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# A Study of the Impact of Digital Technology Innovation on Corporate Greenwash Behaviour

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***Abstract:*** *The study finds that digital technological innovation has a significant impact on corporate greenwashing behavior. First, technological empowerment enhances the transparency and traceability of corporate environmental information, thereby reducing the motivation for "greenwashing" at its source. Second, in terms of supervision and constraints, digital technology breaks the information asymmetry barrier in traditional environmental governance, forming a dynamic tracking and multi-stakeholder collaborative supervision mechanism for corporate environmental behavior. Theoretically, this study offers new insights into environmental information disclosure and green financial supervision. Practically, the research offers policy implications for government departments to construct a "technology-driven" environmental supervision framework and for enterprises to improve their ESG management systems.*

***Keywords:*** *Digital Technology Innovation; Corporate Greenwash Behaviour; Monitoring and Constraining Mechanism*

## 1. Introduction

With the escalation of global climate change and the growing severity of environmental issues, sustainable development and environmental protection have emerged as a universal consensus in the international community. Enterprises and organizations are now under increasing pressure from the global community, governments, and consumer groups, compelling them to adopt tangible environmental protection measures. Corporate greenwashing refers to the practice where enterprises falsify or whitewash environmental pollution-related conduct to cultivate a favorable eco-image and secure related benefits. Traditionally confined to the marketing domain, "greenwashing" has evolved with the rise of ESG reporting, taking on more professional and covert forms.

Digital technological innovation enables enterprises to achieve economic benefits while enhancing resource efficiency, reducing energy consumption, and minimizing pollution emissions, thus fostering green development and facilitating the formulation of scientifically sound green strategies. As digital technology advances rapidly and public digital literacy improves, it has become a powerful tool for monitoring corporate greenwashing, significantly enhancing the transparency of environmental information. Mandatory disclosure mechanisms ensure the authenticity and non-tamperability of such data.

In an increasingly competitive market landscape, a strong environmental reputation can generate substantial goodwill for enterprises, prompting many to adopt proactive eco-measures. However, the practical implementation of environmental protection often incurs significant costs, driving some enterprises to resort to fraudulent environmental practices to protect their interests.

Theoretically, existing research on the economic impacts of digital innovation primarily focuses on high-tech R&D, leveraging technology to boost productivity and reduce resource consumption. This study also expands the discourse on factors influencing greenwashing, which has traditionally centered on four dimensions: institutional environment[1], market dynamics[2], cost pressures[3], and information asymmetry coupled with the lack of third-party certification[3]. Notably, few studies have explored the impact of digital technological innovation on greenwashing behaviors.

Practically, this research contributes to the advancement of digital innovation applications by focusing on the "evaluation" and "supervision" roles of digital technology in curbing greenwashing. It aims to eliminate blind spots for greenwashing, refine standards for identifying such practices, and

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expand the depth and breadth of digital innovation applications, thereby promoting the comprehensive development of this field.

## 2. Assumption development

### *2.1 The impact of digital technology innovation on enterprise "greenwashing" behaviour*

Digital technological innovation can improve the quality of enterprise internal control, digital technological innovation through the reduction of agency costs, increase the proportion of institutional investors, improve enterprise green performance and ease the information asymmetry of enterprises, improve the quality of enterprise internal control. In turn, high-quality internal control can inhibit corporate greenwash through strengthening internal supervision, standardising the decision-making process and improving the quality of information disclosure. Therefore, digital technology innovation plays an important role in improving the quality of corporate internal control and suppressing corporate greenwash behaviour. Therefore, digital technology innovation can improve the quality of internal control and reduce the "greenwash" behaviour of enterprises. Based on this, this paper proposes the following hypothesis H1a:

H1a: Digital technology innovation can inhibit the enterprise's "greenwash" behaviour.

While improving the operational efficiency of enterprises, digital technological innovation may also become a tool to exacerbate the "greenwashing" behaviour. First, technology-enabled information manipulation provides a new type of greenwash for firms. Although advanced technology can improve the transparency of environmental information disclosure, enterprises may selectively disclose local environmental data or embellish environmental performance through algorithmic screening and virtual scenario construction to cover up the real pollution problems[4]. Second, the complexity and opacity of digital technology increases the difficulty of regulation. For example, the use of intelligent regulatory platforms to selectively disclose information[5]. This kind of "technology-enabled greenwashing" not only distorts market signals, but also provides new operating space for enterprises to "greenwash". Based on this, this paper proposes the following hypothesis H1b:

H1b: Digital technology innovation can increase the enterprise's "greenwash" behaviour.

### *2.2 The influence of internal control on digital technology innovation and enterprise "greenwashing" behaviour*

According to the signal transmission theory and agency theory, enterprises tend to release positive signals to obtain external resources and reputation, and the capability of digital technological innovation has become a key signal to demonstrate corporate competitiveness. However, the characteristics of high investment and long cycle in digital technological innovation make enterprises have the potential motivation to use environmental information disclosure for "greenwashing". As the core mechanism of corporate governance, internal control may be alienated in the special context of digital technological innovation.

First, digital technological innovation has a significant positive impact on corporate greenwashing behavior. The improvement of digital technological innovation capability can enhance the discourse power of enterprises in the capital market and product market. In order to further amplify the signal effect of innovation, enterprises may shape a green image through "greenwashing" means such as exaggerating environmental governance investment and selectively disclosing environmental performance. Moreover, digital technological innovation has a significant positive impact on the quality of internal control. Blockchain technology is used to improve information transparency, thereby strengthening the efficiency and effect of internal control.

In summary, the quality of internal control may play a mediating role in the relationship between digital technological innovation and corporate greenwashing behavior. Internal control essentially serves the goals of management. When management has the motivation to obtain short-term benefits through "greenwashing", high-quality internal control may instead become a tool to beautify environmental information disclosure. That is, digital technological innovation improves the quality of internal control, providing more concealed and systematic operational space for corporate "greenwashing" behavior, thereby indirectly intensifying the degree of corporate greenwashing.

H2: Compared with enterprises with low internal control capacity, digital technology innovation in

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enterprises with strong internal control capacity has a more significant impact on the "greenwashing" behavior of enterprises.

## 3. Research Design

### *3.1 Sample selection and data sources*

In 2016, China's Greenwash List suggested that "greenwash" behaviour does not only exist in heavily polluting enterprises, therefore, the research object of this paper is listed companies in Shanghai and Shenzhen A-shares that have published ESG and social responsibility reports from 2011 to 2024. The starting year is 2011, because the domestic digital economy started to develop rapidly in 2011. The data of digital technology innovation is from annual reports of listed companies, and the data of "Bleaching Green" index is from environmental and social responsibility reports (ESG). Other corporate financial data come from the databases of Cathay Pacific and Wardell. In order to avoid the interference of other factors, this paper draws on existing studies to screen and process the sample: (1) delete the data of companies in the finance and insurance industry, ST category, and companies with abnormal financial data; (2) delete the data of companies with a lot of missing data; and (3) in order to mitigate the impact of outliers in the sample, continuous variables in the sample are subjected to the Winsorize treatment of 1 per cent and 99 per cent.

### *3.2 Model Design*

In order to test the impact of digital STI on firms' greenwash behaviour, i.e. to test hypothesis H1, model (1) is constructed.

$$GW_{i,t}=\lambda_0+\lambda_1 TI_{i,t}+\lambda_2 TAGR_{i,t}+\lambda_3 BOARD_{i,t}+\lambda_4 LEV_{i,t}+\lambda_5 OI_{i,t}+\sum INDUSTRY+\sum YEAR+\varphi_{it} \quad (1)$$

In order to test the effect of the level of internal control on the relationship between digital technology innovation and corporate greenwash behaviour, i.e., experimental hypothesis H2, model (2) is constructed.

$$GW_{i,t}=\lambda_0+\lambda_1 TI_{i,t}+\lambda_2 IA_{i,t+}\lambda_3 XM_{i,t+}\lambda_4 TAGR_{i,t}+\lambda_5 BOARD_{i,t}+\lambda_6 LEV_{i,t}+\lambda_7 OI_{i,t}+\sum INDUSTRY+\sum YEAR+\varphi_{it} \quad (2)$$

### *3.3 Definition of variables*

#### *3.3.1 Explained variables*

"Greenwash" index (GW) The concept of greenwash originates from abroad, the dictionary explains that enterprises falsely whitewash the behaviour related to environmental pollution to establish a good image to obtain the relevant benefits. The "greenwash data" of listed companies is measured by referring to the practice of Hu et al. (2023)[6]. If the frequency of environmental publicity in a firm's annual report is higher than the industry average but the firm receives environmental penalties in the same year, it is assigned a value of 1, and if it does not, it is assigned a value of 0.

#### *3.3.2 Explanatory variables*

This paper draws on the measurement of digital technological innovation by Yang and Yang (2024)[4]. Digital patent application data is used to measure the output level of digital technological innovation. Therefore, the technological category of digital technological innovation is defined through the International Patent Classification (IPC), and a comprehensive evaluation system for digital technological innovation is established.

#### *3.3.3 Control Variables*

This paper draws on Yang and Yang (2024)[4], Wang et al. (2024)[7], the study selects the following indicators as control variables, Total Asset Growth Rate (TAGR), Chairman's Ownership Ratio (BOARD), Total Liabilities (TL), and Operating Index (OI) variables are defined as shown in Table 1.

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*Table 1 Summary of information on research variables*

| Variables | Variable name | Symbol | Calculation method |
|---|---|---|---|
| Interpreted Variable | Greenwash Index | GW | If the frequency of environmental protection publicity in a company's annual report is higher than the industry average but the company was subject to environmental penalties in the same year, a value of 1 is assigned; otherwise, a value of 0 is assigned. |
| Explanatory Variables | Digital Technology Innovation level | TI | Define the technological scope of digital technology innovation through the International Patent Classification (IPC), and establish a comprehensive evaluation system for digital technology innovation. |
| Moderating Variables | Internal Control Index | IA | Internal control level |
| Control Variables | Total Assets Growth Rate | TAGR | (Total assets at the end of the period - Total assets at the beginning of the period) ÷ Total assets at the beginning of the period × 100% |
| | Gearing ratio | LEV | (Total Liabilities ÷ Total Assets again) * 100% |
| | Chairman's shareholding ratio | BOARD | Total number of shares held by Chairman ÷ Total number of shares |
| | Operating Index | OI | Ratio of net operating cash flow to gross operating cash flow |

## 4. Empirical Analysis

### *4.1 Descriptive Statistics*

*Table 2 Descriptive statistics*

| Stats | N | Mean | Min | P50 | Max | SD | P25 | P75 |
|---|---|---|---|---|---|---|---|---|
| *GW* | 40534 | 0.168 | 0.000 | 0.000 | 1.000 | 0.374 | 0.000 | 0.000 |
| *TI* | 40534 | 0.069 | 0.000 | 0.037 | 0.492 | 0.091 | 0.016 | 0.080 |
| *XM* | 40534 | 44.543 | 0.000 | 22.992 | 435.416 | 60.092 | 9.769 | 51.565 |
| *IA* | 40534 | 639.529 | 0.000 | 662.995 | 995.360 | 129.097 | 616.150 | 697.990 |
| *TAGR* | 40534 | 0.143 | -0.907 | 0.080 | 45.460 | 0.555 | 0.004 | 0.189 |
| LEV | 40534 | 0.429 | 0.007 | 0.421 | 1.957 | 0.207 | 0.265 | 0.580 |
| BOARD | 40534 | 13.129 | 0.000 | 0.634 | 89.990 | 19.260 | 0.001 | 23.759 |

Table 2 presents the descriptive statistics of the variables included in our paper. The mean value of the digital technological innovation level (TI) is 0.069, indicating that the average level of the sample on this variable is at a relatively low position. The minimum value is 0, and the maximum value reaches 0.492, showing a certain span in the value range. The standard deviation (sd) is 0.091, suggesting that the degree of data dispersion is relatively moderate, and the data shows certain fluctuations around the mean. The mean value of the corporate greenwashing level (GW) is 0.168, indicating that approximately 16.8% of the sample enterprises have greenwashing behaviors.

### *4.2 Regression Analysis*

#### *4.2.1 Regression analysis of digital technology innovation and enterprises' "greenwashing" behaviour*

Based on the panel data model, this study constructs a fixed-effects regression equation to test the impact of digital technological innovation on corporate greenwashing behavior (Table 3). The results show that the coefficient of digital technological innovation (TI) is 1.457, which is significantly positively correlated at the 1% level. This indicates that each 1-unit increase in technological innovation leads to a 1.457-fold increase in the probability of corporate greenwashing behavior. The results support Hypothesis H1b.

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*Table 3 Regression results of digital technological innovation and enterprises' "greenwashing" behaviour*

| VARIABLES | GW |
|---|---|
| GW | 1.457*** |
| | (7.96) |
| TAGR | -0.092*** |
| | (-2.67) |
| LEV | 2.246*** |
| | (28.48) |
| BOARD | -0.009*** |
| | (-9.91) |
| OI | 0.110*** |
| | (3.90) |
| YEAR | Yes |
| INDUSTRY | Yes |
| Observations | 40,509 |
| Pseudo | 0.192 |

***4.2.2 Regression analysis of the level of internal control on digital technology innovation and corporate "greenwashing" behaviour***

The model uses the corporate "greenwashing" index (GW) as the dependent variable to examine the impact of digital technology innovation (TI), internal control levels (IA), and their interaction term (XM) on greenwashing behavior. To investigate whether digital technology innovation enterprises with high internal control levels exhibit a high level of "greenwashing" behavior, we present the OLS regression results in Table 4 based on model (2). As expected, the coefficients of the interaction term XM are significantly positive at the 1% level (0.008, t=5.43), providing support to ourhypothesis H2 that Compared with enterprises with low internal control capacity, digital technology innovation in enterprises with strong internal control capacity has a more significant impact on the "greenwashing" behavior of enterprises. The results also show that the regression coefficient for digital technology innovation (TI) is 3.486, indicating a significant positive correlation at the 1% level. This suggests that for every one-unit increase in digital technology innovation levels, the probability of greenwashing behavior occurring increases significantly by 3.486 times. This result aligns with the expected direction of hypothesis H2, suggesting that technologically advantaged firms may use digital technology as a "greenwashing" tool, either by optimizing disclosure formats to conceal environmental issues or by leveraging technological resources to embellish environmental performance, thereby forming "technology-enabled greenwashing."

*Table 4 Regression results of internal control level on digital technology innovation and corporate "greenwashing" behaviour.*

| VARIABLES | GW |
|---|---|
| TI | 3.486*** |
| | (3.66) |
| XM | 0.008*** |
| | (5.43) |
| IA | 0.003 |
| | (0.12) |
| TAGR | 2.183*** |
| | (26.84) |
| LEV | -0.009*** |
| | (-9.46) |
| BOARD | 0.082*** |
| | (2.85) |
| OI | 3.486*** |
| | (3.66) |
| YEAR | Yes |
| INDUSTRY | Yes |
| Observations | 40,509 |
| Pseudo | 0.192 |

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### *4.3 Robustness Analysis*

The robustness test of this study is carried out using the method of replacing the variable measure.

(1) To ensure the reliability of research conclusions, this paper conducts a robustness test by replacing the measurement method of the "greenwashing" index. In the original model, the "greenwashing" index (GW) adopts a binary variable (if the enterprise's environmental protection propaganda frequency is higher than the industry average but it is subject to environmental penalties in the same year, it is assigned as 1; otherwise, it is 0). In the robustness analysis, drawing on the research of Wang et al. (2024)[7] and Zhang (2022)[8], the "greenwashing" index (GWS) is reconstructed and defined as the standardized gap between the ESG disclosure score (Bloomberg ESG score) and the actual performance score (Hua Zheng ESG score), which measures the degree of corporate greenwashing behavior in the form of a continuous variable. Based on the new measurement method, the regression analysis of Model 1 is carried out. The coefficient of digital technological innovation (TI)is 1.022, which is significantly positively correlated at the 1% level (t=4.11), indicating that each 1-unit increase in the level of corporate digital technological innovation will lead to a 1.022-unit increase in the degree of greenwashing behavior. This result is consistent with the original model (the TI coefficient in Table 3 is 1.457) in direction and the same in significance level, verifying the robustness of Hypothesis H1b and supporting the conclusion of the main regression. The pseudo $R^2$ value of the model is 0.191, slightly higher than 0.190 of the original model, indicating that the new measurement method improves the explanatory power of the model.

(2) To verify the robustness of the research conclusions, this paper further tests Model 2 by using the replaced greenwashing index (GWS) as the explained variable, and introducing digital technological innovation (TI), internal control level (IA), and their interaction term (XM=TI×IA) as the core explanatory variables. The coefficient of digital technological innovation (TI) is 2.532, which is significantly positively correlated at the 5% level (t=2.48), further supporting the robustness of Hypothesis H1b. This indicates that enterprises with technological advantages may use digital technology to cover up environmental issues. The coefficient of the interaction term (XM) is 0.091, which is significantly positively correlated at the 5% level (t=2.51), suggesting that the internal control level (IA) has a positive moderating effect on the relationship between digital technological innovation and greenwashing behavior, verifying the establishment of Hypothesis H2. The pseudo $R^2$ value of the model is 0.196, slightly higher than 0.192 of the original model, indicating that the explanatory power of the model is improved after replacing the measurement method.

## 5. Conclusion

First, the impact of digital technological innovation on corporate greenwashing behavior presents a contradiction. On the one hand, the technological empowerment effect enhances the transparency and traceability of environmental information, helping to compress the operational space for corporate false propaganda. On the other hand, empirical results show a significant positive correlation between digital technological innovation and corporate greenwashing behavior, indicating that technological advantages may be alienated into "greenwashing tools". This finding challenges the traditional perception that "technology is the solution" and reveals the potential risks of technological innovation in environmental governance.

Second, the level of internal control has a positive moderating effect on the relationship between digital technology and greenwashing behavior. The study finds that in enterprises with strong internal control capabilities, the greenwashing intensification effect of digital technological innovation is more significant. Although a high-quality internal control system can standardize the technical application process, it may also be used by management to systematically cover up environmental issues. This indicates that simply relying on technological upgrading and internal control optimization is difficult to curb greenwashing, and the alienation risks of governance tools need to be vigilantly addressed.

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