



Technology Empowerment and Internal Governance Substitution: How Generative Artificial Intelligence Reshapes Corporate Investment Efficiency

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Abstract. Against the backdrop of deep integration between the digital and real economy, generative artificial intelligence, as a cutting-edge general-purpose technology, is fundamentally reshaping firms' underlying information environment and investment decision-making patterns. Using a sample of Chinese A-share-listed companies in Shanghai and Shenzhen from 2015 to 2024, this paper systematically examines the impact of generative artificial intelligence on corporate inefficient investment and the underlying mechanisms. The results show that generative artificial intelligence significantly curbs corporate inefficient investment, and this conclusion remains robust after a series of robustness checks, including distinguishing investment types, replacing explanatory variables, excluding specific samples, and adjusting model specifications. Mechanism tests reveal that GenAI effectively suppresses corporate inefficient investment through two pathways: R&D-driven innovation and mitigation of agency costs. Heterogeneity analysis indicates that the mitigating effect of GenAI on inefficient investment is more pronounced among growth-oriented firms, firms with weak executive technical backgrounds, and heavily capital-intensive industries. These findings not only extend the theoretical framework of the microeconomic consequences of artificial intelligence but also offer practical insights for real-sector firms to optimize capital allocation through digital and intelligent transformation.

Keywords: Generative Artificial Intelligence, Inefficient Investment, R&D Innovation, Agency Costs

1 Introduction

Against the backdrop of the booming digital economy, artificial intelligence technologies are penetrating the production, operation, and strategic decision-making chains of micro-enterprises with unprecedented depth and breadth. In recent years, China has successively issued the Overall Layout Plan for the Construction of a Digital China and the Opinions of the State Council on Deeply Implementing the "Artificial Intelligence+" Action, explicitly positioning artificial intelligence as a core engine for driving high-quality economic development and cultivating new productive forces.

However, the realization of technological dividends is not automatic. In the face of this disruptive technological transformation, how to guide real-sector firms to effectively translate the technological advantages of artificial intelligence into improvements in internal resource allocation efficiency has become a major issue that urgently needs to be addressed by both theoretical and practical circles. For a long time, the problem of inefficient investment has seriously constrained the development quality of China's listed companies: some firms engage in blind expansion leading to resource waste, while others miss development opportunities due to conservative decision-making. Based on classical financial theory, corporate inefficient investment mainly stems from two core contradictions: agency conflicts and information asymmetry. On the one hand, driven by self-interest motives for expansion, management tends to squander free cash flow on projects with negative net present value, resulting in overinvestment; on the other hand, influenced by myopia or risk aversion, management may abandon strategic projects with long-term value, leading to underinvestment[1]. Therefore, exploring new governance mechanisms that can effectively penetrate the information black box and constrain management's irrational decision-making is of great practical urgency for improving the efficiency of capital allocation in Chinese enterprises.

A growing body of academic research has explored the relationship between digital technologies and corporate investment efficiency. Some studies confirm that traditional digital transformation can improve corporate investment efficiency to a certain extent by alleviating financing constraints and information asymmetry[2]. Other scholars point out that general artificial intelligence applications help enhance the quality of corporate innovation and curb overinvestment[3]. Although existing research has yielded fruitful results, two critical avenues for further development remain. First, there is a lack of a technological heterogeneity perspective. Most studies treat digital technologies as a homogeneous variable and rarely isolate or examine generative artificial intelligence as a cutting-edge technological form. Compared with traditional IT systems, GenAI possesses unique attributes in complex scenario simulation, financial risk assessment, and decision-making process transparency, which may lead to distinctly different mechanisms when intervening in corporate capital budgeting decisions [4]. Second, research on internal transmission mechanisms is insufficient. Existing literature largely focuses on how digital technologies alleviate external financing constraints, yet lacks systematic theoretical deconstruction and empirical testing of how they reshape the internal flow of technological resources and hierarchical governance structures, thereby affecting the micro-level pathways of investment decisions.

Given this, this paper takes Chinese A-share listed companies in Shanghai and Shenzhen from 2015 to 2024 as the research sample, employs natural language processing techniques to extract features from annual report texts, constructs a GenAI measurement indicator, and empirically examines the impact of generative artificial intelligence on corporate inefficient investment as well as its dual-channel mechanisms. The potential marginal contributions of this paper are threefold. First, it places GenAI within the analytical framework of micro-level corporate capital budgeting decisions, thereby expanding the research horizon on the economic consequences of generative artificial intelligence. Second, it constructs a dual-channel mediation model driven by R&D innovation and agency cost mitigation, deepening the understanding of technology-driven

allocation of capital factors. Third, by introducing heterogeneous contexts such as corporate life cycle, executives' technological background, and industry factor intensity, it confirms the substitution effect of GenAI in governance and cognitive dimensions, as well as its hedging value against high sunk costs, providing precise micro-level evidence for differentiated industrial digitalization policies.

2 Theoretical Analysis and Hypotheses

2.1 GenAI and Inefficient Investment

GenAI integrates multi-dimensional information, reducing information asymmetry and curbing management's opportunistic behaviors. By providing objective net present value calculations and probabilistic simulations, it corrects cognitive biases like managerial overconfidence and myopia.

H1: The application of GenAI significantly curbs corporate inefficient investment behavior.

2.2 R&D Innovation Mechanism

GenAI accelerates R&D processes and lowers the trial-and-error costs of innovation. This drives firms to reallocate internal capital from nonproductive expenditures toward high-value R&D projects.

H2: R&D innovation plays a mediating role between GenAI and inefficient investment.

2.3 Agency Cost Mechanism

GenAI automates processes and intelligent supervision, exposing anomalous business activities (e.g., related-party transactions) and increasing the cost of managerial rent-seeking. This hardens internal financial constraints.

H3: Agency costs play a mediating role between GenAI and inefficient investment.

3 Research Design

3.1 Data and Variables

The initial sample consists of Chinese A-share listed companies in Shanghai and Shenzhen from 2015 to 2024. After excluding financial firms, ST status firms, and missing data, 30,581 firm-year observations were retained.

Dependent Variable (*IneffInv*). This paper mainly draws on the studies of Richardson (2006) [1], to establish an expected investment model for measuring corporate investment efficiency. Dependent Variable measured as the absolute residual from an expected investment model. The model is specified as:

$$Inv_{i,t}=\alpha_0+\alpha_1Growth_{i,t-1}+\alpha_2Lev_{i,t-1}+\alpha_3Cash_{i,t-1}+\alpha_4Age_{i,t-1}+\alpha_5Size_{i,t-1}+\alpha_6Ret_{i,t-1}+\alpha_7Inv_{i,t-1}+\sum Industry+\sum Year+\varepsilon_{i,t} \quad (1)$$

Independent Variable (*Gen_AI*). Following the research approach of Qiao Penghua et al. (2025) [5], independent Variable constructed using textual analysis to count the frequency of GenAI-related keywords in corporate annual reports, using a proprietary word segmentation dictionary.

Mediators. R&D expenditure ratio (*Innov1*), granted patents (*Innov2*), and administrative expense ratio (*Agency*).

Controls. Firm size (*Size*), firm value (*TobinQ*), ownership concentration (*Top1*), capital structure (*Lev*), and state-ownership status (*SOE*).

Descriptive statistical results of variables are shown in Table 1.

Table 1. Descriptive Statistics of Variables.

Variable Symbol	observations	Mean	Std. Dev.	Min	Max
<i>IneffInv</i>	30581	0.0378	0.0482	0.0004	0.2937
<i>Gen_AI</i>	30581	0.0755	0.3251	0.0000	2.0794
<i>Size</i>	30581	22.4475	1.2948	20.0616	26.4129
<i>TobinQ</i>	30581	2.0514	1.3599	0.8126	8.7515
<i>Top1</i>	30581	32.7998	14.3622	8.6058	72.2453
<i>Lev</i>	30581	0.4352	0.2027	0.0656	0.9264
<i>SOE</i>	30581	0.3376	0.4729	0.0000	1.0000

4 Empirical Results

4.1 Benchmark Regression and Robustness

Controlling for firm and year fixed effects, the estimated coefficient of *Gen_AI* on inefficient investment is -0.0046 (significant at the 1% level). A one-unit increase in GenAI decreases inefficient investment by an average of 0.0046, providing strong support for H1. The findings remain robust after distinguishing between overinvestment and underinvestment, applying a TF-IDF text measurement, excluding high-tech IT industries, and removing samples from first-tier cities. The specific regression results are shown in Table 2 and Table 3.

Table 2. Benchmark Regression Results.

	<i>IneffInv</i>	
	(1)	(2)
<i>Gen_AI</i>	-0.0044*** (0.0010)	-0.0046*** (0.0010)
cons	0.0382*** (0.0001)	-0.1902*** (0.0306)
Controls	No	Yes
Firm/ Year Fixed Effects	Yes	Yes
observations	30581	30581
Adj.R ²	0.2310	0.2404

Note: Robust standard errors clustered at the firm level are reported in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Robustness Test Results.

	<i>OverInv</i>	<i>UnderInv</i>	<i>IneffInv</i>		
	(1)	(2)	(3) TF-IDF	(4) exclude high-tech IT	(5) exclude first-tier cities
<i>Gen_AI</i>	-0.0052*** (0.0020)	0.0046*** (0.0011)	-0.0004*** (0.0002)	-0.0059*** (0.0016)	-0.0041*** (0.0013)
Controls	Yes	Yes	Yes	Yes	Yes
Firm/ Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
observations	12086	17210	30581	25356	22220
Adj.R ²	0.2407	0.2859	0.2400	0.2352	0.2388

4.2 Mechanism Analysis

R&D Innovation. The coefficient of *Gen_AI* on R&D expenditure is 0.2595, and 0.0545 on granted patents (both significant at 5%). GenAI increases ex-ante R&D investment and substantive innovation output, crowding out inefficient blind expansion.

Agency Costs. The coefficient of *Gen_AI* on administrative expenses is -0.0031 (significant at 5%). GenAI curtails managerial perk consumption and inefficient administration, aligning decisions with shareholder value.

The results of mechanism analysis are shown in Table 4.

Table 4. Mechanism Test Results.

	(1) <i>Innov1</i>	(2) <i>Innov2</i>	(3) <i>Agency</i>
<i>Gen_AI</i>	0.2595** (0.1221)	0.0545** (0.0237)	-0.0031** (0.0014)
Firm/ Year Fixed Effects	Yes	Yes	Yes
observations	27170	30581	30580
Adj.R ²	0.8513	0.8323	0.6878

4.3 Heterogeneity Analysis

Corporate Life Cycle. The mitigating effect is notably stronger for growth-oriented firms (coefficient: -0.0075) compared to mature firms (-0.0021), as GenAI alleviates severe external information asymmetry prevalent in early stages.

Executive Technical Background. The effect is more significant in firms with a low proportion of technology-oriented executives (-0.0056) than those with a high proportion (-0.0025). GenAI acts as a cognitive substitute, compensating for executive teams lacking technical expertise.

Capital Intensity. GenAI exhibits an amplified utility in heavily capital-intensive industries (-0.0116) compared to non-capital-intensive ones (-0.0040). Large AI models enable robust virtual testing, which is crucial for asset-heavy sectors where fixed asset investments carry extreme sunk costs.

The results of heterogeneity analysis are shown in Table 5.

Table 5. Heterogeneity Analysis Results.

	(1)Corporate life cycle		(2)Executive technical background		(3)Industry capital intensity	
	Growth	Maturity	Low	High	No	Yes
<i>Gen_AI</i>	- 0.0075*** (0.0025)	- 0.0021** (0.0009)	- 0.0056*** (0.0015)	- 0.0025* (0.0013)	- 0.0040*** (0.0010)	- 0.0116* (0.0059)
Firm/ Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
observations	10846	18408	14741	15277	22211	8316
Adj.R ²	0.2291	0.2460	0.2587	0.2446	0.2615	0.2079

5 Conclusion and Implications

Generative artificial intelligence exerts a universal and significant corrective effect on corporate inefficient investment. This optimization operates through driving R&D innovation and mitigating agency costs. The research suggests that real-sector firms should deeply embed GenAI into core financial decision-making processes rather than treating it purely as an auxiliary cost-reduction tool. Particularly for growth-stage firms and capital-intensive industries, accelerating GenAI deployment is vital for mitigating irreversible investment risks. Governments should support this by expanding public digital infrastructure to lower AI adoption barriers for traditional firms.

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