Research on the Driving Mechanism of Investor Interaction and Enterprise Digital Technology Innovation Based on Principal-Agent Theory

Zeyu Wan *

International Business College, Dongbei University of Finance and Economics, Dalian, China, 116000

* Corresponding Author Email: 19131285869@163.com

Abstract. While the interactivity between investors and listed companies has significantly improved with optimized capital market regulation and the proliferation of information technology, the mechanisms through which it affects corporate digital technology innovation remain unclear. Using data from Chinese A-share listed companies (2013-2023) and combining information from the Shenzhen Stock Exchange's 'Interactive Easy' and the Shanghai Stock Exchange's 'SSE e-Interactive' platforms, this study examines the impact of investor interactivity on corporate digital technology innovation and its underlying mechanisms. The study finds that: First, investor interactivity drives corporate digital technology innovation through three key channels: (1) increasing information transparency, (2) intensifying media scrutiny, and (3) easing financing constraints; Second, the above effects are more prominent in high-tech industries, non-capital-intensive, and environmentally friendly enterprises. Mechanism analysis reveals that interactivity facilitates resource allocation optimization and core technology breakthroughs by mitigating information asymmetry, strengthening external oversight, and diversifying financing channels. This paper reveals the driving role of capital market participants' behavior on corporate digital technology innovation, provides new evidence for the "investor-enterprise" interaction theory, and suggests that government departments optimize the functions of interactive platforms, enterprises formulate differentiated interactive strategies, and investors guide the direction of innovation through technical inquiries.

Keywords: Investor Interactivity, Corporate Digital Technology Innovation, Information Transparency, Media Supervision Pressure, Financing Constraints.

1. Introduction

Digital technological innovation serves as a cornerstone of modern economic development, fostering technological breakthroughs [1], enhancing productivity through technological convergence, and generating new value [2]. China's digital economy surged from several hundred billion USD in 2012 to $7.1 trillion in 2021, ranking as the world's second-largest by scale. However, the country holds only one-eighth of the high-value digital patents compared to the United States, revealing a "digital innovation paradox" where quantitative expansion fails to align with qualitative technological advancement. This paradox stems from China's persistent reliance on foreign technologies in critical sectors, such as semiconductor manufacturing and operating system development. Addressing pathways to enhance corporate digital innovation capabilities has thus become an urgent priority.

The evolution of capital market information interactions has significantly strengthened investor-company engagement. Platforms such as the Shenzhen Stock Exchange's 'Interactive Easy' and the Shanghai Stock Exchange's 'SSE e-Interactive' have introduced bidirectional Q&A mechanisms [3], enhancing the timeliness, relevance, and transparency of information disclosure. These platforms also reduce investors' information processing costs, representing a critical institutional innovation to combat information overload. Prior research indicates that investor interactivity improves capital market information efficiency [4] and reduces systemic stock price crash risks [5]. At the firm level, it facilitates digital transformation by alleviating financing constraints and attracting analyst coverage [6]. Crucially, digital transformation differs fundamentally from digital technological innovation: the former emphasizes process optimization through technology application, whereas the latter focuses on

core technological breakthroughs and convergent innovation [7]. Current literature predominantly examines the economic outcomes of digital innovation—such as ESG performance improvement [8] and high-quality development [9]—while research on its drivers remains nascent, particularly regarding investor interactivity's underexplored impact on technological innovation.

Although existing literature examines investor interactivity's role in capital market efficiency [10] and corporate financialization, its impact on core technological innovation remains underexplored. This study challenges the conventional treatment of digital innovation as an exogenous variable, instead demonstrating how capital market interactions—as an institutional mechanism—endogenously foster corporate breakthroughs in core technologies. The findings deepen theoretical understanding of the "institution-technology" interplay and propose a novel analytical framework to resolve the digital innovation paradox. Practically, the conclusions offer significant insights for constructing incentive mechanisms to support core technological innovation through capital markets and optimizing innovation resource allocation efficiency.

This study contributes threefold: First, it expands the research boundaries of investor interactivity by pioneering the linkage between online platform interactions and digital technological innovation, offering fresh perspectives on capital market-enterprise innovation dynamics. Second, moving beyond the prevailing focus on technology application (digital transformation), it unveils tripartite mechanisms—information transparency enhancement, media supervision intensification, and financing constraint mitigation—through which interactive platforms influence core technological innovation. Third, the findings provide practical guidance for regulators to optimize platform functionalities, for firms to develop industry-specific interaction strategies, and for investors to steer innovation trajectories through technology trend inquiries. These recommendations establish an industry-characteristic-oriented framework for innovation-driven interactions.

2. Mechanism Analysis and Hypothesis Proposal

Investor interactivity can promote corporate digital technology innovation by improving information transparency, thereby optimizing resource allocation and calibrating the direction of innovation. As important participants in the capital market, investors often have a keen insight into industry trends, market demands, and technological frontiers. Through interactive platforms, investors can feedback market dynamics, technical demands, and changes in the competitive environment to enterprises, and this information can provide valuable guidance for the direction of enterprise innovation.

Investor interactivity can promote corporate digital technology innovation by enhancing media supervision pressure, thereby inhibiting short-sighted behavior and strengthening innovation accountability. When investors inquire about technical progress or details of R&D investment through interactive platforms, the media often follows up and amplifies these issues, forming a social supervision network. External public opinion pressure forces management to balance short-term financial indicators and long-term innovation goals, reduce the motivation for "profit whitewashing", and instead establish a transparent innovation assessment system, and other verifiable indicators. Ultimately, this accountability mechanism of "innovation in the sun" pushes the enterprise's technology strategy from a closed laboratory to an open public agenda, and with the help of external supervision, to reconstruct the priority of resource allocation.

Investor interactivity can promote corporate digital technology innovation by alleviating financing constraints, thereby reducing capital costs and expanding innovation investment. Investors directly inquire about the development situation of enterprises through interactive platforms, forcing enterprises to disclose more details. This transparent communication enables financial institutions and other investors to more accurately assess the value of technology, and the requirement for risk premiums decreases. The financing channels of enterprises are expanded from single bank loans to multiple ways such as special science and technology innovation funds and intellectual property pledge. The alleviation of financing constraints not only enables enterprises to expand the scale of digital

technology R&D teams but also supports the continuous investment in long-term high-risk projects. Ultimately, the breakthrough of financing constraints promotes enterprises to truly achieve independent control of core technologies. Based on this, the following hypothesis is proposed.

H1: Investor interactivity can significantly promote corporate digital technology innovation.

3. Research design

3.1. Sample Selection and Data Source

The study employs Chinese A-share listed companies from 2013 to 2023 as the research sample and studies the promoting effect of the interaction between listed companies and investors through exchange network platforms on enterprise digital innovation technology. Companies under Special Treatment (ST) status—indicating financial distress or abnormal operations—were excluded. To address missing data, linear interpolation was applied, while firms in the financial sector were excluded due to their distinct regulatory and operational characteristics. Finally, 37,827 samples from 2013 to 2023 are obtained. Interaction data were sourced from the Q&A records of the Shenzhen Stock Exchange's 'Interactive Easy' and Shanghai Stock Exchange's 'SSE e-Interactive' platforms, compiled by the China Research Data Service Platform (CNRDS). The data for calculating enterprise digital innovation technology and the data of control variables come from the Incopat global patent database, which mainly includes information such as publication numbers, patent types, application numbers, application dates, main IPC numbers, applicants, inventors, and legal statuses. In order to reduce the influence of outliers, this paper performs 1% and 99% winsorization on all micro-level continuous variables.

3.2. Variable Definition and Measurement

Corporate digital technology innovation (DigiInno) is primarily measured using patent data. The IPC information contained in patent data lists the technical field categories to which patents belong, which is conducive to identifying patented digital technology innovation activities. However, since digital technology innovation spans multiple technical domains, indiscriminate inclusion of all digital information transmission patents risks measurement bias.To mitigate this issue, the measurement methodology follows prior studies. Combining the "Statistical Classification of the Digital Economy and Its Core Industries (2021)" issued by the National Bureau of Statistics and the "Reference Table of International Patent Classification and National Economic Industry Classification (2018)", this paper identifies the technical fields to which digital technology innovation belongs and their corresponding IPC codes, thereby identifying the digital technology patents applied by enterprises at the IPC group level, and then constructing an indicator that more comprehensively reflects the digital technology innovation of Chinese listed enterprises, represented by the variable DigiInno.

Investor interactivity is operationalized through the Q&A sections of the 'Interactive Easy' and 'SSE e-Interactive' platforms, which enable bidirectional communication between listed firms and investors. When the interactivity of the "question and answer" section is enhanced, the participation of investors and listed companies increases accordingly. The length and frequency of corporate replies serve as proxies for investor information acquisition efficiency, and can better reflect the effect of improving investors' information acquisition and interpretation ability than investors' questions. Therefore, referring to predecessors, this paper measures the interactivity of network platforms by taking the natural logarithm of the total number of words in the company's answers (the average total number of words in answers and questions) plus 1 in the current year. The specific formula is as follows:

$$\text{Interaction}^{\text{wd}} = \text{Ln}(1 + \text{wd}) \tag{1}$$

Among them, Interaction represents the degree of network platform interaction, and wd represents the text statistics of the listed company's question and answer records, specifically including twds and twdn; twds represents the total number of words in the listed company's answers; twdn represents the average total number of words in the listed company's answers and questions.

Considering the potential impact of other factors on the robustness of the empirical results, this paper selects a series of control variables (Controls), including the asset-liability ratio (the ratio of total liabilities to total assets), the cash flow ratio (the ratio of net cash flow from operating activities to total assets), the duality of positions (1 if the chairman and general manager are the same person, otherwise 0), market value (the ratio of total market value to total assets), and property rights nature (1 for state-owned enterprises, otherwise 0). In addition, in order to control the potential impact of enterprise factors and time trends, this paper controls the firm effect and year effect in the regression analysis.

3.3. Model Establishment

The following fixed-effects model is specified to test Hypothesis H1, that is, the impact of investor interactivity on corporate digital technology innovation.

$$\mathrm{DigiInno}_{it} = \alpha_1 \mathrm{Interation}_{it} + \alpha_k \mathrm{Controls}_{it} + \lambda_t + \mu_t + \varepsilon_{it} + b \quad (2)$$

Subscripts i and t denote firm and year, DigiInno measures corporate digital technology innovation, Interaction captures investor interactivity, the coefficient α_1 is the focus of this paper, a positive α_1 represents that investor interactivity promotes corporate digital technology innovation, Controls represents a series of control variables, μ_i represents the individual fixed effect, $\lambda_t$represents the time fixed effect, ε_{it}represents the random error term, and b represents the constant term.

4. Empirical Results and Analysis

4.1. Descriptive Statistics

Based on table 1, descriptive statistics for DigiInno indicate a mean of 0.637 (SD=1.205), with values ranging from 0 to 5.182, reflecting a right-skewed distribution where most firms exhibit low innovation levels. The mean, standard deviation, maximum, and minimum values of Interactiontwds are 7.077, 3.337, 0, and 17.702, respectively, and the mean, standard deviation, maximum, and minimum values of Interactiontwdn are 8.134, 1.707, 0, and 10.931, respectively, indicating that there are significant differences in investor interactivity among different enterprises. The minimum value of Interactiontwds is 0, indicating that there are indeed some listed companies that have not replied to investors' inquiries. The minimum value of Interactiontwdn is 0, indicating that some listed companies have not received investors' questions, and the overall level of questions and answers among sample companies is slightly low. The means and medians of other unlisted control variables are basically within a reasonable range.

Table 1. Descriptive statistics

Variable	Sample Size	Mean	Standard Deviation	Minimum	Maximum
DigiInno	37827	0.637	1.205	0.000	5.182
Interactiontwds	37676	7.077	3.337	0.000	17.702
Interactiontwdn	37827	8.134	1.707	0.000	10.931
Lev	37827	0.413	0.208	0.054	0.937
Cashflow	37827	0.047	0.069	-0.162	0.242
Dual	37827	0.311	0.463	0.000	1.000
TobinQ	37827	2.062	1.348	0.838	8.865
SOE	37827	0.327	0.469	0.000	1.000

***p<0.01, **p<0.05, *p<0.10

4.2. Baseline results

The results of the benchmark regression analysis of this paper are shown in Table 2. As shown in columns (1) and (3), when the year fixed effect and individual fixed effect are not added, the regression coefficients of investor interactivity (Interactiontwds/twdn) on digital technology innovation (DigiInno) are both significantly positive, meaning that with the establishment of the

interactive platform, enterprises generally have a higher level of digital technology innovation on average. According to the results of columns (2) and (4), after adding the year fixed effect and individual fixed effect, the regression coefficient of the variable DigiInno is 0.0716 (0.0137), which is significantly positive at the 1% level. These results suggest that platform-driven information disclosure accelerates digital technology innovation, thereby supporting Hypothesis H1.

Table 2. Baseline results

Variable	DigiInno (1)	DigiInno (2)	DigiInno (3)	DigiInno (4)
Interationtwds	0.089*** (0.00)	0.0110*** (0.00)		
Interationtwdn			0.0716*** (0.00)	0.0137*** (0.00)
Control Variables	Yes	Yes	Yes	Yes
Year Fixed	No	Yes	No	Yes
Individual Fixed	No	Yes	No	Yes
Sample Size	37827	37827	37827	37827
R^2 Value	0.004	0.003	0.013	0.003

***p<0.01, **p<0.05, *p<0.10

4.3. Robustness Analysis

To ensure robustness, investor interactivity is redefined using four alternative measures. First, the total number of interactions during the period (Interact); second, the average daily number of interactions during the period (DAvg.Inter); third, the average daily number of words in answers during the period (DAvg.twds); fourth, the average daily number of words in answers and questions during the period (DAvg.twdn). The hypothesis of this paper still holds in the robustness test of the independent variable.

Regarding the measurement of digital innovation, most literatures use enterprise-level patent data, identify digital patents through text analysis and IPC information, and then construct measurement indicators of enterprise digital innovation. However, the patent application and authorization cycle is long, with great instability and uncertainty. In addition, many digital innovations in reality are relatively abstract and difficult to apply for patent protection, such as artificial intelligence algorithms and digital business models, leading to incomplete measurement. In this regard, this paper refers to the research methods of predecessors and measures enterprise digital innovation (DigiInno*) based on the annual report text of listed companies combined with text analysis and machine learning methods. The results of the robustness test are consistent with the benchmark regression results of this paper.

5. Heterogeneity Analysis

5.1. Heterogeneity Test of Industry Technology Degree

The effect of investor interactivity may vary due to the different degrees of dependence of enterprises on advanced science and technology. High-tech industries exhibit greater responsiveness to technological advancements. The market dynamics and technical demand information provided by investors through interactive platforms can more directly guide enterprises to adjust their R&D directions and accelerate the layout of frontier technologies. In contrast, low-tech industries follow more rigid innovation trajectories, where external information inputs yield diminishing marginal returns. Therefore, it can be expected that compared with low-tech industries, investor interactivity will have a more obvious promoting effect on the digital technology innovation of high-tech industries. The test results indicate that the above statement holds true.

5.2. Heterogeneity Test of Enterprise Capital Intensity

Compared with capital-intensive enterprises, investor interactivity may have a more significant promoting effect on the digital technology innovation of non-capital-intensive enterprises. Capital-intensive enterprises (such as heavy industry) have long R&D cycles and high asset specificity, and technological innovation more relies on internal resource accumulation, so the marginal effect of external information input is low. Non-capital-intensive enterprises (such as service industry and information technology industry), on the other hand, have higher flexibility and market response speed. Investor interactivity facilitates innovation outcomes by integrating market feedback and optimizing resource allocation. The test results indicate that the above statement holds true.

5.3. Heterogeneity Test of Enterprise Pollution Degree

In environmentally friendly enterprises, investor interactivity has a more significant promoting impact on digital technology innovation. Heavily polluting firms face stringent environmental regulations, diverting innovation resources toward compliance rather than technological breakthroughs. Meanwhile, investors pay more attention to the environmental risks of heavily polluting enterprises. The interactive content may focus more on environmental governance rather than technological innovation, and its driving effect on digital innovation is relatively weak. The test results show that the above statement is correct.

6. Mechanism Test

Based on the theoretical framework of investor interactivity and corporate digital technology innovation and combined with the institutional background of the network interaction platforms of the Shanghai and Shenzhen Stock Exchanges in China, this paper proposes three core action mechanisms: improvement of information transparency, enhancement of media supervision pressure, and alleviation of financing constraints. The following combines the empirical results (Table 3) and theoretical logic to analyze the transmission paths one by one:

6.1. Mechanism Test of Information Transparency

Frequent investor interactions incentivize firms to enhance their information disclosure frameworks, promote the openness of financial data, R&D progress, and strategic planning, and thus improve information transparency and the level of corporate digital technology innovation. A transparent information environment reduces information asymmetry between internal management and external investors, enabling enterprises to more accurately identify market demands and technological trends and optimize the resource allocation of digital technology innovation. Based on this, this paper uses the absolute value of discretionary accruals (Opaque) to measure information transparency. The larger the Opaque value, the lower the information transparency. The test results are shown in Table 3. Columns (1) and (2) test the impact of investor interactivity on information transparency, and the estimated coefficients of Interactiontwds (twdn) are significantly negative. This indicates that interactivity significantly reduces the degree of enterprise information opacity, helps management more accurately capture market demands and technological trends, reduces the risk of innovation direction deviation, and improves the efficiency of digital technology innovation.

6.2. Mechanism Test of Media Supervision Pressure

Investor interactivity improves the level of corporate digital technology innovation by attracting media reports (especially negative reports) and forming external supervision pressure. Media scrutiny pressures management to prioritize long-term innovation over short-term financial metrics and avoid cutting R&D investment to whitewash short-term profits. At the same time, Negative media coverage motivates firms to enhance their reputation via technological advancements. Based on this, this paper uses the Janis-Fadner coefficient (J-F) to construct a media supervision index by referring to the measurement methods of predecessors. The closer J-F is to -1, the greater the media supervision

pressure. The test results are shown in Table 3. Columns (3) and (4) test the impact of investor interactivity on media supervision pressure, and the estimated coefficients of Interactiontwds (twdn) are significantly positive, indicating that interactivity strengthens supervision pressure by increasing media reports (especially negative ones), forcing enterprises to establish a compliant and efficient innovation management system.

6.3. Mechanism Test of Financing Constraints

The theoretical analysis part points out that investor interactivity alleviates financing constraints by improving the quality of information disclosure and market confidence and reducing the communication cost between enterprises and the capital market, thereby improving the level of corporate digital technology innovation. Access to external financing enables firms to scale R&D teams and procure advanced equipment, providing resource guarantees for high-risk digital technology innovation. Based on this, this paper uses the SA index to measure financing constraints. The larger the absolute value of the SA index, the more serious the financing constraints faced by enterprises. The test results are shown in Table 3. Columns (5) and (6) test the impact of investor interactivity on financing constraints, and the estimated coefficients of Interactiontwds (twdn) are significantly negative at the 1% level, indicating that interactivity effectively alleviates the financing dilemma of enterprises, increases disposable funds, and expands the scale of digital technology innovation.

Table 3. Heterogeneity Test of Enterprise Pollution Degree

Variable	Opaque (1)	Opaque (2)	Media (3)	Media (4)	SA Index(5)	SA Index(6)
Interationtwds	-0.0040*** (0.00)		0.0046**(0.00)		-0.0025***(0.00)	
Interationtwdn		-0.0055***(0.00)		0.0053** (0.00)		-0.0034*** (0.00)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Sample Size	35345	35701	37007	37247	36841	37362
R^2 Value	0.085	0.085	0.090	0.089	0.851	0.851

***p<0.01, **p<0.05, *p<0.10

7. Research Conclusions

With the help of China's unique official securities social media "SSE e-Interactive", this study provides pioneering empirical evidence that investor interactivity significantly enhances corporate digital technology innovation (H1 holds), revealing the important role of capital market participants in technological innovation. From a theoretical perspective: First, traditional research has paid more attention to the economic effects of digital technology innovation, while this paper for the first time systematically demonstrates the mechanisms by which investor interactivity drives technological innovation through three paths: improving information transparency, enhancing media supervision pressure, and alleviating financing constraints, providing new evidence for the "investor behavior-enterprise innovation" theoretical framework; Second, combined with the policy characteristics of China's capital market "Interactive Easy" platform and the market structure dominated by retail investors, this study verifies the moderating effect of the institutional environment on the interactive effect (such as the strengthening effect in high-tech industries, non-capital-intensive enterprises, and environmentally friendly enterprises); Third, the findings offer actionable insights for improving corporate governance, capital market efficiency, and innovation ecosystems. From a practical perspective: First, the government should further optimize the functions of investor interactive platforms, such as adding technical demand feedback modules, incentivizing enterprises to absorb market information through interactive channels to accelerate core technology research; Second,

listed companies need to attach importance to investor relations management, actively use interactive platforms to convey the progress of innovation strategies, and attract long-term capital support; At the same time, according to industry characteristics, enterprises with different technology levels, capital intensity, and emission pollution degrees should formulate differentiated interactive strategies to improve the efficiency of innovation resource transformation; Third, institutional and retail investors can guide enterprises to focus on frontier fields through in-depth participation in interaction, forming a virtuous cycle of "market feedback-technological breakthrough-value improvement".

The limitations of this paper are as follows: First, the research only covers A-share listed companies and does not include non-listed enterprises or small, medium, and micro enterprises. Future research could extend the sample to non-listed and SMEs to improve generalizability; Second, digital innovation mainly relies on patent data, which may ignore non-patented innovations (such as algorithm optimization and business model iteration). It is recommended to construct a comprehensive measurement system by combining multi-dimensional indicators such as product revenue and R&D texts; Third, although this paper uses a fixed-effects model, there may be a two-way causal relationship between interactivity and innovation. In the future, a tool variable method can be used to further verify the causal chain.

References

[1] Tao, F., Zhu, P., Qiu, C., et al. (2023). The impact of digital technology innovation on corporate market value. Journal of Quantitative and Technical Economics, *40*(5), 68 – 91. https://doi.org/10.13653/j.cnki.jqte.20230310.010.

[2] Wang, Y., Lei, T., & Dong, H. (2025). Digital technology innovation and corporate ESG performance: Evidence from patent texts and machine learning. Research and Development Management, *37*(1), 31 – 45+183. https://doi.org/10.1358/j.cnki.rdm.20241067.

[3] Huang Bo, Li Haitong, Liu Junqi, et al. Digital Technology Innovation and High-Quality Development of Chinese Enterprises - Evidence from Enterprise Digital Patents [J]. Economic Research, 2023, 58 (03): 97 - 115.

[4] Tan, S., Kan, S., & Cui, X. (2016). Can internet communication improve market information efficiency? Evidence from the Shenzhen Stock Exchange's "Interactive Easy" platform. Journal of Financial Research, (3), 174 – 188.

[5] Ding, H., Lü, C., & Chen, Y. (2018). Investor information ability: Divergence of opinions and stock price crash risk—Evidence from the Shanghai Stock Exchange's "SSE e-Interactive" platform. Management World, *34*(9), 161 – 171. https://doi.org/10.19744/j.cnki.11 - 1235/f.2018.09.013.

[6] An, S., & Zhang, J. (2025). The impact of network platform interaction on corporate innovation investment. Enterprise Economy, (4), 48 – 57. https://doi.org/10.13529/j.cnki.enterprise.economy.2025.04.005.

[7] Ding Hui, Lü Changjiang, Chen Yunjia. Investor Information Ability: Divergence of Opinions and Stock Price Crash Risk - Evidence from the social media "SSE e-Interactive" [J]. Management World, 2018, 34 (09): 161 - 171. DOI: 10.19744/j.cnki.11 - 1235/f.2018.09.013.

[8] Kan Yiwei, Xu Sheng, Li Mingyang. Does Investor Interaction Help Enterprises Fulfill Social Responsibilities? - Evidence from the Exchange Network Interaction Platform [J]. Wuhan Finance, 2022, (02): 27 - 38.

[9] Wang Xincheng, Li Yuan. Chief Information Officer, Enterprise Leaders, and Enterprise Digital Innovation [J]. Science and Technology Progress and Policy, 2022, 39 (13): 83 - 93.

[10] Dai Yanjuan, Shen Weipeng. Cross-Border E-Commerce Reform and Digital Technology Innovation of Export Enterprises - A Quasi-Natural Experiment Based on Cross-Border E-Commerce Comprehensive Pilot Zones [J]. Western Forum, 2024, 34 (01): 47 - 62.