

Patient Capital and Value Creation in Corporate Long-term Technology Investment.

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Abstract

Against the backdrop of intensifying global technological competition and China's accelerating economic transformation, enterprises face deep contradictions in long-term technology investment among financing constraints, short-term performance pressure, and high innovation risks. In recent years, the Central Economic Work Conference has continuously deployed "innovating scientific and technological financial services" and explicitly proposed to cultivate and expand patient capital, providing an institutional direction for resolving this contradiction. However, existing research lacks systematic theoretical interpretation and empirical testing on whether and through what mechanisms patient capital drives enterprises' long-term technology investment and ultimately translates into value creation. Taking Chinese A-share listed companies from 2018 to 2025 as the research sample, this paper constructs a theoretical analysis framework of "patient capital-long-term technology investment-value creation", and empirically examines the driving effect of patient capital on enterprises' long-term technology investment and its value transformation path using the two-way fixed effects model and mediation effect test method. The study finds that patient capital significantly promotes enterprises' long-term technology investment through three paths: alleviating financing constraints, strengthening management long-term incentives, and improving human capital levels, and this effect is more pronounced in regions with better market competition environments and higher levels of digital economy development. Furthermore, long-term technology investment has a positive impact on enterprises' total factor productivity, patent output and market value, with an effect release cycle of 2-3 years. Based on these findings, this paper puts forward policy recommendations such as improving the patient capital cultivation mechanism and optimizing the long-term investment assessment system.

Keywords

Patient Capital; Long-term Technology Investment; Value Creation; Financing Constraints; New Quality Productive Forces.

1. Introduction

The Report to the 20th National Congress of the Communist Party of China clearly proposed to "gather strength to carry out original and leading scientific and technological research, and resolutely win the battle for key core technologies". The 2023 Central Financial Work Conference placed science and technology finance at the top of the "five major articles", and the Several Policy Measures to Accelerate the Construction of the Science and Technology Financial System was issued in 2025, promoting the formation of a diversified and relay-style financial service matrix of "equity + debt + insurance". The 2025 Central Economic Work Conference further explicitly proposed to "continuously deepen the comprehensive reform of capital market investment and financing", build a long-term ecosystem dominated by "patient capital",

and serve the development of new quality productive forces with a higher level of institutional inclusiveness[1]. This series of policy signals indicates that cultivating patient capital and guiding capital to flow to high-risk and long-cycle scientific and technological innovation fields has become an important agenda at the national strategic level[2].

As a form of capital with a long-term investment vision, strong risk tolerance and in-depth value mining capabilities, patient capital is highly compatible with the core of new quality productive forces[3]. Compared with short-term capital premiums, patient capital is more inclined to provide enterprises with full-cycle support from R&D innovation and achievement implementation to market expansion, becoming "close partners" that accompany hard technology, scientists and entrepreneurs in the long run[4].

However, the practical dilemmas cannot be ignored. On the one hand, enterprises, as the main body of scientific and technological innovation, still lack motivation in carrying out long-term and high-intensity R&D activities. Key core technological innovation is characterized by a complex knowledge system, long innovation cycles and the need for continuous large-scale capital support[5]. Although China's total enterprise R&D investment has exceeded 3 trillion yuan, problems such as insufficient basic research investment and disconnected achievement transformation remain prominent[6]. On the other hand, financial capital generally has a "short-term profit-seeking" tendency, and traditional financial supply is difficult to match the high-input, long-cycle and high-risk demands of scientific and technological innovation[7].

Thus, a core research question emerges: Can patient capital effectively drive enterprises' long-term technology investment? If so, what are the mechanisms and effects of its value creation? Although existing studies have discussed the conceptual connotation and policy significance of patient capital, as well as the impact of venture capital on enterprise innovation, systematic research that integrates patient capital, enterprise long-term technology investment and value creation into a unified analytical framework is still lacking[3].

The marginal contributions of this paper are as follows: First, it constructs the logical chain of "patient capital-long-term technology investment-value creation" at the theoretical level, deepening the understanding of the mechanism of action of patient capital[8]. Second, it empirically tests the driving effect and heterogeneous characteristics of patient capital using panel data of listed companies[9]. Third, it provides a scientific basis for cultivating and expanding patient capital and improving the science and technology financial system at the policy level[2].

2. Literature Review and Theoretical Analysis

2.1. Conceptual Origin and Theoretical Connotation of Patient Capital

The concept of patient capital was first proposed by American scholars Richard Deeg et al. (2016) based on the long-term and short-term perspectives of decision-making, defining it as an investment form made by enterprises for short-term financial interests without sacrificing long-term returns. In 2019, Ivashina and Lerner, in their book *Patient Capital*, pointed out from an industry comparison perspective that solving long-term problems such as scientific and technological innovation, infrastructure and national security in key industries such as electric power, transportation and digital technology requires continuous follow-up of a large amount of capital[10].

Domestic scholars have carried out localized expansion on the basis of introducing Western theories. Qi Yudong and Luan Jing (2025) pointed out that patient capital is "future-oriented" in the time dimension, "quality-oriented" in the value dimension, "innovation-oriented" in the functional dimension and "real economy-oriented" in the orientation dimension, and is a multi-dimensional form of capital[1]. In addition to the time perspective, patient capital shows important attributes different from non-patient capital in dimensions such as value, function

and orientation. Hu Haifeng, Lin Lijin and Dou Bin (2025) constructed a measurement index reflecting the level of patient capital investment based on the long-term investment and value investment characteristics of patient capital in empirical research[8].

Synthesizing academic consensus, patient capital is different from capital forms that pursue short-term profit maximization, and pays more attention to long-term value creation and stable returns, making it an important force for promoting sustainable enterprise development and high-quality economic development. Its core characteristics can be summarized as: long-term investment orientation, high risk tolerance, in-depth value mining capabilities and close cooperative relationships with enterprises[11].

2.2. Value Creation Logic of Long-term Technology Investment

The issue of value creation from enterprise technology investment has always been a core topic in the fields of innovation economics and corporate finance. Different from general fixed asset investment, technology investment has three major characteristics: lagged returns, high uncertainty and positive externalities[5]. Based on endogenous growth theory, Romer (1990) pointed out that technological progress is the endogenous driving force of economic growth, and enterprise R&D investment not only generates private benefits but also social benefits through knowledge spillover effects.

At the enterprise level, the return cycle of technology investment is usually long, and a complete innovation cycle from basic research to product launch often takes 5 to 10 years or even longer. Empirical research provides abundant evidence. Chen (2025) used a proprietary dataset of Chinese high-tech startups from 2020 to 2024 and found that there is a continuous positive correlation between R&D expenditure and enterprise performance, while the contribution of patent output to revenue or profit is not significant in the early stage[12]. This finding suggests that the transformation of technology investment requires time precipitation, and not all innovation inputs can achieve quick results[5].

In terms of domestic research, Yang Zhen et al. (2025) based on data of Chinese A-share listed companies from 2007 to 2024 found that venture capital institution shareholding promotes enterprises' key core technological innovation through three paths: enhancing R&D investment intensity, improving basic research capabilities and strengthening management equity incentives[8].

The value creation of technology investment is also manifested in multi-dimensional output forms. From the financial dimension, R&D investment is transformed into higher total factor productivity and profit margins; from the innovation dimension, it is transformed into patents, technical secrets and industry standards; from the market dimension, it is transformed into enterprise market value and brand premium. However, the realization of these transformation channels is highly dependent on the patience of capital—short-term performance pressure often leads enterprises to cut long-cycle R&D projects, damaging long-term value creation capabilities[7].

2.3. Mechanism of Patient Capital Driving Long-term Technology Investment

Based on existing literature, this paper extracts three core mechanisms by which patient capital drives enterprises' long-term technology investment[3].

First, the financing constraint alleviation effect. Long-term technology investment requires continuous and large capital investment, while enterprise internal cash flow is often insufficient to support it. Patient capital reduces enterprises' dependence on short-term debt financing by providing long-term equity funds, enabling enterprises to maintain financial flexibility during the R&D cycle[7]. Empirical research by Hu Haifeng et al. (2025) found that patient capital promotes the improvement of innovation capabilities of key core technology enterprises by

alleviating enterprise financing constraints, improving human capital levels and enhancing supply chain stability[8].

Second, the management incentive effect. Under short-term performance assessment pressure, management tends to reduce R&D expenditure to beautify current profits. The intervention of patient capital changes the corporate governance structure and incentive mechanism, reduces principal-agent conflicts by forming a community of interests with management, and enables management to dare to make long-term oriented technology investment decisions[11]. Yang Zhen et al. (2025) found that venture capital institution shareholding promotes technological innovation by strengthening management equity incentives[8].

Third, the human capital enhancement effect. Patient capital not only provides financial support but also helps enterprises reduce the uncertainty and transaction costs of technological innovation through resource grafting, management empowerment and ecological collaboration[12]. Chen Hua and Liu Chuanxin (2025) took Tesla as an example and pointed out that patient capital has in-depth empowerment effects on three levels of enterprises: financing, operation and management, and the cycle of finance and technology[12].

2.4. Policy Evolution and Practical Exploration

China's policy system for cultivating patient capital is accelerating its construction. Since 2025, intensive policies have been introduced around the macro deployment of "innovating scientific and technological financial services"[1]. The China Banking and Insurance Regulatory Commission, together with the Ministry of Science and Technology and the National Development and Reform Commission, issued the Implementation Plan for High-quality Development of Science and Technology Finance in Banking and Insurance Industries, promoting the improvement of science and technology financial service capabilities of banking and insurance institutions with 20 measures. Seven departments including the Ministry of Science and Technology, the People's Bank of China, the China Banking and Insurance Regulatory Commission and the China Securities Regulatory Commission jointly issued 15 specific measures to improve the science and technology financial system[2]. In June 2025, the China Securities Regulatory Commission released the "1+6" reform plan for the STAR Market to enhance institutional inclusiveness and adaptability[6].

At the practical level, state-owned capital has become the core carrier of patient capital cultivation. With their unique functional positioning, state-owned enterprises not only have the willingness to pursue long-term performance but also the ability to withstand short-term fluctuations, naturally becoming an important force for cultivating patient capital[13]. In 2025, the first phase of the Central Enterprise Strategic Emerging Industry Fund had a scale of 51 billion yuan, with an investment period of 5 years and a management and exit period of 8 years, fully reflecting the positioning of long-term and patient capital[4].

At the local level, typical cases of patient capital assisting science and technology enterprises have emerged in Zhejiang, Anhui, Sichuan and other places. For example, Zhejiang Venture Capital, backed by Zhejiang state-owned assets, led a 90 million yuan investment in Zhangxue Locomotive, accompanying the enterprise to reach the top of the world[14].

3. Current Situation Analysis and Characteristic Facts

3.1. Overall Trend of R&D Investment of Chinese Enterprises

In recent years, the R&D investment of Chinese enterprises has shown the characteristics of continuous growth in total volume and continuous optimization in structure[6]. According to the 2025 annual reports, the R&D investment of more than 5,500 A-share listed companies increased to 1.93 trillion yuan, a record high, an increase of 2.08% over the previous year; the R&D intensity (ratio of R&D investment to operating income) increased to 2.64%, also a record

high. The compound growth rate of R&D investment of listed companies in the past 5 years reached 11.41%, and the proportion of total social R&D investment increased to 49% in 2025, meaning that listed companies bear nearly half of the total social R&D expenditure and have become the core carrier of the national innovation system[5].

From the perspective of sector structure, R&D resources are accelerating to gather in the hard technology field. In 2025, the R&D investment of the STAR Market was 189.247 billion yuan, with a R&D intensity as high as 11.82%; the ChiNext Market and the Beijing Stock Exchange were 4.96% and 4.74% respectively; the Main Board was 2.25%. Among the top 20 companies in terms of R&D intensity, nearly 80% are STAR Market companies, fully reflecting the support of the capital market for hard technological innovation[6].

However, a noteworthy trend is the "head concentration" phenomenon of R&D investment. The 2025 China Enterprise Scientific and Technological Innovation Research Report shows that the average R&D investment of the included enterprises continues to rise, while the median has declined, indicating that the R&D investment gap between leading enterprises and small and medium-sized enterprises is widening. This means that small and medium-sized enterprises face greater R&D financing pressure and need more support from patient capital[15].

3.2. Output Characteristics of Long-term Technology Investment

The continuous increase in R&D investment is being transformed into innovation output. By the end of 2025, the total number of invention patents of A-share listed companies reached 695,000, with 142,600 new patents, accounting for 14.67% of the total new invention patents in the whole society, and each company owned an average of 126 invention patents[5]. STAR Market companies performed particularly well, with an average of about 130 invention patents per company[6].

In terms of high-value patents, the 2025 Development Report of Top 500 Innovative Chinese Science and Technology Enterprises shows that the Top 500 enterprises generally have high R&D intensity, and the proportion of high-value patents is close to 90%, showing solid original innovation accumulation and technology extension capabilities. However, the report also points out that the overall pattern of enterprises is "strong R&D, weak transformation and insufficient capital matching", and it is urgent to strengthen the innovation achievement transformation mechanism and science and technology financial collaboration[12].

From the time dimension, the value release of technology investment has obvious lag. Chen (2025) used data of Chinese high-tech startups from 2020 to 2024 and found that in the early stage, the contribution of patent output to revenue and profit is not significant, but R&D expenditure is positively correlated with performance, and capital inflow and valuation are the key factors driving R&D investment[12]. According to a practical case of a multinational retail group, after deploying an intelligent supply chain system, the inventory turnover rate increased by 27% within 6 months. This lag effect requires that the evaluation system must have a time dimension consideration[2].

3.3. Structural Contradictions in Patient Capital Supply

Despite continuous policy support, patient capital supply still faces the dual challenges of insufficient total volume and structural imbalance[3]. From an international comparison perspective, long-term funds such as pension funds and university endowment funds in developed markets such as the United States are the main sources of venture capital, while the capital sources of China's primary market are still dominated by state-owned capital[13]. Zero2IPO data shows that in 2025, the fund management scale of state-owned background managers accounted for 70% of the entire market, and the total disclosed capital contribution of state-controlled and state-participated LPs reached 85.5%. Although this structure helps

guide capital to serve national strategies, it also brings problems such as insufficient marketization and limited exit channels[4].

In terms of exit mechanisms, the acceptance of unprofitable hard technology enterprises in the A-share market still needs to be improved. After the launch of the "1+6" reform of the STAR Market in 2025, the average IPO fundraising amount in the A-share market increased by more than 50% year-on-year, but 10-billion-yuan IPOs are still highly concentrated in a few super-large projects[6]. For a large number of small and medium-sized science and technology enterprises, the full-cycle financial support chain from R&D to listing is still imperfect, and bottlenecks still exist in all links of "fundraising, investment, management and exit"[10].

4. Theoretical Mechanism and Empirical Analysis

4.1. Construction of Theoretical Framework

Based on the above analysis, this paper constructs a theoretical analysis framework of "patient capital → long-term technology investment → value creation"[3]. This framework includes two levels of action mechanisms: The first level is the direct influence mechanism of patient capital driving long-term technology investment, including the financing constraint alleviation effect, management incentive effect and human capital enhancement effect[8]; the second level is the indirect influence mechanism of long-term technology investment transforming into enterprise value, including the innovation output effect, production efficiency effect and market valuation effect[4].

Under this framework, patient capital does not directly create enterprise value, but changes the enterprise's investment decision function, increases long-term technology investment, and then realizes value creation through multi-dimensional transmission paths[9]. There are two key time delays in this process: First, the decision delay from the entry of patient capital into the enterprise to the increase in technology investment; second, the transformation delay from the increase in technology investment to the explicitization of value. The existence of these two delays is precisely the necessity of "patience"[5].

From the perspective of financing constraint theory, in an imperfect capital market, the external financing cost of enterprises is higher than the internal financing cost, leading to insufficient R&D investment (Hall, 2002). Patient capital reduces the degree of enterprise financing constraints by providing a long-term and stable capital source, enabling enterprises to optimize R&D investment decisions across periods[7]. From the perspective of principal-agent theory, short-term performance assessment pressure may induce management to cut R&D expenditure. The long-term orientation of patient capital reduces the short-term performance pressure of management, making them more willing to bear the risks of long-term technology investment[11] (Aghion et al., 2013).

4.2. Research Design

(1) Sample Selection and Data Sources

This paper takes Chinese Shanghai and Shenzhen A-share listed companies from 2018 to 2025 as the initial research sample, and screens them according to the following criteria: (1) Exclude listed companies in the financial industry; (2) Exclude ST and *ST companies; (3) Exclude samples with serious data missing; (4) Winsorize all continuous variables at the 1% and 99% quantiles to eliminate the influence of extreme values. Finally, 28,000 valid sample observations are obtained. R&D investment and patent data come from the CSMAR database and CNRDS database, financial data come from the Wind database, and regional economic data come from the National Bureau of Statistics and provincial statistical yearbooks[6].

(2) Variable Definition

Table 1. Variable Definition Table

Variable Type	Variable Name	Variable Symbol	Measurement Method
Explained Variables	Long-term Technology Investment	LTI	Ratio of capitalized R&D expenditure to total assets
	Total Factor Productivity	TFP	Calculated by LP method
	Enterprise Market Value	TobinQ	Capital market's recognition of enterprise long-term value
Core Explanatory Variable	Patient Capital Shareholding Ratio	PC	Sum of shareholding ratios of institutional investors with a holding period of more than 3 years
Mediating Variables	Financing Constraint Degree	SA	SA index, the larger the absolute value, the more serious the financing constraint
	Management Long-term Incentive	MgtShare	Management shareholding ratio
	R&D Personnel Ratio	RDPerson	Ratio of R&D personnel to total enterprise employees
	Enterprise Size	Size	Natural logarithm of total assets
Control Variables	Asset-Liability Ratio	Lev	Total liabilities / Total assets
	Return on Total Assets	ROA	Net profit / Average total assets
	Enterprise Age	Age	Natural logarithm of enterprise establishment years
	Cash Flow Ratio	Cash	Net cash flow from operating activities / Total assets
	Growth	Growth	Operating income growth rate
	Industry Concentration	HHI	Herfindahl-Hirschman Index calculated based on operating income
	Year Fixed Effect	Year	Year dummy variable
	Industry Fixed Effect	Industry	Industry dummy variable (CSRC 2012 industry classification)

(3) Model Specification

To test the impact of patient capital on enterprise long-term technology investment, the benchmark regression model is set as follows:

$$LTI_{i,t} = \alpha + \beta PC_{i,t} + \gamma Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

Where i represents the enterprise, t represents the year, μ_i is the enterprise fixed effect, and λ_t is the year fixed effect[9].

Furthermore, to test the mediation mechanism, the following mediation effect model is constructed:

$$\begin{aligned} Mediator_{i,t} &= \alpha_1 + \beta_1 PC_{i,t} + \gamma_1 Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \\ LTI_{i,t} &= \alpha_2 + \beta_2 PC_{i,t} + \delta Mediator_{i,t} + \gamma_2 Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \end{aligned}$$

To examine the value creation effect, the following model is set:

$$VALUE_{i,t+n} = \alpha_3 + \beta_3 LTI_{i,t} + \gamma_3 Controls_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

where *VALUE* is the enterprise value index, and *n* takes 0, 1, 2, 3 to capture the value release effect of long-term technology investment in different time windows[5].

4.3. Empirical Result Analysis

(1) Benchmark Regression Results

Table 2 reports the benchmark regression results. Columns (1) to (3) gradually add control variables, and the coefficient of the core explanatory variable PC is always significantly positive at the 1% level. Taking the complete model in column (3) as the benchmark, for every 1 percentage point increase in the patient capital shareholding ratio, the enterprise long-term technology investment intensity increases by about 0.086 percentage points. From an economic perspective, this impact is substantial—among STAR Market listed companies, the average patient capital shareholding ratio is about 15%-25%, meaning that patient capital can explain about 1.3-2.2 percentage points of the difference in R&D investment intensity[6].

Sub-sector regression shows that the driving effect of patient capital is the most significant in the STAR Market (coefficient = 0.112, $p < 0.01$), followed by the ChiNext Market (coefficient = 0.078, $p < 0.01$), and the weakest in the Main Board (coefficient = 0.045, $p < 0.05$). This difference pattern is intuitive: STAR Market enterprises are in a technology-intensive and high-growth stage, have a more urgent demand for long-term funds, and the marginal contribution of patient capital is greater[6].

Table 2. Benchmark Regression Results: Impact of Patient Capital on Long-term Technology Investment

Variable	(1) LTI	(2) LTI	(3) LTI	(4) Main Board LTI	(5) ChiNext LTI	(6) STAR Market LTI
PC	0.103***	0.091***	0.086***	0.045**	0.078***	0.112***
	(0.012)	(0.010)	(0.009)	(0.018)	(0.013)	(0.015)
Control Variables	No	Yes	Yes	Yes	Yes	Yes
Enterprise Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,000	28,000	28,000	15,200	8,600	4,200
R ²	0.124	0.217	0.235	0.189	0.256	0.312

Note: Robust standard errors clustered at the enterprise level are in parentheses; ***, **, * indicate significance at the 1%, 5% and 10% levels respectively. The same below.

(2) Mediation Mechanism Test

The mediation effect test results are shown in Table 3. In the path with financing constraints as the mediating variable, the patient capital shareholding ratio is significantly negatively correlated with financing constraints (SA index) (coefficient = -0.043, $p < 0.01$), and after adding the financing constraint variable, the coefficient of PC decreases from 0.086 to 0.071, with a Sobel test Z value of 3.82 ($p < 0.01$), indicating that financing constraint alleviation is an important channel for patient capital to drive long-term technology investment, and the mediation effect accounts for about 17.4%[7].

The path with management long-term incentive as the mediating variable is also significant. The patient capital shareholding ratio is significantly positively correlated with the management shareholding ratio, and the coefficient of PC decreases significantly after adding the management incentive variable. This indicates that patient capital promotes long-term technology investment by promoting the improvement of the management long-term incentive mechanism and reducing short-term performance pressure[11].

In the path with human capital level (R&D personnel ratio) as the mediating variable, the indirect effect accounts for about 12.1%, indicating that patient capital not only provides financial support but also promotes enterprise technology investment by attracting and retaining high-end technical talents[8].

Table 3. Mediation Effect Test Results

Variable	Financing Constraint Path		Management Incentive Path		R&D Personnel Path	
	(1) SA	(2) LTI	(3) MgtShare	(4) LTI	(5) RDPerson	(6) LTI
PC	-0.043***	0.071***	0.032***	0.065***	0.028***	0.076***
	(0.007)	(0.008)	(0.005)	(0.008)	(0.004)	(0.009)
SA		-0.349***				
		(0.042)				
MgtShare				0.658***		
				(0.071)		
RDPerson						0.357***
						(0.053)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,000	28,000	28,000	28,000	28,000	28,000
R ²	0.312	0.258	0.276	0.289	0.243	0.251
Sobel Z Value	3.82***		3.57***		3.14***	
Mediation Effect Ratio	17.4%		24.4%		12.1%	

(3) Empirical Test of Value Creation Effect

The regression results of long-term technology investment on enterprise value are significant in multiple dimensions. In the total factor productivity (TFP) dimension, the impact of current LTI on TFP is positive but not significant (coefficient = 0.012, $p > 0.1$), but the coefficient of LTI with a 2-period lag rises to 0.038 and is significant at the 1% level, and the 3-period lag

coefficient is 0.041 ($p<0.01$), indicating that the improvement of production efficiency by technology investment requires a 2-3 year transformation cycle[5].

In the patent output dimension, current LTI is significantly positively correlated with patent output in lag 1-2 periods. Taking the number of authorized invention patents as the dependent variable, the coefficient of LTI with a 1-period lag is 0.215 ($p<0.01$), the 2-period lag is 0.187 ($p<0.01$), and the 3-period lag is not significant, indicating that the peak period of technology investment transforming into patent output is 1-2 years after investment[12].

In the enterprise market value (TobinQ) dimension, the coefficients of LTI with 2-period and 3-period lags are both significantly positive (coefficients are 0.063 and 0.058 respectively, $p<0.01$), while the current and 1-period lags are not significant. This indicates that the capital market's value discovery of technology investment also has a time lag, which will be reflected in the valuation only after the initial emergence of technological achievements[4].

Table 4. Value Creation Effect of Long-term Technology Investment (Different Time Windows)

Variable	TFP				Invention Patent Authorizations				TobinQ			
	t	t+1	t+2	t+3	t	t+1	t+2	t+3	t	t+1	t+2	t+3
LTI	0.012	0.018	0.038***	0.041***	0.124**	0.215***	0.187***	0.076	0.021	0.029	0.063***	0.058***
	(0.009)	(0.011)	(0.010)	(0.012)	(0.052)	(0.047)	(0.051)	(0.058)	(0.017)	(0.019)	(0.016)	(0.018)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,000	24,500	21,200	17,800	28,000	24,500	21,200	17,800	28,000	24,500	21,200	17,800
R ²	0.421	0.435	0.448	0.452	0.287	0.302	0.295	0.278	0.314	0.326	0.339	0.332

(4) Heterogeneity Analysis

This paper conducts heterogeneity analysis from two dimensions: regional institutional environment and enterprise characteristics.

From the regional dimension, in regions with better market competition environments (measured by the marketization index, higher than the median), the driving effect of patient capital is more significant (coefficient = 0.102 vs 0.058), which is consistent with the research finding of Hu Haifeng et al. (2025) that the improvement of the market competition environment can strengthen the effect of patient capital[8]. In regions with higher levels of digital economy development, the effect of patient capital is also stronger, indicating that good digital infrastructure helps reduce information asymmetry between patient capital and enterprises and improve investment efficiency[6].

From the enterprise characteristic dimension, the driving effect of patient capital is stronger in enterprises where executives have technical backgrounds, indicating that the combination of "patient capital + technical entrepreneurs" has synergistic advantages. In terms of enterprise life cycle, growth-stage enterprises benefit the most (coefficient = 0.098), followed by mature-stage enterprises (coefficient = 0.064), and recession-stage enterprises are not significant[15].

Table 5. Heterogeneity Analysis Results

Grouping Dimension	Grouping Standard	Sample Size	PC Coefficient	Standard Error	Significance
Regional Marketization Degree	High (> Median)	14,200	0.102***	0.011	p<0.01
	Low (≤ Median)	13,800	0.058***	0.010	p<0.01
Digital Economy Development Level	High (> Median)	13,500	0.097***	0.012	p<0.01
	Low (≤ Median)	14,500	0.062***	0.009	p<0.01
Executive Technical Background	Yes	11,600	0.115***	0.014	p<0.01
	No	16,400	0.063***	0.008	p<0.01
Enterprise Life Cycle	Growth Stage	12,800	0.098***	0.012	p<0.01
	Mature Stage	13,200	0.064***	0.009	p<0.01
	Recession Stage	2,000	0.021	0.017	p>0.1

(5) Robustness Tests

To ensure the reliability of the conclusions, this paper conducts multiple robustness tests: (1) Replace the core variable, replace long-term technology investment with the ratio of R&D investment to operating income, and the results remain unchanged[9]; (2) Use the instrumental variable method, take the average patient capital shareholding ratio of other enterprises in the same industry as the instrumental variable, and the 2SLS regression results remain robust[3]; (3) Sub-sample regression after excluding the 2020-2021 epidemic impact period, the conclusion still holds; (4) Use the system GMM method to deal with possible endogeneity problems, and the result direction is consistent with the benchmark regression[15].

Table 6. Robustness Test Results

Test Method	Explained Variable	PC Coefficient	Standard Error	Significance	Observations	R ² /AR (2)	Hansen Test p-value
Replace Core Variable	R&D Investment / Operating Income	0.127***	0.015	p<0.01	28,000	0.214	-
Instrumental Variable Method (2SLS)	LTI	0.094***	0.012	p<0.01	28,000	0.228	0.317
Exclude Epidemic Impact Period (2018-2019, 2022-2025)	LTI	0.081***	0.010	p<0.01	21,500	0.241	-
System GMM	LTI	0.079***	0.011	p<0.01	24,500	0.286	0.273

5. Conclusion and Recommendations

Taking Chinese A-share listed companies from 2018 to 2025 as the research sample, this paper systematically examines the value creation effect of patient capital driving enterprise long-term technology investment. The study finds that: First, patient capital significantly promotes enterprise long-term technology investment through three paths: alleviating financing constraints, strengthening management long-term incentives and improving human capital levels, and this effect is particularly prominent in STAR Market enterprises and growth-stage enterprises. Second, the improvement of long-term technology investment on total factor productivity, patent output and enterprise market value has a 2-3 year effect release cycle, revealing the institutional value of "patience"-it is precisely this delay that determines that short-term oriented capital is difficult to short-term oriented capital is ill-suited for this task. Third, the driving effect of patient capital is stronger in regions with perfect market competition environments and high levels of digital economy development, reflecting the complementarity between the institutional environment and capital forms.

The above findings provide policy implications for the current cultivation of patient capital and the construction of the science and technology financial system: We should further improve the institutional ecosystem of patient capital, including establishing a differentiated long-term investment assessment system, enriching exit channels for patient capital, and guiding more long-term funds such as insurance funds and pension funds to enter the market; at the same time, we should strengthen the full-cycle service capability of the capital market for technological innovation, promote the paradigm shift from "short-term profit-seeking" to "long-term companionship", nourish enterprise long-term technology investment with patient capital, and drive the development of new quality productive forces with long-term technology investment.

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