

How has the IT change affected corporate environmental and social violations in transition economies? Evidence from the supply chain perspective

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Data relevant to the studies in this paper are available upon reasonable request.

Author Contributions Statement

Qian Li and Rongcheng Zhu wrote the main manuscript text and Yanbin Liu prepared tables 1-15. All authors reviewed the manuscript.

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Abstract: Corporate entities are the primary drivers of green economic transformation and sustainable development, while information technology can significantly impact corporate environmental and social violations across the supply chain. Therefore, we focus on the impact of information technology change in the supply chain (SITC) on corporate environmental and social violations and explore the mechanisms underlying this effect. Through an empirical analysis of A-share-listed companies in China from 2010 to 2024, we developed a measurement of SITC using computer-assisted textual analysis. The results show that SITC inhibits corporate environmental and social violations through dual mechanisms: 1) enhancing external monitoring capabilities and 2) facilitating knowledge spillover effects. It also significantly affects violations by corporations with high supply chain concentration, lack of government regulation, non-state ownership, and large scale. This research provides evidence on the pathways through which SITC influences corporate environmental and social violations, advancing understanding of how technological change shapes environmental and social accountability challenges.

Key Words: IT change, Corporate violation, Supply chain, Information asymmetry, textual analysis

1. Introduction

Economic growth often comes with enormous environmental and social costs (Kacperczyk & Peydró, 2022), and thus, economic sustainability is of broad societal interest (Busco et al., 2018). As the most important market players, corporate entities are the primary drivers in advancing green economic transformation and sustainable development (Jia et al., 2019; Burke, 2021). However, corporate environmental and social (E&S) violations remain widespread, especially among industrial firms. Such violations are not merely isolated compliance failures, but also reflect information opacity, insufficient stakeholder monitoring, and governance frictions in firms' operating environments.

Literature has been rich in the antecedents of corporate E&S violations, including (1) the institutional and non-institutional factors outside (Cegarra-Navarro et al., 2013; Liang & Renneboog, 2017; Graafland & Noorderhaven, 2020); (2) the stakeholders internal and external, such as the government, media, investors, consumers, employees, and others (Sonnier et al., 2011; Naughton et al., 2019; Libai et al., 2020); (3) the firm-level features such as size, ownership, and internal governance (Rao & Tilt, 2016; Drempetic et al., 2020; Heese et al., 2022). While this literature has substantially advanced our understanding of why firms violate E&S norms, relatively limited attention has been paid to how changes in the information environment surrounding firms reshape such violations. This omission is important because E&S misconduct is often facilitated by information asymmetry between firms and external stakeholders, particularly in complex supply chain relationships.

Information technology can significantly impact corporate violations. The rapid diffusion of information technologies causes corporations to profoundly change how they operate (Bloom et al., 2014), and it also transmits through the supply chain (Glaeser, 2018). Compared with internet

technology, digital technology-based supply chain change (SITC) mitigates information asymmetry in the supply chain by increasing corporations' efficiency in processing upstream and downstream information, such as creditworthiness and reputation (Cabral, 2012; Hollenbeck, 2018; Al-Khatib, 2023). For example, SITC significantly weakens information constraints across supply chains due to limitations imposed by geographic factors (Bernard et al., 2019). Corporations can select business partners with better reputations and higher product quality across a broader range, with greater efficiency (Wang et al., 2018; Goldfarb & Tucker, 2019), thereby promoting optimized resource allocation (Isaksson et al., 2016).

However, existing supply chain literature focuses on the positive and negative impacts on corporate business decisions, while less research has examined the SITC on non-financial decisions such as corporate violations (Kuhn & Mansour, 2014; Bernard et al., 2019). SITC, in this study, refers to the application of the new generation of digital technology in the supply chain (Vial, 2019; Braxton & Taska, 2023). Therefore, this study addresses the following questions: Does SITC affect corporate E&S violations? If so, through what mechanisms does this effect occur, and under what conditions is it more pronounced? China provides an appropriate empirical setting for this investigation. As the world's largest transition economy, China faces persistent tensions between industrial development and environmental and social governance. At the same time, Chinese listed firms are deeply embedded in extensive supplier – customer networks, where information frictions between focal firms and their supply chain partners are highly salient. The rapid expansion of China's digital economy also provides substantial cross-firm and over-time variation in SITC.

Based on data from Chinese listed companies from 2010 to 2024, we constructed an SITC measurement using computer-assisted textual analysis to empirically examine the impact of SITC on corporate violations and its mechanisms. The results show that SITC inhibits corporate violations

through the external monitoring and knowledge spillover mechanisms, and a series of endogeneity and robustness tests support the conclusions. Moreover, SITC significantly impacts violations of corporations that lack government regulation, have high supply chain concentration, and are large-scale. We also found that downstream customers exerted the monitoring governance effect more effectively than upstream suppliers.

This study makes three contributions to the literature. First, it extends research on the antecedents of corporate E&S violations by introducing SITC as an important information-related determinant. Research on corporate E&S antecedents is relatively abundant, but we should pay more attention to information technology factors in companies' environments (Naughton et al., 2019; Libai et al., 2020). This study expands on the impact of IT change on the corporate environment and development decisions, and identifies the key terms of IT change. Second, this study contributes to the literature on supply chain digitalization by documenting its non-financial governance consequences (Bloom et al., 2014; Vial, 2019). This study establishes evidence regarding the pathways through which SITC influences corporate environmental and social violations. Third, this study refines the application of information asymmetry theory in the context of corporate sustainability (Campbell et al., 2012; Blankespoor et al., 2014). SITC improves the efficiency of information processing and mitigates information asymmetry, thereby effectively leveraging stakeholders' monitoring function.

2. Literature and Hypotheses

2.1 Literature

2.1.1 The factors influencing corporate E&S performance

Literature is rich in the factors influencing corporate E&S performance, including the institutional and non-institutional factors (Cegarra-Navarro *et al.*, 2013; Graafland & Noorderhaven,

2020), internal and external stakeholders (Naughton *et al.*, 2019; Libai *et al.*, 2020) and firm-level factors (Drempetic *et al.*, 2020; Heese *et al.*, 2022). Research suggests that country-level institutional and cultural factors are essential in explaining differences in corporate E&S ratings across countries (Liang & Renneboog, 2017; Graafland & Noorderhaven, 2020). For example, corporate E&S ratings are higher in countries with laws that encourage competition, strong civil liberties and political power, and cultural environments that emphasize harmony and autonomy (Liang & Renneboog, 2017). Graafland & Noorderhaven (2020) also confirmed that the liberal economic system and the long-term orientation culture positively influence corporate E&S performance, and the combined effect is stronger than the individual factors. Meanwhile, stakeholders are also essential. When investors strongly prefer E&S, a valuation premium is given to corporate E&S performance (Naughton *et al.*, 2019). Analyst teams analyze and disseminate information about corporate E&S practices, which is essential in rectifying corporate non-compliance and improving corporate E&S performance (Burke, 2021; Heese *et al.*, 2022). Moreover, firm-level factors also influence their E&S performance. Large-scale firms with significant assets are subject to more public scrutiny and perform better (Drempetic *et al.*, 2020). State-owned enterprises are better at fulfilling their responsibilities than other firms because of their specific duties in socio-economic development (Heese *et al.*, 2022). CEO and corporate governance characteristics, such as board traits, also influence the corporate E&S performance (Rao & Tilt, 2016).

2.1.2 Economic consequences of information technology change

IT change has a significant impact on enterprises, including corporate efficiency and performance (Bloom *et al.*, 2014; Mendling *et al.*, 2020), innovation and market value (Kong *et al.*, 2022; Balakrishnan *et al.*, 2014), and the supply chain (Isaksson *et al.*, 2016; Dai *et al.*, 2021). IT change can improve corporate efficiency, and the effect varies significantly across countries (Bloom

et al., 2014). Steelman *et al.* (2019) find that investing in information technology improves corporate performance. Mendling *et al.* (2020) find that different types of digitization technologies can help corporations reduce control costs, increase operational efficiency, and enhance their human capital structure, thereby increasing productivity. IT change can also promote corporate innovation. Kong *et al.* (2022) use the sudden termination of Google search service in China to confirm that access to information is an essential driver of technological progress. In terms of capital market performance, Balakrishnan *et al.* (2014) find that corporations' adoption of digital technology alleviates information asymmetry and improves capital market expectations, thereby increasing firm value and financial stability. From the supply chain perspective, IT change has a diffusion effect. Matarazzo *et al.* (2021) find that customers' adoption of digital technology significantly drives IT change in corporations upstream of the supply chain. In addition, the diffusion effect among supply chain corporations is affected by geographic distance, technology gap, and business dependence intensity (Isaksson *et al.*, 2016) and is moderated by external competitive pressure and customer demand (Dai *et al.*, 2021).

2.2 Hypotheses

SITC promotes the efficiency of information transfer between upstream and downstream in the supply chain and mitigates the problem of information asymmetry (Chen *et al.*, 2020), which ultimately reduces corporate violations through the external monitoring mechanism and knowledge spillover mechanism.

SITC can influence corporate violations through the external monitoring mechanism. Unlike Internet technology, SITC, based on digital technology, enables substantial increases in efficiency in managing upstream and downstream creditworthiness, performance records, reputation, and other information, and reduces information asymmetry between external stakeholders and corporations (Cabral, 2012; Hollenbeck, 2018). For example, technologies such as blockchain achieve traceability

and non-tampering of supply chain information, ensuring the information in the chain is accurate and reliable and generating spillovers to the external (Goldfarb & Tucker, 2019). Meanwhile, SITC significantly reduces constraints across supply chains due to geographic restrictions, enabling upstream and downstream parties to obtain information at lower cost and higher efficiency (Bernard et al., 2019). It can elevate the risk of hiding lousy news (Cheng et al., 2016) and facilitates the monitoring by external stakeholders (Wang et al., 2018). As a result, SITC reduces corporate moral hazard and opportunistic behaviors like corporate violations (Kuhn & Mansour, 2014; Isaksson et al., 2016).

H1a. As SITC levels increase, corporate violations decrease through external monitoring.

SITC can also influence corporate violations through the knowledge spillover mechanism. SITC facilitates the flow of data, knowledge, and information, conducive to information sharing and knowledge spillover among supply chain members, and enhances the learning and exchange of green management experience (Kuhn & Mansour, 2014; Al-Khatib, 2023). Because there is an interdependent relationship between upstream and downstream in the supply chain, such as the products of upstream corporations serving as intermediate inputs for downstream, at this point, SITC drives corporations to break down barriers to factor flows and reach extensive linkages with upstream and downstream, accelerating the transmission and processing efficiency of green product information in the supply chain (Wang et al., 2018; Goldfarb & Tucker, 2019). The information advantage thus created alleviates the operating pressure and financing constraints of cooperative corporations (Cohen & Li, 2020), supports them to optimize resource allocation through green management, and reduces pollution emissions (Li et al., 2018; Kong et al., 2022), thus reducing corporate violations. Therefore, we have the hypotheses:

H1b. As SITC levels increase, corporate violations decrease through knowledge spillover.

3. Method

3.1 Sample and data source

We selected data from 2010 to 2024 as the research sample. Referring to existing studies (Chu et al., 2019; Burke, 2021), this study treats the data as follows: (1) exclude ST, PT category and financial industry listed companies; (2) exclude the samples with year-industry observations less than 10; (3) exclude the samples with missing data on the independent and dependent variables; and (4) for the continuous variables used, they are all shrunk at the 1 and 99% levels.

SITC data is derived from the financial reports of listed companies. Given that most suppliers and customers are non-listed firms with no publicly disclosed financial data, we match the sample of observations whose suppliers and customers are listed firms. For example, the listed suppliers and customers (S1, S2, C1, C2) corresponding to a firm (E) in the sample year (201X) have observations E-S1-201X, E-S2-201X, E-C1-201X, and E-C2-201X. However, the sample size is still relatively small, and we refer to the existing research (Chu *et al.*, 2019) to keep the top five suppliers and customers and obtain 3,226 observations from 1,309 listed companies.

3.2 Measures

3.2.1 Independent variables

The independent variable is SITC (*Itc_s*). Since text analysis provides accurate measurement and continuous data, it is widely used and recognized (Yang, 2022; Liu *et al.*, 2023), we finally used this method to construct SITC. Text analysis includes constructing a dictionary of IT change, analyzing financial reports, and measuring IT change keywords (Hoberg & Maksimovic, 2015; Buehlmaier & Whited, 2018). We explained the steps and methods in detail in Appendix 2. We also conduct correlation tests for SITC. The comparison indicator is IT expenditures as a share of sales (*Itc_i*) (Steelman et al., 2019). The correlation results show that *Itc_i* is significantly positive with

Itc_s ($\beta=0.238$, $p<0.01$). On this basis, we construct supplier/customer firm-annual data based on supply chain relationships. Considering that data from unlisted firms are difficult to obtain and the sample size is small, we refer to existing studies (Chu *et al.*, 2019) and retain the sample where the top five suppliers and customers are listed firms.

3.2.2 *Dependent variables*

The dependent variable is corporate violations. This study constructs indicators of environmental violations (EQ) and social violations (SQ) based on the IPE and CSMAR databases. Among them, IPE is a non-profit organization that builds a database of corporate environmental violations by using big data technology to capture government information and supplement unofficial data through non-governmental organizations, media, and other channels (Seligsohn *et al.*, 2018). CSMAR collects data on company-related litigation with the events' content, the reasons involved, the awards' content, and the enforcement status (Jia *et al.*, 2019), which overlap with the social pillar of the MSCI ESG rating system. Therefore, we use the natural logarithm of illegal pollution records in the IPE database to construct environmental violations and take the natural logarithm of incidents in the China Listed Companies Litigation and Arbitration Research database to measure corporate social violations.

3.2.3 *Control variables*

Referring to Jia *et al.* (2019) and Burke (2021), this study controls three types of variables. First, the primary financial characteristics of the firm, which include firm age (Age), the natural logarithm of years the firm has been in existence; firm size (Size), the natural logarithm of the total assets; gearing ratio (Lev), the ratio of total liabilities to total assets; return on assets (Roa), the ratio of net profit to total assets; and Growth (Grow), the ratio of net profit to total assets. Second, corporate governance, including duality (Tio), whether the board of directors and executives hold concurrent positions; the ratio of independent directors (Indep); Top4, whether a Big 4 accounting firm conducts

the audit; audit opinion (Report), whether the audit report is a labeled opinion. Moreover, we control city-level variables, like economic (Gdp) and education (Edu), measured by the natural logarithm of the GDP per capita and the number of universities, and control individual (Firm) and year (Year) fixed effects.

3.3 Modeling

We constructed the following basic regression model to examine how the SITC impacts E&S violation (1).

$$Violation_{i,t} = \beta_0 + \beta_1 Itc_s_{i,t} + \beta_c \sum Control_{i,t} + \mu_i + \nu_t + \varepsilon_{i,t} \quad (1)$$

Where $Violation_{i,t}$ denotes corporate violations, which has two dimensions: environmental violations (EQ) and social violations (SQ); $Itc_s_{i,t}$ is an indicator of SITC. $Control_{i,t}$ in the model contains the following control variables: year of establishment (Age), firm size (Size), gearing ratio (Lev), return on assets (Roa), growth (Grow), two jobs in one (Tio), proportion of sole directors (Indep), whether Big 4 audited (Top4), Big 4 audit opinion (Report), city economic level (Gdp), city education level (Edu), and individual (Firm) and year (Year) fixed effects. In addition, $\varepsilon_{i,t}$ are randomized disturbance terms.

4. Results

4.1 Descriptive statistics and Pearson correlations

Table 1 presents detailed descriptive statistics for the variables. The mean values of environmental violations (EQ) and social violations (SQ) are 0.247 and 0.147; the maximum values are 2.833 and 2.303, and the minimum values are 0.000, suggesting significant variation in violations across firms. The mean value of the independent variable SITC (Itc_s) is 0.1% (i.e., one occurrence of the keyword in a 1,000-word report), and the maximum value is 1.5%, while the minimum value is 0.000, which indicates that there are significant differences in SITC. Moreover, no obvious

abnormality in the financial and governance variables suggests a reasonable sample.

Insert Table 1 about here

Table 2 presents the Pearson correlation coefficients for the variables. We can see that the Pearson correlation coefficients between SITC (Itc_s) and EQ ($\beta=-0.074, p<0.01$) and SQ ($\beta=-0.010, p<0.05$) are all significantly negative, so we verified Hypothesis 1 preliminarily. However, it is yet to be followed up by subsequent tests. Besides, the absolute values of correlation coefficients between independent and control variables are less than 0.200. The average VIF is 1.300, and the maximum is 1.800, both of which are well below 10. Therefore, there is no need to worry about serious multicollinearity among the variables.

Insert Table 2 about here

4.2 Main effect

Table 3 lists the regression results for the main effect. This section uses the fixed effects model concerning Model 1, and Columns (2) and (4) show the results of the regression of SITC on corporate E&S violations. The results in columns (2) and (4) show that SITC significantly inhibits corporate environmental violations ($\beta=-0.180, p<0.01$) and social violations ($\beta=-0.073, p<0.05$). In terms of economic significance, a 1% increase in the degree of SITC can reduce approximately 0.180 environmental violations and 0.073 social violations. In summary, SITC exhibits a dampening effect on corporate violations, and main effect is supported.

The results have clear economic implications. Holding other factors constant, an increase in

SITC is associated with fewer corporate violations, suggesting that digital changes embedded in supply chain relationships can discipline firms' sustainability-related behavior. The effect is stronger for environmental violations than for social violations. This finding is consistent with studies showing that information technology reduces information frictions and improves interfirm coordination (Bloom et al., 2014; Goldfarb & Tucker, 2019). It also extends the supply chain literature by showing that SITC has governance consequences beyond operational efficiency and market performance.

For the control variables, year of establishment (Age), gearing ratio (Lev), return on assets (Roa), standard audit opinion (Report), and urban education level (Edu) have a significant effect on corporate violations. Long-established firms have more violations disclosed because large firms usually receive more public attention and are assigned higher social expectations (Drempetic *et al.*, 2020); firms with low gearing and high return on assets have spare resources to fulfill their responsibilities and fewer violations (Cohen & Li, 2020); standard audit opinions and higher levels of urban education are conducive to reducing corporate violations (Ke *et al.*, 2015).

Insert Table 3 about here

4.3 Endogeneity tests

This study focuses on the impact of SITC on corporate violations. To address endogeneity in this study, we use Heckman' s two-stage modeling and propensity score matching to address selection bias, and the instrumental variable method to address omitted-variable bias.

4.3.1 Heckman selection model

For this study, the most critical endogeneity problem is sample selection bias: high-quality firms generally have higher SITC scores and are usually better able to fulfill their E&S responsibilities.

Therefore, we follow Heckman (1979) and use a two-stage model to mitigate the endogeneity due to selection bias. Initially, a probit model is employed to examine the association between firm characteristics and SITC to estimate the inverse Mills ratio (IMR). Firm characteristic indicators encompass establishment duration (Age), firm scale (Size), leverage ratio (Lev), asset profitability (Roa), growth potential (Grow), and ownership structure (Owner). Subsequently, the IMR is incorporated into the regression to address potential sample selection bias. As presented in Table 4, the regression outcomes demonstrate the statistical significance of IMR across columns 1-4 at the 1% threshold, substantiating the endogeneity stemming from sample selection. However, SITC still shows inhibitory effects on environmental violations ($\beta=-0.164$, $p<0.01$) and social violations ($\beta=-0.064$, $p<0.05$). Therefore, the findings remain robust.

Insert Table 4 about here

4.3.2 Propensity score matching

Besides the Heckman two-stage model, propensity score matching can mitigate endogeneity problems due to selection bias. Therefore, we refer to Caliendo & Kopeinig (2008) and utilize propensity score matching to mitigate potential endogeneity concerns. The method comprises: (1) computation of propensity scores derived from control variables, with the treatment cohort comprising firms ranked within the highest SITC quartile; (2) implementation of a nearest-neighbor matching protocol to establish correspondences between samples; (3) re-estimation of regression models using the matched pairs. Table 5 (Panel A) shows that univariate mean comparisons reveal negligible disparities in financial characteristic metrics between cohorts. Results in Table 5 (Panel B) confirm the robustness of propensity score matching through standardizing the matched sample: SITC still exhibits a dampening effect on environmental violations ($\beta=-0.180$, $p<0.01$) and social violations ($\beta=-0.073$, $p<0.05$). Therefore, the findings remain robust after propensity score matching.

Insert Table 5 about here

4.3.3 Instrumental variable

This study controls financial and governance characteristics and city-level variables, but endogeneity may arise due to omitted variables. Therefore, we refer to Nunn & Qian (2014) to mitigate endogeneity using instrumental variables based on 1984 postal and telecommunication data

for the prefecture-level cities where supply chain firms are. Theoretically, the communication methods of cities in the process of development will affect the application of new-generation IT by local enterprises and thus satisfy the relevance condition; post and telecommunications, as an information infrastructure, mainly provide daily communication services for the residents of the relevant region and do not directly play a role in the violations of enterprises, and satisfy the exogeneity condition (Nunn & Qian, 2014). Considering that the number of posts and telecommunications in 1984 is cross-sectional data, this study constructs a cross-multiplier term (Terrain) as a final instrumental variable that multiplies the percentage of the population with Internet access in each province in the previous year by the number of post offices in the locations of supply chain firms. Table 6 reports the results of the instrumental variables method. The regression coefficients of the instrumental variables in column (1) are significantly positive ($\beta=0.018, p<0.01$), indicating that they satisfy the correlation condition; the results in columns (2) and (3) show that the SITC inhibitory effects on corporate environmental violations ($\beta=-0.193, p<0.01$) and social violations ($\beta=-0.074, p<0.05$) remain robust.

Insert Table 6 about here

4.4 Other robustness tests

Besides the endogeneity test, we also apply other robustness tests for the conclusions, including alternative measures of variables, and exclude the interference of Internet factors.

4.4.1 Alternative measures of IT change

Considering the differences in the literature on the definition of IT change, we refer to Steelman *et al.* (2019) and Braxton & Taska (2023) and use the $\Delta IT_{i,t}$ to construct SITC. Table 7 presents the

results of alternative measures of the dependent variable. This section uses a fixed effects model. Column (1) indicates that SITC ($\beta=-0.075, p<0.10$) significantly inhibits corporate environmental violations, and column (2) indicates that SITC ($\beta=-0.107, p<0.01$) significantly inhibits corporate social violations. The results indicate that the findings remain robust.

Insert Table 7 about here

4.4.2 *Alternative measures of violation*

Unlike the natural logit measure in the main effects, this section uses absolute numbers and whether a violation occurred for robustness testing (Burke, 2021). The results in Table 8 show that SITC has a significant inhibitory effect on the number ($\beta=-0.519, p<0.01$) and occurrence ($\beta=-0.149, p<0.01$) of environmental violations and a negative inhibitory impact on the number ($\beta=-0.195, p<0.05$) and occurrence ($\beta=-0.066, p<0.01$) of social violations. The results suggest that the findings remain robust after alternative measures.

Insert Table 8 about here

4.4.3 *Exclusion of Internet effect*

This study defines IT change as new-generation technology, removing the part of Internet technology from digital technology. However, Internet technology can impact corporate violations (Forman & Zeebroeck, 2012). Therefore, this section measures the level of Internet technology in the city where the firms are and adds it to the model as a control variable. The results in Table 9 show that the regression coefficients of SITC on environmental violations in columns (1) and (3) are

significantly negative at the 1% level, those on social violations in columns (2) and (4) are significantly negative at the 5% level. The results indicate that the findings remain robust after excluding the effect of Internet technology.

Insert Table 9 about here

4.4.4 Increasing the sample size

In this section, we constructed an alternative measure that captures SITC in firms' external infrastructure, rather than relying only on matched listed suppliers and customers (Zhu & Li, 2024). It is closely related to our main explanatory variable because both measures capture changes in the information conditions under which firms interact with external stakeholders. However, this alternative measure does not require supplier and customer firms to be listed. Therefore, it allows us to expand the sample size. The results in Table 10 show that SITC in firms' external infrastructure has a significant inhibitory effect on the environmental violations ($\beta=-0.139, p<0.01$) and a significant inhibitory impact on social violations ($\beta=-0.085, p<0.01$). The results suggest that the findings remain robust after increasing the sample size.

Insert Table 10 about here

5. Further verification

5.1 Mechanism test

5.1.1 External monitoring mechanism

SITC reduces information asymmetry in the supply chain by weakening the information constraints due to geographic constraints (Bernard et al., 2019), allowing firms to access information in the supply chain at a lower cost and with greater efficiency (Cabral, 2012; Hollenbeck, 2018), which makes it more costly for firms to hide lousy news (Cheng et al., 2016) and can reduce corporate violations (Kuhn & Mansour, 2014; Isaksson et al., 2016). Therefore, this section tests the mechanism by firm-level Baidu index (Baidu) and information asymmetry (Asym). Table 11 shows the results of the external monitoring mechanism. Column (1) shows the result of SITC on the Baidu index ($\beta=0.711, p<0.01$) is significantly positive, and column (2) indicates the result of SITC on information asymmetry ($\beta=-0.166, p<0.01$) is significantly negative.

These results support the external monitoring mechanism. When supply chain information becomes more transparent and easier to process, external stakeholders can better observe firm behavior and identify potential misconduct (Hollenbeck, 2018). Increased visibility raises the expected cost of hiding bad news and engaging in E&S violations (Isaksson et al., 2016). Therefore, SITC reduces corporate violations by strengthening external governance pressure.

Insert Table 11 about here

5.1.2 Knowledge spillover mechanism

SITC facilitates information sharing and knowledge flow between upstream and downstream firms in the supply chain, accelerates their knowledge transfer and processing efficiency, and promotes their learning of green management-related knowledge (Kuhn & Mansour, 2014; Goldfarb & Tucker, 2019). It supports collaborating corporations in optimizing resource allocation through green management, reducing pollution emissions (Li et al., 2018; Kong et al., 2022), thereby reducing

corporate violations. Therefore, this section takes the total amount of green innovation (Green_t) and the quality of green innovation (Green_i) of enterprises as the influencing mechanism variables. Table 12 presents the results.

Insert Table 12 about here

Column (1) shows that the regression coefficient of SITC on the total amount of green innovation ($\beta=0.095$, $p<0.01$) is significantly positive, and column (2) shows that the regression coefficient of SITC on the quality of green innovation ($\beta=0.176$, $p<0.01$) is significantly positive. The results support the knowledge spillover mechanism. SITC enables firms to absorb and apply sustainability-related knowledge from supply chain partners. This strengthens their green innovation capacity and reduces the likelihood of environmental and social misconduct. This finding complements the external monitoring mechanism. SITC reduces violations through both a pressure-based channel and a capability-based channel. In other words, digitalized supply chain relationships not only make misconduct more visible and costly, but also provide firms with the knowledge resources to avoid such misconduct (Goldfarb & Tucker, 2019; Kong et al., 2022).

5.2 Moderating effect

SITC helps to reduce information asymmetry in the supply chain (Cabral, 2012; Hollenbeck, 2018) and facilitates deep partnerships between upstream and downstream firms (Goldfarb & Tucker, 2019), influencing the impact of SITC on corporate E&S violations. Referring to Jiang et al. (2023), this study measures supply chain concentration (Supply) using the Top 5 customer and supplier concentration. Therefore, this study tests the moderating role of supply chain concentration through cross-multiplier terms in model 2 (Isaksson *et al.*, 2016).

$$Violation_{i,t} = \beta_0 + \beta_1 Itc_{-s_{i,t}} + \beta_2 Supply_{i,t} + \beta_3 Itc_{-s_{i,t}} * Supply_{i,t} + \beta_c \sum Control_{i,t} + \mu_i + \nu_t + \varepsilon_{i,t} \quad (2)$$

Where $Violation_{i,t}$ denotes corporate violations, which has three dimensions: environmental violations (EQ) and social violations (SQ); $Itc_{-s_{i,t}}$ is an indicator of SITC. $Supply_{i,t}$ is the moderating variable, $Itc_{-s_{i,t}} * Supply_{i,t}$ is the standardized cross-multiplier term. $Control_{i,t}$ in the model contains the following control variables: year of establishment (Age), firm size (Size), gearing ratio (Lev), return on assets (Roa), growth (Grow), two jobs in one (Tio), proportion of sole directors (Indep), whether Big 4 audited (Top4), Big 4 audit opinion (Report), city economic level (Gdp), city education level (Edu), and individual (Firm) and year (Year) fixed effects. In addition, $\varepsilon_{i,t}$ are randomized disturbance terms.

Table 13 presents the results of the moderating effect of supply chain concentration. The results in column (2) show that the inhibitory effect of SITC on environmental violations is more potent in higher supply chain concentration ($\beta = -0.031, p < 0.01$); the results in column (4) show that the regression coefficient of SITC on social violations ($\beta = -0.000, p > 0.10$) is not significant but still negative in higher supply chain concentration, although it is not significant still negative. Thus, the results partly confirm the moderating effect of supply chain concentration.

 Insert Table 13 about here

5.3 Heterogeneity tests

5.3.1 Heterogeneity of government supervision

As a critical stakeholder, the government can exert external governance over firms (Kedia & Rajgopal, 2011), thereby influencing the impact of SITC on corporate violations. Therefore, this study categorizes the sample into two groups based on whether the officials inspect the firms (Jia *et al.*,

2019). Table 14 presents the heterogeneity test of government regulation. The results in columns (1) and (2) show that the moderating effect of SITC is more significant ($\beta=-0.179, p<0.01$) in inhibiting environmental violations in firms that lack government regulation compared to government-regulated firms ($\beta=-0.234, p<0.05$). The results in columns (3) and (4) show that the inhibitory effect of SITC on social violations of firms lacking government regulation is more significant ($\beta=-0.120, p<0.01$) compared to government-regulated firms ($\beta=0.045, p>0.10$). Therefore, the results confirm the moderating effect.

Insert Table 14 about here

5.3.2 Heterogeneity of firm size

Large-scale firms, which have broader stakeholder constituencies and face stricter institutional regulation and public scrutiny than small ones (Drempetic *et al.*, 2020), lose legitimacy and experience severe crises when E&S breaches occur (Kölbel *et al.*, 2017), a risk that is amplified by SITC. Therefore, this study tests the moderating role of firm size by dividing the sample into two groups, large-scale and small-scale firms, based on the median asset (Drempetic *et al.*, 2020). Table 15 presents the heterogeneity test of firm size. The results show the inhibitory effect of SITC on large-scale firms' environmental violations is more significant ($\beta=-0.219, p<0.01$) compared to small-scale firms ($\beta=-0.082, p<0.01$). The results in columns (3) and (4) show that, compared to small-scale firms ($\beta=-0.033, p>0.10$), the SITC has a more substantial inhibitory effect on governance violations in large-scale firms ($\beta=-0.115, p<0.05$). So, the results confirm the moderating effect of firm size.

Insert Table 15 about here

5.3.3 Heterogeneity of property rights

Compared with state-owned enterprises, non-state-owned enterprises usually receive less direct government supervision and public attention (Heese *et al.*, 2022). As a result, they may face greater information opacity and weaker external governance pressure. Under such conditions, SITC can play a more effective governance role by improving transparency of information, strengthening external monitoring, and increasing the expected cost of E&S misconduct.. Therefore, this study tests the moderating role of firm size by dividing the sample into two groups, non-state-owned enterprises and state-owned enterprises (Jia *et al.*, 2019). Table 16 presents the heterogeneity test under different property rights conditions. The results show the inhibitory effect of SITC on non-state-owned firms' environmental violations is more significant ($\beta=-0.165, p<0.01$). The results in columns (2) and (4) show that, compared to state-owned ($\beta=-0.117, p<0.10$), the SITC has a more substantial inhibitory effect on governance violations in non-state-owned firms ($\beta=-0.069, p<0.05$). So, the results confirm the moderating effect of property rights.

Insert Table 16 about here

5.5 Upstream and downstream differences

This section will examine the differences between customers and suppliers. Although upstream and downstream firms in the supply chain can effectively exert supervisory governance effects through their influence and deterrence to improve partners' internal monitoring systems and

governance levels, this impact is not symmetrical (Dhaliwal *et al.*, 2016). Therefore, we divide the sample into two groups of customers and suppliers to check the difference.

Insert Table 17 about here

Table 17 presents the results of upstream and downstream differences. The data in the table show that SITC in the customer group has a more significant effect on corporate environmental violations ($\beta=-0.218, p<0.01$) and social violations ($\beta=-0.057, p<0.10$) than the supply chain group sample. It implies that in the process of SITC, enhancing information sharing between supply chains and promoting the formation of stable relationships in supply chains (Chu *et al.*, 2019), customers more effectively exert the monitoring governance effect on suppliers (Dhaliwal *et al.*, 2016), which reduces corporate violations.

6. Conclusion and Discussion

6.1 Conclusions

We conducted a series of tests focusing on SITC and corporate violations. The main results show that SITC inhibits corporate violations, complementing the impact of information technology on corporate E&S strategy from a supply chain perspective (Kuhn & Mansour, 2014; Bernard *et al.*, 2019). Because SITC improves the efficiency of upstream and downstream monitoring and technology transfer and alleviates information asymmetry within the supply chain (Chen *et al.*, 2020), ultimately reducing corporate violations. We used Heckman's two-stage modeling and propensity score matching to address selection bias, and the instrumental variable method to address omitted-variable bias. Besides the endogeneity test, we also applied other robustness tests for the conclusions, including alternative measures of dependent and independent variables, excluding Internet

interference, and increasing the sample size.

Furthermore, we tested the mechanisms and delineated the potential impacts across different stakeholders. First, SITC inhibits corporate violations through the external monitoring mechanism (Cabral, 2012; Hollenbeck, 2018) and knowledge spillover mechanism (Kuhn & Mansour, 2014; Goldfarb & Tucker, 2019). Second, SITC has a more substantial impact on corporate violations in higher supply chain concentration because it enhances information sharing across supply chains (Chu *et al.*, 2019). Third, the impact of SITC on violations of corporations lacking government regulation is more significant because stakeholders pay less attention to them, and SITC plays a complementary role (Jia *et al.*, 2019). Then, SITC has a greater impact on large-scale corporations because they have a broader range of stakeholders and greater oversight (Drempetic *et al.*, 2020). Finally, we examined differences between upstream and downstream and confirmed that customers more effectively exert the governance effect of monitoring (Dhaliwal *et al.*, 2016), reducing corporate violations.

6.2 Implications

This study provides insights into corporate and government practices. Corporations must fully integrate their advantages and external markets to realize sustainable development. The government can formulate targeted policies to accelerate the digitalization of corporations and promote high-quality economic growth.

Firstly, corporations should strengthen collaboration with other corporations in the supply chain. IT change in the supply chain can encourage corporations to break down “digital silos” and reshape their competitive advantages. Therefore, corporations should construct a learning organization and learn from customers and suppliers the knowledge and experience in information technology and E&S concepts. On this basis, corporations can establish deeper cooperative relationships with partners through property rights or contractual links to broaden the diffusion channels and enhance

diffusion effects.

Secondly, the government should focus on guiding collaboration among corporations in the supply chain. IT changes in the supply chain can help corporations break through the plight of “data silos,” so the government needs to optimize policies around demand to break down the “information silos” between links in the supply chain. For example, it should promote information sharing between upstream and downstream corporations and encourage customers to transmit market demand information to suppliers through new-generation information technology to promote synergistic development. Moreover, it enables advantageous corporations to establish supply chain alliances to stabilize the cooperative relationship in the supply chain.

6.3 Limitations and future research

This study has limitations that need further exploration in the future. The limitations include (1) Although the records can objectively reflect corporate violations, there are still violations that regulators have not detected but have occurred. Under the current conditions, our research does not include these data. (2) Incomplete access to the sample companies’ supply chain information. Because most of the upstream and downstream companies of the sample are unlisted companies and have no publicly disclosed financial reports, it is hard to obtain more information about the supply chain. This approach may not accurately represent the broader population in this study, mainly because non-listed firms are excluded due to data accessibility issues and could exhibit different dynamics in terms of IT change.

Moreover, we present a vision for future research: exploring the influencing factors and economic consequences of corporate digital responsibility. With industries relying increasingly on next-generation technologies and the evolving legal and regulatory environment, there is a need to explore the possible ethical and social implications of these technologies (Lobschat et al.). For

example, artificial intelligence is having a considerable impact on the job market, while algorithms based on big data may jeopardize the welfare of consumers.

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Table 1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>EQ</i>	3,226	0.247	0.574	0.000	2.833
<i>SQ</i>	3,226	0.147	0.430	0.000	2.303
<i>Itc_s</i>	3,226	0.001	0.003	0.000	0.015
<i>Age</i>	3,226	2.767	0.372	1.609	3.466
<i>Size</i>	3,226	21.891	1.253	19.790	25.557
<i>Lev</i>	3,226	0.406	0.210	0.041	0.891
<i>Roa</i>	3,226	0.042	0.059	-0.208	0.191
<i>Grow</i>	3,226	0.157	0.319	-0.489	1.675
<i>Tio</i>	3,226	0.241	0.427	0.000	1.000
<i>Indep</i>	3,226	0.367	0.048	0.333	0.556
<i>Top4</i>	3,226	0.033	0.177	0.000	1.000
<i>Report</i>	3,226	0.969	0.173	0.000	1.000
<i>Gdp</i>	3,226	10.799	2.717	0.000	13.135
<i>Edu</i>	3,226	2.845	1.326	0.000	4.533

Table 2. Results of Pearson correlation coefficient

Variables	(1)	(2)	(3)
(1) <i>EQ</i>	1.000		
(2) <i>SQ</i>	0.046***	1.000	
(3) <i>Itc_s</i>	-0.074***	-0.010**	1.000

Notes: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 3. Results of main effect

VARIABLES	(1)	(2)	(3)	(4)
	<i>EO</i>	<i>EO</i>	<i>SO</i>	<i>SO</i>
<i>Itc_s</i>		-0.180*** (-5.068)		-0.073** (-2.501)
<i>Age</i>	0.062** (2.108)	0.056* (1.900)	0.120*** (4.920)	0.118*** (4.814)
<i>Size</i>	0.194*** (21.046)	0.190*** (20.565)	-0.002 (-0.298)	-0.004 (-0.529)
<i>Lev</i>	0.156*** (2.747)	0.140** (2.465)	0.140*** (2.979)	0.133*** (2.835)
<i>Roa</i>	-0.040 (-0.216)	-0.027 (-0.149)	-0.303** (-1.991)	-0.298* (-1.959)
<i>Grow</i>	-0.013 (-0.433)	-0.003 (-0.104)	-0.019 (-0.785)	-0.015 (-0.622)
<i>Tio</i>	0.005 (0.253)	0.013 (0.608)	-0.001 (-0.034)	0.003 (0.141)
<i>Indep</i>	-0.256 (-1.397)	-0.262 (-1.436)	0.514*** (3.393)	0.511*** (3.380)
<i>Top4</i>	0.122** (2.393)	0.120** (2.358)	-0.004 (-0.089)	-0.005 (-0.111)
<i>Report</i>	0.066 (1.263)	0.072 (1.386)	-0.277*** (-6.435)	-0.274*** (-6.379)
<i>Gdp</i>	0.001 (0.135)	0.000 (0.088)	0.003 (0.967)	0.003 (0.944)
<i>Edu</i>	-0.026*** (-3.166)	-0.017** (-2.054)	-0.010 (-1.388)	-0.006 (-0.838)
<i>Constant</i>	-4.140*** (-18.984)	-4.026*** (-18.435)	-0.109 (-0.603)	-0.062 (-0.343)
<i>Year Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	3,226	3,226	3,226	3,226
<i>R²</i>	0.231	0.237	0.045	0.047
<i>ΔR²</i>	-	0.006	-	0.002

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 4. Results of the heckman selection model

VARIABLES	(1) <i>EO</i>	(2) <i>SO</i>
<i>Itc_s</i>	-0.164*** (-4.864)	-0.064** (-2.177)
<i>Imr</i>	3.322*** (18.648)	2.172*** (3.981)
<i>Age</i>	1.744*** (18.405)	1.623*** (4.283)
<i>Size</i>	1.223*** (21.803)	0.096*** (3.655)
<i>Lev</i>	1.258*** (15.601)	0.155*** (3.281)
<i>Roa</i>	-2.962*** (-12.598)	-4.498*** (-4.220)
<i>Grow</i>	-0.169*** (-5.746)	-0.039 (-1.538)
<i>Tio</i>	0.032 (1.547)	-0.092*** (-3.099)
<i>Indep</i>	-5.096*** (-16.337)	2.415*** (4.816)
<i>Top4</i>	0.374*** (7.447)	-0.022 (-0.521)
<i>Report</i>	0.793*** (12.658)	-1.372*** (-4.915)
<i>Gdp</i>	-0.009** (-2.218)	-0.009* (-1.919)
<i>Edu</i>	-0.230*** (-16.471)	-0.031*** (-3.293)
<i>Constant</i>	-35.121*** (-20.901)	-9.359*** (-3.996)
<i>Year Fixed Effect</i>	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes
<i>Observations</i>	3,226	3,226
<i>R²</i>	0.312	0.052
<i>ΔR²</i>	0.075	0.005

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels. ΔR^2 , the last line of the table, is the result compared to Model 2 and 4 in Table 3.

Table 5. Results of propensity score matching

Panel A: Results of univariate mean difference test				
	Mean after matching		Difference	T value
	Treat group	Control group		
<i>Age</i>	2.929	2.930	-0.002	-0.040
<i>Size</i>	22.909	22.880	0.023	0.380
<i>Lev</i>	0.516	0.534	-0.090	-1.590
<i>Roa</i>	0.030	0.018	0.207	3.420*
<i>Grow</i>	0.139	0.142	-0.010	-0.016
<i>Tio</i>	0.161	0.153	0.019	0.390
<i>Indep</i>	0.362	0.365	-0.067	-1.230
<i>Owner</i>	0.564	0.583	-0.039	-0.680

Panel B: Results of propensity score matching			
VARIABLES	(1)	(2)	
	<i>EO</i>	<i>SO</i>	
<i>Itc_s</i>	-0.180*** (-5.068)	-0.073** (-2.501)	
<i>Age</i>	0.056* (1.900)	0.118*** (4.814)	
<i>Size</i>	0.190*** (20.565)	-0.004 (-0.529)	
<i>Lev</i>	0.140** (2.465)	0.133*** (2.835)	
<i>Roa</i>	-0.027 (-0.149)	-0.298* (-1.959)	
<i>Grow</i>	-0.003 (-0.104)	-0.015 (-0.622)	
<i>Tio</i>	0.013 (0.608)	0.003 (0.141)	
<i>Indep</i>	-0.262 (-1.436)	0.511*** (3.380)	
<i>Top4</i>	0.120** (2.358)	-0.005 (-0.111)	
<i>Report</i>	0.072 (1.386)	-0.274*** (-6.379)	
<i>Gdp</i>	0.000 (0.088)	0.003 (0.944)	
<i>Edu</i>	-0.017** (-2.054)	-0.006 (-0.838)	
<i>Constant</i>	-4.026*** (-18.435)	-0.062 (-0.343)	
<i>Year Fixed Effect</i>	Yes	Yes	
<i>Firm Fixed Effect</i>	Yes	Yes	
<i>Observations</i>	3,226	3,226	
<i>R²</i>	0.237	0.047	

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 6. Results of instrumental variable

VARIABLES	(1)	(2)	(3)
	<i>Itc_s</i>	<i>EQ</i>	<i>SQ</i>
<i>Itc_s</i>		-0.193*** (-7.001)	-0.074** (-2.542)
<i>Terrain</i>	0.018*** (26.810)		
<i>Controls</i>	Yes	Yes	Yes
<i>Constant</i>	-5.099*** (-2.561)	-51.889*** (-7.188)	-34.631*** (-6.179)
<i>Year Fixed Effect</i>	Yes	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes	Yes
<i>Cragg-Donald Wald F</i>	71.852***		
<i>Observations</i>	3.226	3.226	3.226
<i>R²</i>	0.890	0.270	0.087

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 7. Results of alternative measures of IT change

VARIABLES	(1)	(3)
	<i>EO</i>	<i>SO</i>
<i>Itc_sr</i>	-0.075* (-1.679)	-0.107*** (-2.915)
<i>Age</i>	0.062** (2.095)	0.120*** (4.903)
<i>Size</i>	0.194*** (20.986)	-0.003 (-0.393)
<i>Lev</i>	0.155*** (2.722)	0.138*** (2.938)
<i>Roa</i>	-0.053 (-0.289)	-0.323** (-2.118)
<i>Grow</i>	-0.012 (-0.390)	-0.017 (-0.710)
<i>Tio</i>	0.008 (0.345)	0.002 (0.127)
<i>Indep</i>	-0.255 (-1.390)	0.516*** (3.411)
<i>Top4</i>	0.121** (2.366)	-0.006 (-0.136)
<i>Report</i>	0.065 (1.255)	-0.277*** (-6.455)
<i>Gdp</i>	0.001 (0.137)	0.003 (0.970)
<i>Edu</i>	-0.025*** (-3.056)	-0.008 (-1.206)
<i>Constant</i>	-4.128*** (-18.929)	-0.092 (-0.514)
<i>Year Fixed Effect</i>	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes
<i>Observations</i>	3,226	3,226
<i>R²</i>	0.231	0.048

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 8. Results of alternative measures of violation

VARIABLES	(1)	(2)	(3)	(4)
	<i>EO</i>	<i>SO</i>	<i>EO</i>	<i>SO</i>
<i>Itc_s</i>	-0.519*** (-3.622)	-0.195** (-2.188)	-0.149*** (-5.821)	-0.066*** (-2.826)
<i>Age</i>	0.099 (0.830)	0.326*** (4.399)	0.056*** (2.640)	0.086*** (4.457)
<i>Size</i>	0.740*** (19.806)	-0.034 (-1.473)	0.103*** (15.402)	0.002 (0.410)
<i>Lev</i>	0.284 (1.239)	0.528*** (3.706)	0.106*** (2.590)	0.038 (1.016)
<i>Roa</i>	0.065 (0.088)	-0.433 (-0.938)	-0.063 (-0.477)	-0.379*** (-3.146)
<i>Grow</i>	-0.048 (-0.402)	-0.073 (-0.984)	-0.008 (-0.390)	-0.007 (-0.338)
<i>Tio</i>	0.009 (0.104)	0.013 (0.231)	0.008 (0.531)	-0.009 (-0.666)
<i>Indep</i>	-0.784 (-1.062)	1.359*** (2.961)	-0.294** (-2.227)	0.277** (2.317)
<i>Top4</i>	0.572*** (2.775)	-0.082 (-0.641)	0.079** (2.144)	0.003 (0.079)
<i>Report</i>	0.152 (0.723)	-0.793*** (-6.088)	0.077** (2.055)	-0.195*** (-5.737)
<i>Gdp</i>	0.014 (0.844)	0.020** (1.996)	-0.001 (-0.415)	-0.000 (-0.140)
<i>Edu</i>	-0.057* (-1.677)	-0.040* (-1.897)	-0.011* (-1.796)	-0.001 (-0.268)
<i>Year/Firm Fixed</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	3,226	3,226	3,226	3,226
<i>R²</i>	0.197	0.044	0.183	0.040

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels. Columns (1) and (2) are the results of absolute numbers, while Columns (3) and (4) are the results of whether or not an violation occurred.

Table 9. Results of exclusion of Internet effect

VARIABLES	(1) <i>EO</i>	(2) <i>EO</i>	(3) <i>SO</i>	(4) <i>SO</i>
<i>Itc_s</i>	-0.144** (-3.942)	-0.181*** (-5.109)	-0.076** (-2.508)	-0.073** (-2.487)
<i>Iti_s</i>	-19.279*** (-3.647)		1.589 (0.362)	
<i>Inter</i>		-0.016 (-1.084)		0.003 (0.257)
<i>Age</i>	0.054* (1.842)	0.053* (1.802)	0.118*** (4.819)	0.118*** (4.818)
<i>Size</i>	0.192*** (20.763)	0.190*** (20.557)	-0.004 (-0.547)	-0.004 (-0.527)
<i>Lev</i>	0.123** (2.170)	0.140** (2.462)	0.135*** (2.855)	0.133*** (2.835)
<i>Roa</i>	-0.067 (-0.363)	-0.026 (-0.142)	-0.295* (-1.934)	-0.299* (-1.960)
<i>Grow</i>	-0.002 (-0.076)	-0.002 (-0.078)	-0.015 (-0.625)	-0.015 (-0.628)
<i>Tio</i>	0.016 (0.746)	0.011 (0.510)	0.002 (0.127)	0.003 (0.162)
<i>Indep</i>	-0.271 (-1.485)	-0.263 (-1.441)	0.512*** (3.384)	0.511*** (3.380)
<i>Top4</i>	0.116** (2.284)	0.117** (2.304)	-0.004 (-0.103)	-0.004 (-0.098)
<i>Report</i>	0.068 (1.315)	0.073 (1.409)	-0.274*** (-6.370)	-0.274*** (-6.382)
<i>Gdp</i>	0.001 (0.169)	0.000 (0.052)	0.003 (0.935)	0.003 (0.951)
<i>Edu</i>	-0.014* (-1.705)	-0.017** (-2.035)	-0.006 (-0.869)	-0.006 (-0.843)
<i>Constant</i>	-4.044*** (-18.550)	-4.010*** (-18.322)	-0.061 (-0.335)	-0.065 (-0.360)
<i>Year Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	3,226	3,226	3,226	3,226
<i>R²</i>	0.240	0.237	0.047	0.047

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 10. Results of increasing the sample size

VARIABLES	(1)	(2)
	<i>EO</i>	<i>SO</i>
<i>Itc_s</i>	-0.139*** (-2.813)	-0.085*** (-3.647)
<i>Age</i>	0.307*** (7.444)	0.074* (1.763)
<i>Size</i>	0.077*** (11.040)	0.001 (0.129)
<i>Lev</i>	-0.100*** (-3.485)	0.149*** (5.067)
<i>Roa</i>	-0.015 (-0.257)	-0.290*** (-4.815)
<i>Grow</i>	-0.012 (-1.593)	-0.030*** (-3.855)
<i>Tio</i>	0.001 (0.107)	-0.013 (-1.434)
<i>Indep</i>	0.096 (1.236)	0.216*** (2.714)
<i>Top4</i>	-0.050* (-1.845)	-0.066** (-2.362)
<i>Report</i>	-0.017 (-0.927)	-0.251*** (-13.699)
<i>Gdp</i>	-0.007 (-0.564)	-0.056*** (-4.228)
<i>Edu</i>	-0.071*** (-4.509)	0.031* (1.911)
<i>Constant</i>	-27.948*** (-4.979)	-37.037*** (-6.447)
<i>Year Fixed Effect</i>	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes
<i>Observations</i>	30,482	30,482
<i>R²</i>	0.092	0.056

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 11. Results of external monitoring mechanism

VARIABLES	(1)	(5)
	<i>Baidu</i>	<i>Asym</i>
<i>Itc_e</i>	0.711*** (4.554)	-0.166*** (-4.639)
<i>Age</i>	-0.263* (-1.882)	-0.081** (-2.525)
<i>Size</i>	0.494*** (11.313)	-0.235*** (-23.411)
<i>Lev</i>	-0.957*** (-3.559)	0.345*** (5.594)
<i>Roa</i>	3.333*** (3.829)	0.153 (0.767)
<i>Grow</i>	-0.645*** (-4.614)	0.010 (0.321)
<i>Tio</i>	0.419*** (4.083)	-0.015 (-0.616)
<i>Indep</i>	1.482* (1.714)	-0.463** (-2.332)
<i>Top4</i>	0.020 (0.081)	0.010 (0.175)
<i>Report</i>	0.044 (0.177)	0.078 (1.388)
<i>Gdp</i>	0.061*** (3.209)	0.001 (0.148)
<i>Edu</i>	-0.062 (-1.540)	0.004 (0.485)
<i>Constant</i>	-6.992*** (-6.765)	5.187*** (21.861)
<i>Year Fixed Effect</i>	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes
<i>Observations</i>	3,226	3,219
<i>Adj.R²</i>	0.085	0.171

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 12. Results of knowledge spillover mechanism

VARIABLES	(1)	(2)
	<i>Green t</i>	<i>Green i</i>
<i>Itc_e</i>	0.095* (1.755)	0.176*** (4.313)
<i>Age</i>	-0.241*** (-4.969)	-0.166*** (-4.541)
<i>Size</i>	0.187*** (12.323)	0.136*** (11.916)
<i>Lev</i>	0.185** (1.987)	0.010 (0.138)
<i>Roa</i>	-0.300 (-0.993)	-0.165 (-0.728)
<i>Grow</i>	0.057 (1.176)	0.041 (1.131)
<i>Tio</i>	0.084** (2.374)	0.061** (2.291)
<i>Indep</i>	0.019 (0.062)	-0.056 (-0.247)
<i>Top4</i>	0.261*** (3.124)	0.207*** (3.298)
<i>Report</i>	0.331*** (3.887)	0.176*** (2.750)
<i>Gdp</i>	0.011 (1.619)	0.005 (1.036)
<i>Edu</i>	0.042*** (3.025)	0.037*** (3.556)
<i>Constant</i>	-3.580*** (-9.986)	-2.587*** (-9.597)
<i>Year Fixed Effect</i>	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes
<i>Observations</i>	3,226	3,226
<i>Adj.R²</i>	0.102	0.095

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 13. Moderating effect of supply chain centralization

VARIABLES	(1) <i>EO</i>	(2) <i>EO</i>	(3) <i>SO</i>	(4) <i>SO</i>
<i>Itc_s</i>		-0.173*** (-4.866)		-0.073** (-2.473)
<i>Supply</i>	0.001** (2.240)	0.001* (1.764)	0.000 (0.442)	0.000 (0.256)
<i>Itc_s*Supply</i>		-0.031*** (-2.617)		-0.000 (-0.003)
<i>Age</i>	0.061** (2.068)	0.052* (1.766)	0.120*** (4.911)	0.118*** (4.804)
<i>Size</i>	0.193*** (20.940)	0.189*** (20.438)	-0.002 (-0.317)	-0.004 (-0.538)
<i>Lev</i>	0.153*** (2.695)	0.143** (2.519)	0.139*** (2.968)	0.133*** (2.827)
<i>Roa</i>	-0.043 (-0.234)	-0.024 (-0.129)	-0.304** (-1.994)	-0.299* (-1.960)
<i>Grow</i>	-0.015 (-0.513)	-0.000 (-0.013)	-0.020 (-0.801)	-0.015 (-0.630)
<i>Tio</i>	0.006 (0.270)	0.016 (0.733)	-0.001 (-0.031)	0.003 (0.141)
<i>Indep</i>	-0.271 (-1.475)	-0.278 (-1.525)	0.511*** (3.375)	0.510*** (3.368)
<i>Top4</i>	0.125** (2.448)	0.122** (2.402)	-0.003 (-0.078)	-0.004 (-0.104)
<i>Report</i>	0.068 (1.304)	0.070 (1.346)	-0.276*** (-6.425)	-0.274*** (-6.370)
<i>Gdp</i>	0.000 (0.098)	0.000 (0.064)	0.003 (0.959)	0.003 (0.939)
<i>Edu</i>	-0.027*** (-3.244)	-0.018** (-2.148)	-0.010 (-1.402)	-0.006 (-0.850)
<i>Constant</i>	-4.148** (-19.033)	-4.012*** (-18.371)	-0.110 (-0.611)	-0.063 (-0.349)
<i>Year Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	3,226	3,226	3,226	3,226
<i>R²</i>	0.232	0.239	0.045	0.047

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels.

Table 14. Heterogeneity test of government supervision

VARIABLES	(1) <i>EO</i>	(2) <i>EO</i>	(3) <i>SO</i>	(4) <i>SO</i>
<i>Itc_s</i>	-0.179*** (-4.685)	-0.234** (-2.536)	-0.120*** (-3.566)	0.045 (0.741)
<i>Age</i>	0.058* (1.703)	0.063 (1.058)	0.162*** (5.343)	0.017 (0.443)
<i>Size</i>	0.194*** (17.775)	0.195*** (10.338)	-0.025*** (-2.598)	0.033*** (2.686)
<i>Lev</i>	0.079 (1.215)	0.239** (1.976)	0.166*** (2.869)	0.013 (0.163)
<i>Roa</i>	-0.005 (-0.026)	-0.040 (-0.096)	-0.225 (-1.244)	-0.436 (-1.592)
<i>Grow</i>	0.018 (0.562)	-0.063 (-0.975)	0.005 (0.176)	-0.106** (-2.488)
<i>Tio</i>	0.013 (0.543)	-0.013 (-0.255)	0.013 (0.640)	-0.019 (-0.553)
<i>Indep</i>	-0.173 (-0.848)	-0.647 (-1.576)	0.392** (2.175)	0.400 (1.472)
<i>Top4</i>	0.214*** (3.050)	0.099 (1.231)	-0.049 (-0.791)	0.013 (0.253)
<i>Report</i>	0.015 (0.260)	0.221** (1.979)	-0.322*** (-6.244)	-0.137* (-1.852)
<i>Gdp</i>	-0.005 (-0.988)	0.011 (1.453)	-0.002 (-0.557)	0.007 (1.287)
<i>Edu</i>	-0.016* (-1.717)	-0.023 (-1.218)	-0.003 (-0.413)	-0.009 (-0.725)
<i>Constant</i>	-4.024*** (-15.741)	-4.314*** (-9.527)	0.415* (1.837)	-0.719** (-2.399)
<i>Year Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	2,339	887	2,339	887
<i>R²</i>	0.250	0.242	0.064	0.048

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels. Columns (1) and (3) are the results of firms that lack government regulation, while Columns (2) and (4) are the results of government-regulated firms.

Table 15. Heterogeneity test of firm size

VARIABLES	(1)	(2)	(3)	(4)
	<i>EO</i>	<i>EO</i>	<i>SO</i>	<i>SO</i>
<i>Itc_s</i>	-0.219*** (-3.129)	-0.082*** (-3.418)	-0.115** (-2.216)	-0.033 (-0.984)
<i>Age</i>	0.098* (1.777)	0.050** (2.407)	0.114*** (2.780)	0.123*** (4.281)
<i>Size</i>	0.313*** (16.559)	0.072*** (5.562)	-0.022 (-1.588)	-0.010 (-0.555)
<i>Lev</i>	0.492*** (4.786)	-0.054 (-1.294)	0.187** (2.465)	0.091 (1.558)
<i>Roa</i>	0.461 (1.269)	-0.141 (-1.124)	-0.359 (-1.338)	-0.175 (-1.011)
<i>Grow</i>	0.007 (0.147)	-0.016 (-0.684)	0.024 (0.656)	-0.083*** (-2.628)
<i>Tio</i>	0.034 (0.753)	-0.009 (-0.615)	0.023 (0.689)	-0.018 (-0.913)
<i>Indep</i>	-0.502 (-1.484)	-0.275* (-2.117)	1.030*** (4.122)	0.155 (0.866)
<i>Top4</i>	0.034 (0.493)	0.003 (0.032)	0.005 (0.104)	-0.233** (-1.966)
<i>Report</i>	0.076 (0.725)	0.036 (1.028)	-0.061 (-0.789)	-0.434*** (-9.059)
<i>Gdp</i>	0.013* (1.786)	-0.005 (-1.597)	0.009 (1.597)	-0.001 (-0.287)
<i>Edu</i>	-0.053*** (-3.457)	-0.001 (-0.206)	-0.011 (-0.983)	-0.004 (-0.444)
<i>Constant</i>	-7.125*** (-15.278)	-1.410*** (-5.019)	-0.117 (-0.341)	0.390 (1.005)
<i>Year Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	1,613	1,613	1,613	1,613
<i>R²</i>	0.262	0.230	0.040	0.089

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels. Columns (1) and (3) are the results of large-scale firms, while Columns (2) and (4) are the results of small-scale firms.

Table 16. Heterogeneity test of property rights

VARIABLES	(1) <i>EO</i>	(2) <i>EO</i>	(3) <i>SO</i>	(4) <i>SO</i>
<i>Itc_s</i>	-0.165*** (-5.304)	-0.298*** (-2.933)	-0.069** (-2.241)	-0.117* (-1.652)
<i>Age</i>	0.082*** (2.848)	-0.006 (-0.088)	0.142*** (4.971)	0.095** (2.120)
<i>Size</i>	0.197*** (19.270)	0.176*** (10.517)	-0.008 (-0.763)	-0.007 (-0.607)
<i>Lev</i>	-0.031 (-0.547)	0.389*** (3.216)	0.142** (2.508)	0.191** (2.257)
<i>Roa</i>	-0.204 (-1.194)	0.227 (0.517)	-0.195 (-1.149)	-0.340 (-1.110)
<i>Grow</i>	0.039 (1.382)	-0.079 (-1.222)	-0.053* (-1.878)	0.053 (1.174)
<i>Tio</i>	-0.006 (-0.338)	0.100 (1.306)	-0.001 (-0.039)	0.017 (0.316)
<i>Indep</i>	-0.031 (-0.177)	-0.983** (-2.374)	0.533*** (3.101)	0.573** (1.981)
<i>Top4</i>	0.474*** (5.870)	0.027 (0.351)	-0.116 (-1.443)	0.024 (0.456)
<i>Report</i>	0.011 (0.226)	0.097 (0.854)	-0.548*** (-10.991)	0.182** (2.309)
<i>Gdp</i>	0.001 (0.339)	-0.008 (-0.821)	-0.000 (-0.074)	0.007 (0.961)
<i>Edu</i>	0.003 (0.370)	-0.046*** (-2.589)	0.015* (1.780)	-0.033*** (-2.601)
<i>Constant</i>	-4.282*** (-18.569)	-3.255*** (-7.355)	0.194 (0.845)	-0.390 (-1.263)
<i>Year Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	2,029	1,197	2,029	1,197
<i>R²</i>	0.254	0.185	0.101	0.036

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels. Columns (1) and (3) are the results of non-state-owned enterprises, while Columns (2) and (4) are the results of state-owned enterprises.

Table 17. Results of upstream and downstream differences

VARIABLES	(1) <i>EO</i>	(2) <i>EO</i>	(3) <i>SO</i>	(4) <i>SO</i>
<i>Itc_s</i>	-0.218*** (-5.184)	-0.139** (-2.126)	-0.057* (-1.740)	-0.105* (-1.795)
<i>Age</i>	0.017 (0.480)	0.141*** (2.747)	0.090*** (3.211)	0.182*** (3.962)
<i>Size</i>	0.168*** (14.439)	0.227*** (14.679)	0.007 (0.724)	-0.023* (-1.675)
<i>Lev</i>	0.269*** (3.930)	-0.100 (-0.987)	0.099* (1.862)	0.221** (2.429)
<i>Roa</i>	0.115 (0.521)	-0.264 (-0.804)	-0.119 (-0.693)	-0.592** (-2.008)
<i>Grow</i>	-0.004 (-0.107)	-0.007 (-0.150)	-0.013 (-0.445)	-0.022 (-0.503)
<i>Tio</i>	0.031 (1.160)	-0.034 (-0.917)	-0.012 (-0.585)	0.020 (0.593)
<i>Indep</i>	-0.322 (-1.478)	-0.149 (-0.449)	0.676*** (3.979)	0.193 (0.649)
<i>Top4</i>	-0.032 (-0.534)	0.434*** (4.694)	0.025 (0.537)	-0.105 (-1.270)
<i>Report</i>	0.149** (2.210)	-0.028 (-0.347)	-0.183*** (-3.484)	-0.400*** (-5.444)
<i>Gdp</i>	-0.004 (-0.789)	0.009 (1.231)	-0.004 (-1.041)	0.018*** (2.681)
<i>Edu</i>	-0.012 (-1.131)	-0.029* (-1.901)	0.002 (0.204)	-0.018 (-1.324)
<i>Constant</i>	-3.531*** (-13.091)	-4.962*** (-13.189)	-0.325 (-1.548)	0.296 (0.875)
<i>Year Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Firm Fixed Effect</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	1,996	1,230	1,996	1,230
<i>R²</i>	0.236	0.271	0.043	0.078

Notes: The t-test results are shown in parentheses, and *, **, *** indicate significance at 0.1, 0.05, and 0.01 levels. Columns (1) and (3) are the results of customer group firms, while Columns (2) and (4) are the results of supply chain group firms.

References

- [1] Al-Khatib, A. W. (2023). The impact of industrial Internet of things on sustainable performance: the indirect effect of supply chain visibility. *Business Process Management Journal*, Vol. 29 No. 5, pp. 1607-1629.
- [2] Bernard, A. B., Moxnes, A., and Saito, Y. U. (2019). Production networks, geography, and firm performance. *Journal of Political Economy*, Vol. 127 No. 2, pp. 639-688.
- [3] Balakrishnan, K., Billings, M. B., Kelly, B., and Ljungqvist, A. (2014). Shaping liquidity: On the causal effects of voluntary disclosure. *Journal of Finance*, Vol. 69 No. 5, pp. 2237-2278.
- [4] Blankespoor, E., Miller, G. S., and White, H. D. (2014). The role of dissemination in market liquidity: Evidence from firms' use of Twitter. *The Accounting Review*, Vol. 89 No. 1, pp. 79-112.
- [5] Bloom, N. (2014). Fluctuations in uncertainty. *Journal of Economic Perspectives*, Vol. 28 No. 2, pp. 153-176.
- [6] Braxton, J. C., and Taska, B. (2023). Technological change and the consequences of job loss. *American Economic Review*, Vol. 113 No. 2, pp. 279-316.
- [7] Buehlmaier, M. M., and Whited, T. M. (2018). Are financial constraints priced? Evidence from textual analysis. *Review of Financial Studies*, Vol. 31 No. 7, pp. 2693-2728.
- [8] Burke, J. J. (2021). Do boards take environmental, social, and governance issues seriously? Evidence from Media Coverage and CEO Dismissals. *Journal of Business Ethics*, Vol. 176, pp. 1-25.
- [9] Busco, C., Giovannoni, E., Granà, F. and Izzo, M.F. (2018). Making sustainability meaningful: aspirations, discourses and reporting practices. *Accounting, Auditing & Accountability Journal*, Vol.31 No.8, pp.2218-2246.
- [10] Cabral, L. (2012). Reputation on the Internet. *The Oxford handbook of the digital economy*, pp.

343-354.

- [11] Caliendo, M., and Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, Vol. 22 No. 1, pp. 31-72.
- [12] Campbell, J. T., Eden, L., and Miller, S. R. (2012). Multinationals and corporate social responsibility in host countries: Does distance matter?. *Journal of International Business Studies*, Vol. 43, pp. 84-106.
- [13] Cegarra-Navarro, J. G., Martinez-Martinez, A., Ortega Gutiérrez, J., & Luis Leal Rodríguez, A. (2013). Environmental knowledge, unlearning, and performance in hospitality companies. *Management Decision*, 51(2), 341-360.
- [14] Chen, M., Sun, P., and Xiao, Y. (2020). Optimal monitoring schedule in dynamic contracts. *Operations Research*, Vol. 68 No. 5, pp. 1285-1314.
- [15] Cheng, Q., Du, F., Wang, X., and Wang, Y. (2016). Seeing is believing: Analysts' corporate site visits. *Review of Accounting Studies*, Vol. 21, pp. 1245-1286.
- [16] Chu, Y., Tian, X., and Wang, W. (2019). Corporate innovation along the supply chain. *Management Science*, Vol. 65 No. 6, pp. 2445-2466.
- [17] Cohen, D. A., and Li, B. (2020). Customer-base concentration, investment, and profitability: The US government as a major customer. *The Accounting Review*, Vol. 95 No. 1, pp. 101-131.
- [18] Dai, R., Liang, H., and Ng, L. (2021). Socially responsible corporate customers. *Journal of Financial Economics*, Vol. 142 No. 2, pp. 598-626.
- [19] Dhaliwal, D., Judd, J. S., Serfling, M., and Shaikh, S. (2016). Customer concentration risk and the cost of equity capital. *Journal of Accounting and Economics*, Vol. 61 No. 1, pp. 23-48.
- [20] Drempetic, S., Klein, C., and Zwergel, B. (2020). The influence of firm size on the ESG score: Corporate sustainability ratings under review. *Journal of Business Ethics*, Vol. 167, pp. 333-360.

- [21]Forman, C., and Zeebroeck, N. V. (2012). From wires to partners: How the Internet has fostered RandD collaborations within firms. *Management Science*, Vol. 58 No. 8, pp. 1549-1568.
- [22]Glaeser, S. (2018). The effects of proprietary information on corporate disclosure and transparency: Evidence from trade secrets. *Journal of Accounting and Economics*, Vol. 66 No. 1, pp. 163-193.
- [23]Goldfarb, A., and Tucker, C. (2019). Digital economics. *Journal of Economic Literature*, Vol. 57 No. 1, pp. 3-43.
- [24]Graafland, J., and Noorderhaven, N. (2020). Culture and institutions: How economic freedom and long-term orientation interactively influence corporate social responsibility. *Journal of International Business Studies*, Vol. 51, pp. 1034-1043.
- [25]Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica: Journal of the Econometric Society*, Vol. 47, No. 1, pp. 153-161.
- [26]Heese, J., Pérez-Cavazos, G., and Peter, C. D. (2022). When the local newspaper leaves town: The effects of local newspaper closures on corporate misconduct. *Journal of Financial Economics*, Vol. 145 No. 2, pp. 445-463.
- [27]Hoberg, G., and Maksimovic, V. (2015). Redefining financial constraints: a text-based analysis. *Review of Financial Studies*, Vol. 28 No. 5, pp. 1312-1352.
- [28]Hollenbeck, B. (2018). Online reputation mechanisms and the decreasing value of chain affiliation. *Journal of Marketing Research*, Vol. 55 No. 5, pp. 636-654.
- [29]Isaksson, O. H., Simeth, M., and Seifert, R. W. (2016). Knowledge spillovers in the supply chain: Evidence from the high tech sectors. *Research Policy*, Vol. 45 No. 3, pp. 699-706.
- [30]Jia, N., Rai, A., and Xu, S. X. (2020). Reducing capital market anomaly: The role of information technology using an information uncertainty lens. *Management Science*, Vol. 66 No. 2, pp. 979-

1001.

- [31]Kacperczyk, M. T., and Peydró, J. L. (2022). Carbon emissions and the bank-lending channel. Available at *SSRN* 3915486.
- [32]Kedia, S., and Rajgopal, S. (2011). Do the SEC's enforcement preferences affect corporate misconduct?. *Journal of Accounting and Economics*, Vol. 51 No. 3, pp. 259-278.
- [33]Kölbel, J. F., Busch, T., and Jancso, L. M. (2017). How media coverage of corporate social irresponsibility increases financial risk. *Strategic Management Journal*, Vol. 38 No. 11, pp. 2266-2284.
- [34]Kong, D., Lin, C., Wei, L., and Zhang, J. (2022). Information accessibility and corporate innovation. *Management Science*, Vol. 68 No. 11, pp. 7837-7860.
- [35]Kuhn, P., and Mansour, H. (2014). Is internet job search still ineffective?. *The Economic Journal*, Vol. 124 No. 581, pp. 1213-1233.
- [36]Li, Q., Xue, Q., Truong, Y., & Xiong, J. (2018). MNCs' industrial linkages and environmental spillovers in emerging economies: The case of China. *International Journal of Production Economics*, Vol. 196, pp. 346-355.
- [37]Liang, H., and Renneboog, L. (2017). On the foundations of corporate social responsibility. *The Journal of Finance*, Vol. 72 No. 2, pp. 853-910.
- [38]Libai, B., Bart, Y., Gensler, S., Hofacker, C. F., Kaplan, A., Kötterheinrich, K., and Kroll, E. B. (2020). Brave new world? On AI and the management of customer relationships. *Journal of Interactive Marketing*, Vol. 51 No. 1, pp. 44-56.
- [39]Liu, Y., Dong, J., Mei, L., and Shen, R. (2023). Digital innovation and performance of manufacturing firms: An affordance perspective. *Technovation*, Vol. 119, pp. 102458.
- [40]Lobschat, L., Mueller, B., Eggers, F., Brandimarte, L., Diefenbach, S., Kroschke, M., and Wirtz,

- J. (2021). Corporate digital responsibility. *Journal of Business Research*, Vol. 122, pp. 875-888.
- [41] Matarazzo, M., Penco, L., Profumo, G., and Quaglia, R. (2021). Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective. *Journal of Business Research*, Vol. 123, pp. 642-656.
- [42] Mendling, J., Pentland, B. T., and Recker, J. (2020). Building a complementary agenda for business process management and digital innovation. *European Journal of Information Systems*, Vol. 29 No. 3, pp. 208-219.
- [43] Naughton, J. P., Wang, C., and Yeung, I. (2019). Investor sentiment for corporate social performance. *The Accounting Review*, Vol. 94 No. 4, pp. 401-420.
- [44] Nunn, N., and Qian, N. (2014). US food aid and civil conflict. *American Economic Review*, Vol. 104 No. 6, pp. 1630-1666.
- [45] Rao, K., and Tilt, C. (2016). Board composition and corporate social responsibility: The role of diversity, gender, strategy and decision making. *Journal of Business Ethics*, Vol. 138, pp. 327-347.
- [46] Seligsohn, D., Liu, M., & Zhang, B. (2018). The sound of one hand clapping: transparency without accountability. *Environmental Politics*, Vol. 27 No. 5, pp. 804-829.
- [47] Sonnier, G. P., McAlister, L., and Rutz, O. J. (2011). A dynamic model of the effect of online communications on firm sales. *Marketing Science*, Vol. 30 No. 4, pp. 702-716.
- [48] Steelman, Z. R., Havakhor, T., Sabherwal, R., and Sabherwal, S. (2019). Performance consequences of information technology investments: Implications of emphasizing new or current information technologies. *Information Systems Research*, Vol. 30 No. 1, pp. 204-218.
- [49] Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *The Journal of Strategic Information Systems*, Vol. 28 No. 2, pp. 118-144.

- [50] Wang, J., Wu, X., and Krishnan, V. (2018). Decision structure and performance of networked technology supply chains. *Manufacturing and Service Operations Management*, Vol. 20 No. 2, pp. 199-216.
- [51] Yang, C. H. (2022). How artificial intelligence technology affects productivity and employment: firm-level evidence from taiwan. *Research Policy*, Vol. 51 No. 6, p. 104536.
- [52] Zhu, R., & Li, Q. (2024). The impact of IT change on corporate environmental violations: Toward information asymmetry and stakeholder theory. *Journal of Environmental Management*, 371, 123240.

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Appendix A: Variable description

Table A Definition of variables

Type	Variable	Code	Measurement
Dependent variable	Environmental violation	<i>EQ</i>	We combine the crawler and manual method to obtain the number of environmental supervision records on the IPE website, the original value plus one, and the natural logarithm
	Social violation	<i>SQ</i>	We select events related to social violations from the litigation arbitration database, add 1 to the original value, and take the natural logarithm
Independent variable	SITC	<i>Itc_s</i>	Intercepted the MD&A part for text analysis to obtain the proportion of IT change characteristic words in the reports and match them by customers/suppliers.
Moderator variable	Supply chain concentration	<i>Supply</i>	We use top 5 customer and supplier concentration.
	Firm age	<i>Age</i>	Age of firm plus one to take the logarithm
Control variable	Asset size	<i>Size</i>	Natural logarithm of assets
	Gearing ratio	<i>Lev</i>	Ratio of liabilities to assets
	Return on asset	<i>Roa</i>	Ratio of net profit to assets
	Growth	<i>Grow</i>	Revenue growth rate
	Duality	<i>Tio</i>	If the board of directors and senior management concurrently assign a value of 1, otherwise 0
	Independent directors	<i>Indep</i>	Independent directors as a percentage of board members
	The Four Great Audits	<i>Top4</i>	If the audit is big four is 1, otherwise it is 0
	Audit opinions	<i>Report</i>	1 for unqualified opinion, 0 otherwise
	City economic	<i>Gdp</i>	Logarithms of GDP per capita of each city in the current year
	Urban education	<i>Edu</i>	Logarithmic number of universities in each city in that year
Individual effect	<i>Firm</i>	Fixed effects controls firm variable	
Year effect	<i>Year</i>	Fixed effects controls year variable	

Appendix B: Textual analysis

Considering that the text analysis method can accurately measure continuous data and has recently been widely used and recognized in information technology (Yang, 2022; Liu et al., 2023), we finally chose this method to measure IT change indicators. Text analysis mainly includes three parts: constructing a lexicon of IT change, text analysis of financial reports, and generating IT change indicators (Hoberg & Maksimovic, 2015; Buehlmaier & Whited, 2018). Next, we explain the specific steps and details of the measurement.

Building lexicon

The first step is to construct a lexicon of IT change. The key to the text analysis method is to construct a suitable lexicon, which will affect the accuracy of the indicators. Referring to Yang (2022) and Liu et al. (2023), we classify IT into five categories: internet, artificial intelligence, big data, cloud computing, and blockchain, then respectively summarize and organize keywords. On this basis, we expanded the thesaurus of the characteristics by reading the national-level digital-related policy documents and government work reports released by the Chinese government. Then, we used a panel of three experts from recently published high-level papers in IT to evaluate this feature thesaurus to finalize the structured feature words, as shown in Table B.

Word segmentation

The second step is to analyze the text of the reports. Referring to Yang (2022) and Liu et al. (2023), we obtain the financial reports from Sina Finance and Snowball.com through R programming and extract the Management Discussion and Analysis (MD&A) section, which includes the company's development strategies and business plans, which reflect the extent of corporate IT change (Hoberg & Maksimovic, 2015; Buehlmaier & Whited, 2018). Next, we expanded the 145 structured feature words from step one into the "jieba" Chinese lexicon of the Python software package and performed lexicographic processing on the text content. The IT changes are 107 feature words, including four categories.

Construction method

The third step is the construction of indicators of IT change. Considering the difference in the length of the MD&A, we use the indicator after dividing the word frequency of the keywords by the report word number. In the robustness section, we refer to Steelman et al. (2019) and Braxton & Taska (2023), which use the difference to measure IT change, where $\Delta IT_{i,t} = IT_{i,t} - IT_{i,t-1}$.

Table B Structural feature words of IT change

Panel A: Analysis of the Relevant Concepts of IT Change			
Category	Internet technology	Digital technology	IT change
Internet	√	√	
Artificial intelligence		√	√
Big data		√	√
Cloud computing		√	√
Blockchain		√	√
Panel B: Characteristic words corresponding to different technology categories			
Category	Structured feature word		
Internet	Internet, Mobile Internet, Industrial Internet, Internet solutions, Internet technology, Internet thinking, Internet action, Internet business, Internet mobile, Internet applications, Internet marketing, Internet strategy, Internet platform, Internet model, Internet business model, Internet Ecology, E-commerce, Internet, Internet +, Online and offline, Online to offline, O2O, B2B, C2C, B2C, C2B, Networking, Internet medical care, Mobile payment, Third-party payment, NFC payment, Network connection, Internet finance, Digital finance		
Artificial intelligence	Artificial intelligence, Business intelligence, Image understanding, Decision assistance systems, Intelligent data analysis, Intelligent robots, Machine learning, Deep learning, Semantic search, Face recognition, Speech recognition, Authentication, Autonomous driving, Natural language processing, Intelligence wear, Smart agriculture, Intelligent transportation, Intelligent medical care, Intelligent customer service, Smart home, Smart investment, Smart travel, Smart environmental protection, Smart grid, Intelligent marketing, Unmanned retail, Smart energy, High-end intelligence, Industrial intelligence, Mobile intelligence, Intelligent control, Intelligent terminal, Intelligent mobile, Intelligent management, Intelligent factory, Intelligent logistics, Intelligent manufacturing, Intelligent warehousing, Intelligent technology, Intelligent equipment, Intelligent production, Intelligent network, Intelligent system, Intelligent, Intelligent fault diagnosis		
Big data	Big data, Data mining, Text mining, Data visualization, Heterogeneous data, Credit reporting, Augmented reality, Mixed reality, Virtual reality, Virtual manufacturing, Data management, Data network, Data platform, Data center, Data science, Digital control, Digital technology, Digital communication, Digital network, Digital intelligence, Digital terminal, Digital marketing, Digitalization		
Cloud computing	Cloud computing, Stream computing, Graph computing, Memory computing, Multi-party security computing, Brain-like computing, Green computing, Cognitive computing, Converged architecture, Billion-level concurrency, EB-level storage, Internet of things, Information physics systems, Cloud IT, Cloud ecology, Cloud services, Cloud platforms, Industrial clouds		
Blockchain	Blockchain, Distributed computing, Digital currency, Cryptocurrency, Differential privacy technology, Smart contract, Decentralization, Ethereum, Non-homogenization, Tokens, Timestamps, Hash values, Hash rates, Distributed ledger, Distributed network, Superbook, Public chain, Private chain, Alliance chain, Cross-chain technology		