

# 1 AI-GENERATED CONTENT AND ESG: A QUASI-NATURAL EXPERIMENT BASED ON CHATGPT <sup>1</sup>

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## Abstract

Digital business has entered an unprecedented era with the advent of Generative Artificial Intelligence (GenAI), presenting new opportunities and challenges for high quality development. This study investigates the impact of Artificial Intelligence-Generated Content (AIGC) on firms' ESG (Environmental, Social, and Governance) performance, drawing on panel data from Chinese listed enterprises between 2003 and 2023, and using a difference-in-differences (DID) method. The result shows that AIGC adoption significantly improves corporate ESG performance, and this finding remains robust across a series of rigorous robustness checks. Further analysis reveals that this effect operates primarily through enhanced corporate digital transformation and green technological innovation. Heterogeneity analysis suggests that the positive effect of AIGC accession is more pronounced among firms located in eastern regions and national computation hubs and among those undergoing digital transformation and being audited by a Big4 accounting firm. These findings offer valuable insights for both firms and policymakers seeking to leverage large models to advance sustainability in the digital economy.

**Keywords:** AIGC, ESG, ChatGPT

**JEL Classification:** D22, O33

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## 1. Introduction

The ESG framework emphasizes that while pursuing economic benefits, enterprises should comprehensively coordinate three key dimensions: environmental protection, social value creation, and optimization of governance structures. This innovative development model holds strategic importance not only for accelerating China's transition to a green low-carbon economy, promoting equitable social development, and establishing modern governance systems, but also benefits corporate brand building and the pursuit of long-term value. Against this backdrop, Chinese regulatory authorities have progressively intensified policy guidance in recent years, driving corporate ESG practice enhancement through institutional innovation.

China's ESG governance achieved structural breakthroughs in 2024 through the tripartite release of the Sustainable Development Reporting Guidelines by its leading stock exchanges. This regulatory milestone institutionalized the nation's first mandatory framework for listed firms to systematically disclose integrated ESG metrics. This regulatory advancement signifies the transition of China's ESG disclosure regime from voluntary practice to standardized supervision. Concurrently, policy documents issued by the State-owned Assets Supervision and Administration Commission (SASAC) emphasized reinforcing the exemplary role of central state-owned enterprises (SOEs), explicitly requiring deep integration of ESG principles throughout operational management processes. By implementing mechanisms to enhance disclosure quality and linking executive compensation to ESG performance outcomes, these measures aim to cultivate internationally influential ESG benchmark enterprises.

The importance of corporate ESG performance for socio-economic development is widely acknowledged, yet effectively implementing ESG initiatives requires enterprises to possess the capacity for efficient resource allocation to balance diverse stakeholder demands. Therefore, identifying endogenous drivers within firms that enhance such performance constitutes a critical area of inquiry. In recent years, the advent of conversational AI models, such as ChatGPT, has garnered global attention and has spurred significant attention in the field of generative AI (Cheng, 2025). As a frontier direction in artificial intelligence, generative AI is transforming the way human knowledge is produced, thereby accelerating the reshaping of the global innovation landscape. In 2024, the "Artificial Intelligence+" initiative was first mentioned in the State Council's work report, designating generative AI as a key area for fostering new productivity, and encouraging its integration into education, healthcare, manufacturing, and other industries. The Central Economic Workshop further emphasized the importance of "driving innovation through technological advancement" to accelerate the industrialization of AI technologies. The rapid development of generative AI not only serves to drive China's sustained economic growth but also provides technical support to enhance the ESG performance of businesses.

AIGC demonstrates its robust capabilities in data processing, pattern recognition, and automated generation. AI shows significant potential and technological advantages in addressing corporate ESG challenges (Chen et al., 2024). Research by Vinuesa et al. (2020) reveals that AI can contribute to achieving 134 Sustainable Development Goals, with particularly strong performance in environmental and social objectives. AI can optimize the energy structure through air quality monitoring and pollution source identification (Kaginalkar et al., 2021) and improve the efficiency of renewable energy sources (Yin and Zeng, 2023). Specifically, AIGC not only facilitates rapid collection and systematization of massive ESG-related operational data for enterprises but also provides modeling tools to enhance production efficiency, operational management, and innovation capabilities. Furthermore, AI can integrate production factors such as data, equipment, and labor by connecting upstream/downstream enterprises, government agencies, and other stakeholders, creating a multi-agent collaborative network. This synergy ultimately evolves into competitive advantages based on the AIGC ecosystem, which facilitates green technology innovation and enables efficient multi-stakeholder coordination at the ecosystem level. This

process helps reduce energy consumption intensity and pollution emissions, ultimately improving corporate ESG performance. Some research has shown that enterprises can use AI technology to achieve effective integration of information and reduce information asymmetry with the market and investors. As a result, it can enhance investors' confidence and willingness to invest, giving enterprises the opportunity to obtain more economic resources (Chu et al., 2024). Huo et al. (2025) confirm that AI contributes to the inter-regional transmission of green values and the widespread implementation of green innovations, highlighting the spatially distributed and multidimensional synergy inherent in the AIGC ecosystem. Currently, while some practical cases demonstrate specific applications of AIGC in achieving corporate ESG goals, there remains a paucity of empirical research examining the mechanisms and magnitude of AIGC's impact on corporate ESG objectives. Although some studies have explored the impact of digital transformation on ESG development (Fang et al., 2023), they have not elaborated on the role of key technologies in digital transformation processes. As a result, it is difficult to provide clear guidance for enterprises to achieve improvements in ESG performance. On this basis, this study comprehensively examines the specific impacts of AIGC on corporate ESG level and its underlying mechanisms. At the same time, it further explores the heterogeneous impacts within the framework of various regional and corporate-level features. Based on the research conclusions, relevant policy recommendations are put forward.

## 2. Literature review and hypotheses

### 2.1. *The Impact of AIGC on ESG Performance: Resource-Based View*

From the perspective of resource-based view, high-quality data resources can meet the value, scarcity, incomplete imitability and irreplaceability to some extent, and can help enterprises to build sustainable competitive advantages (Barney, 2000). As a strategic technology for a new round of scientific and technological innovation, AIGC is capable of fully and efficiently exploring a vast amount of data resources. AIGC, through its unique data-processing capabilities, algorithm-optimizing capabilities, and intelligent decision-making capabilities, has significantly influenced enterprises' performance in the three dimensions of environment, society, and governance. The ability of enterprises to integrate data resources has been indirectly verified to some extent.

In terms of environmental benefits, the core advantage of AIGC lies in its ability to rapidly process and conduct in-depth analysis of multi-source heterogeneous data, which can improve the energy efficiency of enterprises, provide environmental simulation forecasts, and track energy audits. At present, external uncertainties are accelerating the restructuring of the global energy landscape, heightening volatility and risk in energy markets (Su et al., 2024; 2025). AIGC, by transforming big data into actionable decision support, can help mitigate this uncertainty, optimize energy consumption structures, and enhance sustainability in environmental development. On the one hand, AI, through its ability to streamline data processing, expedite knowledge formation, and enhance decision-making capabilities, has the potential to play an important role in addressing climate change and curbing greenhouse gas emissions (Keding & Meissner, 2021). By playing the role of the large model, the formation of artificial intelligence-driven energy solutions promotes the transformation and upgrading of traditional industries, and achieves the green development of energy-intensive industries (Tian et al., 2023). With China's pledge to peak carbon emissions by 2030 and achieve carbon neutrality by 2060, socially responsible investing (SRI) has become increasingly prevalent in the country. In response, Bai et al. (2023) explore the impact of China's carbon-neutral bonds—used as underlying assets in SRI—on the renewable energy stock market. In this context, the application of large language models can enhance the efficiency of socially responsible investment, thereby improving capital market performance and, in turn, reinforcing firms' sustainable development capacity. On the other hand, the environment continues to

generate a large amount of real-time data to become the basis of large-scale model analysis. AI for science, especially for artificial intelligence-driven scientific research has been rapidly applied in the field of climate, helping humans to achieve climate monitoring, analysis and prediction (Bi et al., 2023). AIGC conducts real-time monitoring and modeling of energy consumption and emission data throughout the entire production process, helping enterprises accurately identify high-energy-consuming production links, achieve energy tracking and auditing, scientifically evaluate the performance of energy use, reduce resource consumption and waste generation during the production and operation of enterprises, and serve the construction of a more efficient resource management and allocation system. Ultimately, it enhances the environmental performance of enterprises. Promoting energy savings by automating energy audits and optimizing the design of renewable energy systems can help improve the efficiency of carbon capture and storage (Mannuru et al., 2023).

In terms of social benefits, AI can fully utilize data resources and conduct real-time monitoring of social feedback, helping enterprises better understand and meet the needs and expectations of stakeholders such as consumers and employees. This promotes positive interaction between enterprises and stakeholders, allows for precise alignment with social needs, and enables enterprises to better assume and fulfill their social responsibilities. First, AIGC can replace repetitive work with data-driven tasks that humans take a lot of time to complete, thereby improving social productivity (Bouschery et al., 2023). The improvement in corporate production efficiency is conducive to reducing operating costs, alleviating the resource constraints faced by enterprises, and enabling them to have more abundant resources for ESG development. Secondly, through the collection and analysis of complex data sets, AI large model technology optimizes the decision-making mode of enterprises in various fields such as products and services, and forms a native innovation paradigm based on large models (Shi et al., 2024). Adequate data and precise analytical decision-making help precisely identify user needs, reduce costs arising from decision-making errors, and, to some extent, avoid short-sighted actions by decision-makers that sacrifice the long-term interests of the enterprise, thereby enhancing the enterprise's ability to fulfill its social responsibilities. Moreover, AI creates more emerging job opportunities, expanding the capacity for firms to fulfill their social responsibilities. The new form of productivity brought by AIGC exerts a dual impact on the labor market—enhancing efficiency while potentially displacing traditional roles (Qin et al., 2024). In this context, a firm's commitment to social responsibility may become a key driver in steering technological advancement toward socially beneficial outcomes.

In terms of governance benefits, the application of AI plays a crucial role in improving the internal control of enterprises. AI large-scale model technology helps utilize data resources, reduce information asymmetry, and enhance corporate governance capabilities. First, AIGC fundamentally transforms the way knowledge is reorganized and disseminated. Through training with massive amounts of information, it gradually reduces the cost of acquiring specialized knowledge, which is conducive to improving coordination among various corporate departments. Specifically, AIGC can integrate data and knowledge elements from multiple fields and departments. Through large-scale knowledge reorganization, it allows all departments to make decisions based on common data sources, improving the consistency and accuracy of decision-making, enabling cross-departmental knowledge sharing, enhancing inter-departmental communication efficiency, and promoting organizational innovation within the enterprise. Second, more abundant internal corporate information support facilitates timely responses to employees' needs, helping companies improve employee benefits and overall governance capabilities. Vinuesa et al. (2020) highlighted that intelligent management systems contribute to greater workplace diversity and improved employee satisfaction. Similarly, Tamburri (2020) demonstrated that AI facilitates organizational diversity by enabling more effective recruitment algorithms and customized career development pathways. Third, some scholars' research shows that there are limitations to using current ESG ratings as a reliable metric, and ESG dashboards using machine

learning will cut through the noise in big data and provide users with the most relevant ESG metric information (Asif et al., 2023). And AIGC is driving the formation of a framework for the cross-boundary integration and interaction of network resources, which helps reduce false advertising and promote a substantial improvement in corporate governance. For example, based on the perspective of the indirect impact of AI on corporate sustainable development, Zhang (2024) conducted a study and found that AI can suppress the "greenwashing" behavior of enterprises, revealing how AI reduces false advertising of enterprises in the aspect of ESG. AI technology has achieved the integration of different governance areas such as board performance, financial distress prediction, and fraud detection, and has promoted the improvement of the corporate governance level (Ahdadou et al., 2024). Therefore, in terms of the organizational compliance system, many organizations are using AIGC to evaluate the governance performance of enterprises under the ESG framework. To sum up, applying AIGC to the entire process of corporate governance is conducive to reducing the information asymmetry between the management and the board of directors. Through the automation of the collection and analysis of corporate data, it can increase the update frequency and transparency of information, curb the self-interested behavior of the management, and improve the quality of the internal governance of enterprises. Therefore, we propose the following hypotheses:

**H1: AIGC has a positive effect on corporate ESG performance.**

**H2: AIGC enhances corporate ESG performance by driving digital transformation.**

## ***2.2. The Role of Green Technology Innovation in Enhancing AIGC-ESG***

### ***Linkage: Ecosystem Competitive Advantages***

Given the ecosystem-based advantages of the digital era (Li et al., 2019), the impact of AIGC on firms' capacity for sustainable development should be analyzed from a more systemic perspective. Changes in resource organization and value realization models encourage firms to innovate continuously, establish new business relationships, and shape value delivery networks. Although there are few clear definitions of ecosystem competitive advantage in current research, we can consider ecosystem competitive advantage as the value creation capability and performance of an enterprise that is higher than that of its competitors through the construction and coordination of a business ecosystem based on the ecosystem structure view. The "ecosystem" in this context was introduced into business by Moore et al. (1993) who simply described it as the result of industry firms cooperating and competing at the same time to satisfy customer needs. In contrast, Ander (2017) proposes an "ecosystem structure view" and defines an ecosystem as a coordinated and coherent structure of partners who work together to realize a core value proposition through multilateral interactions. Jacobides et al. (2018) argue that firms can build unique competitive advantages by leading value propositions to construct and orchestrate "coherent structures" that enable the formation and development of business ecosystems and empower participants to co-create value. The theory of ecosystem competitive advantage emphasizes that under the premise of digital economy, the unclear industry boundary, the endogenous business network effect of enterprises and the uncertainty of competition patterns make the ecosystem become the main body of competition, and the advantages of the ecosystem are beyond the ability of a single enterprise. The formation of competitive advantages in the ecosystem is mainly through the integration of complementary external resources, effective allocation of resources, giving play to the complementarity of resources and network externalities, and efficient incentive mechanism design to activate resource utilization efficiency and allocation efficiency, so that differentiated partners can collaborate and innovate to create value for the entire ecosystem. Based on the above research, it can be generally concluded that ecosystem competitive advantage stems from the interaction and resource integration among the participants

of the ecosystem. Therefore, value co-creation is regarded as a key prerequisite for ecosystem competitive advantage.

The effect of AIGC in promoting corporate green innovation is rooted in the ecosystem competitive advantages of AI. Some research points out that with the exponential growth of the available data volume, it has become more difficult for investors, companies, and government agencies to make balanced decisions when dealing with environmental ESG issues (Burnaev et al., 2023). However, AIGC breaks the exclusivity and monopolization of a single entity through ecosystem-based collaboration, reduces information asymmetry, drives data-driven decision-making, and reconstructs the resource allocation model as well as the fundamental logic of corporate green innovation. Specifically, AIGC large models leverage ecosystems to integrate complementary elements and participants through extensive, diversified ecosystem connections. Compared with traditional analysis methods, they demonstrate superior capabilities in collecting and processing natural language data, yielding more precise and effective results, diversified operational models, optimized organizational resource allocation, and more agile ecosystem coordination. The study by Davenport and Ronanki (2018) revealed the capabilities of AI in strengthening the decision-making process and enhancing customer interactions across various industries.

In terms of environmental benefits, enterprises can improve resource efficiency through environment-oriented innovation strategies while enhancing their market competitiveness. AIGC can help enterprises better integrate environment-related data and information, connect upstream and downstream enterprises and external resources such as environmental protection agencies, form an ecosystem for environmental governance, and facilitate green technology innovation. Through an open innovation platform, AIGC attracts value chain participants to form a technological symbiosis network and even absorb consumers and the general public from various fields to carry out open-source innovation through rapid social sentiment feedback, consumer evaluations, and the AIGC innovation platform. On the one hand, this process promotes the transformation of the enterprise's innovation model. Enterprises attract upstream and downstream partners through the open-source achievements of GTI (Green Technology Innovation), forming an ecosystem alliance with technological symbiosis and complementary resources. On the other hand, enterprises within the ecosystem, especially small and medium-sized enterprises (SMEs), can overcome the cost limitations of cross-regional technological cooperation. At the same time, enterprises developing green technologies can achieve profits through ecosystem dissemination, and this process is conducive to revitalizing the regional green technology market. Therefore, the AIGC-based ecosystem greatly reduces the threshold for green innovation, helps enterprises establish a cost-effective innovation-environmental performance synergy network within the ecosystem, and ultimately forms a differentiated ecosystem positioning within the regional industrial cluster.

One of the important main bodies of the AIGC ecosystem is the social participants that enterprises face. Therefore, in this regard, AIGC also reduces the degree of information asymmetry between enterprises and social stakeholders. That is, the most practical application of AI by society is to evaluate a company's performance based on the company's public information, financial reports, social media comments, etc. This method implements natural language processing (NLP) algorithms, which can quickly scan texts to extract specific words (such as locations, dates, and names) and generate summary reports (Burnaev et al., 2023; Chekalina et al., 2022). Therefore, from the perspective of social supervision, this urges enterprises to pay more attention to their brand images and make green technology investments, thereby improving their ESG rating levels.

It should be further explained that there are indeed differentiated positions and competition within the ecosystem. On the contrary, forming a differentiated advantage within the ecosystem enables enterprises to obtain more substantial profits. Scholars argue that ecosystem firms need to have resource or capability advantages and strong market and technology awareness and responsiveness in order to occupy a pivotal position in the ecosystem, dominate the rule-making,

coordinate the relationship between partners and resource allocation, and play a strategic leading role in defining the ecosystem blueprint (Dattee et al., 2018; Foss et al., 2023). Therefore, within the incentive framework of the AIGC-based ecosystem, enterprises can carry out green technology innovation through algorithms while maintaining extensive connections within the ecosystem. This approach not only meets the ESG disclosure requirements but also helps enterprises gain a dominant position in the ecosystem. Pioneering enterprises in green innovation can output technical standards and the "voice in rule-making" through the industrial chain network of the ecosystem built on AIGC technology, thereby obtaining stronger competitiveness within the system. They can also leverage their competitive advantages in the ecosystem to spread this competitiveness beyond the ecosystem.

In summary, this study takes green technology innovation as the core implementation path of the theoretical framework of the impact of AIGC on ESG. Through the application of the ecosystem competitive advantages formed by AIGC, it widely connects multiple subjects and elements, optimizes production processes, reduces environmental costs, and promotes open-source innovation. Through open-source innovation based on the AIGC ecosystem, enterprises can not only respond to ESG policy requirements but also conform to the logic of "innovation-driven differentiated advantages" inherent in ecosystem competition. Therefore, the mediating role of green technology innovation fundamentally reveals the dynamic adaptability of the ecosystem competition theory in the context of digital transformation and demonstrates its theoretical flexibility in reconciling environmental sustainability and technological progress under the development conditions of contemporary enterprises. Accordingly, we propose the third hypothesis:

**H3: AIGC improves corporate ESG performance by encouraging green technology innovation.**

### 3. Empirical Study and Data

This paper examines the impact of AIGC on companies' ESG level. The launch of ChatGPT in 2022 is widely regarded as an unprecedented breakthrough in digital technology, marking the first significant integration of AIGC into socioeconomic activities and the frontier of business innovation. We treat this exogenous emergence of AIGC as a quasi-natural experiment, introducing heterogeneous shocks to firms based on the nature of their business operations. Whether a firm engages in large-model-related business serves as the criterion for sample classification, with those identified as "True" assigned to the treatment group, and others to the control group. Specifically, following the Chinese National Industrial Classification standard, we designate firms whose two-digit industry codes fall under C39, I63, I64, I65, J66, J67, J68, J69, M73, M74, M75, O81, and P82—corresponding to AIGC-related industries—as the treatment group. Firms in the treatment group are more likely to benefit from AIGC-driven digital advancements and potentially leverage them to enhance sustainable competitiveness—reflected in improved ESG performance. To assess this impact, we employ a DID approach using samples from Chinese listed firms spanning the period from 2003 to 2023. The econometric model is specified as follows:

$$ESG_{it} = \alpha_0 + \alpha_1 Treat_i \times Post_t + \alpha_2 Controls_{it} + \mu_i + \theta_t + \varepsilon_{it} \quad (1)$$

where  $ESG_{it}$  denotes the ESG performance of firm  $i$  in year  $t$ . The variable  $Treat_i$  is a dummy equal to 1 for firms in the treatment group—i.e., those engaged in large-model-related business.  $Post_t$  is a time dummy that equals 0 for the period before the introduction of ChatGPT (AIGC) in 2022 and 1 thereafter. The coefficient  $\alpha_1$  thus captures the impact of AIGC on corporate ESG performance, where a positive estimate is expected in line with our hypothesis. To mitigate

potential endogeneity arising from omitted variable bias, we include a set of control variables that can influence ESG performance, including firm's age of listing ( $AGE_{it}$ ), total assets ( $SIZE_{it}$ ), return on assets ( $ROA_{it}$ ), Debt-to-Assets Ratio ( $DAR_{it}$ ), first major shareholder's shareholding ratio ( $OWN\_con1_{it}$ ), and shareholding ratio of institutional investors ( $INSTO_{it}$ ). We further control for duality and the board size in robustness tests to eliminate interference from decision-making concentration on ESG performance. These variables are collectively represented by the vector  $Controls_{it}$ . Additionally,  $\mu_i$  captures corporate fixed effects, which account for time-invariant firm-specific characteristics, while  $\theta_t$  denotes year fixed effects, controlling for time-specific influences common across firms.  $\varepsilon_{it}$  is the error term. We use the ESG rating index provided by the Huazheng ESG Evaluation System to measure firms' ESG performance. This system is developed with reference to international practices while incorporating the characteristics and realities of the domestic market. Its key advantages include a long historical coverage and quarterly updates, ensuring a high degree of timeliness. In contrast, other domestic ESG evaluation systems often suffer from limitations such as limited coverage, shorter historical spans, and lower update frequencies. Firm-level control variables are sourced from the RESSET Database.

Additionally, **Section 4.4** presents a mechanism analysis to examine how digital transformation and green innovation contribute to strengthening the AIGC-ESG relationship. The first channel is based on the premise that the emergence of ChatGPT has pressured firms to undergo digital transformation in order to adapt to the new market environment shaped by AIGC. Digitalization, in turn, leads to higher efficiency and resource savings. The second channel posits that AI-driven green innovation reduces corporate pollutant emissions, thereby enhancing ESG outcomes. We measure digital transformation by the word frequency of related terms in annual reports (in logarithms) and green technological innovation by the number of green invention patents independently granted to the firm in a given year (in logarithms). The classification of green patents follows the criteria set by the *State Intellectual Property Office of China*.

**Table 1. Variable definition and summary statistics**

| Panel A: Variable Definition |                                                                                                                                                          |        |          |     |      |      |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------|-----|------|------|
| Variables                    | Definition                                                                                                                                               |        |          |     |      |      |
| ESG                          | ESG rating index provided by the <i>Huazheng ESG Evaluation System</i> .                                                                                 |        |          |     |      |      |
| DID                          | The AIGC effect captured by the DID approach.                                                                                                            |        |          |     |      |      |
| AGE                          | Log of Age of listing.                                                                                                                                   |        |          |     |      |      |
| SIZE                         | Enterprise scale: Log of total assets.                                                                                                                   |        |          |     |      |      |
| ROA                          | Net profit after tax divided by total assets.                                                                                                            |        |          |     |      |      |
| DAR                          | Debt-to-Assets Ratio.                                                                                                                                    |        |          |     |      |      |
| OWN_con1                     | First major shareholder's shareholding ratio                                                                                                             |        |          |     |      |      |
| INSTO                        | Shareholding ratio of institutional investors.                                                                                                           |        |          |     |      |      |
| Duality                      | A dummy variable that takes the value of 1 if the roles of board chairman and general manager (or CEO) are held by the same individual, and 0 otherwise. |        |          |     |      |      |
| BoardSize                    | Number of board members.                                                                                                                                 |        |          |     |      |      |
| Panel B: Summary Statistics  |                                                                                                                                                          |        |          |     |      |      |
| Variables                    | N                                                                                                                                                        | Mean   | Std.Dev. | Min | Max  | VIF  |
| ESG                          | 42575                                                                                                                                                    | 4.1006 | 0.9031   | 1   | 7.75 |      |
| DID                          | 42575                                                                                                                                                    | 0.0533 | 0.2246   | 0   | 1    | 1.02 |

|           |       |         |          |          |          |      |
|-----------|-------|---------|----------|----------|----------|------|
| AGE       | 42575 | 2.2501  | 0.7751   | 0.6931   | 3.5553   | 1.24 |
| SIZE      | 42575 | 13.0163 | 1.5361   | 2.2494   | 22.2206  | 1.47 |
| ROA       | 42575 | 0.0409  | 0.4548   | -51.9457 | 22.0029  | 1.86 |
| DAR       | 42575 | 46.0612 | 129.3615 | 0.1725   | 17834.55 | 1.87 |
| OWN_con1  | 42575 | 33.604  | 15.1426  | 0.2863   | 89.991   | 1.40 |
| INSTO     | 42575 | 44.1017 | 24.7376  | 0        | 101.1401 | 1.67 |
| Duality   | 42575 | 0.2922  | 0.4548   | 0        | 1        | 1.12 |
| BoardSize | 42575 | 8.5511  | 1.8244   | 3        | 21       | 1.22 |

4. Results

4.1. Benchmark Regression

The benchmark regression is conducted based on Equation (1), and the estimation results are shown in Table 2. Columns (1) and (2) report the estimates based on two-way fixed effects. Column (1) includes only the core explanatory variable, while Column (2) additionally incorporates control variables. Both coefficients are positively associated with statistical significance at the 1% level, with the estimate in Column (2) exhibiting a larger absolute value. These findings indicate that AIGC significantly promotes improvements in ESG performance, thereby providing support for H1. AIGC-enabled models facilitate the utilization of data resources to enhance firm-level environmental efficiency (e.g., Keding & Meissner, 2021), fulfill social responsibilities (e.g., Shi et al., 2024), and optimize internal controls (e.g., Vinuesa et al., 2020). In addition, the estimation results for the control variables indicate that the debt-to-assets ratio (DAR) has a negative effect on ESG performance. This finding aligns with the common view that highly leveraged firms face greater financial risk and are subject to constraints that may hinder their ESG performance. The relationship between corporate debt and ESG level has been well-documented in the existing research (Apergis et al., 2022; Srivastava et al., 2024; Li et al., 2024).

Table 2. The effect of AIGC on corporate ESG performance

| VARIABLES | (1)                  | (2)                   |
|-----------|----------------------|-----------------------|
|           | ESG                  | ESG                   |
| DID       | 0.2348***<br>(0.081) | 0.2655***<br>(0.075)  |
| AGE       |                      | -0.3597***<br>(0.060) |
| SIZE      |                      | 0.2119***<br>(0.014)  |
| ROA       |                      | -0.0190*<br>(0.011)   |
| DAR       |                      | -0.0001*<br>(0.000)   |
| OWN_con1  |                      | 0.0015<br>(0.001)     |
| INSTO     |                      | -0.0009               |

|                         |           |           |
|-------------------------|-----------|-----------|
|                         |           | (0.001)   |
| Constant                | 4.0840*** | 2.1323*** |
|                         | (0.005)   | (0.174)   |
| Co FEs                  | Y         | Y         |
| Year FEs                | Y         | Y         |
| Observations            | 43,458    | 43,378    |
| Adjusted_R <sup>2</sup> | 0.512     | 0.531     |

*Note: Robust standard errors clustered at the industry level are shown in parentheses. The symbols \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively; the same applies below.*

## 4.2. Robustness Tests

We conduct a series of tests to verify the robustness of the baseline model specification, with results presented in Table 3. Columns (1) and (2) exclude ST-designated firms and those in the financial sector. ST designation signals abnormal operating conditions, and removing such firms helps mitigate the influence of outliers and noise on the estimates. In addition, financial firms (e.g., banks, securities companies, and insurers) differ significantly from non-financial firms in terms of financial structures, regulatory frameworks, and profit-generation mechanisms. Excluding these firms improves the consistency and comparability of the sample. The regression results in both columns remain significantly positive, lending further support to the baseline findings.

Columns (3) and (4) add additional layers of fixed effects. Specifically, Column (3) extends the two-way fixed effects model by incorporating industry-specific time trends, while Column (4) further includes city-specific time trends. These additions help account for unobserved time-varying factors at the industry and city levels, thereby addressing potential endogeneity caused by omitted variable bias. Both models produce strongly positive coefficients with significance at the 1% level, confirming the robustness of the benchmark results under stricter fixed effects specifications.

Columns (5) and (6) introduce additional controls related to the concentration of corporate decision-making. Specifically, the duality of CEO and board chair roles (Duality), and the size of board members, are added. The former captures the unification of decision-making and execution, while the latter reflects the degree of internal checks and balances. These governance characteristics can influence a firm's strategic orientation toward sustainable development (e.g., green transformation and social legitimacy), thereby affecting ESG performance. Moreover, decision-making structures may interact with the adoption of new decision-support tools such as AIGC, making it reasonable to control for governance concentration. Column (5) adopts two-way fixed effects, while Column (6) further controls for industry-specific time trends. Both models produce significantly positive coefficients at the 1% level, providing additional evidence for the reliability of the baseline estimation.

We further perform a placebo test using fictitious treatment groups to rule out potential biases from unobservable omitted variables. Specifically, we randomly draw samples from all listed firms 500 times, and in each iteration, we randomly assign firms to pseudo-treatment and pseudo-control groups for estimation. The kernel density distribution of the resulting coefficients is presented in **Figure 1**. The estimates are predominantly centered around zero, with most corresponding p-values exceeding 0.1, indicating that the estimated coefficients are statistically indistinguishable from zero in the vast majority of cases. These results underscore that the observed treatment effect is unlikely to be driven by random variation or omitted variable bias. This further suggests that AIGC has no systematic effect on ESG performance under random assignment, thereby reinforcing the credibility of our baseline findings. Since the baseline estimate lies far to the right of the simulated distribution, we do not mark it explicitly in **Figure 1**.

Table 3. Results on robustness tests

| VARIABLES               | (1)                  | (2)                                           | (3)                                           | (4)                                           | (5)                                           | (6)                                           |
|-------------------------|----------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
|                         | ESG                  | ESG                                           | ESG                                           | ESG                                           | ESG                                           | ESG                                           |
| DID                     | 0.2199**<br>(0.086)  | 0.2476***<br>(0.073)<br>-0.2358***<br>(0.059) | 0.2735***<br>(0.076)<br>-0.3599***<br>(0.061) | 0.2675***<br>(0.077)<br>-0.3480***<br>(0.061) | 0.2584***<br>(0.076)<br>-0.3596***<br>(0.059) | 0.2647***<br>(0.079)<br>-0.3600***<br>(0.060) |
| AGE                     |                      | 0.2505***<br>(0.022)                          | 0.2125***<br>(0.015)                          | 0.2066***<br>(0.014)                          | 0.2096***<br>(0.013)                          | 0.2097***<br>(0.014)                          |
| SIZE                    |                      | 0.0755<br>(0.097)                             | -0.0197*<br>(0.011)                           | -0.0119<br>(0.011)                            | -0.0225*<br>(0.012)                           | -0.0233*<br>(0.012)                           |
| ROA                     |                      | -0.0079***<br>(0.001)                         | -0.0001*<br>(0.000)                           | -0.0001*<br>(0.000)                           | -0.0001*<br>(0.000)                           | -0.0001*<br>(0.000)                           |
| DAR                     |                      | 0.0026**<br>(0.001)                           | 0.0009<br>(0.001)                             | 0.0009<br>(0.001)                             | 0.0014<br>(0.001)                             | 0.0008<br>(0.001)                             |
| OWN_con1                |                      | -0.0022***<br>(0.001)                         | -0.0008<br>(0.001)                            | -0.0008<br>(0.001)                            | -0.0009<br>(0.001)                            | -0.0009<br>(0.001)                            |
| INSTO                   |                      |                                               |                                               |                                               | -0.0174<br>(0.019)                            | -0.0208<br>(0.019)                            |
| Duality                 |                      |                                               |                                               |                                               | -0.0018<br>(0.007)                            | -0.0018<br>(0.007)                            |
| BoardSize               |                      |                                               |                                               |                                               | 2.1909***<br>(0.179)                          | 2.2097***<br>(0.179)                          |
| Constant                | 4.2222***<br>(0.006) | 1.7810***<br>(0.267)                          | 2.1436***<br>(0.170)                          | 2.1861***<br>(0.167)                          | Y                                             | Y                                             |
| Co. FEs                 | Y                    | Y                                             | Y                                             | Y                                             | Y                                             | Y                                             |
| Year FEs                |                      |                                               |                                               |                                               |                                               |                                               |
| Ind. FEs # Time Trend   |                      |                                               |                                               |                                               |                                               |                                               |
| City FEs # Time Trend   |                      |                                               |                                               |                                               |                                               |                                               |
| Observations            | 32,221               | 32,160                                        | 43,378                                        | 43,378                                        | 42,240                                        | 42,240                                        |
| Adjusted R <sup>2</sup> | 0.439                | 0.461                                         | 0.535                                         | 0.543                                         | 0.528                                         | 0.532                                         |

Note: Columns (1) and (2) exclude ST firms and those in the financial sector. Columns (3) and (4) further control for time trends that vary by industry and city. Columns (5) and (6) additionally include control variables reflecting the concentration of corporate decision-making.

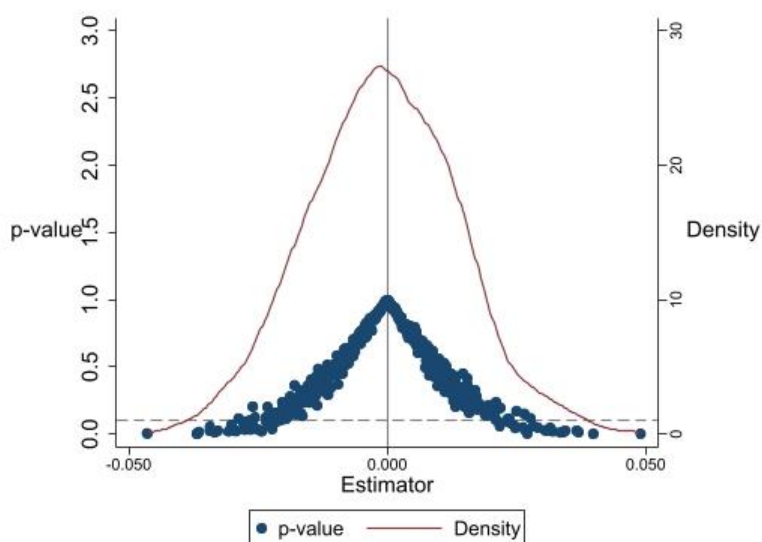


Figure 1. Placebo Tests - Fictitious Treatment Group

### 4.3. Mechanism Analysis

In this section, we examine the mechanisms through which AIGC enhances corporate ESG performance. **Table 4** presents the results for the digital transformation channel using two-way fixed effects models. Column (1) reports estimates without control variables, while Column (2) includes them. In both cases, the coefficients are positive and highly significant ( $p < 0.01$ ), suggesting that AIGC has a substantial impact on firms' digital transformation levels, thus providing support for H2. This finding suggests that the emergence of AIGC not only encourages but also compels firms to accelerate their digital transformation. A higher digital transformation index reflects greater digital dependence in firm operations, which allows AIGC to be more deeply and precisely embedded into various aspects of corporate decision-making and activity. This integration enhances operational efficiency and reduces resource misallocation, thereby directly improving managerial effectiveness. In turn, these efficiency gains may free up organizational capacity to invest in environmental and social initiatives, ultimately leading to improved ESG performance.

We further examine the green technology innovation (GTI) channel through which AIGC enhances corporate ESG performance. **Table 5** illustrates the results. Columns (1) and (2) use two-way fixed effects, while Columns (3) and (4) additionally control for industry-specific time trends to account for unobservable, time-varying factors at the industry level. Across all four model specifications, the estimated coefficients report positive and significant estimates (10% level), suggesting that AIGC adoption positively influences firms' green innovation levels, supporting H3. A higher level of green innovation not only directly improves ESG performance through the environmental (E) dimension but also guides overall business development toward more sustainable practices. This, in turn, gradually enhances firms' capacity to serve societal needs and optimizes organizational structures.

**Table 4. Mechanism: Digital transformation**

| <b>VARIABLES</b>        | <b>(1)</b>                   | <b>(2)</b>                   |
|-------------------------|------------------------------|------------------------------|
|                         | Digital Transformation Index | Digital Transformation Index |
| DID                     | 0.2606***<br>(0.046)         | 0.2102***<br>(0.039)         |
| Control Variables       | N                            | Y                            |
| Co. FEs                 | Y                            | Y                            |
| Year FEs                | Y                            | Y                            |
| Observations            | 53,397                       | 52,403                       |
| Adjusted_R <sup>2</sup> | 0.756                        | 0.765                        |

**Table 5. Mechanism: Green technology innovation**

| <b>VARIABLES</b>        | <b>(1)</b>         | <b>(2)</b>         | <b>(3)</b>         | <b>(4)</b>         |
|-------------------------|--------------------|--------------------|--------------------|--------------------|
|                         | Green Innovation   | Green Innovation   | Green Innovation   | Green Innovation   |
| DID                     | 0.1361*<br>(0.071) | 0.1278*<br>(0.072) | 0.1444*<br>(0.074) | 0.1376*<br>(0.075) |
| Control Variables       | N                  | Y                  | N                  | Y                  |
| Co. FEs                 | Y                  | Y                  | Y                  | Y                  |
| Year FEs                | Y                  | Y                  | Y                  | Y                  |
| Ind. FEs # Time Trend   |                    |                    | Y                  | Y                  |
| Observations            | 52,185             | 51,959             | 52,183             | 51,957             |
| Adjusted_R <sup>2</sup> | 0.403              | 0.405              | 0.404              | 0.406              |

#### 4.4. Heterogeneity

##### 4.4.1 Regional Heterogeneity

To explore regional heterogeneity in the impact of AIGC on corporate ESG performance, we divide the sample into eastern and central-western regions based on differences in economic development levels. Columns (1) and (2) of **Table 6** present the corresponding results. We discover that firms in both eastern and central-western regions exhibit statistically significant results at the 10% level or higher. Notably, the coefficient for eastern firms is not only more significant but also larger in absolute magnitude, indicating that firms in the eastern region benefit more from AIGC in enhancing their ESG performance. This finding may be attributed to the eastern region's advanced economy and mature industrial structure, which together foster a robust digital ecosystem. The abundance of data resources and the widespread application of efficient data-mining technologies create ample space for AIGC to enhance corporate operations. Moreover, firms in the east, driven by intense market competition, often possess stronger digital foundations—or are “born digital”—allowing them to integrate AIGC capabilities into their business processes with lower trial-and-error costs. At the same time, firms in central and western regions also experience ESG performance gains from AIGC adoption, though to a lesser extent. These benefits may stem from a gradually upgrading consumption structure and the availability of natural resources that facilitate the deployment of clean energy projects. The coefficients for firms in central and western regions yield significantly positive coefficients at the 10% significance

level, suggesting that AIGC holds considerable potential to accelerate industrial transformation and economic upgrading in these areas.

**Table 6. Heterogeneity: Regional heterogeneity**

| VARIABLES               | (1)Eastern China     | (2)Central and Western China |
|-------------------------|----------------------|------------------------------|
|                         | ESG                  | ESG                          |
| DID                     | 0.2894***<br>(0.070) | 0.1814*<br>(0.108)           |
| Control Variables       | Y                    | Y                            |
| Co. FEs                 | Y                    | Y                            |
| Year FEs                | Y                    | Y                            |
| Observations            | 30,381               | 12,978                       |
| Adjusted_R <sup>2</sup> | 0.524                | 0.533                        |

#### 4.4.2 Computation Hubs Effects

Building on the analysis of regional heterogeneity, we further examine whether firms located in the designated “Eastern Data, Western Computing” (EDWC) hub provinces exhibit better performance. In a coordinated policy initiative, the National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIIT), along with other relevant agencies, announced the establishment of national computation hub nodes in four key economic regions—Beijing-Tianjin-Hebei, the Yangtze River Delta, the Greater Bay Area, and the Chengdu-Chongqing—as well as in several resource-abundant western provinces, including Inner Mongolia, Guizhou, Gansu, and Ningxia. The initiative—referred to as the “Eastern Data, Western Computing” strategy—aims to strategically redirect computing demand from eastern regions to the west, thereby fostering the coordinated advancement of China’s national digital infrastructure. We divide the sample based on whether firms are located in one of these eight computing hub provinces and employ a difference-in-differences-in-differences (DDD) method to test whether the impact of AIGC on ESG performance varies accordingly. Columns (1) and (2) of **Table 7** show the results. Both estimates are statistically significant at the 10% level or better, confirming the presence of heterogeneity: firms located in computing hub provinces are more likely to benefit from AIGC adoption in enhancing their ESG performance.

The rationale lies in that the eastern region has leveraged the establishment of data centers to seize the opportunities presented by AIGC, continually fostering emerging business models. By driving deep industrial transformation, firms in this region have shifted toward more socially responsible modes of operation, which is reflected in improved ESG performance. At the same time, the eastern region’s strong demand for computing power has significantly stimulated the development of the AI infrastructure industry in the western region. This has, in turn, compelled western areas to deploy frontier technologies and equipment, and to accelerate the development of green electricity and sustainable computing capacity. Moreover, AIGC has created new employment opportunities—such as data labeling centers—that provide jobs for women, people with disabilities, and those with lower educational attainment, thereby expanding the scope for corporate social responsibility. These dynamics help explain why firms in both eastern and western China, albeit to varying degrees, have benefited from AIGC-driven improvements in ESG performance. While the effect is more pronounced in the east, the west and central hold significant potential for future development. The Three-Year Progress Report on the East-West Computing Resource Transfer Initiative (2025) indicates that western computing hubs have increased local

enterprises' AIGC penetration rate by 27%. Concurrently, the Transition Finance Catalog provides a 5% interest rate concession for AIGC projects in western regions. Coupled with the relocation of 60% of non-real-time computing demand from eastern regions under this initiative, these measures collectively create scale effects in technology application. Western hub nodes now handle 95% of China's AI training demand, granting local enterprises priority access to low-latency computing services and accelerating AIGC adoption. Western regions should leverage this policy-driven opportunity to achieve technological leapfrogging and further enhance corporate ESG performance.

**Table 7. Heterogeneity: Computation hubs**

| VARIABLES               | (1)                 | (2)                 |
|-------------------------|---------------------|---------------------|
|                         | ESG                 | ESG                 |
| c.Computation # c.DID   | 0.0644*<br>(0.034)  | 0.0855**<br>(0.039) |
| Computation             | 0.1037<br>(0.089)   | 0.1008<br>(0.082)   |
| DID                     | 0.1852**<br>(0.084) | 0.1995**<br>(0.083) |
| Control Variables       | N                   | Y                   |
| Co. FEs                 | Y                   | Y                   |
| Year FEs                | Y                   | Y                   |
| Observations            | 43,458              | 43,378              |
| Adjusted_R <sup>2</sup> | 0.512               | 0.531               |

#### 4.4.3 Digital Transformation

We further explore whether the effect of AIGC on ESG performance differs across firms with varying levels of digital transformation. While digitalization is not a necessary condition for firms to benefit from AIGC, companies can still leverage AIGC for strategic decision-making at key points to optimize their traditional business operations more efficiently. We examine this by splitting the sample according to firms' engagement in digital transformation. **Table 8** presents the results. It is evident that firms undergoing digital transformation experience a significant improvement in ESG performance from AIGC advancement at the 1% level, whereas no significant effect is observed among non-digitally transforming firms. This suggests that the effectiveness of AIGC relies on an integrated internal digital ecosystem that spans across operational stages and functional areas. AIGC tools trained on proprietary, first-hand data are more likely to provide precise and actionable insights for enhancing firm performance. The collection, integration, management, and application of such data, however, depends heavily on the firm's performance on digitalization.

Table 8. Heterogeneity: Digital transformation

| VARIABLES               | (1)Digital Transformation = 1 | (2)Digital Transformation = 0 |
|-------------------------|-------------------------------|-------------------------------|
|                         | ESG                           | ESG                           |
| DID                     | 0.2481***<br>(0.067)          | 0.3314<br>(0.209)             |
| Control Variables       | Yes                           | Yes                           |
| Co. FEs                 | Yes                           | Yes                           |
| Year FEs                | Yes                           | Yes                           |
| Observations            | 28,490                        | 14,255                        |
| Adjusted_R <sup>2</sup> | 0.549                         | 0.569                         |

#### 4.4.4 Audited by a *Big4* Accounting Firm

In this subsection, we examine whether being audited by one of the *Big4* accounting firms (PwC, Deloitte, EY, or KPMG) influences the impact of AIGC on corporate ESG level. **Table 9** presents the results. We find that firms audited by *Big4* accounting firms do not exhibit a statistically significant improvement in ESG performance following AIGC exposure. In contrast, firms not audited by *Big4* firms demonstrate strong positive significance ( $p < 0.01$ ), suggesting that AIGC adoption is associated with enhanced ESG performance in these firms. A plausible explanation is that firms audited by the Big Four already benefit from stronger external monitoring and higher-quality disclosure standards, which likely lead to more comprehensive ESG reporting and greater market scrutiny even before the emergence of AIGC. For other firms, however, AIGC provides a valuable opportunity to enhance sustainability performance by improving operational efficiency and enabling the development of new business models. In essence, AIGC serves as a catalyst that helps firms with relatively weaker ESG practices to catch up with their more advanced counterparts in the market.

Table 9. Heterogeneity: Audited by one of the *Big4* accounting firm

| VARIABLES               | (1)Big4 = 1       | (2)Big4 = 0          |
|-------------------------|-------------------|----------------------|
|                         | ESG               | ESG                  |
| DID                     | 0.1914<br>(0.120) | 0.2586***<br>(0.080) |
| Control Variables       | Y                 | Y                    |
| Co. FEs                 | Y                 | Y                    |
| Year FEs                | Y                 | Y                    |
| Observations            | 3,076             | 40,246               |
| Adjusted_R <sup>2</sup> | 0.595             | 0.514                |

## 5. Conclusions

This study investigates how AIGC influences the ESG performance of Chinese firms. Utilizing panel data from listed companies in China over the period 2003–2023 and applying a difference-in-differences (DID) methodology, the results indicate that AIGC has a significant positive effect on ESG performance. The conclusion holds under various robustness checks. Mechanism analyses suggest that AIGC improves ESG outcomes by prompting firms to pursue digital

transformation in response to the evolving economic landscape and by encouraging green technological innovation. Further heterogeneity analysis demonstrates that the beneficial impact of AIGC on ESG performance is particularly significant for firms located in the eastern region, those situated in provinces designated as national computing power hubs, firms engaged in digital transformation, and those not subject to *Big4* audits.

Our findings yield clear policy implications. The advancement of AIGC contributes to improved corporate ESG performance by promoting digital transformation and stimulating green innovation. Policymakers should therefore support firms in adopting more advanced digital and intelligent technologies that help reduce environmental pollution, improve resource efficiency, and accelerate green innovation processes to achieve sustainable technological outcomes. Moreover, the heterogeneity analysis shows that the positive effect of AIGC on ESG performance is especially significant in firms located in eastern regions and in provinces designated as national computation hubs. These findings offer three key policy implications: Firstly, deep integration of AIGC with energy management systems should be prioritized, particularly deploying AIGC-enabled smart energy bases in renewable-rich areas. This converts regional resource advantages into quantifiable ESG improvements through machine learning-optimized energy storage scheduling. Secondly, leveraging national strategies like the "Eastern Data Western Computing" initiative, local governments should promote cross-regional optimization of computing resources to lower AIGC adoption barriers, cultivate a distinctive green computing-low carbon industry dual-circulation ecosystem. Thirdly, developing AIGC service platforms for SMEs should coordinate collaboration between eastern and central-western enterprises across scales. This fosters a diversified symbiotic ecosystem where established firms stabilize markets while SMEs enhance innovation flexibility.

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