

Research on the Impact of Patient Capital on Firm Total Factor Productivity

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Abstract: Against the backdrop of China's pursuit of high-quality economic development, patient capital—characterized by its long-term orientation and stability—is regarded as a crucial force for overcoming corporate innovation bottlenecks and enhancing total factor productivity (TFP). This study examines this relationship using 14 years of data from A-share listed companies in China. The findings reveal that: (1) patient capital significantly promotes TFP growth; (2) digital technological innovation serves as an important mediating channel; and (3) the strength and nature of this relationship vary significantly across different contextual conditions, such as firm market power and life cycle stage. The paper recommends improving the institutional design of capital markets and optimizing corporate information disclosure and governance environments to better leverage patient capital as a strategic enabler of new quality productive forces and high-quality development.

Keywords: Patient Capital; TFP; Digital Technological Innovation.

1. Introduction

Embroidery is a famous intangible cultural heritage in China. Embroidery contains abundant materials. Interesting patterns are directly related to the development of the times, economic changes and people's living standards. Although embroidery art is a very old art, it is a symbol of a nation and an inexhaustible source of Chinese people's creation under the whole social background. For fashion designers, it is necessary to fully tap the characteristics of traditional embroidery art, and then innovate in the continuous design process. By giving full play to the artistic value of embroidery, it can help the inheritance and development of art, and make the development of contemporary fashion art have vigorous vitality.

The world is currently undergoing profound technological and industrial transformations, with scientific innovation and competition along global value chains becoming central arenas of international strategic rivalry. In its pursuit of high-quality economic development, China has prioritized enhancing firm-level total factor productivity (TFP) as a cornerstone of modernization. However, enterprises often struggle to sustain investment in foundational research due to the short-term profit orientation prevalent in financial markets. Against this backdrop, patient capital—characterized by long-term commitment and deep engagement—has been accorded strategic significance in overcoming innovation bottlenecks. In recent years, China's central government has intensively promoted policies to foster the development of patient capital.

The concept of patient capital can be traced back to 1983, when Stan Lundine, a Democratic Party member of the U.S. Congress, critiqued shortcomings in America's innovation ecosystem and proposed that "banks should offer more favorable financing terms to support firms undertaking high-risk yet long-term promising ventures." Although Lundine did not explicitly use the term "patient capital," his proposal essentially advocated for financial innovation to redirect capital from short-term returns toward long-term enterprise growth. Later, Friedman elevated the notion from a context-specific remedy to a general-purpose instrument against

financial short-termism. Building on this, Deeg and Hardie formally define patient capital as equity or debt capital that prioritizes long-term returns and maintains sustained investment even when firms face short-term operational pressures[2]. Total factor productivity measures the aggregate output efficiency achieved given multiple input factors.

Existing studies on the economic effects of patient capital have largely focused on its roles in promoting macroeconomic development, facilitating industrial transformation, and supporting firm-level growth. At the macro level, patient capital—marked by long-term horizons, high risk tolerance, and a focus on co-creating value—plays a multidimensional role in advancing high-quality economic development. It is particularly well-suited to long-cycle, large-scale projects, effectively fostering both human and physical capital accumulation and helping overcome infrastructure constraints that hinder growth. At the micro level, patient capital alleviates corporate financing constraints[14], providing stable, long-term funding that incentivizes strategic, forward-looking investments[19].

In the context of industrial upgrading, patient capital enables traditional industries to undergo digital transformation, thereby facilitating the shift from old to new growth drivers and expanding new economic frontiers[4]. Regarding firm performance, equity-type patient capital is more effective than debt-type patient capital in promoting breakthroughs in core digital technologies[29]. Patient capital significantly enhances corporate resilience[36], primarily through improving information disclosure quality, strengthening internal controls[33], mitigating agency conflicts[35], and bolstering innovation continuity and governance.

Research on determinants of firm TFP generally distinguishes between external environmental factors and internal firm characteristics. External influences include regional economic development[32], financial market development[8], the digital economy, government subsidies [15], and policy support[37]. Internal firm-level factors encompass technological innovation and R&D investment, financing constraints, return on equity, firm size, firm age, and growth potential.

Synthesizing these two strands of literature reveals that while significant progress has been made in understanding the link between patient capital and TFP, important gaps remain. In particular, the transmission channels connecting patient capital to TFP warrant deeper exploration—especially whether novel pathways exist beyond those already identified. Addressing this gap constitutes the primary contribution and innovation of this study.

2. Theoretical Analysis and Research Hypotheses

1. The Impact of Patient Capital on TFP

TFP growth does not merely result from additive input increases but stems from firms integrating resources and embedding technological standards into production functions, thereby reducing internal institutional frictions and improving organizational and allocative efficiency—ultimately shifting the production possibility frontier outward[34]. This reflects a transition from resource-driven to efficiency-driven growth.

Resource-Based View theory posits that competitive advantage arises not from external market opportunities but from internal resources that are valuable, rare, inimitable, and non-substitutable[1]. However, such resources require long-term investment[16] and temporal accumulation [7]. In today’s highly liquid and short-termist capital markets, firms often fall into a “resource instrumentalization” trap: frequent capital flows and investor obsession with short-term financial metrics lead to fragmented[12] and myopic resource allocation, hindering strategic asset formation.

Patient capital—a form of capital characterized by long-term investment horizons and stable ownership—provides firms with predictable, continuous funding. More importantly, it introduces external networks and governance expertise, acting as a “resource catalyst” that accelerates VRIN resource accumulation and organizational capability building, thereby laying the foundation for TFP growth.

Since Schumpeter[22], innovation theory has consistently identified technological innovation as the core engine of TFP growth[21]. Yet major innovations often confront the “valley of death”—high costs, long cycles, high uncertainty, and funding discontinuity risks. Short-term capital, seeking immediate returns, cannot sustain such projects. Patient capital, with its cross-cycle commitment, ensures R&D continuity and enhances commercialization efficiency through resource integration[31]. Crucially, innovation is not just technological breakthrough but also systemic organizational evolution. Through governance participation, patient capital introduces advanced management knowledge, reduces misallocation, and enables firms to truly rely on organizational efficiency[25] and innovation accumulation [13] for long-term TFP growth—this is the essence of patient capital.

Therefore, this paper proposes the following hypothesis:

H1: Patient capital positively promotes firm total factor productivity.

2. Patient Capital, Digital Technological Innovation and TFP

Sustained innovation and technological progress are indispensable for TFP enhancement in high-quality development. Digital technological innovation significantly improves capital-labor matching efficiency by reconstructing

production processes, optimizing managerial decisions, and breaking down information silos. However, its high cost, long duration, and uncertainty often deter firms due to financing constraints and managerial myopia.

Here, patient capital—guided by long-term value and deep governance involvement—becomes pivotal in overcoming innovation barriers. Specifically, it empowers digital innovation through three channels: By deeply engaging in corporate governance, patient investors introduce frontier industry insights and external knowledge networks[19], helping firms identify key trends and make forward-looking investments. Their tolerance for short-term volatility also suppresses managerial myopia, steering resources toward long-term capability building. Beyond easing external financing constraints[36], patient capital ensures cross-cycle R&D continuity[3]. Long-term holdings also trigger peer effects, attracting follow-on investment. Through governance participation, patient capital optimizes organizational structure, attracts talent, and enhances technology commercialization efficiency[30]. Ultimately, digital innovation drives production function expansion via dual technological and organizational advancement.

Therefore, this paper proposes the following hypothesis:

H2: Patient capital enhances TFP by promoting digital technological innovation.

3. Research Design

1. Sample Selection and Data Sources

This paper select Chinese A-share listed firms from 2010 to 2024 as our sample, excluding financial firms, ST/*ST firms, those with abnormal financials, and observations with missing key variables. All continuous variables are winsorized at the 1% and 99% levels. Firm-level data come from the CSMAR database, innovation data from CNRDS, and regional data from the National Bureau of Statistics of China. This paper controls for firm fixed effects and year fixed effects in regressions.

2. Model construction and variable definition

(1) Model construction

$$TFP_{it} = \alpha_0 + \alpha_1 \times PC_{it} + \alpha_2 \times Controls_{it} + ID_i + Year_t + \varepsilon_{it}$$

where i denotes firm, t denotes year; TFP_{it} is total factor productivity; PC_{it} is patient capital; μ_i and λ_t are firm and year fixed effects; ε_{it} is the error term.

(2) Variable Definitions

1) Independent variable

Patient Capital (PC): This paper decompose PC into stable equity (Invest) and relationship-based debt (Debt).

Invest: This paper classify institutional investors into low-, medium-, and high-turnover groups based on share turnover; the low-turnover group’s ownership ratio serves as Invest.

Debt: This paper measure Debt as the ratio of long-term liabilities to total liabilities.

2) Dependent variable

TFP: Measured via the OP method in baseline regressions; LP method used for robustness checks.

3) Mediating variable

Digital Technological Innovation (Dig): This paper uses the natural logarithm of authorized digital economy invention patents.

4) Control variables

Control variables: See Table 1.

Table 1. Definition of variables

Variable Name	Symbol	Measurement
Firm Age	Age	Natural log of years since establishment
Firm Size	Size	Natural log of total assets
ROE	ROE	Net profit / average net assets
Leverage	Lev	Total liabilities / total assets
Fixed Asset Ratio	FAR	Net fixed assets / total assets
Book-to-Market Ratio	BM	Book value per share / market price per share
Employees	Employees	Natural log of employee count
Management Ownership	MgtOwn	Shares held by directors/supervisors/executives / total shares
Financial Background of Board	FinBack	Dummy = 1 if any director/supervisor/executive has finance background
GDP Growth Rate	GDPgrowth	Year-on-year regional GDP growth

(3) Descriptive Statistics

Table 2. Descriptive Statistics

Variables	Variables	Variables	Variables	Variables	Variables
TFP	33,904	6.647	0.770	5.017	8.791
Invest	33,904	0.0123	0.0220	0	0.119
Debt	33,904	0.121	0.147	0	0.613
Age	33,904	2.975	0.320	2.079	3.611
ROE	33,904	0.0485	0.139	-0.752	0.319
Lev	33,904	0.411	0.204	0.0569	0.894
FAR	33,904	0.211	0.150	0.00316	0.667
GDPgrowth	33,904	0.0853	0.0528	-0.2502	0.2988
BM	33,904	0.610	0.246	0.120	1.176
Size	33,904	23.17	1.257	20.922	27.324
Employees	33,904	7.656	1.209	4.836	11.07
MgtOwn	33,904	0.143	0.196	0	0.676
FinBack	33,904	0.617	0.486	0	1

After initial cleaning, descriptive statistics are reported in Table 2. The standard deviation of the dependent variable TFP is 0.770, indicating that it lies within a relatively stable range overall. The variable Invest has a mean of 0.0123 and a maximum value of 0.119, suggesting that a large number of firms in the sample have a value of zero for this measure. This implies that most firms exhibit a relatively low level of stable equity ownership. For Debt, the maximum value is 0.613, the mean is 0.121, and the standard deviation is 0.147. This indicates that, on average, firms show limited reliance on relational financing; however, a subset of firms exhibits substantial dependence on support from banks and other financial institutions. Furthermore, these figures suggest considerable heterogeneity in bank-firm relationships across the sample.

4. Empirical Results and Analysis

1. Benchmark regression

Using a two-way fixed effects model with firm-clustered standard errors, results (Table 3.) show both Invest and Debt significantly and positively affect TFP. Stable equity reduces managerial myopia[28], curbing underinvestment in R&D[24] and stabilizing governance. Relationship debt provides tailored credit based on soft information[9], easing financing constraints and mitigating agency problems through monitoring.

Table 3. Benchmark regression

	(1)	(2)
	TFP	TFP
Invest	0.6597***	
	(0.119)	
Debt		0.0908***
		(0.029)
Controls	YES	YES
ID	YES	YES
YEAR	YES	YES
N	33904	33904
r2 a	0.5881	0.5878

According to the results, Invest has a statistically significant positive effect on TFP. This is because stable equity ownership places greater emphasis on the firm's long-term value, thereby reducing managerial tendencies to sacrifice investments in R&D, innovation, and other long-term activities in pursuit of short-term stock price performance. Moreover, stable equity contributes to a more robust corporate governance structure and fosters a consistent and supportive organizational environment.

Similarly, Debt also exerts a significantly positive influence on total factor productivity through long-term credit arrangements. Long-term lenders, through sustained cooperation, gain deeper insights into firms' true operational conditions[9], enabling them to provide more precise credit support that alleviates firms' financing constraints[26]. Additionally, relationship-based lenders can exert effective

monitoring through credit screening and post-loan management, which helps mitigate agency problems arising from managerial discretion. Ultimately, this oversight

mechanism contributes positively to enhancing firms' total factor productivity.

Table 4. Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
	TFP	TFP	TFP	TFP	TFP	TFP
Invest	0.6902***		0.1772*		0.7111***	
	(0.124)		(0.095)		(0.127)	
Debt		0.0830***		0.2823***		0.0834***
		(0.029)		(0.018)		(0.030)
Controls	YES	YES	YES	YES	YES	YES
N	33904	33904	33762	33762	29560	29560
r ² a	0.6859	0.6856	0.7544	0.7561	0.6014	0.6009

2. Robustness Checks

(1) Alternative Measure of the Dependent Variable

This paper estimates TFP using the LP method. The regression results are reported in columns (1) and (2) of Table 4. The findings show that even when TFP is measured via the LP approach, both Invest and Debt continue to exert a statistically significant positive effect. This confirms the robustness of the baseline regression results.

(2) High-Dimensional Fixed Effects

This paper further employs a high-dimensional fixed effects model for estimation. Columns (3) and (4) of Table 4. present the corresponding results. The coefficients on Invest and Debt remain significantly positive, indicating that the positive impact of patient capital on TFP holds even after rigorously controlling for high-dimensional fixed effects. This reinforces the robustness of our core findings.

(3) Exclusion of Special Years

Table 5. Endogeneity Test

	Invest	TFP	Debt	TFP
IV-Invest	0.2937***			
	(0.043)			
Invest		3.8976*		
		(2.358)		
IV-Debt			0.3018***	
			(0.027)	
Debt				1.9607***
				(0.295)
Controls	YES	YES	YES	YES
N	33764	33764	33764	33764
r ² a	0.2074	0.7144	0.3746	0.6645

To mitigate potential distortions caused by external shocks in specific years, this paper conducts an additional robustness check by excluding observations from 2015 and 2020. The year 2015 witnessed a financial market turmoil that triggered severe stock market volatility; in response, the central government redirected liquidity toward the real estate sector, fueling a housing price surge and regional financial risks due to excessive credit expansion in property markets[23], which deteriorated corporate financing conditions and intensified operational pressures. Meanwhile, the unexpected outbreak of the COVID-19 pandemic in 2020 severely disrupted supply chains and halted offline business operations. After removing data from these two anomalous years, the estimated effects of stable equity and relational debt on TFP remain significantly positive, further supporting the robustness of our baseline results.

(4) Endogeneity Test

There may be a bidirectional causal relationship between patient capital and TFP, potentially leading to endogeneity bias. To address this issue, this paper adopts a Two-Stage Least Squares approach for causal identification.

Specifically, This paper construct instrumental variables as the average values of Invest and Debt among other firms in the same industry and year, excluding the focal firm itself. Table 5. reports the 2SLS estimation results. The first-stage regressions confirm that both instruments are strongly correlated with their respective endogenous explanatory variables, with F-statistics far exceeding the critical threshold

of 16.38, thereby rejecting the null hypothesis of weak instruments. In the second stage, the estimated coefficients for both Invest and Debt remain significantly positive, indicating that patient capital robustly enhances TFP—consistent with theoretical expectations.

3. Mechanism Test

Building on the finding that patient capital significantly and positively affects TFP, this section further investigates the underlying transmission mechanisms. This paper estimates the following three sets of regressions:

$$TFP_{it} = \alpha_0 + \alpha_1 \times PC_{it} + \alpha_2 \times Controls_{it} + ID_i + Year_t + \varepsilon_{it}$$

$$M_{it} = a_0 + a_1 \times PC_{it} + a_2 \times Controls_{it} + ID_i + Year_t + \varepsilon_{it}$$

$$TFP_{it} = b_0 + b_1 \times PC_{it} + b_2 \times Controls_{it} + b_3 \times M_{it} + ID_i + Year_t + \varepsilon_{it}$$

M denotes the mediating variable—digital technological innovation (Dig). This paper measures Dig as the natural logarithm of the number of authorized invention patents related to the digital economy. Table 6. reports the mediation regression results using Dig as the mediator.

Columns (1) and (4) show that both Invest and Debt significantly promote TFP. Columns (2) and (5) indicate that Invest and Debt also have significant positive effects on Dig. In columns (3) and (6), after including Dig in the regression, Invest, Debt, and Dig all remain significantly and positively associated with TFP. This pattern supports a partial mediation effect.

These findings are theoretically well-grounded. First, a firm's capital structure and risk appetite are shaped by the

stability and investment horizon of its capital[20]. Firms backed by patient capital are more inclined toward long-term value creation and thus more willing to provide sustained financial support for digital technology projects characterized by long development cycles and high uncertainty[17]. Second, patient capital broadens firms' access to information[27], alleviates financing constraints, and enhances their ability to identify digital innovation opportunities[29]. Moreover, patient capital facilitates human capital upgrading[6], strengthening the intellectual foundation required for

innovation, and enables firms to rationally manage uncertainty[5], thereby steadily advancing high-risk, long-cycle digital R&D initiatives. Digital technological innovation serves as a key driver of TFP growth[17]. It improves operational efficiency by digitizing management processes, which reduces internal monitoring costs and agency costs[38]. Additionally, it optimizes capital allocation decisions[11], ultimately fostering high-quality development and enhancing TFP.

Table 6. Mechanism Test

	(1)	(2)	(3)	(4)	(5)	(6)
	TFP	Dig	TFP	TFP	Dig	TFP
Invest	0.6597*** (0.119)	0.5598** (0.279)	0.6553*** (0.118)			
Debt				0.0908*** (0.029)	0.0803* (0.046)	0.0901*** (0.029)
Dig			0.0078* (0.004)			0.0080* (0.004)
Controls	YES	YES	YES	YES	YES	
ID	YES	YES	YES	YES	YES	
YEAR	YES	YES	YES	YES	YES	
cons	-30.2795*** (0.972)	-13.5089*** (1.537)	-30.1736*** (0.973)	-30.2607*** (0.976)	-13.4772*** (1.553)	-30.1531*** (0.978)
N	33904	33904	33904	33904	33904	33904
r ² a	0.5881	0.1952	0.5882	0.5878	0.1951	0.5879

4. Heterogeneity Analysis

(1) Market Power

To further investigate whether the impact of patient capital on TFP varies with their competitive position in the market, this paper conducts a heterogeneity analysis based on market power. This paper measures firm-level market power using the Lerner index and split the sample into two groups: firms with weak market power and those with strong market power. The results are reported in Table 7.

Table 7. Heterogeneity Analysis by Market Power

	(1)	(2)	(3)	(4)
	Weak	Strong	Weak	Strong
Invest	0.3375* (0.190)	0.6730*** (0.128)		
Debt			0.1579*** (0.043)	1.9607*** (0.295)
Controls	YES	YES	YES	YES
ID	YES	YES	YES	YES
YEAR	YES	YES	YES	YES
N	17108	16796	17108	16796
r ² a	0.5463	0.6208	0.5474	0.6198

Table 8. Heterogeneity Analysis by Market Power

	(1)	(2)	(3)	(4) Growth	(5) Maturity	(6) Decline
	Growth	Maturity	Decline	Growth	Maturity	Decline
Invest	0.5084*** (0.178)	0.6713*** (0.162)	0.3817 (0.359)			
Debt				0.0829** (0.038)	0.0038 (0.040)	0.4371*** (0.087)
Controls	YES	YES	YES	YES	YES	YES
ID	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES
N	13119	13506	7279	13119	13506	7279
r ² a	0.6288	0.6598	0.4357	0.6288	0.6588	0.4426

The positive effect of Invest on TFP is significantly stronger among firms with greater market power—a pattern consistent with the “the strong get stronger” dynamic. Firms with high market power typically enjoy more stable cash flows and greater resilience to external shock, enabling them to commit to long-term investments in core technology development and digital transformation. This enhances their resource allocation efficiency and boosts innovation output. In contrast, firms with weaker market power face intense survival pressures, which constrain the governance effectiveness of stable shareholders and limit their ability to support long-term strategic initiatives.

Conversely, the positive impact of Debt on TFP is primarily concentrated among firms with weaker market power,

reflecting a “lifeline in times of need” role. These firms are generally more vulnerable to financing constraints. However, relationship-based lenders—such as banks—can leverage long-term interactions to gather soft information about borrowers, thereby mitigating information asymmetry between firms and external investors and providing more stable credit support[10]. Moreover, patient debt capital can enhance corporate governance through active monitoring and participation in strategic decisions, helping firms overcome critical growth bottlenecks[18]. In contrast, firms with strong market power have access to more diversified financing channels and rely less on relational debt, rendering the marginal effect of Debt relatively limited.

(2) Firm Life Cycle

To examine whether the impact of patient capital on TFP varies across different stages of the firm life cycle, this paper further conducts a heterogeneity analysis by firm life cycle stage. This paper classifies firms into three life cycle stages: growth, maturity, and decline. The regression results are reported in Table 8.

Columns (1)–(3) show that the positive effect of Invest on TFP is statistically significant in both the growth and maturity stages, but becomes insignificant in the decline stage. This suggests that the productivity-enhancing role of patient equity follows an inverted U-shaped pattern over the firm life cycle—strong during expansion and stabilization phases, but diminishing as the firm enters decline.

During the growth stage, although firms face high uncertainty, stable equity investors can still alleviate financing constraints through long-term capital support. As firms enter the maturity stage, their strategies become more stable and governance structures more robust, creating a solid foundation for implementing long-term investments. At this point, investors can more effectively engage in corporate governance, promote managerial optimization, and improve resource allocation efficiency—thereby enhancing TFP. In contrast, during the decline stage, firms confront shrinking market demand, technological obsolescence, and other structural challenges. Even with access to long-term capital, they often struggle to reverse adverse trends, leading to a diminished marginal contribution of patient capital.

Columns (4)–(6) reveal a different pattern for Debt: its positive effect on TFP is significant in both the growth and decline stages, but relatively weak and statistically insignificant during the maturity stage. This implies that relational debt plays a supportive role particularly when firms face either high investment needs or severe financial distress and restructuring pressures, whereas its marginal contribution is limited during the stable maturity phase when internal cash flows are abundant and external financing constraints are less binding.

5. Conclusion and Recommendations

(1) Conclusion

Using a sample of Chinese listed firms, this paper systematically investigates the impact of patient capital on TFP and draws the following key conclusions: First, patient capital significantly enhances firm-level TFP. Second, digital technological innovation serves as a crucial transmission channel through which patient capital boosts TFP. Third, the effect of patient capital on TFP varies depending on firms' market power and life cycle stage, indicating notable heterogeneity across different corporate contexts.

(2) Recommendations

The government should further improve the foundational institutions of the capital market to attract, cultivate, and expand long-term institutional investors—such as social security funds, insurance funds, pension funds, and public welfare foundations. Measures such as tax incentives and relaxed investment restrictions can be implemented to strengthen these investors' willingness to hold equity stakes, enhance investment stability, and encourage active participation in corporate governance. Additionally, deepening the registration-based IPO reform and improving the quality of information disclosure and transparency in corporate governance will help create a favorable investment environment for patient capital.

Regulatory authorities should guide listed companies to improve their governance structures—for example, by promoting board independence and fostering checks and balances within governance mechanisms—to mitigate risks associated with insider control. Furthermore, institutional frameworks should be strengthened to facilitate meaningful involvement of institutional investors in corporate governance, ensuring that patient capital functions not only as a source of financing but also as an effective monitor and strategic partner. This would enable patient capital to contribute advanced management practices, foster technology collaboration, and ultimately support sustainable enterprise development.

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