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Technological Innovation and Corporate Sustainability Performance: The Mediating Role of Green Accounting Information Disclosure in China

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Abstract

This study investigates the impact of technological innovation (TI) on corporate sustainability performance (CSP) and examines the mediating role of green accounting information disclosure (GAID) among Chinese ChiNext-listed firms. Using panel data covering 6,154 firm-year observations from 2015 to 2024 obtained from the CSMAR database, the study employs firm- and year-fixed-effects models with robust standard errors and applies a three-step mediation approach. The results show that technological innovation has a significant positive effect on corporate sustainability performance. In addition, technological innovation significantly enhances green accounting information disclosure, which in turn positively affects sustainability performance, indicating a partial mediating effect. These findings suggest that technological innovation improves sustainability outcomes both directly and indirectly through enhanced disclosure practices. This study extends the Triple Bottom Line framework by incorporating technological innovation and highlights the role of signaling mechanisms in sustainability research. The results provide practical implications for firms to integrate innovation with sustainability strategies and for policymakers to promote institutional frameworks supporting both innovation and transparent environmental disclosure.

Keywords:technological innovation; corporate sustainability performance; green accounting information disclosure; ESG performance; ChiNext market;

1. INTRODUCTION

Corporate sustainability performance (CSP) has emerged as a critical research focus in both academic and practical domains, particularly in emerging economies where rapid industrialization exacerbates environmental and social challenges (Nguyen et al., 2024; Ahmad et al., 2022).In China, firms are under increasing pressure to balance economic growth with environmental responsibility within evolving regulatory frameworks and sustainability-oriented policies, including carbon neutrality targets and green finance initiatives (Zhou et al., 2021). These institutional developments have significantly reshaped corporate behavior, making sustainability performance a critical determinant of long-term competitiveness and legitimacy in capital markets (Broadstock et al., 2021; Zhang et al., 2021; Liu et al., 2023). In this context, identifying the key drivers and mechanisms underlying CSP is both theoretically important and practically relevant.

The existing literature generally conceptualizes CSP within the framework of the Triple Bottom Line (TBL), which emphasizes the simultaneous achievement of economic, environmental, and social performance (Elkington, 1997; Dyllick & Hockerts, 2002). While these foundational studies establish the conceptual basis of sustainability, recent research has increasingly focused on the strategic implications of CSP. Empirical evidence suggests that firms with higher sustainability performance tend to achieve superior long-term financial outcomes, enhanced stakeholder trust, and improved market valuation (Eccles et al., 2014; Friede et al., 2015; Khan et al., 2022).Furthermore, recent studies indicate that CSP contributes to firm resilience and value creation under conditions of environmental uncertainty and regulatory pressure (Zhang et al., 2021; Li et al., 2022). These findings

reinforce the view that CSP is not merely a compliance requirement but a strategic resource that supports sustainable competitive advantage.

Among the various determinants of CSP, technological innovation is increasingly identified as a key driver of sustainable development. From a theoretical perspective, the Porter Hypothesis suggests that environmental challenges and regulatory pressures can stimulate innovation, thereby improving both environmental and economic performance (Porter & van der Linde, 1995). Building upon this argument, recent empirical studies provide strong evidence that technological innovation enhances firms' ability to improve resource efficiency, reduce emissions, and develop environmentally friendly products and processes. For instance, Shahzad et al. (2020), Wang et al. (2022), and Liu et al. (2023) find that innovation-driven firms achieve higher sustainability performance by optimizing resource allocation and enhancing operational efficiency. In particular, digital and green technological innovations have been identified as key enablers of sustainable transformation in emerging economies (Zhang et al., 2022; Li et al., 2021). These findings suggest that technological innovation serves as a crucial internal capability that drives multidimensional sustainability outcomes.

However, the relationship between technological innovation and CSP is complex and not always straightforward. Innovation activities are characterized by high costs, uncertainty, and long payback periods, which may negatively affect short-term financial performance (Hall & Lerner, 2010). Recent studies suggest that the effectiveness of innovation in improving sustainability outcomes depends on institutional conditions, disclosure quality, and stakeholder recognition (He et al., 2021; Zhao et al., 2022). In emerging markets such as China, where market mechanisms and regulatory frameworks are still evolving, information asymmetry may hinder the transformation of innovation activities into observable sustainability performance. This implies that technological innovation alone may not fully explain variations in CSP, and additional mechanisms are required to bridge the gap between internal capabilities and externally recognized outcomes.

In this regard, green accounting information disclosure (GAID) has emerged as a critical mechanism through which firms communicate sustainability-related information to stakeholders. GAID includes disclosures on environmental costs, emissions, resource utilization, and sustainability initiatives, thereby enabling stakeholders to assess firms' environmental and social performance. A growing body of literature indicates that high-quality sustainability disclosure enhances transparency, reduces information asymmetry, and improves investor confidence (Du et al., 2021; Li et al., 2022; Chen et al., 2022). Furthermore, ESG disclosure has been shown to improve firm value, reduce financing constraints, and strengthen market performance, particularly in environmentally sensitive industries (Huang et al., 2020; Zhang et al., 2022). These findings highlight the critical role of disclosure in shaping corporate sustainability outcomes.

From a theoretical perspective, signaling theory provides a robust theoretical perspective for understanding the role of GAID. Firms can use disclosure to signal their capabilities and performance under conditions of information asymmetry (Spence, 1973). Recent studies extend this perspective to sustainability disclosure, suggesting that firms with superior environmental performance and innovation capabilities are more likely to engage in high-quality disclosure to differentiate themselves from competitors (Connelly et al., 2011; Cho et al., 2015; Du et al., 2021). In this context, GAID functions not only as an information disclosure mechanism but also as a strategic tool for enhancing corporate legitimacy and stakeholder trust.

In addition, GAID also plays an internal governance role. By requiring firms to systematically measure and report environmental performance, disclosure practices enhance accountability and encourage more sustainable managerial decision-making (Michelon et al., 2015; Zhang et al., 2020; Li et al., 2022). In this sense, GAID not only reflects existing sustainability performance but also shapes future

performance by influencing organizational behavior. This dual role suggests that GAID may serve as a critical link between technological innovation and CSP.

Despite the growing literature on technological innovation and sustainability disclosure, their interaction remains insufficiently explored. Most studies treat innovation and disclosure as independent determinants of firm performance, overlooking their potential interaction in shaping sustainability outcomes (Du et al., 2021; Zhang et al., 2022). In particular, limited research has examined whether GAID acts as a mediating mechanism through which technological innovation influences CSP. This represents an important research gap, as it fails to capture the full pathway through which innovation is translated into observable sustainability performance.

The mediating role of GAID can be explained as follows. Technological innovation enhances firms' internal capabilities to improve environmental and social performance; however, these improvements may not be fully recognized by external stakeholders without effective disclosure. Through GAID, firms can communicate their innovation-driven sustainability efforts, thereby enhancing transparency, building stakeholder trust, and improving corporate reputation (Huang et al., 2020; Li et al., 2022). Therefore, GAID serves as a transmission mechanism that converts internal innovation capabilities into externally recognized sustainability performance.

This issue is particularly salient in the context of China's capital markets. The ChiNext Market, which focuses on high-growth and innovation-oriented firms, provides a unique setting for examining the interplay between technological innovation, disclosure, and CSP. Firms listed on ChiNext are more innovation-driven and subject to greater regulatory scrutiny, making them more likely to engage in both technological innovation and sustainability disclosure (Zhang et al., 2022; Liu et al., 2023). This context offers valuable insights into how innovation and disclosure jointly influence sustainability performance in emerging economies.

To address these gaps, this study develops an integrated analytical framework combining the Triple Bottom Line perspective with signaling theory, examining both the direct effect of technological innovation on CSP and the indirect effect mediated by GAID. By doing so, this study provides a more comprehensive understanding of how innovation translates into sustainability outcomes in emerging market contexts.

2.LITERATURE REVIEW

2.1Theoretical Framework

Building upon the preceding discussion, this study develops a theoretical framework that integrates the Triple Bottom Line (TBL) perspective with signaling theory to explain the relationship between technological innovation, green accounting information disclosure (GAID), and corporate sustainability performance (CSP).

From the perspective of the TBL framework, corporate sustainability performance is a multidimensional construct encompassing economic, environmental, and social dimensions (Elkington, 1997; Dyllick & Hockerts, 2002; Slaper & Hall, 2011). While these foundational studies establish the conceptual basis of sustainability, more recent research has emphasized the strategic implications of achieving balanced performance across these three dimensions. Firms that effectively integrate economic growth with environmental and social responsibility are more likely to enhance long-term value creation, resilience, and competitive advantage (Broadstock et al., 2021; Zhang et al., 2021; Li et al., 2022). Within this framework, technological innovation is widely recognized as a key internal driver of sustainability performance. Innovation enables firms to improve resource efficiency, reduce environmental externalities, and enhance productivity through cleaner production technologies and process optimization. Recent empirical studies provide robust evidence that firms with higher R&D intensity and innovation capabilities achieve superior environmental and

sustainability outcomes, particularly in emerging markets (Shahzad et al., 2020; Wang et al., 2022; Liu et al., 2023; Zhang et al., 2022).

However, the TBL framework primarily focuses on internal performance improvements and does not fully explain how such performance is communicated to and evaluated by external stakeholders. To address this limitation, signaling theory is incorporated into the analytical framework. According to signaling theory, firms can reduce information asymmetry by voluntarily disclosing credible information that signals their quality, capabilities, and future prospects to stakeholders (Spence, 1973; Connelly et al., 2011). Recent studies further extend signaling theory to the context of sustainability, demonstrating that environmental and ESG disclosures play a critical role in shaping stakeholder perceptions, reducing uncertainty, and influencing investment decisions (Du et al., 2021; Huang et al., 2020; Li et al., 2022). In this regard, disclosure is not merely a reporting activity but a strategic communication mechanism that enhances corporate legitimacy and market valuation.

In this study, green accounting information disclosure (GAID) serves as a critical signaling mechanism linking technological innovation and sustainability performance. Firms with stronger technological innovation capabilities are more likely to generate high-quality, verifiable sustainability-related information and disclose it to external stakeholders. Recent empirical evidence suggests that innovation-driven firms exhibit higher disclosure quality and transparency, as they possess more advanced data systems and stronger incentives to communicate their sustainability efforts (Chen et al., 2022; Zhang et al., 2022; Liu et al., 2023). Through GAID, firms communicate their environmental practices, innovation activities, and commitment to sustainable development, thereby enhancing transparency and legitimacy. Furthermore, recent studies show that high-quality environmental disclosure significantly improves stakeholder trust, reduces financing constraints, and enhances firm value (Du et al., 2021; Li et al., 2022; Huang et al., 2020).

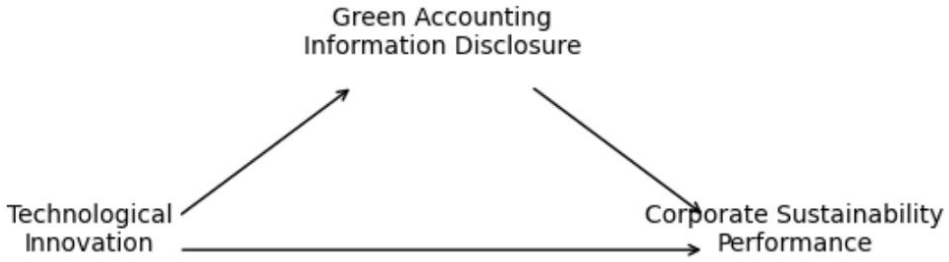
Importantly, GAID not only reflects internal sustainability efforts but also influences how such efforts are interpreted and valued by external stakeholders. By reducing information asymmetry and enhancing credibility, GAID strengthens the transmission of technological innovation outcomes into observable sustainability performance. Recent literature highlights that disclosure quality plays a critical role in transforming internal capabilities into external performance recognition, particularly in emerging market contexts characterized by institutional uncertainty (Zhao et al., 2022; Wang et al., 2022). In this sense, GAID functions as both a signaling mechanism and a governance tool that enhances accountability and improves decision-making processes (Michelon et al., 2015; Zhang et al., 2020; Li et al., 2022).

Therefore, GAID acts as a bridge connecting internal capabilities (technological innovation) and external outcomes (CSP). It enables firms to effectively communicate their innovation-driven sustainability performance, thereby enhancing stakeholder recognition and market valuation.

Based on the above analysis, this study proposes a mediation framework in which technological innovation influences corporate sustainability performance both directly and indirectly through green accounting information disclosure.

Figure 1

Research Framework



2.2Technological Innovation and Corporate Sustainability Performance

Technological innovation plays a crucial role in enhancing corporate sustainability performance (CSP) by improving firms' efficiency, reducing environmental impact, and strengthening long-term competitiveness. From the perspective of the Triple Bottom Line (TBL) framework, innovation contributes to economic, environmental, and social dimensions of performance (Dyllick & Hockerts, 2002; Slaper & Hall, 2011). In particular, technological innovation enables firms to adopt cleaner production processes, optimize resource utilization, and reduce emissions, thereby improving environmental and operational efficiency. The Porter Hypothesis further suggests that well-designed environmental regulations can stimulate innovation that simultaneously enhances environmental and economic performance (Porter & van der Linde, 1995).

Recent empirical studies provide strong support for the positive relationship between technological innovation and sustainability performance. For instance, Shahzad et al. (2020) and Wang et al. (2022) find that innovation-driven firms achieve higher sustainability performance by improving resource efficiency and reducing environmental externalities. Similarly, Zhang et al. (2022) and Liu et al. (2023) show that technological innovation significantly enhances ESG performance and facilitates green transformation in emerging economies. In the context of China, Li et al. (2021) and Zhao et al. (2022) demonstrate that firms with higher R&D intensity are more likely to achieve superior environmental and economic outcomes, particularly under increasing regulatory pressure. These findings suggest that technological innovation serves as a critical internal capability that drives sustainable development and long-term firm performance.

However, the relationship between technological innovation and CSP is not without challenges. Innovation activities are typically associated with high costs, uncertainty, and long payback periods, which may impose short-term financial pressure on firms (Hall & Lerner, 2010). Recent studies further indicate that the effectiveness of innovation in improving sustainability performance depends on institutional environments, regulatory support, and complementary mechanisms such as information disclosure (He et al., 2021; Du et al., 2021). In emerging markets, where market mechanisms and institutional frameworks are still evolving, the benefits of innovation may not be immediately observable.

Despite these potential constraints, the long-term benefits of technological innovation are generally considered to outweigh its short-term costs. By enhancing firms' ability to improve environmental performance, optimize resource allocation, and strengthen competitive advantage, technological innovation plays a fundamental role in achieving corporate sustainability objectives.

Therefore, technological innovation is expected to have a positive impact on corporate sustainability performance.

H1: Technological innovation positively affects corporate sustainability performance.

2.3Technological Innovation and Green Accounting Information Disclosure

Technological innovation is expected to enhance green accounting information disclosure (GAID) by strengthening firms' internal capabilities and incentives to disclose sustainability-related information. Innovative firms typically possess more advanced technologies, data processing systems, and managerial practices, which enable them to measure, monitor, and report environmental performance more accurately and systematically. From a resource-based perspective, technological innovation enhances firms' internal capabilities, thereby facilitating more comprehensive, credible, and transparent disclosure practices (Barney, 1991; Hart, 1995). In particular, firms with stronger innovation capacity are better equipped to generate high-quality environmental data, which provides the foundation for effective sustainability disclosure.

Recent empirical studies provide strong support for this relationship. For instance, Liu et al. (2021) and Zhang et al. (2022) find that firms with higher technological innovation intensity tend to exhibit higher ESG disclosure quality and transparency. Similarly, Li et al. (2022) and Du et al. (2021) show that firms with stronger innovation capabilities are more likely to engage in proactive environmental disclosure, particularly under increasing regulatory and stakeholder pressure. In the context of emerging markets, Wang et al. (2022) and Huang et al. (2020) further demonstrate that technological capability enhances firms' ability to collect and disclose sustainability-related information, thereby improving disclosure completeness and reliability. These findings suggest that technological innovation not only improves firms' internal performance but also strengthens their capacity to communicate such performance to external stakeholders.

From the perspective of signaling theory, firms with superior capabilities have stronger incentives to voluntarily disclose information to distinguish themselves from less capable competitors (Spence, 1973; Connelly et al., 2011). Recent studies extend this argument to sustainability contexts, indicating that firms with stronger innovation capabilities are more likely to use environmental and ESG disclosure as a strategic signal to reduce information asymmetry and enhance legitimacy (Du et al., 2021; Li et al., 2022). Through high-quality GAID, firms can effectively communicate their innovation-driven sustainability efforts, thereby attracting investors and strengthening stakeholder trust.

Nevertheless, disclosure decisions may also involve proprietary costs and strategic considerations, which could constrain voluntary disclosure (Verrecchia, 1983). More recent research suggests that firms may balance the benefits of transparency with the risks of information leakage, particularly in highly competitive industries (Zhao et al., 2022). Despite these potential constraints, the overall evidence indicates that firms with stronger technological innovation capabilities are more likely to engage in proactive, transparent, and high-quality environmental disclosure.

Therefore, technological innovation is expected to positively influence green accounting information disclosure.

H2: Technological innovation positively affects green accounting information disclosure.

2.4Green Accounting Information Disclosure and Corporate Sustainability Performance

Green accounting information disclosure (GAID) plays a critical role in enhancing corporate sustainability performance (CSP) by improving transparency and reducing information asymmetry between firms and stakeholders. By disclosing environmental costs, emissions, and sustainability practices, firms provide stakeholders with relevant and verifiable information to assess their environmental and social performance. From a signaling perspective, high-quality disclosure serves as a credible signal of firms' underlying sustainability capabilities, thereby influencing stakeholders' perceptions and resource allocation decisions (Spence, 1973; Connelly et al., 2011). Recent studies further emphasize that ESG and environmental disclosure significantly enhance corporate

transparency and legitimacy, particularly in emerging markets characterized by higher information asymmetry (Du et al., 2021; Li et al., 2022).

A growing body of recent empirical research provides strong support for the positive role of sustainability disclosure in improving firm outcomes. For instance, Huang et al. (2020) and Du et al. (2021) show that high-quality ESG disclosure significantly reduces financing constraints and improves firm value. Similarly, Li et al. (2022) and Zhang et al. (2022) find that environmental disclosure enhances corporate performance by strengthening investor confidence and improving resource allocation efficiency. In addition, Chen et al. (2022) and Wang et al. (2022) demonstrate that firms with higher disclosure quality tend to achieve superior sustainability performance, particularly in environmentally sensitive industries. These findings suggest that disclosure not only reflects corporate sustainability practices but also actively contributes to improved sustainability outcomes.

From a governance perspective, GAID also promotes internal sustainability improvements by increasing accountability and monitoring pressure. Enhanced disclosure mechanisms encourage firms to adopt more responsible environmental and social practices in order to maintain consistency between reported information and actual performance. Recent studies indicate that disclosure practices can influence managerial decision-making and drive firms toward more sustainable operational strategies (Zhang et al., 2020; Li et al., 2022). Moreover, sustainability disclosure has been shown to strengthen stakeholder engagement and improve long-term firm resilience under regulatory and environmental uncertainty (Broadstock et al., 2021; Zhao et al., 2022).

However, some studies suggest that disclosure may involve symbolic or strategic behavior, potentially weakening its effectiveness when not supported by substantive performance improvements (Cho et al., 2015). More recent research also highlights that the effectiveness of disclosure depends on its credibility and quality, particularly in markets where regulatory enforcement varies (Du et al., 2021; Wang et al., 2022). Despite these concerns, the overall evidence indicates that high-quality green accounting information disclosure contributes to improved corporate sustainability performance.

Therefore, green accounting information disclosure is expected to positively influence corporate sustainability performance.

H3: Green accounting information disclosure positively affects corporate sustainability performance.

2.5The Mediating Role of Green Accounting Information Disclosure

While technological innovation can directly enhance corporate sustainability performance (CSP), its impact may also operate through indirect mechanisms. One important mechanism is green accounting information disclosure (GAID), which serves as a bridge linking firms' internal capabilities with external stakeholder evaluation. Technological innovation improves firms' internal sustainability performance by enhancing resource efficiency, reducing environmental externalities, and enabling the development of green technologies. Recent studies confirm that innovation-driven firms achieve superior environmental and sustainability outcomes by optimizing resource allocation and improving operational efficiency (Shahzad et al., 2020; Wang et al., 2022; Liu et al., 2023). However, these improvements may not be fully recognized or valued by external stakeholders in the absence of effective and credible information disclosure.

From the perspective of signaling theory, firms use disclosure to convey private information about their capabilities and performance under conditions of information asymmetry (Spence, 1973; Connelly et al., 2011). In this context, GAID enables firms to communicate their innovation-driven sustainability efforts to investors, regulators, and other stakeholders, thereby enhancing transparency and credibility. Recent empirical studies suggest that firms with stronger technological capabilities are more likely to engage in high-quality ESG and environmental disclosure, using disclosure as a strategic signal to reduce uncertainty and enhance legitimacy (Du et al., 2021; Li et al.,

2022; Zhang et al., 2022). Through this signaling process, stakeholders are better able to recognize and evaluate firms' sustainability performance, which contributes to improved CSP.

Empirical evidence further supports this indirect mechanism. Recent studies show that sustainability disclosure enhances firm value, reduces financing constraints, and strengthens stakeholder trust, particularly in emerging markets (Huang et al., 2020; Du et al., 2021; Wang et al., 2022). In addition, disclosure practices can reinforce internal sustainability improvements by increasing accountability and external monitoring, thereby promoting more responsible corporate behavior (Zhang et al., 2020; Li et al., 2022). These findings suggest that GAID not only reflects firms' underlying innovation capabilities but also acts as a transmission mechanism that converts internal innovation outcomes into externally recognized sustainability performance.

However, some studies caution that disclosure may be symbolic if not supported by substantive performance improvements, potentially weakening its mediating role (Cho et al., 2015). More recent research also emphasizes that the effectiveness of disclosure depends on its credibility and institutional context, particularly in emerging markets with varying levels of regulatory enforcement (Zhao et al., 2022; Liu et al., 2023). Despite these limitations, the prevailing evidence indicates that GAID plays a critical role in transmitting the effects of technological innovation into observable sustainability performance.

Therefore, green accounting information disclosure is expected to mediate the relationship between technological innovation and corporate sustainability performance.

H4: Green accounting information disclosure mediates the relationship between technological innovation and corporate sustainability performance.

3. METHODS

3.1. Sample Selection and Data Sources

The sample of this study is drawn from firms listed on the ChiNext Market of the Shenzhen Stock Exchange over the period from 2015 to 2024. The ChiNext Market primarily consists of high-growth and innovation-oriented firms, making it an appropriate empirical setting for examining the relationship between technological innovation and corporate sustainability performance (CSP). Compared with firms listed on the main boards, ChiNext firms typically exhibit higher levels of research and development (R&D) investment and stronger innovation capabilities, which provide a suitable context for investigating innovation-driven sustainability outcomes (Zhang et al., 2022; Liu et al., 2023).

The study period from 2015 to 2024 is selected for several reasons. First, this period captures the rapid development of green innovation and sustainability practices in China following the implementation of major environmental policies and green development strategies, such as the "Made in China 2025" initiative and carbon neutrality targets (He et al., 2021). Second, sustainability-related information disclosure has become more standardized and comprehensive during this period, improving data availability and reliability (Du et al., 2021; Li et al., 2022). Third, the selected time span allows for the observation of dynamic relationships among technological innovation, information disclosure, and sustainability performance over time.

The initial sample includes all firms listed on the ChiNext Market during the study period. Following prior empirical studies, several screening criteria are applied to ensure data quality and reliability (Wang et al., 2022; Zhao et al., 2022). First, firms with missing key financial or sustainability-related data are excluded. Second, firms classified as ST or *ST are removed due to their abnormal financial conditions, which may bias empirical results. Third, firms in the financial industry are excluded because of their distinct financial structures and regulatory environments. Finally, to mitigate the

influence of outliers, all continuous variables are winsorized at the 1% and 99% levels, consistent with common practice in empirical corporate finance and sustainability research (Liu et al., 2023).
After applying these screening procedures, the final sample consists of firm-year observations suitable for subsequent empirical analysis.
The data used in this study are obtained from multiple sources. Financial data and firm characteristics are collected from the China Stock Market and Accounting Research (CSMAR) database, which is widely used in Chinese capital market research (Zhang et al., 2021). Technological innovation is measured using R&D-related indicators derived from firms' financial statements. Green accounting information disclosure (GAID) data are manually collected from annual reports and sustainability reports, following established disclosure scoring methods in the literature (Michelon et al., 2015; Du et al., 2021). In addition, control variables are constructed based on information obtained from the CSMAR database.

3.2. Variable Measurement

In this study, all variables are defined and measured based on established literature to ensure consistency, reliability, and comparability. Corporate sustainability performance (CSP) is constructed as a composite index following the Triple Bottom Line (TBL) framework, which integrates economic, environmental, and social dimensions. Specifically, economic performance is measured by return on assets (ROA), environmental performance is proxied by environmental disclosure scores, and social performance is captured by employee-related indicators, such as employee expenditure intensity. These components are standardized and aggregated to form the overall CSP index. This composite measurement approach has been widely adopted in prior studies to capture the multidimensional nature of sustainability performance (Eccles et al., 2014; Clarkson et al., 2008; Waddock & Graves, 1997). More recent studies further validate the use of composite ESG- or TBL-based indices in measuring corporate sustainability performance, particularly in emerging market contexts (Liu et al., 2023; Zhang et al., 2022).
Technological innovation (TI), as the core explanatory variable, is measured using R&D intensity, defined as the ratio of R&D expenditure to operating revenue. This measure reflects firms' commitment to innovation activities and has been widely used in empirical research (Hall & Lerner, 2010). In addition, the number of green patent applications is employed as a supplementary proxy to capture innovation output and environmental innovation performance (Chen et al., 2006). Recent studies suggest that combining input-based and output-based indicators provides a more comprehensive assessment of technological innovation capabilities (Shahzad et al., 2020; Li et al., 2021).
Green accounting information disclosure (GAID), the mediating variable, is measured based on the extent and quality of environmental and sustainability-related information disclosed in firms' annual reports and sustainability reports. A disclosure index is constructed following established scoring methods, where higher scores indicate greater transparency and higher disclosure quality (Dhaliwal et al., 2011; Plumlee et al., 2015). Recent literature further emphasizes that ESG and environmental disclosure indices are effective measures of firms' transparency and sustainability communication, particularly in emerging markets characterized by higher information asymmetry (Du et al., 2021; Li et al., 2022; Chen et al., 2022).
To control for potential confounding effects, several firm-level control variables are included. Firm size is measured by the natural logarithm of total assets, firm age is calculated as the number of years since establishment, and financial leverage is measured as the ratio of total liabilities to total assets. In addition, industry and year fixed effects are incorporated to control for unobservable heterogeneity across industries and over time. This approach is consistent with recent empirical studies on corporate sustainability and innovation, which emphasize the importance of controlling

for firm characteristics and macro-level variations (Wang et al., 2022; Zhao et al., 2022).The detailed definitions and measurements of all variables are summarized in Table 1.

Table 1. Variable Definitions and Measurements

Variable Type	Variable	Abbreviation	Measurement
Dependent Variable	Corporate Sustainability Performance	CSP	Measured by ESG composite score reflecting economic, social, and environmental performance (Eccles et al., 2014; Friede et al., 2015).
Independent Variable	Technological Innovation	TI	Measured as R&D intensity: TI = R&D expenditure / operating revenue (Hall & Lerner, 2010; Lin et al., 2022).
Mediating Variable	Green Accounting Information Disclosure	GAID	Measured by environmental information disclosure score based on corporate reports (Dhaliwal et al., 2011; Plumlee et al., 2015).
Control Variable	Firm Size	FS	Measured as the natural logarithm of total assets: FS = ln(Total Assets) (Dang et al., 2018).
Control Variable	Leverage	LEV	Measured as total liabilities divided by total assets: LEV = Total Liabilities / Total Assets (Rajan & Zingales, 1995).
Control Variable	Firm Age	AGE	Measured as the natural logarithm of firm age (in years): AGE = ln(Age) (Coad et al., 2016).

3.3. Model Specification

To test the proposed hypotheses, this study employs panel regression models. Following prior studies, firm-level and year fixed effects are included to control for unobservable heterogeneity (Wooldridge, 2010). In addition, a mediation analysis framework is adopted to examine the indirect effect of technological innovation on corporate sustainability performance (Baron & Kenny, 1986).

First, the baseline model is constructed to examine the impact of technological innovation on corporate sustainability performance:

$$CSP_{i,t}=\alpha_0+\alpha_1 TI_{i,t}+Controls_{i,t}+\mu_i+\lambda_t+\varepsilon_{i,t} \quad (1)$$

To further explore the underlying mechanism, the mediating role of green accounting information disclosure (GAID) is examined. Specifically, the following models are estimated:

$$GAID_{i,t}=\beta_0+\beta_1 TI_{i,t}+Controls_{i,t}+\mu_i+\lambda_t+\varepsilon_{i,t} \quad (2)$$

$$CSP_{i,t}=\gamma 0+\gamma 1GAID_{i,t}+Controls_{i,t}+\mu i+\lambda t+\varepsilon i,t \quad (3)$$

$$CSP_{i,t}=\delta 0+\delta 1TI_{i,t}+\delta 2GAID_{i,t}+Controls_{i,t}+\mu i+\lambda t+\varepsilon i,t \quad (4)$$

The definitions and measurements of all variables are provided in Table 1.

4.RESULTS AND DISCUSSION

4.1. Descriptive Statistics

Table 2 reports the descriptive statistics of the main variables based on STATA analysis. The sample consists of 6,154 firm-year observations of Chinese ChiNext listed firms over the period 2015–2024.

The mean value of corporate sustainability performance (CSP) is 72.992, indicating that, on average, firms exhibit a relatively high level of sustainability performance. The standard deviation suggests moderate variation across firms, reflecting differences in sustainability practices.

Technological innovation (TI), measured by R&D intensity, has a mean value of 0.063, implying that firms invest approximately 6.3% of their operating revenue in innovation activities. The relatively large maximum value (0.323) indicates that some firms engage in substantially higher levels of technological investment.

Green accounting information disclosure (GAID) shows a mean value of 1.906, with noticeable dispersion across firms, suggesting significant heterogeneity in environmental disclosure quality among Chinese listed companies.

Regarding control variables, firm size (FS) has a mean value of 21.647, indicating that the sample is dominated by medium- and large-sized firms. The average leverage ratio (LEV) is 0.355, reflecting a moderate level of financial leverage. Firm age (AGE), measured as the natural logarithm of firm age, has a mean value of 1.539, suggesting variation in firm maturity across the sample.

Overall, the descriptive statistics indicate sufficient variability in the data, providing a solid basis for subsequent regression analysis.

Table 2. Descriptive statistics of the main variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
CSP	6154	72.992	5.421	44.670	85.700
TI	6154	0.063	0.041	0.000	0.323
GAID	6154	1.906	0.894	0.000	3.871
FS	6154	21.647	1.223	18.123	26.299
LEV	6154	0.355	0.193	0.007	0.933
AGE	6154	1.539	0.641	0.000	2.708

4.2 Correlation Analysis

Table 3 reports the correlation matrix among the main variables used in this study. As expected, technological innovation (TI) is positively and significantly correlated with corporate sustainability performance (CSP) ($r = 0.085$, $p < 0.01$), providing preliminary evidence that firms with higher R&D intensity tend to exhibit superior sustainability outcomes.

Among the control variables, firm size (FS) shows a positive and statistically significant relationship with CSP ($r = 0.136$, $p < 0.01$), suggesting that larger firms are more capable of allocating resources toward sustainability practices. In contrast, firm age (AGE) and leverage (LEV) are negatively correlated with CSP ($r = -0.126$ and $r = -0.203$, respectively, both significant at the 1% level), indicating that older firms and highly leveraged firms may encounter constraints in improving sustainability performance.

Furthermore, the correlations among independent and control variables are generally moderate, with none exceeding the commonly accepted threshold of 0.8. This implies that multicollinearity is unlikely to be a serious concern in subsequent regression analyses, a conclusion that is further supported by the variance inflation factor (VIF) results.

Table 3.Correlation Matrix.

Note: Note: *p < 0.1, **p < 0.05, ***p < 0.01

Variables	CSP	TI	FS	AGE	LEV
CSP	1				
TI	0.085***	1			
FS	0.136***	-0.131***	1		
AGE	-0.126***	0.091***	0.364***	1	
LEV	-0.203***	-0.209***	0.390***	0.241***	1

Table 4. Variance Inflation Factors (VIF)

Variable	VIF	1/VIF
TI	1.560	0.643
FS	1.570	0.636
AGE	1.330	0.753
LEV	1.600	0.624
Mean	—	1.515

4.3Regression Results and Main Effect Analysis

Table 5 reports the baseline regression results examining the impact of technological innovation (TI) on corporate sustainability performance (CSP). Based on the fixed effects model, the empirical results provide strong support for the proposed hypothesis.

Specifically, the coefficient of technological innovation (TI) is positive and statistically significant at the 1% level ($\beta = 7.458$, $p < 0.01$), indicating that an increase in R&D intensity significantly enhances corporate sustainability performance. This finding suggests that firms with higher levels of technological investment are more capable of improving their environmental, social, and governance

performance, thereby achieving higher sustainability outcomes. The result is consistent with the theoretical expectation that technological innovation serves as a critical driver of sustainable development by improving resource efficiency and promoting green transformation.

Regarding the control variables, firm size (FS) exhibits a significantly positive effect on CSP ($\beta = 2.309$, $p < 0.01$), implying that larger firms tend to have stronger sustainability performance due to greater access to resources and more mature management systems. In contrast, firm age (AGE) shows a significantly negative relationship with CSP ($\beta = -1.315$, $p < 0.01$), suggesting that older firms may face structural inertia and reduced flexibility in adopting sustainability practices. Similarly, leverage (LEV) is negatively and significantly associated with CSP ($\beta = -6.785$, $p < 0.01$), indicating that higher financial pressure constrains firms' ability to invest in sustainability initiatives.

In terms of model performance, the R-squared value is 0.515, indicating that the model explains a substantial proportion of the variation in corporate sustainability performance. The F-statistic is significant at the 1% level, confirming the overall validity of the regression model.

Overall, the empirical results demonstrate that technological innovation plays a crucial role in enhancing corporate sustainability performance, thereby supporting Hypothesis 1.

Table 5. Baseline Regression Results

Variables	CSP
TI	7.458*** (2.191)
FS	2.309*** (0.178)
AGE	-1.315*** (0.125)
LEV	-6.785*** (0.658)
_cons	26.972*** (3.720)
N	6154
R^2	0.515
Adj. R^2	0.406
F	70.520

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses.

4.4Robustness Check

To ensure the reliability of the empirical findings, this study conducts robustness tests by replacing the dependent variable. Specifically, Tobin's Q is used as an alternative measure of corporate sustainability performance to re-estimate the baseline regression model.

The regression results are presented in Table 6. The coefficient of technological innovation (TI) remains positive and statistically significant at the 1% level (β = 1.965, p < 0.01), indicating that the positive effect of technological innovation on corporate sustainability performance is robust to alternative variable specifications. This finding confirms that firms with higher levels of R&D investment continue to exhibit superior performance when measured by market-based indicators.

Regarding the control variables, firm size (FS) remains significantly negatively associated with Tobin's Q (β = -0.826, p < 0.01), while firm age (AGE) shows a significantly positive relationship (β = 0.335, p < 0.01). Leverage (LEV) exhibits a weak negative effect, which is marginally significant at the 10% level (β = -0.255, p < 0.1). These results are generally consistent with the baseline regression findings, although slight variations are observed due to the different measurement of the dependent variable.

Overall, the robustness test results are highly consistent with the baseline regression analysis, confirming that the positive relationship between technological innovation and corporate sustainability performance is stable and reliable. Therefore, the main findings of this study are robust.

Table 6. Robustness Check Results.

Variables	Tobin
TI	1.965*** (0.631)
FS	-0.826*** (0.056)
AGE	0.335*** (0.036)
LEV	-0.255* (0.135)
_cons	19.488*** (1.175)
N	6154
R^2	0.618
Adj. R^2	0.532
F	65.627

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses.

4.5Intermediary Effect Analysis

To examine the mediating role of green accounting information disclosure (GAID) in the relationship between technological innovation (TI) and corporate sustainability performance (CSP), this study employs a stepwise mediation analysis based on a three-step regression approach.

Model (1) confirms that technological innovation has a statistically significant and positive effect on corporate sustainability performance (β = 7.458, p < 0.01), providing strong support for H1. This result indicates that firms with higher levels of R&D intensity tend to achieve superior sustainability outcomes.

The positive and economically meaningful coefficient suggests that technological innovation enhances CSP by improving resource efficiency, reducing environmental impact, and strengthening long-term competitiveness, consistent with recent empirical evidence on innovation-driven sustainability performance (Wang et al., 2022; Liu et al., 2023).

Model (2) shows that technological innovation significantly promotes green accounting information disclosure ($\beta = 0.888$, $p < 0.05$), satisfying the first condition for mediation and supporting H2. This finding suggests that firms with stronger innovation capabilities are more likely to engage in high-quality environmental disclosure. One plausible explanation is that innovative firms possess more advanced technological infrastructure and data processing capabilities, enabling them to generate and disclose sustainability-related information more accurately and systematically. In addition, these firms have stronger incentives to signal their environmental commitment and innovation capabilities to external stakeholders through enhanced disclosure (Du et al., 2021; Zhang et al., 2022).

Model (3) introduces GAID into the regression model and finds that GAID has a positive and statistically significant effect on CSP ($\beta = 0.790$, $p < 0.01$), thereby supporting H3. At the same time, the coefficient of technological innovation remains positive and statistically significant but decreases in magnitude compared to Model (1). This pattern indicates that GAID partially mediates the relationship between technological innovation and corporate sustainability performance, providing empirical support for H4.

The mediation effect can be interpreted through both signaling and governance perspectives. From a signaling perspective, GAID enables firms to communicate their innovation-driven sustainability efforts to investors, regulators, and other stakeholders, thereby reducing information asymmetry and enhancing external recognition. As a result, stakeholders are more likely to value firms' sustainability performance, which contributes to improved CSP. From a governance perspective, the process of disclosure requires firms to systematically collect, measure, and report environmental information, which increases accountability and encourages more responsible corporate behavior. Consequently, GAID strengthens the transmission of internal innovation capabilities into externally observable sustainability outcomes (Li et al., 2022; Wang et al., 2022).

Overall, the results provide robust evidence that green accounting information disclosure serves as a critical transmission mechanism through which technological innovation is translated into corporate sustainability performance. The presence of partial mediation further suggests that while disclosure plays an important role, technological innovation also affects CSP through additional direct and indirect channels.

Table 7. Regression Results with GAID as Mediator

Note: *p<0.1; **p<0.05; ***p<0.01. Robust standard errors in parentheses.

Variables	(1) CSP	(2) GAID	(3) CSP
TI	7.458*** (2.191)	0.888** (0.429)	6.757*** (2.183)
GAID			0.790*** (0.095)
FS	2.309*** (0.178)	0.363*** (0.032)	2.022*** (0.181)
AGE	-1.315*** (0.125)	0.176*** (0.023)	-1.454*** (0.126)
LEV	-6.785*** (0.658)	0.188* (0.109)	-6.933*** (0.652)
_cons	26.972*** (3.720)	-6.343*** (0.669)	31.981*** (3.759)
N	6154	6154	6154
R^2	0.515	0.588	0.523

5.CONCLUSION

5.1Research Findings

This study investigates the impact of technological innovation on corporate sustainability performance and further examines the mediating role of green accounting information disclosure using panel data of Chinese ChiNext-listed firms from 2015 to 2024. Based on empirical analysis, several important findings are obtained.

First, technological innovation is found to have a significantly positive effect on corporate sustainability performance. The regression results indicate that firms with higher levels of R&D investment tend to achieve better sustainability outcomes. This finding highlights the crucial role of innovation in promoting corporate sustainable development, suggesting that technological advancement enhances firms' capabilities in resource allocation, environmental management, and long-term value creation.

Second, technological innovation significantly improves the quality of green accounting information disclosure. Firms that actively engage in innovation activities are more likely to disclose environmental information in a transparent and standardized manner. This result implies that innovation not only enhances internal operational efficiency but also strengthens external communication and signaling mechanisms.

Third, green accounting information disclosure has a significantly positive impact on corporate sustainability performance. This finding confirms that high-quality environmental disclosure contributes to improved corporate sustainability outcomes by reducing information asymmetry and enhancing stakeholder trust.

Finally, the mediation analysis reveals that green accounting information disclosure plays a partial mediating role in the relationship between technological innovation and corporate sustainability performance. Specifically, technological innovation not only directly promotes sustainability performance but also indirectly enhances it through improving the quality of green information disclosure. This result provides empirical support for the integrated mechanism linking technological innovation, information disclosure, and corporate sustainability.

5.2Theoretical Contributions

This study makes several important theoretical contributions to the literature on corporate sustainability performance. First, it extends the Triple Bottom Line (TBL) framework by incorporating technological innovation as a key driver of sustainability performance. The findings suggest that innovation capability plays a critical role in enhancing firms' long-term sustainability, thereby enriching the traditional TBL perspective.

Second, this study integrates signaling theory to explain how technological innovation influences corporate sustainability performance through green accounting information disclosure. By identifying green accounting information disclosure as a mediating mechanism, this research provides new insights into how firms translate internal innovation activities into external sustainability outcomes.

Third, this study offers empirical evidence from China's ChiNext market, contributing to the understanding of sustainability practices in emerging and innovation-driven economies. This contextual evidence enhances the applicability of sustainability theories in developing market settings.

5.3Practical Implications

The findings of this study provide several practical implications for corporate managers and policymakers. First, firms should increase investment in technological innovation, as innovation not only enhances operational efficiency but also significantly improves corporate sustainability performance. Managers are encouraged to integrate innovation strategies with sustainability objectives to achieve long-term development.

Second, companies should strengthen the quality and transparency of green accounting information disclosure. High-quality environmental disclosure can enhance corporate credibility and effectively communicate sustainability efforts to external stakeholders, thereby improving market recognition and trust.

Third, policymakers should promote regulatory frameworks and incentive mechanisms that encourage both technological innovation and standardized environmental information disclosure. In particular, policies supporting green innovation and disclosure practices can play a crucial role in guiding firms toward sustainable development.

5.4Limitations and Recommendations for Future Research

(1) Methodological Scope – This study adopts a quantitative research design based on panel data analysis, which may not fully capture the underlying managerial motivations and decision-making processes associated with technological innovation and sustainability practices. While quantitative approaches provide robust empirical evidence, they may overlook contextual and behavioral factors influencing corporate strategies. Future research could employ mixed-method designs, such as interviews or case studies, to provide deeper insights into how firms integrate technological innovation with sustainability strategies (Rahman & Alam, 2024).

(2) Sample Scope – The sample is limited to firms listed on China's ChiNext market, which primarily consists of innovation-driven enterprises. Although this context is appropriate for examining the role of technological innovation, the findings may not be fully generalizable to firms operating in different institutional environments or industries. Future research could extend the analysis to other capital markets or sectors to enhance external validity (Nguyen et al., 2024).

(3) Measurement Scope – This study employs proxy indicators to measure technological innovation and corporate sustainability performance. Although these measures are widely adopted in prior literature, they may not fully capture the multidimensional nature of sustainability outcomes under the Triple Bottom Line framework. Future research could incorporate more comprehensive indicators across economic, social, and environmental dimensions to provide a more holistic evaluation of corporate sustainability performance (Kumar & Sahu, 2024).

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