

The Impact of Digital Transformation on Excessive Investment by Enterprises

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Abstract

Against the backdrop of the nation's drive to develop new-quality productive forces, the digital transformation of enterprises-with its ability to provide a powerful source of technological momentum-has become a key pathway to achieving high-quality development. Overinvestment is a widespread phenomenon amongst listed companies in China; therefore, investigating the impact of digital transformation on the investment efficiency of these enterprises holds significant theoretical and practical value for enhancing the global competitiveness of Chinese enterprises and informing policy-making. This paper uses Chinese A-share listed companies from 2011 to 2024 as the research sample and employs fixed-effects and mediation models for analysis. The empirical results indicate that digital transformation can significantly improve the investment efficiency of enterprises engaged in excessive investment, a finding that remains valid after a series of robustness tests; digital transformation curbs inefficient investment through three channels: reducing agency costs, alleviating financing constraints and enhancing information transparency; there are significant differences in the effectiveness of transformation across enterprises in different regions, industries and with different ownership structures. Based on the above findings, this paper proposes that efforts should be made to promote digital transformation among enterprises, strengthen policy support, innovate investment and financing models, foster coordinated development across regions, improve governance systems, and establish an evaluation mechanism for digital transformation.

Keywords

Digital Transformation; Investment Efficiency; Overinvestment.

1. Introduction

Investment decision-making is at the heart of corporate management, with the fundamental aim of channelling limited capital into projects capable of generating positive returns, thereby maximising corporate value and shareholder interests. Sound decision-making requires a rigorous assessment of risks and returns; however, in practice, influenced by factors such as management incentives, market sentiment or information asymmetry, the flow of corporate capital often deviates from the optimal path, the most typical example being over-investment. Specifically, over-investment refers to blind expansion that reduces the efficiency of capital allocation by accepting sub-optimal investment opportunities, particularly projects with a net present value below zero. Such behaviour not only lowers the return on capital and erodes shareholder wealth, but also consumes significant liquidity, making the enterprise more susceptible to cash flow disruptions and debt crises when affected by macroeconomic factors or fluctuations in its core business. The Report of the 20th National Congress of the Communist Party of China explicitly states the need to "enhance the key role of investment in optimising the supply structure". Therefore, reducing inefficient investment and maintaining reasonable investment growth are of great significance to the high-quality development of China's economy.

In recent years, corporate digital transformation has remained a hot topic. Digital transformation is not merely a matter of purchasing software or upgrading IT systems; rather, it involves the comprehensive integration of cutting-edge digital technologies into a company's core business operations, production management and customer service. Essentially, it enhances a company's competitiveness in the digital economy era through cost reduction, efficiency improvements and business model innovation. A large body of existing research either examines the links between corporate digital transformation and digital finance, green finance or supply chains, or focuses on the impact of digital transformation on corporate development directions and behavioural decision-making; however, there is relatively little research on how digital transformation influences corporate over-investment. This paper selects firms characterised by excessive investment-where inefficient investment is particularly pronounced-to examine how digital transformation improves investment efficiency through three pathways: reducing agency costs, alleviating financing constraints and minimising information asymmetry. It systematically explores the mechanisms and boundaries of its impact on investment efficiency, which holds significant implications for firms in optimising investment decisions, allocating resources and conducting risk early warning.

2. Literature Review

Amid the current wave of the digital economy, corporate digital transformation-by breaking down internal information barriers and enabling real-time data sharing-has significantly enhanced internal control governance and asset turnover rates. This, in turn, effectively mitigates financial risks and lays a sound financial foundation for enterprises to undertake high-efficiency investments (Yue Fanqi, 2026). At the same time, digital technology can greatly alleviate internal and external information asymmetries and principal-agent problems; its efficient data processing capabilities curb short-sighted behaviour by management. Bi Pengbo (2026) argues that digital transformation can curb corporate 'greenwashing' practices, thereby facilitating the enterprise's green transition. Furthermore, the high level of information transparency brought about by digital transformation not only attracts greater attention from analysts and enhances oversight, but also effectively stimulates enterprises' intrinsic drive for innovation. This prompts enterprises to increase investment in research and development and directs capital precisely towards core technological fields, thereby accelerating the formation of new-quality productive forces (Yang Yin et al., 2026). This paper integrates principal-agent theory, financing constraint theory and information asymmetry theory, treating them as mediating effects, to examine the impact of digital transformation on corporate investment efficiency. This research can guide enterprises in making better investment decisions and embarking on a path of high-quality development.

For a long time, over-investment-a typical form of irrational decision-making-has often stemmed from internal factors such as excessive confidence among senior executives, leading to a decline in corporate value as the scale of investment expands year on year (He Yong, 2024). To encourage enterprises to maintain rational investment decision-making amidst blind capital expansion, previous literature has largely focused on the constraining role of the macroeconomic environment. Li Dongyan (2025) found that the policy of refunding value-added tax carry-forwards can curb excessive investment by enterprises; Lei Ling (2024) concluded that, from the dual perspective of a 'proactive government' and an 'effective market', adjustments to macroeconomic growth targets can intervene in and guide micro-level investment behaviour. However, relying solely on external macroeconomic policies often fails to address internal governance challenges within firms. With the rise of the digital economy, technology-enabled solutions have demonstrated significant governance potential. Wang Xiaoyan (2024) argues that digital finance exerts a significant restraining effect on excessive

investment by state-owned enterprises (SOEs) and that it can curb such investment by reducing agency costs within these enterprises. Building on the aforementioned research, this paper shifts its focus from the external macro-environment to the internal corporate sphere to examine the impact of digital transformation on corporate over-investment. It aims to reveal how digital technology acts as a new form of internal control mechanism to curb management's reckless expansionist behaviour, thereby assisting enterprises in optimising resource allocation and advancing towards high-quality development[1-6].

There is significant spatial imbalance between the development of digital infrastructure and the level of economic development in China. Differences in resource endowments, the degree of marketisation and the policy environment across the eastern, central and western regions directly result in marked regional heterogeneity in the progress and current status of enterprises' digital transformation (Wang Shouyi, 2023). Furthermore, industry characteristics fundamentally determine a company's capacity for technological development and talent acquisition. High-tech enterprises inherently possess a stronger R&D foundation and greater innovative drive; when confronted with emerging digital technologies such as artificial intelligence and big data, the 'empowering' effect on their breakthrough innovations is markedly higher than that of non-high-tech enterprises (Lin Chunpei, 2025). Finally, the nature of ownership shapes enterprises' distinctly different governance structures and resource acquisition logic. State-owned enterprises bear multiple social responsibilities and possess unique organisational inertia; their value innovation through digitalisation and intelligentisation often follows specific process mechanisms and policy orientations (Dong Xueyan, 2026). In contrast, non-state-owned enterprises face greater market survival and financing constraints, and digital transformation typically yields greater marginal utility for them in terms of risk mitigation and efficiency enhancement (Yue Fanqi, 2026). Therefore, analysing these three dimensions helps to provide a comprehensive and multidimensional portrayal of the differentiated impacts of digital transformation[7-11].

3. Theoretical Analysis and Hypotheses

3.1. Digital Transformation and Corporate Overinvestment

By utilising new-generation digital technologies such as big data, cloud computing, artificial intelligence and blockchain, enterprises can thoroughly break down the 'data silos' that were previously scattered across finance, production and sales departments, thereby facilitating the flow and sharing of information within the organisation. Enterprises thus shift from a decision-making model reliant on the personal experience of senior executives to one supported by objective algorithms and data. Through digital transformation, an enterprise's business processes, organisational structure, operational models and decision-making mechanisms can be comprehensively upgraded.

Corporate over-investment is a persistent challenge in the fields of corporate governance and modern finance; whilst it may appear to be positive expansion, it can in fact cause significant damage to corporate value. This irrational behaviour stems primarily from principal-agent conflicts and information asymmetry. When a company has ample internal cash flow and shareholders lack specific insight into management's decision-making, management-often driven by a desire to expand their own influence and secure greater benefits-can fall prey to 'overconfidence', leading to blind optimism about the market and, consequently, a strong impulse to make reckless investments.

The underlying rationale for digital transformation serving as an effective remedy to curb corporate over-investment lies in its ability to break down internal information barriers whilst strengthening external oversight. Digital transformation enables real-time monitoring of internal financial and operational data, enhancing the quality of internal controls and ensuring

that any abnormal capital outflows or inefficiently idle assets are swiftly identified and flagged by the system. When the investment decision-making chain becomes completely transparent, the impulse for blind expansion driven by overconfidence or self-interest on the part of senior executives is strictly curbed by this line of defence. Digital transformation significantly enhances the quality of corporate disclosure and overall transparency; this not only effectively reduces information asymmetry between the company and the outside world but also attracts close scrutiny from a large number of external market analysts. The synergy between analysts and the external macro-environment weaves a tight net around the enterprise. In this high-pressure, transparent environment, any attempts by management to conceal ineffective investments by embellishing performance or engaging in 'greenwashing' will be swiftly exposed, thereby forcing management to curb their inefficient investment behaviour[12-19]. Based on this, this paper proposes Hypothesis 1:

H1: Digital transformation can significantly curb excessive investment by enterprises

3.2. The Intermediary Role of Agency Costs

According to agency theory, due to the separation of management authority from operational control, if ample internal cash flow within a company lacks effective oversight, it is highly susceptible to being exploited by management—who possess an information advantage—for reckless expansion and the pursuit of consumption whilst in office, thereby leading to over-investment.

Digital transformation enables the pre-emptive scrutiny of investment projects; project approval no longer relies solely on the subjective judgement of management, but is underpinned by objective algorithms and data, thereby weeding out inefficient investments. Throughout the capital flow process, digital technology facilitates continuous and effective monitoring and tracking, allowing shareholders and the board of directors to gain a clear understanding of how funds are being utilised, whilst effectively curbing individualistic behaviour on the part of management. Digital tools enable the quantification of investment performance, making it easier to determine accountability for failed investments. This precise traceability mechanism ensures that senior executives' performance appraisals are tightly linked to actual rates of return on investment; when accountability for reckless investment is enforced, management's overconfidence and impulse to expand are curbed[20-26]. This leads to Hypothesis 2:

H2: Digital transformation curbs excessive corporate investment by reducing agency costs

3.3. The Mediating Role of Financing Constraints

According to the theory of financing constraints, when investment channels are obstructed or financing costs are excessively high, firms are unable to secure the necessary funding even when investment opportunities arise; this, to a certain extent, constrains management's excessive investment behaviour.

Digital transformation, by improving the quality of information disclosure, enhancing credit ratings and promoting deep integration with fintech, can effectively lower financing barriers and alleviate firms' external financing constraints. Particularly in firms facing significant agency conflicts, the introduction of standardised and visualised financial and operational trajectories through digital means not only helps firms secure external funding at a lower cost but also ensures that such funds are inherently subject to monitoring and supervision by financial institutions and external markets.[27-30] This method of financing significantly curtails management's scope for the unauthorised misappropriation of funds, thereby channelling capital towards more effective investment projects. Based on this, Hypothesis 2 is proposed:

H3: Digital transformation curbs excessive investment by alleviating financing constraints

3.4. The Mediating Role of Information Transparency

Information asymmetry between internal capital allocation decisions and external stakeholders can lead to the failure of market oversight mechanisms and the exacerbation of agency conflicts, thereby distorting executives' investment incentives and triggering irrational over-investment.

As a disruptive form of technological governance, digital transformation-by introducing cutting-edge technologies such as big data mining, cloud computing, blockchain traceability and intelligent financial shared service platforms-has completely broken down traditional departmental data silos within enterprises, significantly enhancing the visibility, real-time nature and traceability of financial data and business operations. Boards of directors, market analysts, financial institutions and the wider community of external investors now possess 'penetrative' scrutiny capabilities, enabling them to precisely track the flow of every capital transaction and the true input-output ratio of each project at a very low cost of information search. This transparency helps to mitigate moral hazard in the principal-agent relationship, reduces the monitoring costs for external groups, and thereby imposes strict constraints on management's impulse towards blind expansion, effectively curbing excessive investment. On this basis, Hypothesis 4 is proposed:

H4: Digital transformation curbs corporate over-investment by enhancing information transparency

4. Research Design

4.1. Data Sources

This study uses Chinese A-share listed companies from 2011 to 2024 as the sample, screened according to the following criteria: (1) financial enterprises were excluded; (2) all ST-listed and delisted companies were excluded to avoid interference from abnormal operating conditions; (3) observations where the company was insolvent (debt-to-asset ratio ≥ 1) or where key variables were missing were excluded; (4) Truncation at the 1 per cent two-tailed level was applied to continuous variables to control for the interference of outliers on parameter estimates. The relevant annual report data were obtained from the official websites of the Shenzhen and Shanghai Stock Exchanges' statutory information disclosure platforms, whilst other raw data were sourced from the Guotai-An Economic and Financial Research Database (CSMAR). Empirical analysis was conducted using the econometric software Stata 18.0.

4.2. Model Design

To test the impact of the core explanatory variables on the dependent variable, the following econometric model was constructed:

$$\text{Overinv}_{i,t} = \alpha_0 + \alpha_1 \text{Digital}_{i,t} + \alpha_2 X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

Where the subscripts i and t denote industry and year, respectively; the dependent variable is corporate over-investment (Overinv); the core explanatory variable is corporate digital transformation (Digital); the control variable matrix X is used to control for other potential influencing factors; μ represents the industry fixed effect and λ represents the time fixed effect; and ε is the random error term.

The mechanism analysis employs a 'three-step' mediation model:

$$\text{Mediator}_{i,t} = \theta_0 + \theta_1 \text{Digital}_{i,t} + \theta_2 X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (2)$$

$$\text{Overinv}_{i,t} = \beta_0 + \beta_1 \text{Digital}_{i,t} + \beta_2 \text{Mediator}_{i,t} + \beta_3 X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (3)$$

where Mediator represents the mediating variables: financing constraints (KZ), agency costs (Ofee) and information transparency (TRANS). Model (2) is used to test the impact of digital transformation on the mediating variables, whilst Model (3) is used to test the mediating effect of these variables in the process by which digital transformation influences corporate over-investment.

4.3. Definition of Variables

Dependent variable: Overinvestment (Overinv). This study adopts Richardson's (2006) classic model of inefficient investment, using the residual method to measure corporate investment efficiency; that is, it predicts the normal investment level based on the investment model and then calculates the degree of deviation between actual investment and predicted investment. The model takes a firm's actual investment expenditure for the year (the ratio of capital expenditure to total assets at the beginning of the period) as the dependent variable, and selects variables such as Tobin's Q (Q), the operating cash flow ratio (Cashflow), the debt-to-equity ratio (Lev), firm size (Size), years since listing (Age) and annual stock return (Return) as independent variables to establish the expected investment model:

$$\text{INVEFF}_{i,t} = \alpha_0 + \alpha_1 Q_{i,t-1} + \alpha_2 \text{Cashflow}_{i,t-1} + \alpha_3 \text{Lev}_{i,t-1} + \alpha_4 \text{Size}_{i,t-1} + \alpha_5 \text{Age}_{i,t} + \alpha_6 \text{Return}_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (4)$$

The fitted values from this model are taken as the 'normal investment level', and the residuals between actual investment and the predicted values are treated as investment deviations. $\text{INVEFF}_{i,t}$ represents a firm's investment efficiency. The larger the absolute value of the residual, the further the firm's investment decisions deviate from the rational level, and the lower the investment efficiency. When the forecast residual $\varepsilon > 0$, this is defined as over-investment, indicating that actual investment exceeds the estimated optimal level; when the forecast residual $\varepsilon < 0$, this is defined as under-investment, indicating that actual investment falls short of the estimated optimal level.

Core explanatory variable: Digital transformation (Digital). Drawing on the approach adopted by He Fan and Liu Hongxia (2019), this paper measures a firm's level of digitalisation as the proportion of digital transformation-related items-as disclosed in the year-end breakdown of intangible assets in the notes to the financial statements of listed companies-relative to the total value of intangible assets. Specifically, where the breakdown of intangible assets includes keywords related to digital transformation technologies-such as 'software', 'network', 'client-side applications', 'management systems' and 'smart platforms'-as well as associated patents, these items are defined as 'digital technology intangible assets'. The values of multiple such digital technology intangible assets for the same company in the same financial year are then aggregated to calculate their proportion of total intangible assets for that year, which serves as a proxy variable for the firm's level of digital transformation.

Control variables. Firm size (Size), debt-to-equity ratio (Lev), cash flow ratio (Cashflow), return on equity (ROE), quick ratio (Quick), inventory-to-assets ratio (Inv), revenue growth rate (Growth) and years since establishment (FirmAge) were selected as control variables.

Mediating variables. Firstly, agency costs are proxied by the operating expense ratio (Ofee), calculated in accordance with the method proposed by Han Qing and Wang Hua (2014), namely the proportion of total operating expenses-comprising selling, general and administrative expenses and financial expenses-relative to operating revenue. If managers incur redundant expenditure for personal gain, this typically manifests as an abnormally high level of operating expenses. Secondly, financing constraints are measured using the KZ index (KZ), which is

constructed based on corporate financial indicators and reflects the availability of funds in external financing markets. A higher value indicates that the firm faces greater financing barriers. Third, information transparency (TRANS) is measured by constructing a composite index, TRANS, following the approach of Xin Qingquan (2014). This index is derived from the average of the following variables: earnings quality (DD), the disclosure assessment index (DSCORE), the number of analysts covering the firm (ANALYSTS), the accuracy of analysts' earnings forecasts (ACCURACY), and the percentile rank of the variable sample selected from the BIG4 auditors' perspective. This composite index is used to measure information transparency[31-36].

Table 1. Table of Variable Definitions

Variable Type	Variable Name	Symbol	Variable Definition
Dependent variable	Overinvestment	Overinv	Richardson investment model Residuals greater than 0
Explanatory variables	Digital transformation	Digital	(Items of intangible assets + Amount relating to digital transformation) / Total intangible assets
Mediating variable	Operating expense ratio	Ofee	(Sales expenses + Administrative expenses + Financial expenses) / Operating revenue
	Financing constraints	KZ	KZ Index
	Information asymmetry	TRANS	Comprehensive Indicator TRANS
Control variables	Company size	Size	Natural logarithm of total assets
	Debt-to-asset ratio	Lev	Total liabilities / Total assets
	Cash flow ratio	Cashflow	Net cash flow from operating activities / Current liabilities
	Return on Equity	ROE	Net profit / Average net assets
	Quick ratio	Quick	Quick assets / Current liabilities
	Inventory as a percentage of total assets	Inv	Inventory / Total Assets
	Revenue growth rate	Growth	(Current-period revenue - Previous-period revenue) / Previous-period revenue
	Years in operation	FirmAge	Date of establishment

5. Empirical Analysis

5.1. Results of the Baseline Regression

This paper employs a fixed-effects model, controlling for industry and year fixed effects, to examine the impact of digital transformation on corporate over-investment.

In columns (1) and (2) of Table 2, the coefficients for digital transformation are significantly negative, indicating that it significantly reduces the degree of investment deviation, thereby curbing firms' over-investment behaviour and enhancing investment efficiency, thus validating H1.

Table 2. Benchmark regression results

	(1) Overinv	(2) Overinv
Digital	-0.0100*** (-2.94)	-0.0117*** (-3.65)
Size		-0.0037*** (-6.45)
Lev		0.0205*** (3.83)
CashFlow		-0.0160 (-1.57)
ROE		0.0075 (1.20)
Quick		-0.0021*** (-4.01)
Inv		-0.1018*** (-13.23)
Growth		0.0481*** (18.40)
FirmAge		-0.0120*** (-5.71)
_cons	0.0484*** (71.55)	0.1674*** (12.30)
N	11,965	11,965
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

5.2. Robustness Tests

Table 3. Robustness Tests

	(1) Overinv	(2) Overinv	(3) Overinv	(4) Overinv
Digital	-0.0082*** (-4.43)		-0.0101*** (-2.96)	-0.0130*** (-3.71)
Digital_B		-0.0034*** (-6.15)		
_cons	0.1802*** (19.96)	0.2013*** (14.55)	0.0562*** (5.78)	0.1744*** (12.02)
N	22,477	12,250	11,968	10,553
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

To verify the reliability of the baseline regression results, this paper employs the following robustness tests: Firstly, by altering the measurement of the dependent variable (Column 1), the regression residuals are calculated using the Biddle (2009) model, yielding results on over-investment that serve as an alternative to the Richardson model; Second, the measurement method for the independent variable was altered (Column 2). Following Wu Fei's approach, keywords were extracted from corporate annual reports via big data scraping, and word frequency was used to measure the extent of a firm's digital transformation; Third, the

regression model was changed (Column 3), with a re-ev using the TOBIT model, which is well-suited to truncated data; Fourth, the digital sector was excluded (Column 4), as the digital sector itself has a higher level of digitalisation compared to traditional sectors; regression was therefore performed using a sample that did not include the digital sector[37-40].

The results of the robustness tests are shown in Table 3; all are significant, supporting hypothesis H1.

5.3. Testing for Mediating Effects

This paper further examines the roles of four mediating variables: agency costs, financing constraints and information transparency. Table 4 presents the results of the mediation analysis. Overall, the empirical findings indicate that digital transformation significantly reduces firms' overinvestment behaviour through multiple channels.

Table 4. Results of the mediation effect test

	(1) Ofee	(2) Overinv	(3) KZ	(4) Overinv	(5) TRANS	(6) Overinv
Digital	-0.0153* (-1.69)	-0.0115*** (-3.60)	-0.1669** (-2.09)	-0.0128*** (-4.04)	0.0426*** (3.16)	-0.0116*** (-3.64)
Ofee		0.0153** (2.36)				
KZ				0.0013** (2.48)		
TRANS						-0.0010 (-0.29)
_cons	0.4802*** (14.90)	0.1601*** (11.49)	2.8985*** (8.69)	0.1646*** (12.05)	-1.4405*** (-25.96)	0.1660*** (11.22)
N	11965	11965	11,862	11,862	11965	11965
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Fixed-year effects	Yes	Yes	Yes	Yes	Yes	Yes

The results in columns (1) and (2) show that the coefficient for the effect of digital transformation on agency costs is -0.0153 , which is significant at the 10 per cent level. This indicates that digital transformation can reduce excessive investment behaviour by lowering internal agency costs within firms. The study found that firms with a higher proportion of operating expenses exhibit more pronounced investment deviations and are more prone to over-investment when undergoing scale expansion. Digital tools can enhance internal controls, thereby curbing irrational investment behaviour resulting from management overconfidence, preventing resource misallocation, and consequently curbing over-investment whilst improving corporate investment efficiency; Hypothesis H2 is thus supported.

The results in columns (3) and (4) show that the coefficient for the effect of digital transformation on financing constraints is -0.1669 , which is significant at the 1 per cent level. This indicates that digital transformation can curb excessive investment behaviour by reducing firms' financing constraints. Consequently, by improving the quality of information disclosure and expanding financing channels, digital transformation reduces the difficulty of firm financing, thereby alleviating under-investment and enhancing investment efficiency; Hypothesis H3 is thus supported.

The results in columns (5) and (6) show that the coefficient of the effect of digital transformation on information transparency is 0.0426 , which is significant at the 1 per cent

level. This indicates that digital transformation can enhance corporate information transparency. Firms with high information transparency are more likely to attract investor attention; consequently, management is less likely to engage in arbitrary investment decisions, thereby reducing resource misallocation and improving investment efficiency. Hypothesis H4 is thus supported.

In summary, the results of the mediation analysis indicate that digital transformation curbs excessive investment by enterprises and enhances investment efficiency by reducing agency costs, alleviating financing constraints and improving information transparency.

5.4. Heterogeneity Analysis

To further analyse whether there are differences in the impact of digital transformation on corporate over-investment, this paper conducts heterogeneity tests across three dimensions: region, sector and industry. The regional heterogeneity test is divided into three regions- Eastern, Central and Western; the sectoral heterogeneity test distinguishes between state-owned and non-state-owned enterprises; and the industry heterogeneity test distinguishes between high-tech and non-high-tech enterprises.

5.4.1. Regional Heterogeneity

Enterprises were categorised into Eastern, Central and Western regions based on their geographical location, and regression analyses were subsequently conducted. As shown in Table 5, digital transformation among enterprises in the Eastern and Central regions exerts a significant inhibitory effect on their excessive investment behaviour, whilst digital transformation among enterprises in the Western region also reduces excessive investment to a certain extent.

The Eastern region possesses significant advantages in terms of digital infrastructure, technological resources, the development of capital markets and corporate management capabilities, whilst the Central region has made significant progress in attracting industrial relocation from the East by leveraging its talent pool and geographical advantages; consequently, the results for these two regions are statistically significant. In contrast, the impact of digital development in the Western region-which lags behind in this regard-on over-investment has not yet fully manifested. Furthermore, given the potential for a 'time lag effect' in the Western region, policy-making should avoid a 'one-size-fits-all' approach and instead be tailored to local conditions.

Table 5. Results of the regional heterogeneity test

	(1) Eastern Region	(2) Central	(3) West
Digital	-0.015*** (0.006)	-0.080*** (0.023)	-0.009 (0.019)
Cons	-0.030 (0.051)	-0.048 (0.110)	-0.188 (0.143)
N	8897	1804	1267
Controls	Yes	Yes	Yes
R-squared	0.166	0.186	0.149
Individual fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

5.4.2. Sectoral Heterogeneity

Based on the nature of the industry, enterprises are categorised into state-owned and non-state-owned enterprises. The results in Table 6 show that, compared with non-state-owned enterprises, digital transformation has a more significant dampening effect on over-investment

in state-owned enterprises. The primary reason for this lies in the fact that state-owned enterprises possess stronger advantages in the integration of policy resources and are guided by macro-level compliance requirements. Their digital transformation is able to more effectively penetrate traditional soft budget constraints; through objective algorithmic decision-making and rigorous financial monitoring, it precisely corrects management's inclination towards blind expansion, thereby optimising the role of digital technology in enhancing the efficiency of capital allocation at a higher level.

Table 6. Results of the Industry Heterogeneity Test

	(1) State-owned enterprises	(2) Non-state-owned enterprises
Digital	-0.020** (0.009)	-0.015** (0.007)
Cons	-0.158** (0.074)	-0.074 (0.058)
N	3859	8109
Controls	Yes	Yes
R-squared	0.133	0.185
Individual fixed effects	Yes	Yes
Year fixed effect	Yes	Yes

5.4.3. Industry Heterogeneity

Companies were categorised as high-tech or non-high-tech based on industry characteristics. The results, as shown in Table 7, indicate that high- high-tech companies exert a more significant restraining effect on corporate over-investment compared to non-high-tech companies. High-tech enterprises possess a higher level of cutting-edge technology, enabling them to better predict investment risks and provide robust support for their own investment decision-making, thereby avoiding irrational investment behaviour. In contrast, non-high-tech enterprises lack this technological support; consequently, although digital transformation can curb excessive investment, the results are not as pronounced.

Table 7. Results of the industry heterogeneity test

	(1) High-tech enterprises	(2) Non-high-tech enterprises
Digital	-0.022*** (0.007)	-0.011 (0.008)
Cons	-0.095 (0.058)	-0.047 (0.076)
N	7,380	4588
Controls	Yes	Yes
R-squared	0.186	0.121
Individual fixed effects	Yes	Yes
Year fixed effect	Yes	Yes

6. Conclusion and Recommendations

An empirical analysis of Chinese A-share listed companies from 2011 to 2024 indicates that digital transformation plays a significant role in helping enterprises curb excessive investment and enhance the efficiency of capital allocation. Digital transformation can substantially reduce deviations in corporate investment and effectively curb management's appetite for blind

expansion, thereby exerting a significant restraining effect on excessive investment. This conclusion remains robust following multiple robustness tests. In terms of the mechanism and pathways, digital transformation primarily achieves this by reducing internal agency costs, standardising operating expenditure, enhancing access to capital by alleviating external financing constraints, and strengthening market and investor oversight through improved information transparency. This thereby corrects inefficient investment deviations on multiple fronts. Heterogeneity analysis reveals that the curbing effect is more pronounced in the eastern and central regions; Compared with non-state-owned enterprises, digital transformation exerts a greater restraining effect on over-investment by state-owned enterprises, effectively penetrating traditional 'soft budget constraints'; owing to their technological foundations and advantages in risk management, high-tech enterprises achieve more pronounced governance outcomes through digital transformation.

Based on the above findings, to further harness the potential of digitalisation and improve corporate investment outcomes, enterprises and relevant authorities must implement multifaceted measures. Enterprises should advance comprehensive digital capability enhancement, moving beyond superficial IT system upgrades to deeply integrate cutting-edge digital technologies-such as big data and cloud computing-into all processes of production, operations and investment decision-making, utilising objective algorithms and data monitoring to curb impulsive and blind investment. Enterprises must improve corporate governance and multi-dimensional financing mechanisms, utilising digital tools to resolve internal data silos, enhance the quality and transparency of information disclosure, and reduce agency costs. At the same time, they should pursue innovation in digital financial models to broaden diversified financing channels, thereby achieving the precise and effective allocation of capital. The government should implement tailored, differentiated support policies. Given the heterogeneity of regions and industries, it should increase investment in digital infrastructure and provide preferential policies for central and western regions, as well as traditional non-high-tech enterprises, whilst avoiding a 'one-size-fits-all' approach. At the same time, it should encourage state-owned enterprises to play a leading and exemplary role, utilising a variety of measures to advance the high-quality development of the real economy.

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