in green innovation, positioning technological innovation as a driving force and safeguard for promoting green and low-carbon transformation.

However, green technology innovation faces severe budget constraints. In this context, green bonds provide substantial financial support for the development of green innovations. Compared to traditional command-and-control policies, market-based policy instruments offer advantages such as lower costs and higher efficiency (Barnett, 1980). Consequently, market-based tools like green finance have gradually become important means for governments to manage pollution and regulate corporate behavior (He et al., 2022). Among them, green bonds, which provide financial support for environmentally friendly projects (Flammer, 2021), have become one of the most important tools in the green finance system. In recent years, the role of green bonds in China has become increasingly significant. In 2015, the National Development and Reform

Commission issued the "Green Bond Issuance Guidelines"; in 2021, the People's Bank of China, the NDRC, and the China Securities Regulatory Commission jointly issued the "Green Bond Support Project Catalog (2021 Edition)", removing fossil fuel projects like coal from the support scope and standardizing green bond criteria; in 2022, the Central Clearing Company released the "Chinese Bond-Green Bond Environmental Benefit Disclosure Index System Corporate Standard," further perfecting the green bond index system in the Chinese market. That same year, according to statistics from the Climate Bonds Initiative (CBI), Chinese green bonds included in the CBI green bond database reached $85.4 billion, making it the largest green bond market in the world. However, due to characteristics such as low short-term economic benefits, high investment costs, and long investment return periods associated with environmental governance and low-carbon transition, implementing effective policy incentives has become a significant challenge. Against this backdrop, green bonds as market-based financing tools can effectively discount the long-term benefits of environmental improvement to short-term funds, providing strong financial support for the development of green innovations.

However, the lag in accompanying regulatory policies makes it difficult to ensure their effectiveness. In line with the theme of this paper, the lag in regulatory policies reflects both environmental governance and green innovation regulation. In environmental governance, the effectiveness of market-based policy tools like the Pigouvian tax depends on a comprehensive enterprise-level environmental data system. Yet, to date, China lacks a unified national environmental pollution index system for enterprises, making it difficult for the government to accurately measure corporate pollution and fully leverage the effectiveness of market-based policy tools. For example, in 2015, North China Pharmaceutical Group, based on its good environmental performance, became the first pilot unit for establishing an environmental management self-regulation system in Hebei Province. However, just one year later, in 2016, it was ordered by the government to cease production due to severe pollution, resulting in economic losses exceeding 50 million yuan. This illustrates how the absence of a corporate environmental indicator system makes it difficult for the government to accurately measure corporate environmental performance, thereby affecting the actual effectiveness of its policy tools. Moreover, in green innovation regulation, due to the inherently vague evaluation standards, difficulty of verification, and long practical cycles of green innovation, the regulation remains unclear. Specifically, even after four updates, China's Patent Law still has not provided precise standards for measuring green patents. At the same time, the specific regulatory bodies remain highly unclear, with common occurrences of overlapping regulation and ambiguous functions among different institutions across various cities. Under an imperfect regulatory system, the substantial funds brought about by green bonds provide incentives for corporate deception, which is a significant barrier China faces in this field (Shi et al., 2008). Such behavior is also referred to as "greenwashing." "Southern Weekend" even formed an annual "China Greenwashing List" by observing and collecting characteristics of Chinese companies' performances, with many companies like Sanyuan Foods making the list.

The widespread application of digital technology has also deepened the information barriers between governments and businesses. Due to the vast number of businesses, the diversity of green patents filed by them, and the technical thresholds of the patents themselves, it is difficult for the government to precisely evaluate each patent filed by all enterprises, indicating inherent information barriers between the government and businesses. For example, in 2015, Volkswagen was caught by the United States Environmental Protection Agency for embedding special software in vehicle engines to circumvent emissions tests. In the context of the rapid development of digital technologies like cloud computing, artificial intelligence, big data, and blockchain, enterprises as market players often learn and apply new specialized knowledge faster than governments, which leads to a lag in the application of digital technology between governments and businesses. However, due to the lack of a scientific and comprehensive enterprise-level environmental indicator system, the environmental performance and patent applications of companies are often based on data from their laboratories. The unequal application of digital technology further enhances the potential for businesses to engage in deceptive practices. For instance, using artificial intelligence, businesses can easily alter or generate highly realistic and difficult-to-detect images and videos through deepfake technology, thus facilitating deceptive practices during the filing of green patents and environmental performance reviews.

In summary, against the backdrop of an increasingly severe environmental situation, China has chosen the development of sustainable technologies centered on green innovation as a crucial tool for environmental governance, and has vigorously promoted green finance, particularly the development of the green bond system, to alleviate the financial constraints faced by green innovation. However, due to the lack of a unified and comprehensive environmental indicator system at the corporate level and significant gaps in the regulation of green innovation in terms of measurement standards, inspection methods, and regulatory bodies, businesses are more likely to engage in "strategic green innovation" to profit from the substantial financial incentives provided by green bonds, exploiting the information barriers between government and business. Furthermore, the differentiated application of digital technology between government and businesses may exacerbate these issues. Therefore, how to improve the aforementioned government regulatory system, reduce the information barriers between government and businesses, and enhance the effectiveness of green bonds has become a priority in China's environmental governance. This paper systematically analyzes the impact of green bonds on corporate environmental performance through a scientifically rigorous method, deeply examining its underlying mechanisms. It lays a theoretical foundation for subsequent research in related fields, provides scientific support for businesses to improve their environmental performance, and offers both theoretical and empirical support for the government to fully implement the green bond strategy and refine the green innovation regulatory system.

The marginal contribution of this paper is: first, it addresses the gap in existing literature concerning the impact of green bonds on corporate environmental performance. This paper utilizes the implementation of the 2021 "Green Finance Evaluation Scheme for Banking Financial Institutions" (hereinafter referred to as the "Scheme") to conduct a policy test, using corporate environmental responsibility performance (E) as the dependent variable, employing a difference-in-differences model (DID) with controls for both firm fixed effects and time fixed effects to reconstruct the baseline regression model for measuring the aforementioned issue, and empirically tests the effectiveness of this policy on corporate green performance, laying the groundwork for further research into the mechanisms by which green bonds impact the socio-economic landscape. Second, it supplements the research on the heterogeneity of corporate green innovation. Given the challenges in measuring corporate green patents, to avoid potential debates between "basic research and applied research," this paper innovatively employs the "green utility model technology" as an indicator to precisely identify substantial green innovations by enterprises and utilizes a difference-in-differences model, to empirically investigate how, under weaker regulatory constraints and stronger financial incentives, enterprises, driven by the need to maximize their own interests, significantly shift their motivation towards strategic green innovation, proposing a new approach to refining the green innovation regulatory system. Third, it enhances the research on corporate potential for deception and innovatively proposes the impact of digital technology applications on corporate potential for deception. This paper constructs an index of corporate digital transformation levels using web scraping technology, based on information barrier theories selected from existing literature, and introduces a new influence mechanism under the traditional "government-business" information barrier framework, where the heterogeneous distribution of digital technologies further intensifies the information barriers between governments and enterprises, providing new insights into reducing the information barriers between enterprises and the government.

## 2. Literature Review

Currently, research on the impact of green bonds on corporate environmental performance is scarce, and their mechanisms are not yet well-developed. Due to the profit-seeking nature of businesses, corporate decision-making primarily relies on profitability, while environmental regulations often come with significant economic costs (Greenstone et al., 2012), necessitating action by governments or market investors to incentivize businesses to enhance their environmental performance; From the government's perspective, the government can effectively reduce carbon emissions through partially market-based policy tools (Zaklan et al., 2023); From the investor's perspective, due to investors' decision preferences and other factors, there is a negative correlation between corporate value and carbon emissions, and companies that voluntarily disclose their carbon emissions tend to have a higher corporate value compared to those that do not disclose (Matsumura et al., 2014). However, as an emerging market financing tool, the role of green bonds in corporate environmental decision-making is not yet clear, and while some studies suggest a strong correlation between green bonds and better corporate environmental performance, research on their causal relationship is lacking (Flammer, 2021). Building on this, research on their impact mechanism is even more lacking, with traditional views suggesting that green bonds enhance a company's financing capabilities, thereby helping to improve its environmental performance. However, the proportion of green bonds in the overall bond market remains very limited (Taghizadeh-Hesary et al., 2019; Le et al., 2020), and they do not offer lower interest rates compared to other bonds (Flammer, 2021), making their role in alleviating corporate financing constraints controversial. Furthermore, given the crucial role of green innovation in improving the environment, research on how the financial incentives provided by green bonds affect corporate motives for green innovation is still in its infancy.

Additionally, the literature on the heterogeneity of green innovation is very limited. Existing studies generally agree that green innovation is crucial for corporate environmental performance and sustainable development (Carrión-Flores et al., 2010; Aghion et al., 2016), and Veugelers (2012) and Calel (2020) have also confirmed that appropriate governmental policy tools can motivate corporate green innovation. However, the motivation for corporate innovation does not always drive productivity; instead, innovation is often used as a “strategic” activity with less emphasis on the quality of the innovation (Kelm et al., 1995). Given substantial policy support and financial incentives, as well as the difficulty in measuring green innovation, there may be more “strategic” activities, i.e., more strategic green innovation. Strategic innovation, compared to substantial innovation, often involves lower costs and technology levels and does not genuinely foster technological progress (Li Wenjing et al., 2016). Meanwhile, research on the heterogeneity of corporate green innovation remains scarce. Specifically, like other innovations, in terms of evaluation criteria (i.e., patents), due to the existence of both basic and applied research, the measurement standards for patents cannot simply be based on their practical effects (Mansfield, 1986). Moreover, unlike other patents, green patents involve environmental issues with the characteristics of public goods (Hanemann, 1991), often requiring longer research and testing cycles and presenting greater challenges in verification, further expanding the opportunities for corporate deception. This also makes it difficult to conduct research on the heterogeneity of corporate green innovation.

Finally, existing research on the potential for corporate deception is still not fully developed. For example, Nagin et al. (2002) show through studies on employee-employer relationships that when employees perceive the marginal benefits to exceed costs, they engage in deceptive practices such as shirking, and a significant proportion of employees adjust their deceptive behaviors based on the extent of monitoring; Sliwka (2009) demonstrated that when participants profit from deception, other participants are more likely to lose trust in them; Houser et al. (2012) further found that when one party in a game receives an unfair payoff, they are more likely to cheat in the game to obtain a higher return. These cases all reveal that under lower regulatory constraints, corporations are more likely to engage in deception to maximize their own interests, yet research into corporate deception capabilities is still lacking. Existing research typically focuses on the differentiated deceptive capabilities displayed by firms and their impact on welfare (Ben-David, 2011; Jiang et al., 2014; Dee et al., 2019), but there is little exploration into the causes of these capabilities. For instance, Reynaert et al. (2021), based on studies of information barriers, indicate that the actual per unit carbon emissions from vehicles produced by automakers are significantly higher than the emissions claimed in their promotions, with the gap widening between 1998 and 2014.

Green bonds, as a form of green finance, have their impact on corporate environmental performance typically explained through signaling theory (Flammer, 2021). Specifically, as companies often have a better understanding of their own capabilities and characteristics than investors, the information barriers between companies and investors increase the transaction costs for investors in choosing their ideal companies, which is also reflected in the companies' environmental performance (Lyon et al., 2011). Therefore, companies can issue green bonds to send positive environmental signals to investors; with these signals, they can attract investors with environmental preferences, ultimately improving their performance in the financial market (Flammer, 2013; El Ghoul et al., 2011; Dyck et al., 2019). Based on signaling theory, companies need to establish credible signals to achieve the aforementioned pathway, necessitating better environmental performance. Furthermore, the increased financing provided by green bonds reduces budget constraints for companies, objectively enhancing their ability to improve environmental performance. In summary, although there is still a lack of research on the causal relationship between the issuance of green bonds and corporate environmental performance, this paper can make the following hypothesis:

H1: The issuance of green bonds has improved corporate environmental performance.

Existing research generally suggests that green bonds have a positive impact on corporate green innovation, with the mechanism often linked to financial constraints; that is, the relaxation of financial constraints facilitates corporate innovation (Himmelberg et al., 1994; Brown et al., 2009; Amore et al., 2013). However, innovation activities exhibit path dependence (Bernstein, 2015), where companies with a wealth of innovative technologies in a particular field tend to continue innovating due to reduced marginal costs, while those without a competitive advantage are more likely to cease innovating. This is equally applicable to green innovation, where companies with poorer environmental performance are more likely to reduce their green innovation compared to cleaner companies (Aghion et al., 2016; Amore et al., 2016). Building on this, the Porter Hypothesis (Porter et al., 1995) suggests that corporate green innovation may be closely related to regulatory policies, and Rennings (2000) further confirmed that neither technology push nor market incentives provide sufficient motivation for green innovative firms; instead, the environmental regulatory framework is the key driver of corporate green innovation. Based on this theory, due to the lack of unified national environmental regulatory data at the corporate level in China, government policies regulating corporate environmental performance are relatively backward and their effectiveness is questionable, casting doubt on their ability to motivate green innovation in businesses. Moreover, with substantial financial incentives, companies are more inclined to treat innovation as a "strategic" activity, i.e., acquiring policy subsidies through "strategic innovations" of poor quality and short duration (Li et al., 2016). Therefore, due to the long testing periods and difficulties associated with green innovation, the current lack of accurate, unified standards for green innovation, and the substantial policy incentives, it is more likely that businesses will engage in "strategic actions" relative to other types of innovation. Consequently, this paper proposes the following second core hypothesis:

H2: Due to the information barriers between enterprises and the government, delayed regulatory policies and substantial financial incentives make companies more inclined to engage in strategic green innovation.

Information barriers have long been considered a significant obstacle in addressing environmental issues (Lowe et al., 2009; Archie et al., 2012), with discussions on their causes including loss of information due to interdisciplinary communication (Feldman et al., 2009) and characteristics such as the timeliness of information (Dillings et al., 2011). Building on this, Reynaert (2021) empirically verified the existence of information barriers in environmental issues, with the previously mentioned 2015 Volkswagen emissions scandal and the 2016 North China Pharmaceutical incident also supporting this theory. Combining this theory with the previously argued correlation between green innovation and regulatory policies leads to the conclusion: the strengthening of information barriers will further promote "strategic innovative behavior" in enterprises. Moreover, due to operational pressures and other reasons, government application of new technologies often lags behind enterprises (West et al., 2009), particularly in the field of information and communication technologies (Ndou, 2004). Therefore, as a new technology highly related to information and communication technologies, the relatively delayed adoption of digital technologies by governments further strengthens the information barriers between enterprises and the government. In summary, this paper proposes the third research hypothesis:

H3: The differentiated use of digital technology between enterprises and governments has intensified the information barriers between them, further motivating enterprises to engage in strategic green innovation.

## 3. Research Design

### (1) Data

This paper selects Chinese A-share listed companies as the research sample, setting the study period from 2009 to 2023. To ensure data accuracy, this paper reviews and corrects outliers in the sample, ultimately obtaining panel data for 14 years from 4484 listed companies, totaling 42,196 observations.

**Explained Variable**

Corporate Environmental Performance ($E$). Given that China does not currently have a unified national environmental index system at the corporate level, this paper uses the environmental rating within the Environmental, Social, and Governance (ESG) framework as the dependent variable, where values are assigned to listed companies' environmental ratings from low to high to obtain observations.

**Explanatory Variable**

Implementation of the 2021 "Scheme"($did$). On July 1, 2021, the People's Bank of China issued the "Scheme," announcing the quarterly conduct of green finance evaluations and systematically establishing an evaluation index system, which includes both quantitative and qualitative indicators, with quantitative indicators weighted at 80% and qualitative indicators at 20%. Specific indicators are shown in Table 1. This marks the first time that a systematic implementation plan for green finance has been formulated in China, significantly expanding the channels for enterprises to obtain green bond financing and the total funds available from green bonds. Therefore, the implementation of the aforementioned policy has provided enterprises with a substantial incentive to improve environmental performance and engage in green innovation. It can be considered a positive external shock, thus this paper uses this event to measure the core mechanisms described earlier. Specifically, this paper constructs the following variables: '$du$' as an individual dummy variable, where $du$=1 indicates enterprises that have issued green bonds after July 1, 2021, and $du$=0 represents enterprises that have not issued green bonds after this policy milestone. '$dt$' is a time dummy variable, assigned a value of 1 in the year the policy takes effect and in subsequent years, and 0 otherwise.

Table 1 Evaluation Indicator System of the "Scheme"

| | |
|---|---|
| Quantitative Criteria (80%) | Proportion of Green Finance Business Total |
| | Proportion of Green Finance Business Total Share |
| | Year-on-Year Growth Rate of Total Green Finance Business |
| | Proportion of Total Green Finance Business Risk Amount |
| Qualitative Criteria (20%) | Implementation of Nation and Local Green Finance Policies (30%) |
| | Development and Implementation Status of Institutional Green Finance Regulations (40%) |
| | Financial Support for the Development of Green Industries (30%) |

**Mechanism Variables**

Corporate Green Innovation. Building upon the baseline regression model, this study primarily examines the impact of the "Plan" on corporate green innovation. Green patents are commonly used in literature to measure the capacity for green innovation. However, at least two debates exist regarding this measure. First, the debate arising from the diversity in patent types; for instance, some patents (also referred to as research patents) are not intended for commercial application and do not directly positively impact the environment, making it inappropriate to judge their actual effect based solely on direct environmental impact. Second, the criteria for green patents are vague, making it difficult to measure green innovation capabilities accurately due to long inspection periods and other characteristics. To precisely identify corporate green innovation capabilities, this paper selects two more accurately defined and higher standard variables: independent applications for green utility model patents ($green\_patent3$) and joint applications for green utility model patents ($green\_patent6$). According to the "Patent Law of the People's Republic of China," utility model patents, compared to other types, must have a definite physical form, thereby avoiding identification errors caused by patent type diversification. Furthermore, these patents are required to demonstrate greater practical value during evaluation, which also mitigates potential errors due to vague standards. Meanwhile, this paper also employs weaker practicality green invention independent patents ($green\_patent2$), to provide a comparative analysis of the aforementioned variables. Data for these mechanism variables are sourced from the CSMAR database.

Degree of Corporate Digital Transformation ($DCG$). To examine the role of digital technology in enhancing corporate capabilities, this study adopts the method used by Wu et al. (2021), utilizing Python web scraping techniques to collect and analyze the frequency of digital characteristic words in listed companies' annual reports. This approach has resulted in a comprehensive indicator of corporate digital transformation. The indicator's construction system includes sub-indicators of underlying technology applications such as Artificial Intelligence ($AI$), Big Data Technology ($DT$), Cloud Computing ($CC$), and Blockchain Technology ($BD$), along with a sub-indicator for Technological Practice Applications ($ADT$).

**Control Variables**

In line with existing studies and based on the research question and data availability of this paper, the following factors that significantly impact corporate environmental performance are controlled: the shareholding proportion of the largest circulating shareholder ($Shrcr1$), the logarithm of total corporate assets ($lnsize$), return on assets ($ROA$), debt-to-asset ratio ($DAR$), and the logarithm of the number of years the company has been listed ($lnAge$). The data for these control variables are sourced from the CSMAR database. Descriptive statistics for the aforementioned variables can be seen in Table 2.

Table 2 Descriptive Statistics for Key Variables

| VARIABLES | (1)<br>N | (2)<br>mean | (3)<br>sd | (4)<br>min | (5)<br>max |
|---|---|---|---|---|---|
| E_level | 42,196 | 1.913 | 1.147 | 1 | 9 |
| E | 42,195 | 60.30 | 7.602 | 29.46 | 95.16 |
| green_patent2 | 37,220 | 1.244 | 11.08 | 0 | 637 |
| green_patent3 | 37,220 | 0.742 | 5.359 | 0 | 368 |
| green_patent5 | 37,220 | 1.918 | 21.51 | 0 | 1,376 |
| green_patent6 | 37,220 | 0.999 | 7.364 | 0 | 421 |
| DAR | 42,177 | 0.459 | 1.268 | -0.195 | 178.3 |
| ROA | 42,175 | 0.0383 | 0.366 | -64.82 | 20.79 |
| Shrcr1 | 42,168 | 33.94 | 15.10 | 0.286 | 89.99 |
| lnsize | 42,177 | 6.101 | 1.520 | -4.770 | 15.19 |
| lnAge | 42,179 | 2.059 | 0.927 | 0 | 3.497 |
| DCG | 42,168 | 1.351 | 1.399 | 0 | 6.301 |
| AI | 42,168 | 0.357 | 0.768 | 0 | 5.852 |
| BD | 42,168 | 0.0218 | 0.163 | 0 | 3.584 |
| CC | 42,168 | 0.509 | 0.941 | 0 | 5.969 |
| DT | 42,168 | 0.489 | 0.878 | 0 | 5.694 |
| ADT | 42,168 | 0.908 | 1.114 | 0 | 6.040 |

**(2) Empirical Model**

To investigate the impact of the implementation of the 2021 "Scheme" on corporate environmental performance, this paper constructs and tests a difference-in-differences model (1), which controls for both year and individual fixed effects.

$$E\_level_{it} = \beta_0 + \beta_1 Treatment_i * Post_t + \sum \beta CVs + \delta_i + \lambda_t + \varepsilon_{it} \#(1)$$

In this model, the subscripts i and t represent the company and the year, respectively. The dependent variable is corporate environmental performance ($E\_level$); the key explanatory variable is the implementation of the 2021 "Scheme" ($Treatment_i * Post_t$); $CVs$ refer to the control variables mentioned previously; $\delta_i$ represents the firm−specific fixed effects; $\lambda_t$ represents the year-specific fixed effects; $\varepsilon_{it}$ is the random disturbance term.

## 4. Results

### (1) Baseline Regression Results

Table 3 displays the baseline regression results of the impact of the 2021 "Scheme" on corporate environmental performance. Columns (1) through (4) show the regression results controlled for different fixed effects, with column (4) incorporating both year and individual fixed effects. The regression results indicate that the coefficient for the core explanatory variable is 0.563, significantly positive at the 1% level, suggesting that the implementation of the 2021 "Scheme" significantly enhanced corporate environmental performance, with a notable increase of 56.3% following its implementation. This positive effect may be attributed to the "Scheme" enhancing incentives for banks to issue green bonds through improvements in the green bond management system and incentive standards, thereby increasing the scale of corporate green bond financing and alleviating budget constraints related to environmental performance. Furthermore, the significant positive coefficients for corporate debt-to-asset ratio ($DAR$) and total corporate assets ($lnsize$) also corroborate the positive impact of corporate finance on environmental performance.

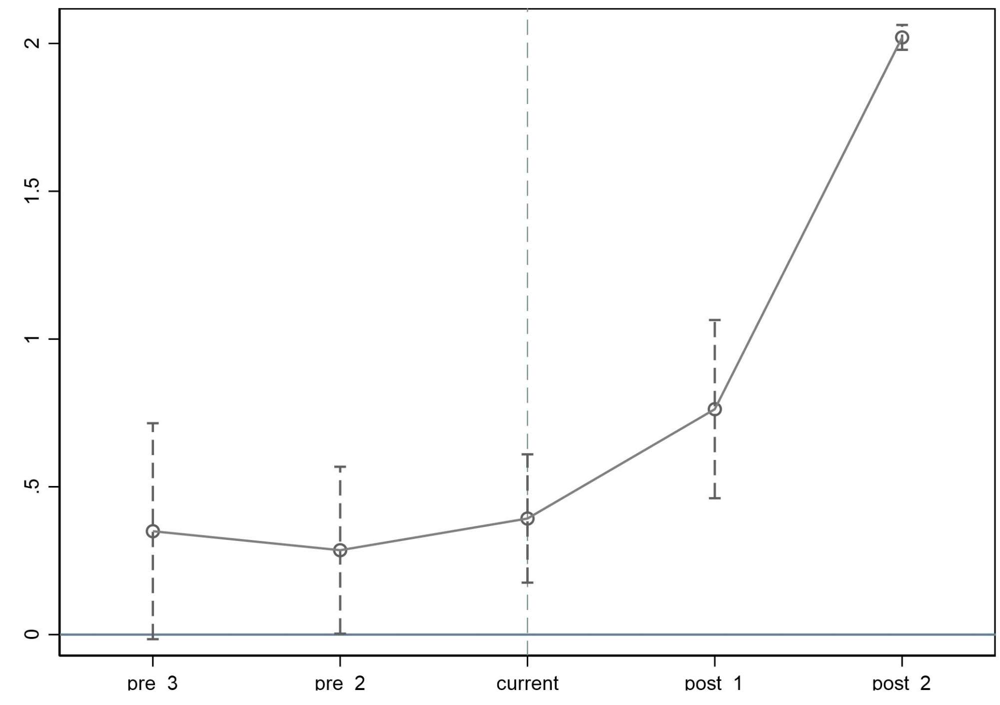
Table 3[1]

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | E_level | | | |
| did | 0.712*** | 0.639*** | 0.632*** | 0.563*** |
| | (9.25) | (8.27) | (9.83) | (8.75) |
| DAR | 0.006 | 0.011** | 0.010** | 0.010** |
| | (1.06) | (1.99) | (2.34) | (2.22) |
| ROA | -0.005 | 0.009 | 0.001 | 0.008 |
| | (-0.28) | (0.50) | (0.07) | (0.57) |
| Shrcr1 | -0.003*** | -0.002*** | -0.004*** | -0.003*** |
| | (-9.38) | (-6.75) | (-5.33) | (-3.95) |
| lnsize | 0.215*** | 0.202*** | 0.171*** | 0.086*** |
| | (55.68) | (52.03) | (22.07) | (10.22) |
| lnAge | -0.104*** | -0.101*** | 0.088*** | -0.158*** |
| | (-16.71) | (-16.42) | (8.27) | (-11.24) |
| Observations | 42,162 | 42,161 | 41,672 | 41,671 |
| R-squared | 0.076 | 0.089 | 0.544 | 0.556 |
| ID FE | NO | NO | YES | YES |
| year FE | NO | YES | NO | YES |

To ensure the scientific validity of the research conclusions, this study uses the year prior to the policy as the baseline group and conducts a parallel trends test on the baseline regression model. Figure 1 shows the results of this test. The findings indicate that the study's design passes the parallel trends test and that the 2021 "Scheme" had a significant positive impact on corporate environmental performance in the year of its issuance and subsequent years, thus confirming Core Hypothesis 1 of this paper.

Figure 1 Parallel Trends Test

[1] ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. The same applies to the table below.



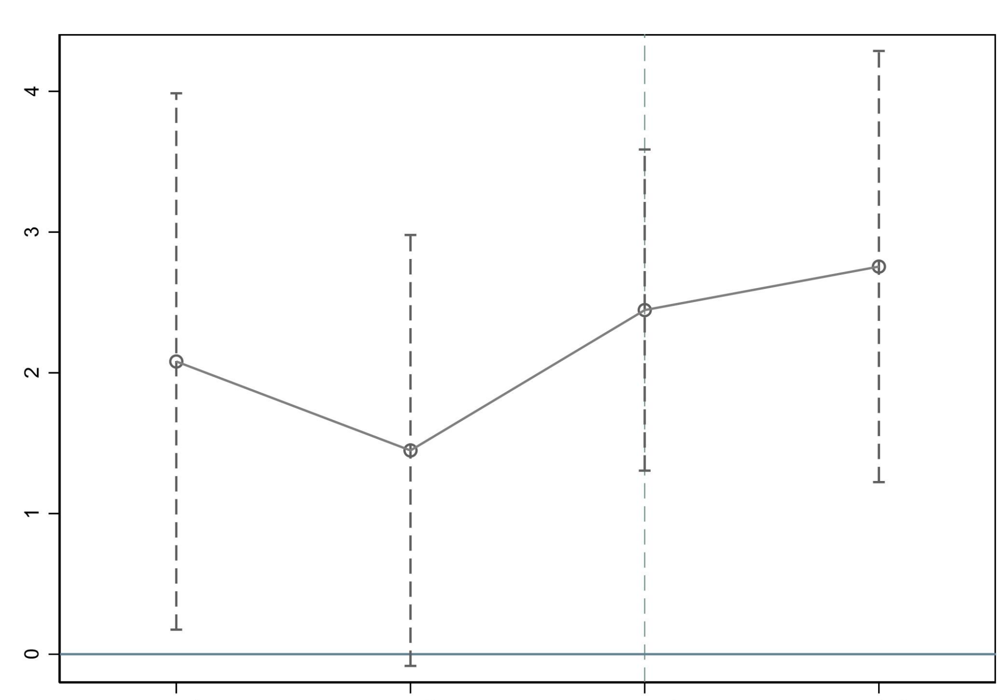

**(2) Robustness Test**

In light of existing research, this paper conducted robustness tests on the baseline regression model using different indicators. Given that environmental rating data may artificially reduce the variance of environmental performance among companies within the same rating, this study used environmental score data to replace the core dependent variable to test the robustness of the baseline regression results. Table 4 displays these regression results, and Figure 2 reports the parallel trends test results for this regression model. The regression results indicate that, even with the replacement of databases, the implementation of the 2021 "Scheme" significantly positively affected corporate environmental performance at the 1% significance level in all model regressions. These findings demonstrate strong robustness in the conclusions of the baseline regression of this paper.

Table 4

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | | E | | |
| did | 3.699*** | 2.627*** | 3.404*** | 2.170*** |
| | (7.28) | (5.17) | (8.43) | (5.41) |
| DAR | -0.002 | 0.030 | 0.066** | 0.066** |
| | (-0.06) | (0.86) | (2.44) | (2.48) |
| ROA | -0.032 | 0.066 | 0.021 | 0.074 |
| | (-0.26) | (0.55) | (0.23) | (0.82) |
| Shrcr1 | -0.022*** | -0.016*** | -0.020*** | -0.017*** |
| | (-8.99) | (-6.54) | (-4.80) | (-3.94) |
| lnsize | 1.550*** | 1.483*** | 1.261*** | 0.805*** |
| | (60.95) | (58.00) | (26.00) | (15.30) |
| lnAge | -0.847*** | -0.830*** | 0.470*** | -1.364*** |
| | (-20.75) | (-20.43) | (7.08) | (-15.60) |
| Observations | 42,161 | 42,161 | 41,671 | 41,671 |
| R-squared | 0.087 | 0.104 | 0.594 | 0.608 |
| ID FE | NO | NO | YES | YES |
| year FE | NO | YES | NO | YES |

Figure 2



## 5. Further Analysis

In the aforementioned studies, while it has been demonstrated that the implementation of the 2021 "Scheme" has a positive impact on corporate environmental performance, the mechanism linking it with green innovation has not been specifically analyzed. Given the significant role of green innovation in corporate environmental governance and the primary purpose of green bonds, this paper will further focus on the impact mechanism of the 2021 "Scheme" implementation on corporate green innovation. Before conducting empirical tests, a review of existing literature reveals substantial information barriers between enterprises and governments (Reynaert et al., 2021). Specifically, due to the vast number of enterprises regulated by local governments and the significant differences in the fields of green patents among different enterprises, coupled with the difficulty in measuring green patents as previously mentioned, it is challenging for government staff to accurately assess the actual green innovation performance of each enterprise. Moreover, as direct participants in the market, enterprises learn and apply new technologies and methods much faster than the government. Thus, the gap in the application of new methods and technologies between enterprises and governments further exacerbates the information barriers. A notable example is that various automobile brands manipulate laboratory conditions and data to achieve lower emission readings to pass emission tests or obtain policy subsidies. Reynaert et al. (2021) in their study of ten automobile brands found that the actual carbon emissions of these brands from 1998 to 2014 were significantly higher than those recorded in laboratory tests, and this disparity has grown over time, further confirming the information barriers between enterprises and governments.

**(1) Heterogeneity of Green Innovation**

Building on the aforementioned analysis, this paper examines the actual impact of the 2021 "Scheme" on green innovation. Initially, the paper uses the indicator of independent applications for green utility model patents ($green\_patent3$) to explore the effects of the 2021 "Scheme" on corporate green utility model patents, and employs the joint application indicator for green utility model patents ( $green\_patent6$ ) for robustness testing. Table 5 displays these results, with the relevant regression coefficients significantly negative at the 1% level, indicating that the implementation of the 2021 "Scheme" inhibited the production of corporate green utility model patents. However, considering corporate motivation and R&D capabilities, in the context of the flourishing development of green bonds, which significantly enhances financial incentives and eases budget constraints, the motivation and capability of companies to develop green patents should not decrease. Therefore, a possible explanation is that under specific incentives, the capability to develop this type of patent may have shifted to other patent types.

Table 5

| VARIABLES | (1)<br>green_patent3 | (2)<br>green_patent6 |
|---|---|---|
| did | -1.896*** | -4.015*** |
| | (-4.17) | (-6.96) |
| DAR | 0.006 | 0.009 |
| | (0.31) | (0.36) |
| ROA | 0.005 | 0.004 |
| | (0.08) | (0.04) |
| Shrcr1 | 0.002 | 0.001 |
| | (0.61) | (0.14) |
| lnsize | 0.075* | 0.115** |
| | (1.83) | (2.21) |
| lnAge | 0.041 | 0.010 |
| | (0.60) | (0.11) |
| Observations | 36,717 | 36,717 |
| R-squared | 0.584 | 0.645 |
| ID FE | YES | YES |
| year FE | YES | YES |

To test this hypothesis, this paper selected another type of patent indicator for examination, namely, green invention patents. Similarly to the previous section, the paper uses the indicator for independent applications of green invention patents ($green\_patent2$) to empirically explore the impact of the 2021 "Scheme" on corporate green invention patents. Table 6 reports these results, with the relevant regression coefficients being significantly positive at the 1% level. This indicates that the implementation of the 2021 "Scheme" significantly enhanced the development of green invention patents by corporations. These findings support the notion of a shift in corporate motivation towards the development of different types of green patents.

Table 6

| VARIABLES | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | green_patent2 | | | |
| did | 2.783** | 3.281*** | 2.839*** | 3.258*** |
| | (2.27) | (2.66) | (2.83) | (3.22) |
| DAR | 0.084 | 0.085 | 0.016 | 0.013 |
| | (1.59) | (1.62) | (0.37) | (0.29) |
| ROA | 0.036 | 0.046 | 0.023 | 0.044 |
| | (0.20) | (0.25) | (0.15) | (0.30) |
| Shrcr1 | -0.016*** | -0.016*** | 0.005 | 0.010 |
| | (-4.19) | (-4.13) | (0.62) | (1.32) |
| lnsize | 1.433*** | 1.428*** | 0.360*** | 0.056 |
| | (35.64) | (35.00) | (4.37) | (0.62) |
| lnAge | -0.521*** | -0.528*** | 0.439*** | -0.132 |
| | (-7.95) | (-8.02) | (3.80) | (-0.86) |
| Observations | 37,198 | 37,198 | 36,717 | 36,717 |
| R-squared | 0.035 | 0.035 | 0.517 | 0.518 |
| ID FE | NO | NO | YES | YES |
| year FE | NO | YES | NO | YES |

It should be noted that, according to documents from the National Intellectual Property Administration, compared to green utility model patents, green invention patents are reviewed with significantly less emphasis on practicality and more focus on innovation. However, due to the lack of clear and definite criteria for green patents and the long inspection periods characteristic of green patents, combined with a series of policy incentives for priority examination and approval of green patents initiated by the National Intellectual Property Administration since 2017, the impact of non-practical green invention patents on the corporate environment is very limited. One possible explanation is that the accumulation of such patents, which are more aligned with non-commercial purposes typical of research-type patents, helps companies make breakthroughs in practical patents. However, combining the coefficients from Tables 6 and 7, one can even draw a conclusion contrary to theory: the accumulation of green invention patents (research-type) has led to a decrease in the number of green utility model patents. This significant reduction, coupled with a significantly increased budget, cannot be explained by budget constraint theory, which further indicates the presence of deceptive green innovation practices among enterprises under China's unique constraints, thereby confirming Core Hypothesis 2 of this paper.

**(2) Application of Digital Technology**

Building on the aforementioned analysis, this paper uses a moderating effect model to explore the moderating effects of the degree of corporate digitalization and its specific technology areas on the mechanisms impacting corporate environmental responsibility. It further investigates the mechanisms through which the use of digital technology affects these mechanisms. Table 7 displays these results. Column (1) shows the moderating effect of corporate digitalization level on corporate environmental responsibility after the implementation of the "Scheme", where N is the interaction term between corporate digital transformation and the difference-in-differences variable ($Treatment_i * Post_t$). Columns (2) to (5) respectively show the moderating effects of five types of digital technologies: Artificial Intelligence ($AI$), Big Data Technology ($DT$), Cloud Computing ($CC$), Blockchain Technology ($BD$), and Technology Practice Application ($ADT$) after the implementation of the "Scheme", where N1 to N5 are their respective interaction terms with the difference-in-differences variable.

Table 7

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Green_patent2 | | | | | |
| did | -7.559*** | -1.688 | 3.321*** | -5.162*** | -3.779*** | -6.445*** |
| | (-4.95) | (-1.47) | (3.26) | (-4.38) | (-3.01) | (-4.87) |
| DCG | 0.442*** | | | | | |
| | (6.72) | | | | | |
| N | 7.684*** | | | | | |
| | (9.54) | | | | | |
| DAR | 0.010 | 0.010 | 0.013 | 0.011 | 0.009 | 0.011 |
| | (0.24) | (0.22) | (0.29) | (0.26) | (0.21) | (0.26) |
| ROA | 0.055 | 0.063 | 0.045 | 0.053 | 0.051 | 0.050 |
| | (0.37) | (0.43) | (0.30) | (0.36) | (0.35) | (0.34) |
| Shrcr1 | 0.012 | 0.014* | 0.010 | 0.011 | 0.012* | 0.010 |
| | (1.59) | (1.86) | (1.33) | (1.55) | (1.67) | (1.40) |
| lnsize | -0.044 | -0.086 | 0.053 | -0.018 | -0.045 | -0.003 |
| | (-0.48) | (-0.94) | (0.58) | (-0.20) | (-0.49) | (-0.03) |
| lnAge | -0.220 | -0.293* | -0.136 | -0.200 | -0.241 | -0.202 |
| | (-1.42) | (-1.90) | (-0.88) | (-1.29) | (-1.56) | (-1.31) |
| AI | | 1.361*** | | | | |
| | | (13.57) | | | | |
| N1 | | 16.938*** | | | | |
| | | (9.66) | | | | |
| BD | | | 0.405 | | | |
| | | | (1.07) | | | |
| N2 | | | -5.627 | | | |
| | | | (-0.45) | | | |
| CC | | | | 0.611*** | | |
| | | | | (6.58) | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| N3 | | | | 25.728*** | | |
| | | | | (13.94) | | |
| DT | | | | | 0.711*** | |
| | | | | | (8.04) | |
| N4 | | | | | 11.327*** | |
| | | | | | (9.54) | |
| ADT | | | | | | 0.387*** |
| | | | | | | (5.31) |
| N5 | | | | | | 10.100*** |
| | | | | | | (11.39) |
| Observations | 36,717 | 36,717 | 36,717 | 36,717 | 36,717 | 36,717 |
| R-squared | 0.520 | 0.522 | 0.518 | 0.522 | 0.521 | 0.521 |
| ID FE | YES | YES | YES | YES | YES | YES |
| year FE | YES | YES | YES | YES | YES | YES |

Among the columns, except for column (3), the coefficients of the interaction terms in the other columns are significantly positive at the 1% level. This indicates that the degree of corporate digitization and its subdivided technologies such as artificial intelligence, big data, blockchain, and applied tech practices significantly enhanced the shift in R&D momentum from green utility model patents to green invention patents due to the implementation of the "Scheme". Given that theories on this phenomenon are not yet unified, this paper adopts the viewpoint of Reynaert et al. (2021), interpreting the phenomenon from the perspective of information barriers. Due to the vast number of companies and significant heterogeneity among them, clear information barriers exist between the government and businesses, which often lead to corporate deceit in environmental issues such as carbon emissions through the manipulation of laboratory data. Furthermore, government employees, compared to front-line R&D staff, focus more on social management and possess relatively lower expertise in specialized fields, which could accentuate information barriers in areas requiring high expertise such as green patents. On this basis, as the primary agents in market activities, corporations' profit-driven needs lead them to adopt and apply emerging technologies much faster than government officials, resulting in a significant lag in the adoption of new technologies like digital technologies within government sectors. The use of digital technologies such as artificial intelligence significantly enhances corporate capabilities to deceive. For instance, in the Volkswagen emissions case, companies had to install actual control programs to regulate vehicle emissions; however, with AI, companies could easily simulate specific emission reductions at certain times through algorithms. This logic also aligns with the findings of Reynaert et al., where the discrepancy in carbon emissions across different car brands has significantly increased over time, thus validating Core Hypothesis 3 of this paper.

## 6. Heterogeneity Analysis

**(1) Corporate Equity**

This paper categorizes the sample based on the nature of corporate equity into state-owned enterprises (SOEs) and non-state-owned enterprises, and further divides SOEs into central and local SOEs for heterogeneity analysis. Table 8 reports these results. Columns (1) to (4) sequentially show the heterogeneous effects of the "Scheme" implementation on the environmental performance of state-owned, central, local, and non-state-owned enterprises, respectively. The regression coefficients are significantly positive, indicating that the implementation of the aforementioned policy has had a positive impact on the environmental levels of enterprises with different equity structures.

Table 8

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | E_level | | | |
| | SOE | CSOE | LSOE | Non-SOE |
| did | 0.503*** | 0.580** | 0.458*** | 0.585*** |
| | (5.22) | (2.54) | (4.22) | (3.43) |
| DAR | -0.066 | -0.342 | -0.083 | 0.008* |
| | (-1.19) | (-1.30) | (-1.44) | (1.85) |
| ROA | -0.125 | -0.878** | -0.102 | 0.007 |
| | (-1.53) | (-2.25) | (-1.23) | (0.47) |
| Shrcr1 | -0.004*** | -0.004 | -0.005*** | -0.002** |
| | (-3.75) | (-1.27) | (-3.69) | (-2.33) |
| lnsize | 0.101*** | 0.123** | 0.113*** | 0.064*** |
| | (6.65) | (2.10) | (6.86) | (5.73) |
| lnAge | 0.153*** | 0.416*** | 0.114*** | -0.238*** |
| | (4.49) | (3.34) | (3.15) | (-13.84) |
| Observations | 13,809 | 1,678 | 12,090 | 22,936 |
| R-squared | 0.615 | 0.665 | 0.613 | 0.635 |
| ID FE | YES | YES | YES | YES |
| year FE | YES | YES | YES | YES |

Building on this, the paper also examines the heterogeneous effects of the "Scheme" implementation on green utility model patents across different equity types of enterprises, as reported in Table 9. Columns (1) to (4) consecutively display the regression results for state-owned enterprises, central SOEs, local SOEs, and non-state-owned enterprises. The coefficients for state-owned enterprises are not significant, while those for non-state-owned enterprises are significantly negative at the 1% level. This indicates that under policy incentives, non-state-owned enterprises are more inclined to engage in strategic green innovation for profit. This tendency may relate to two factors. First, compared to non-state-owned enterprises, state-owned enterprises face less pronounced profit incentives; they are not primarily driven by profit maximization and must consider the national interest in their decision-making, reducing their motivation for strategic green innovation. Second, state-owned enterprises face stricter policy constraints compared to non-state-owned ones. Since the ownership of these enterprises belongs to the state, beyond traditional legal constraints, they are subject to stricter governmental regulation, and the information barriers between them and the government are relatively weaker, increasing the costs of engaging in such behaviors.

Table 9

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | green_patent3 | | | |
| | SOE | CSOE | LSOE | Non-SOE |
| did | -0.855 | 0.135 | -0.869 | -5.496*** |
| | (-1.36) | (0.10) | (-1.21) | (-7.88) |
| DAR | -0.262 | 0.098 | -0.317 | 0.006 |
| | (-0.89) | (0.08) | (-1.01) | (0.38) |
| ROA | -0.181 | 0.208 | -0.189 | 0.009 |
| | (-0.42) | (0.11) | (-0.42) | (0.19) |
| Shrcr1 | -0.004 | -0.003 | -0.002 | 0.007** |
| | (-0.62) | (-0.17) | (-0.25) | (2.22) |
| lnsize | 0.123 | -0.025 | 0.159* | 0.068* |
| | (1.49) | (-0.09) | (1.75) | (1.71) |
| lnAge | -0.027 | 0.045 | -0.031 | 0.072 |
| | (-0.14) | (0.07) | (-0.15) | (1.16) |
| Observations | 13,388 | 1,610 | 11,734 | 22,362 |
| R-squared | 0.635 | 0.750 | 0.617 | 0.569 |
| ID FE | YES | YES | YES | YES |
| year FE | YES | YES | YES | YES |

**(2) Industry**

Since corporate environmental responsibility is closely related to the industry in which a company operates, and the issuance of green bonds varies significantly across industries, this paper will conduct an industry heterogeneity analysis, discussing the differences between manufacturing and non-manufacturing industries, as well as between heavily polluting and non-heavily polluting industries.

**Manufacturing and Non-Manufacturing Industries**

As a core industry of the nation, manufacturing tends to place greater emphasis on technical practices compared to other industries. Additionally, manufacturing companies, involved in specific product production phases and constrained by facilities and equipment, tend to have more stable environmental performance that is less susceptible to change. This paper conducted a heterogeneity study on manufacturing and non-manufacturing enterprises, with results shown in Table 10. The related regression coefficients for both manufacturing and non-manufacturing enterprises are significantly positive, indicating that the implementation of the "Scheme" has significantly improved the environmental performance of both sectors.

Table 10

| | (1) | (2) |
|---|---|---|
| VARIABLES | E_level | |
| | Manu | Non-Manu |
| did | 0.429*** | 0.566*** |
| | (3.59) | (7.30) |
| DAR | 0.009** | 0.012 |
| | (1.99) | (1.30) |
| ROA | 0.013 | 0.013 |
| | (0.47) | (0.57) |
| Shrcr1 | -0.003*** | -0.002 |
| | (-3.21) | (-1.43) |
| lnsize | 0.149*** | 0.081*** |
| | (12.18) | (5.52) |
| lnAge | -0.218*** | -0.097*** |
| | (-12.60) | (-3.82) |
| Observations | 26,532 | 15,101 |
| R-squared | 0.578 | 0.559 |
| ID FE | YES | YES |
| year FE | YES | YES |

Moreover, this paper further examined the heterogeneous effects of strategic green innovation mechanisms between the two sectors, with results reported in Table 11. The related regression coefficient for manufacturing enterprises is not significant, while for non-manufacturing enterprises, it is significantly negative at the 1% level. This indicates that non-manufacturing enterprises are more inclined to engage in strategic green innovation under policy incentives. This phenomenon may be due to manufacturing enterprises placing a greater emphasis on technical practices compared to non-manufacturing enterprises, making the patent effects of manufacturing enterprises easier to verify and thereby increasing their potential costs of deception.

Table 11

| | (1) | (2) |
|---|---|---|
| VARIABLES | green_patent3 | |
| | Manu | Non-Manu |
| did | -1.124* | -2.595*** |
| | (-1.84) | (-4.09) |
| DAR | 0.110 | 0.010 |
| | (0.51) | (0.43) |
| ROA | -0.086 | 0.015 |
| | (-0.19) | (0.21) |
| Shrcr1 | -0.009 | 0.008* |
| | (-1.64) | (1.89) |
| lnsize | 0.067 | 0.119** |
| | (0.81) | (2.25) |
| lnAge | 0.105 | 0.030 |
| | (0.81) | (0.35) |
| Observations | 10,411 | 26,252 |
| R-squared | 0.497 | 0.607 |
| ID FE | YES | YES |
| year FE | YES | YES |

**Heavily Polluting and Non-Heavily Polluting Industries**

Heavy-polluting industries and non-heavy-polluting industries differ significantly in their environmental costs, which in turn affects factors related to their environmental responsibility performance. Referencing existing studies, this paper classifies industries into heavy and non-heavy polluting categories based on the Ministry of Environmental Protection's 2008 "Listed Companies Environmental Protection Inspection Industry Classification Management Directory", "Guidelines for Environmental Information Disclosure of Listed Companies", and the China Securities Regulatory Commission's 2012 revised "Industry Classification Guidelines for Listed Companies". Table 12 reports these results, showing that both heavy and non-heavy polluting industries significantly improved their environmental performance under policy incentives. Similarly, this paper also examined the impact of strategic green innovation under policy incentives on the aforementioned enterprises. Table 13 reports these results, indicating no significant differential effects between them.

Table 12

| | (1) | (2) |
|---|---|---|
| VARIABLES | E_level | |
| | Heavily | Non-Heavily |
| did | 0.619*** | 0.539*** |
| | (6.39) | (6.37) |
| DAR | 0.051 | 0.008* |
| | (1.04) | (1.80) |
| ROA | -0.038 | 0.008 |
| | (-0.38) | (0.51) |
| Shrcr1 | -0.004*** | -0.002** |
| | (-3.32) | (-2.53) |
| lnsize | 0.123*** | 0.089*** |
| | (6.74) | (8.39) |
| lnAge | -0.196*** | -0.158*** |
| | (-6.97) | (-9.53) |
| Observations | 11,682 | 29,956 |
| R-squared | 0.586 | 0.557 |
| ID FE | YES | YES |
| year FE | YES | YES |

Table 13

| | (1) | (2) |
|---|---|---|
| VARIABLES | E_level | |
| | Heavily | Non-Heavily |
| did | -4.431*** | -1.026** |
| | (-4.87) | (-2.24) |
| DAR | 0.007 | -0.001 |
| | (0.27) | (-0.02) |
| ROA | 0.030 | -0.005 |
| | (0.21) | (-0.05) |
| Shrcr1 | 0.009* | -0.006 |
| | (1.79) | (-1.16) |
| lnsize | 0.234*** | -0.026 |
| | (3.50) | (-0.44) |
| lnAge | -0.060 | 0.190* |
| | (-0.62) | (1.81) |

| | | |
|---|---|---|
| Observations | 23,246 | 13,399 |
| R-squared | 0.609 | 0.492 |
| ID FE | YES | YES |
| year FE | YES | YES |

## 7. Conclusions

Since the 18th National Congress, environmental governance has gradually become one of China's key issues, with existing studies identifying green innovation as a core element in addressing this issue. Green bonds, as market-based green financial instruments, provide substantial funding for companies to develop green innovations and improve environmental performance. However, given China's still imperfect green innovation regulatory system and the inherently difficult-to-monitor nature of green innovation, how to prevent companies from profiting through deceit and correctly guiding their green innovation motivations remains a pressing issue. Against this backdrop, this paper, using data from 4,484 listed companies on China's A-share market from 2009 to 2023, examines the impact and mechanisms of the 2021 "Scheme" on corporate environmental levels. The main conclusions are as follows: (1) The enactment of the 2021 "Scheme" significantly improved corporate environmental levels by enhancing the green bond regulatory framework and banking sector bond issuance incentives, thereby expanding green financing channels and increasing green financing scale; (2) The enactment of the 2021 "Scheme" significantly reduced the development of corporate green utility model patents, indicating strategic green innovation deceptions due to imperfect regulatory policies and budget incentives. Specifically, the study shows that after the implementation of the "Scheme," companies shifted their research focus to green invention patents, which require less practicality, but this did not lead to the expected increase in practical green patents, and even had a negative effect; (3) The use of digital technologies facilitated the emergence of the aforementioned strategic innovations. The latency in the application of digital technologies between governments and enterprises further reduced the potential risk costs of corporate deceit, thereby promoting strategic green innovation; (4) Heterogeneity analysis indicates that the aforementioned mechanisms have differential impacts on companies with different equity structures, executive characteristics, and industry traits, with non-state-owned and non-manufacturing enterprises being more inclined to engage in strategic green innovation under policy incentives.

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