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Article

The Impact of Patient Capital on the High-Quality Development of Enterprises in Strategic Emerging Industries

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Abstract: The high-quality development of enterprises in strategic emerging industries plays a crucial role in achieving high-quality economic development. As a form of long-term strategic investment adhering to the principles of value investing, patient capital is emerging as a key driver of high-quality development in these enterprises. Based on data from 743 listed enterprises in China's strategic emerging industries from 2014 to 2023, this study examines the differential effects of patient capital on the high-quality development of these enterprises. It further tests the mediating roles of digital-green transformation synergy, information asymmetry, and financing constraints, as well as the moderating role of artificial intelligence applications. The results indicate: First, patient capital plays a significant role in promoting the high-quality development of enterprises in strategic emerging industries; second, patient capital promotes the high-quality development of these enterprises by enhancing the level of synergy in digital and green transformation, alleviating information asymmetry, and easing financing constraints. Third, the application of artificial intelligence enhances the positive impact of patient capital on the high-quality development of enterprises in strategic emerging industries; fourth, the impact of patient capital on the high-quality development of enterprises in strategic emerging industries exhibits distinct differences across regional heterogeneity and industrial characteristics. Analysis of regional heterogeneity reveals that enterprises in the central region are more sensitive to patient capital in terms of high-quality development, while an analysis of industrial heterogeneity reveals that the effects of two distinct forms of patient capital—stable equity and relationship-based debt—are more pronounced in promoting high-quality development in the new energy vehicle industry, energy conservation and environmental protection industry, biotechnology industry, new materials industry, and next-generation information technology industry. Compared to relationship-based debt, stable equity significantly promotes high-quality development in the high-end equipment manufacturing and new energy industries. This study provides theoretical foundations and policy implications for leveraging patient capital to drive high-quality development in strategic emerging industries.

Keywords: Patient Capital; Digital-Green Transition Synergy; Information Asymmetry; Financing Constraints; Artificial Intelligence Applications; High-Quality Enterprise Development; Strategic Emerging Industries

1. Introduction

Enterprises in strategic emerging industries are based on major technological breakthroughs and significant development needs. They are characterized by high knowledge and technology density, strong innovation and breakthroughs, great growth potential, and high comprehensive benefits. They play a huge driving role in the overall and long-term development of the economy and society and are an important decisive force leading the country's future development [1]. High-quality development is the primary task in comprehensively building a modern socialist country. In December 2023, the Central Economic Work Conference emphasized: "We must uphold high-quality development as the fundamental principle of the new era, fully, accurately, and comprehensively implement the new development philosophy, and promote the economy to achieve effective qualitative improvement and reasonable quantitative growth [2]". As the new round of technological revolution and industrial transformation accelerates, global technological innovation has entered a period of intense activity, with leading and disruptive innovations continuously emerging and rapidly permeating economic and industrial sectors. Since strategic emerging industries are often driven by cutting-edge technologies and possess significant strategic, pioneering, disruptive, and uncertain characteristics, their innovation activities require extensive trial-and-error R&D and relatively long development cycles. Being in the incubation and early industrialization stages, these industries face insufficient short-term innovation returns and highly uncertain long-term returns. Consequently, without commensurate financial support, they often struggle with inadequate and intermittent funding. Breakthroughs in cutting-edge technologies are certainly not achieved overnight; they require intensive and long-term, stable investment. In this context, the importance of patient capital becomes particularly evident.

Current research on the impact of patient capital on high-quality corporate development has yielded relatively systematic empirical conclusions, all of which confirm that patient capital plays a significant positive role in promoting high-quality corporate development. This is because the long-term orientation of patient capital aligns closely with the sustainability requirements of high-quality corporate development. Patient capital possesses core characteristics such as risk tolerance, long investment horizons, and strong strategic synergy. It can tolerate the high uncertainty and long return cycles associated with corporate innovation activities, providing stable financial support for long-term investments such as R&D, equipment upgrades, and industrial chain integration [3, 4], thereby breaking through the financial constraints imposed by traditional short-term capital on enterprises' long-term development. By deeply engaging in corporate governance, patient capital investors leverage their extensive industry experience and informational advantages to effectively curb management's short-sighted behavior and opportunistic tendencies [5], reduce information asymmetry and agency costs [6], and drive enterprises to focus on core businesses and strategic upgrades while avoiding inefficient investments. Simultaneously, the involvement of patient capital sends positive signals to the market regarding an enterprise's development potential, helping to enhance corporate creditworthiness and resource integration capabilities, and fostering a favorable external environment for high-quality development [7].

A review of relevant literature reveals that while domestic research on high-quality corporate development has considered the impact of patient capital, it has primarily focused on private enterprises and has not fully examined the influence of patient capital on enterprises in strategic emerging industries. This study utilizes data from 743 Chinese enterprises in strategic emerging industries from 2014 to 2023 to examine the impact of patient capital on the high-quality development

of these enterprises. The main contributions include: 1) It verifies that patient capital plays a promotional role in the high-quality development of enterprises in strategic emerging industries; 2) By introducing digital-green transformation synergy, information asymmetry, and financing constraints, this study enriches the transmission mechanism of patient capital on enterprises in strategic emerging industries; 3) By incorporating the level of artificial intelligence application, this study further deepens the scenario-based mechanism of patient capital on enterprise high-quality development. The structure of this paper is as follows: Part Two covers theoretical analysis and research hypotheses; Part Three covers research design; Part Four covers empirical research; Part Five covers conclusions and recommendations.

2. Theoretical Analysis and Research Hypotheses

2.1. The Impact of Patient Capital on the High-Quality Development of Enterprises in Strategic Emerging Industries

Patience capital typically features a long-term investment perspective and lower demands for short-term returns, enabling it to tolerate the high uncertainty and long return cycles inherent in technological innovation and market expansion. This aligns precisely with the characteristics of enterprises in strategic emerging industries, which are technology-intensive, require substantial R&D investment, and face complex industrialization pathways [8]. During the enterprise's growth process, patient capital not only provides continuous and stable financial support, alleviates financing constraints, and reduces strategic myopia caused by short-term performance pressures, but also guides enterprises to focus on core technological breakthroughs and long-term value creation through deep involvement in corporate governance and the provision of strategic resources and management expertise. This long-term alignment between capital and the enterprise helps enhance the continuity and stability of innovation, incentivizes forward-looking strategic positioning in key areas, optimizes resource allocation efficiency, and improves total factor productivity [9].At the same time, the stable support of patient capital can boost the confidence of external investors and partners, improve the enterprise's innovation ecosystem, and thereby foster an endogenous growth mechanism oriented toward innovation-driven development and quality-first principles [10]. Ultimately, this drives enterprises in strategic emerging industries to transition from scale expansion to improvements in quality and efficiency, achieving high-quality development [8, 11]. Based on this, Hypothesis 1 is proposed.

H1: Patient capital has a significant positive impact on the high-quality development of enterprises in strategic emerging industries.

2.2. Channels Through Which Patient Capital Influences the High-Quality Development of Enterprises in Strategic Emerging Industries

1) Synergy in Digital and Green Transitions

The core attributes of patient capital—long-term holding, high risk tolerance, and a focus on long-term value—enable it to provide stable and sustained financial support for the digital and green transformations of enterprises in strategic emerging industries. This effectively alleviates the pressures posed by the high investment, long cycles, and uncertainty of short-term returns associated with these two types of transformation. At the same time, through long-term-oriented resource

allocation and strategic guidance, patient capital drives enterprises to deeply integrate the application of digital technologies with green development needs. By leveraging digital technologies such as big data and artificial intelligence to empower energy consumption monitoring, carbon footprint tracking, and green production optimization—thereby achieving "promoting green initiatives through digital technology"—while also using green development goals to drive the iterative upgrading of digital technologies, creating a virtuous cycle of "guiding digital technology through green development." This, in turn, drives the construction and enhancement of synergistic capabilities for digital and green transformation [12]; As a product of the deep integration of digitalization and green development, the synergy of digital-green transformation can inject momentum into enterprises' high-quality development through multiple pathways. It not only enhances total factor productivity by optimizing production processes and reducing resource and energy consumption as well as carbon emissions, but also helps enterprises overcome resource and environmental constraints and expand into green product and service sectors to optimize industrial structures. Furthermore, it relies on digital technologies to strengthen environmental risk control and compliance management, thereby enhancing sustainable development capabilities [13], which fully aligns with the core tenets of high-quality development: "innovation, coordination, green, openness, and sharing." Based on this, Hypothesis H2a is proposed.

H2a: Patient capital promotes the high-quality development of enterprises in strategic emerging industries by enhancing the level of synergy between digital and green transformation.

2) Information Asymmetry

Information asymmetry is a core obstacle hindering the high-quality development of enterprises, and patient capital, with its long-term investment nature, serves as a key mechanism for overcoming this challenge. In capital markets, there is a significant information gap between enterprises and investors: enterprises hold core information such as technological potential and growth trajectories, while investors find it difficult to comprehensively assess enterprise value due to factors such as information acquisition costs and professional barriers. This asymmetry can easily lead to adverse selection and moral hazard, resulting in financing difficulties for high-quality enterprises or distortions in resource allocation [14]. Through an investment paradigm of "trading time for space," patient capital can deeply engage in corporate operations. By leveraging the trust and professional capabilities built through long-term partnership, it reduces the cost of information screening and accurately identifies a company's true value [15]. Simultaneously, its "non-short-term profit-seeking" nature weakens a company's incentive to deviate from its long-term strategy to accommodate short-term market pressures, thereby encouraging the company to focus on high-quality development factors such as technological innovation and governance optimization [16]. This two-way information transmission mechanism not only optimizes the efficiency of capital allocation but also attracts more rational capital through signaling effects, creating a virtuous cycle that ultimately helps enterprises break through information barriers and achieve sustainable growth [17]. Hypothesis H2b is proposed.

H2b: Patient capital promotes high-quality corporate development by reducing information asymmetry.

3) Financing Constraints

Patient capital, characterized by a long-term value orientation and high-risk tolerance, serves as a key pillar for alleviating corporate financing constraints and driving high-quality development. Its

mechanism of action is clear and progressive: high-quality corporate development relies on long-cycle activities such as technological innovation and industrial upgrading. Due to their long return cycles and high risks, these activities often clash with the short-term profit-seeking demands of traditional capital, leading to financing constraints [18]. Patience capital, however, can precisely match these long-cycle funding needs. By adopting a stable holding strategy to avoid the risk of short-term divestment, it provides sustained financial support for enterprises' technological breakthroughs, transformation, and upgrading, thereby resolving financing challenges at their root [19]. At the same time, its high-risk tolerance allows it to share the risks of innovation and trial-and-error with enterprises. Moreover, the mere presence of patience capital sends a positive signal to the market, serving as a credit endorsement for enterprises, which further broadens financing channels and optimizes financing structures [20]. Additionally, patient capital can also participate in corporate governance and guide the aggregation of production factors, thereby directing resources toward core innovation activities, optimizing total factor productivity, and helping enterprises cultivate core competitiveness. Ultimately, this achieves an effective transition from alleviating financing constraints to enabling high-quality development, aligning with the core requirements of industrial upgrading and high-quality economic development [16]. Hence, Hypothesis H2c is proposed.

H2c: Patient capital promotes high-quality development of enterprises by alleviating financing constraints.

2.3. Mechanism of Patient Capital's Impact on the High-Quality Development of Enterprises in Strategic Emerging Industries

2.3.1. The Moderating Role of Enterprises 'AI Application Levels

Enterprises in strategic emerging industries are characterized by being technology-intensive, having long development cycles, and carrying high risks; they rely on long-term investments from patient capital to support continuous innovation and iteration [18]. The deep application of artificial intelligence (AI) technology effectively reduces innovation uncertainty by enhancing corporate data insights, optimizing resource allocation efficiency, and accelerating the commercialization of technology, thereby strengthening the sustainability of capital investment and improving expected returns. At the same time, the dynamic capability building enabled by AI allows enterprises to respond more agilely to market changes, further alleviating patient capital's concerns regarding risk exposure and encouraging investors to provide long-term, stable financial support. This positive moderating effect essentially creates a synergistic effect between technological progress and patient capital, driving the efficient conversion of innovation resources and ultimately achieving the goal of high-quality enterprise development. Consequently, Hypothesis H3a is proposed.

H3a: The application of artificial intelligence positively moderates the promotional effect of patient capital on the high-quality development of enterprises in strategic emerging industries.

2.3.2. Heterogeneous Effects of Patient Capital on the High-Quality Development of Enterprises in Strategic Emerging Industries

1) Regional Heterogeneity

Enterprises in the strategic emerging industries of the central region are currently in a critical window period of transition from factor-driven to innovation-driven growth. Compared to the

eastern region, while they possess a certain industrial foundation and human capital reserves, they face bottlenecks such as insufficient short-term capital supply and weak sustainability of innovation investment. The long-term nature of patient capital precisely aligns with the extended-cycle demands of R&D and capacity expansion in emerging industries. On one hand, it alleviates enterprises' financing constraints by providing stable capital support; on the other hand, through proactive post-investment management, it addresses the shortcomings in high-end productive services in the central region, thereby generating a powerful, "timely and crucial" driving effect on enterprises' high-quality development. In contrast, the development of strategic emerging industries in the eastern region has reached maturity, with leading enterprises having diversified financing channels. Consequently, the marginal contribution of patient capital is relatively diminished, resulting in a weaker impact compared to the central region. The development of strategic emerging industries in the western region is constrained by inherent deficiencies in core factor endowments: first, a shortage of high-end innovative talent and weak corporate capabilities in technology absorption and transformation, making it difficult to effectively leverage the innovation-enabling benefits of patient capital; second, the industrial chain is underdeveloped and industrial cluster effects have yet to take shape, making it difficult to rapidly commercialize R&D outcomes driven by patient capital [21]; third, the institutional environment and level of marketization are relatively lagging, resulting in high transaction costs for post-investment management and exit mechanisms of patient capital. These constraints prevent the financial advantages and resource integration capabilities of patient capital from effectively reaching the core aspects of enterprises' high-quality development. This leads to the formulation of Hypothesis H3b.

H3b: The effect of patient capital on promoting high-quality enterprise development exhibits regional heterogeneity.

2) Sub-sector Heterogeneity Among Enterprises in Strategic Emerging Industries

In terms of the compatibility between industrial attributes and patient capital, advanced manufacturing sectors such as the new energy vehicle industry and the next-generation information technology industry—as technology- and capital-intensive, long-cycle industries—require long-term, large-scale capital investment and risk-taking in areas such as full-industry-chain coordination and infrastructure deployment. Meanwhile, patient capital's characteristics—including long-term funding supply, deep industrial resource integration capabilities, and keen sensitivity to policy-driven opportunities—can precisely align with the long-cycle demands of industrial development. This effectively alleviates enterprises' financing constraints, drives collaborative innovation across the industrial chain, and helps enterprises withstand cyclical fluctuations in the industry [18]. Based on this, Hypothesis H3c is proposed

H3c: The effect of patient capital on promoting high-quality enterprise development is moderated by the sub-industry heterogeneity of strategic emerging industries.

3. Research Design

3.1. Model Specification

To examine the impact of patient capital on the high-quality development of enterprises in strategic emerging industries and its underlying mechanisms, this study establishes a baseline regression model, as shown in Equations (1) and (2).

$$HQD_{i,t} = \alpha_0 + \alpha_1 \text{Equity}_{i,t} + \sum \beta Controls_{i,t} + \gamma_i + \chi_t + \varepsilon_{i,t} \quad (1)$$

$$HQD_{i,t} = \alpha_0 + \alpha_1 Debt_{i,t} + \sum \beta Controls_{i,t} + \gamma_i + \chi_t + \varepsilon_{i,t} \quad (2)$$

where HQD is the dependent variable—the high-quality development index; Equity and Debt are the core independent variables—patience capital; Controls are control variables; γ_i is the industry fixed effect; χ_t is the time fixed effect; and $\varepsilon_{i,t}$ is the random error term.

To test Hypothesis 2, following Jiang Ting's [22] two-step mechanism testing approach, we treat digital transformation synergy, information asymmetry, and financing constraints as dependent variables to conduct separate mechanism tests, and construct the transmission mechanism models (3) and (4). To test Hypothesis 3, we treat the level of AI application as a moderator and construct models (5) and (6).

$$MV_{i,t} = \alpha_0 + \alpha_1 \text{Equity}_{i,t} + \sum \beta Controls_{i,t} + \gamma_i + \chi_t + \varepsilon_{i,t} \quad (3)$$

$$MV_{i,t} = \alpha_0 + \alpha_1 Debt_{i,t} + \sum \beta Controls_{i,t} + \gamma_i + \chi_t + \varepsilon_{i,t} \quad (4)$$

$$HQD_{i,t} = \alpha_0 + \alpha_1 \text{Equity}_{i,t} + \alpha_2 AI_{i,t} + \alpha_3 \text{Equity}*AI_{i,t} + \sum \beta Controls_{i,t} + \gamma_i + \chi_t + \varepsilon_{i,t} \quad (5)$$

$$HQD_{i,t} = \alpha_0 + \alpha_1 Debt_{i,t} + \alpha_2 AI_{i,t} + \alpha_3 \text{Debt}*AI_{i,t} + \sum \beta Controls_{i,t} + \gamma_i + \chi_t + \varepsilon_{i,t} \quad (6)$$

In Equations (3) and (4), MV denotes the mediating variable. In the regression analysis, digital-green transformation synergy (DGS), the information asymmetry index (ASY), and financing constraints (FC) are used as dependent variables, respectively. In Equations (5) and (6), the frequency of AI-related terms and the logarithm of +1 are used as proxy indicators for AI application levels in the regression analysis.

3.2. Variable Specification

3.2.1. Dependent Variables

As the theoretical connotations and implications of high-quality economic development continue to deepen and clarify, the traditional one-dimensional evaluation paradigm based on total factor productivity has become inadequate to fully reflect the complex characteristics of economic development quality. Based on this, this study draws on the multidimensional comprehensive evaluation frameworks developed by Chi Guohua et al. [23], Gao Shiyu [24], and Li Huan [25]. By systematically integrating the five core dimensions of innovation-driven development, structural coordination, openness, green development, and social sharing, we construct an enterprise high-quality development evaluation system comprising 12 secondary indicators. Specifically, in the innovation dimension, observable indicators such as R&D intensity and the proportion of R&D personnel are established; in the green development dimension, indicators such as environmental management disclosure and environmental governance disclosure are selected. The specific indicators and measurement methods are shown in Table 1.

3.2.2. Explanatory Variables

Following the research methods of Jiang Zhongyu [15] and Wu Minjia [26], patient capital is defined using relational debt and stable equity, respectively. Relational debt is measured by the ratio of long-term liabilities to total liabilities, while stable equity is calculated based on the proportion of

shares held by long-term institutional investors. The data used for these calculations is sourced from the Guotaian database.

Table 1. Construction of the Enterprise High-Quality Development Evaluation System.

Primary Indicators	Second-Level Indicators	Calculation Method
Innovation	R&D Personnel Ratio	R&D Personnel / Total Workforce
	Intangible Assets Ratio	Total Intangible Assets / Total Assets
	R&D Expenditures	R&D Expenditures / Revenue
Coordination	Return on Total Assets	(Total Profit + Interest Expense) / Average Total Assets
	Inventory Turnover Ratio	Cost of Goods Sold / Average Inventory
	Debt-to-Equity Ratio	Total Liabilities / Total Assets
	Revenue Growth Rate	Increase in Revenue / Previous Year's Revenue
Green	Environmental Management Disclosure	Whether environmental philosophy is disclosed; aggregate value of 8-dimensional indicators
	Environmental Governance Disclosure	Aggregate score of 6-dimensional indicators, including waste reduction and emissions control
Open	Open Access Outcomes	Revenue from overseas operations / Total revenue
Share	Return on Equity	Net Income / Average Equity
	Asset Tax Rate	(Taxes and Surcharges + Income Tax Expense) / Operating Revenue

3.2.3. Mediating Variables

1) Digital-Green Transition Synergy

Digital-Green Transformation Synergy (DGS) is measured using the Digital-Green Transformation Synergy Index. Following the research by Yu Feifei et al. [27], the digitalization and greening levels are first calculated, and then the Digital-Green Transformation Synergy Index is computed using a coupling coordination model. The comprehensive evaluation index system for corporate digital-green transformation synergy is shown in Table 2.

Regarding digitalization, following the approach of Zhang Yongsheng et al. [28], we manually screened the detailed items of intangible assets in the notes to the financial statements for keywords related to digitalization, such as “digitalization,” “network,” “client,” and “e-commerce.” We then summed the amounts of these relevant items and calculated their ratio to total intangible assets as a proxy variable to reflect the extent of the company’s investment in digitalization. Following the approach of Li Xueqin et al. [29], we screened and aggregated the total number of digital invention patent applications filed by the company in the current year based on the “Classification of Key Digital Technology Patents (2023)” issued by the China National Intellectual Property

Administration and the corresponding IPC codes from the International Patent Classification reference table. The number of digital invention patents was thus used as an output indicator of digitalization. The data for digitalization calculations was sourced from Guotaian. In summary, the firm's level of digitalization (Digit) is calculated using the entropy method.

Table 2. Comprehensive Evaluation Index System for Enterprise Digital-Green Transition Synergy.

		Primary Indicators	Second-Level Indicators
Synergy of Digital and Green Transformation	Digital Transformation	Digital Intangible Assets	Ratio of Digital-Related Intangible Assets to Total Intangible Assets
		Digital Economy Patents	Number of Digital Economy Patent Applications Filed by Listed Companies
	Green Transition	Green Patents	Logarithm of the sum of green invention applications and green utility model applications
		Environmental Investment	Ratio of environmental protection investment to total assets
		ESG Environmental Performance	Environmental dimension score in the Huazheng ESG rating

Regarding green development, following the approach of Xiao Hongjun et al. [30], the proportion of environmental protection investment to total investment is used as a positive indicator of green investment. To more accurately measure a company's environmental performance in terms of green development, environmental protection investment data is sourced from Mark Data. The composite score for the "E" (Environment) component of the Huazheng ESG Rating is selected as a proxy variable for corporate environmental performance; data is sourced from the Huazheng ESG Rating. Additionally, the sum of a listed company's green invention patent applications and green utility model applications, plus one, is taken and its logarithm is calculated to serve as an output indicator for corporate greening; green patent data is sourced from CNRDS. In summary, the degree of corporate greening (Green) is calculated using the entropy method.

Finally, an Excel spreadsheet is used to calculate the synergy of green transformation. First, the coupling degree C for measuring green transformation synergy is constructed:

$$C = 2[D\text{igit}*\text{Green}/(\text{Digit}+\text{Green})^2]^{1/2} \tag{7}$$

Next, the coordination index T for digital-green transformation synergy is calculated using Equation (8). Considering that digitalization and greening are equally important for corporate digital-green transformation synergy, default weight coefficients a = b = 0.5 are assigned.

$$T = \text{a}*D\text{igit}+\text{b}*\text{Green} \tag{8}$$

Finally, the synergy of digital-green transformation calculated using Equation (9) is used as the measurement indicator for the digital-green transformation synergy DGS:

$$DGS = \sqrt{C*T} \tag{9}$$

2) Information Asymmetry

Following Li Jipeng's [31] approach to mediating variables, this study selects information asymmetry as the mediating variable. Based on the construction methods proposed by Song Min et al. [32] and Yu Wei et al. [33], we first construct three stock liquidity indicators: the liquidity ratio

(LR), the illiquidity ratio (ILL), and the yield reversal indicator (GAM). Poorer stock liquidity implies a higher degree of information asymmetry. We then perform principal component analysis on LR, ILL, and GAM to construct a composite information asymmetry (ASY) index.

3）Financing Constraints

Following the approach of Kuang Xuewen et al. [34], we use the FC index to measure financing constraints; a higher value of this index indicates a greater degree of financing constraints. The FC index is sourced from the Guotaian database.

3.2.4. Moderating Variables

Following the approach of Yang Chunlei [35], we introduce a firm's level of AI application as a moderating variable for the high-quality development of strategic emerging industries. The method for measuring the level of AI application follows the approach of Yao Jiaquan [36]: based on the MD&A text in annual reports, we statistically analyze the frequency of 73 AI-related terms and measure the firm's level of AI application using the logarithm of the AI term frequency plus one.

3.2.5. Control Variables

Following the approaches of scholars such as Xie Jie [37], Qiang Guoling [38], and Hu Haifeng [39], we include control variables that may influence high-quality development. The data is sourced from the Guotaian database. A detailed description of the variables used in this study is presented in Table 3.

Table 3. Variable Definitions.

Variable Type	Name	Symbol	Explanation of Indicator Values
Dependent Variable	High-Quality Development	HQD	Calculated using the entropy method after abbreviating each indicator
Explanatory Variables	Relational debt	Debt	Long-term debt / Total debt
	Stable Equity	Equity	Long-term Institutional Investor Ownership Ratio
Intermediary variables	Synergy in Digital-Green Transition	DGS	Digital-Green Transition Synergy as Estimated by the Coupling Coordination Model
	Information asymmetry	ASY	Principal Component Analysis (PCA) to construct a comprehensive information asymmetry (ASY) index
	Financing Constraints	FC	Financing Constraint Index
Moderating Variables	Artificial Intelligence	AI	Artificial Intelligence: Word Frequency and the Logarithm of +1
Control Variables	Board Size	BOARD	Logarithm of the number of board members
	Tobin's Q	TBQ	(Market Capitalization of Floating Shares + Number of Non-Trading Shares × Book Value per Share + Book Value of Liabilities) / Total Assets
	Dual Role	DUAL	The Chairman and General Manager are the same person
	Total Asset Turnover Ratio	Ato	Revenue / Average Total Assets
	Management Shareholding Ratio	Mshare	Number of Shares Held by Directors, Supervisors, and Senior Management / Total Number of Shares
	Current Ratio	Liquidity	Current Assets / Total Assets
	Equity Balance	Balance	Shareholding ratio of the 2nd to 5th largest shareholders / Shareholding ratio of the largest shareholder

3.3. Sample Data

For the research sample, this paper utilizes data from 743 A-share companies included in the 2014–2023 China Strategic Emerging Industries Enterprise Composite Index. After excluding ST-listed companies, financial sector firms, and companies with severe missing data for key variables, a total of 7,430 observations were retained. The research data used in this paper were sourced from the CSMR database, MD&A reports of listed companies, the China Research Data Service Platform (CNRDS), and the Mark database.

4. Empirical Results and Analysis

4.1. Descriptive Statistics

This study utilized Stata 17 software to perform descriptive statistics on each variable. The results show that the average value of the high-quality development index for enterprises in strategic emerging industries is 0.164, with a maximum value of 0.564 and a minimum value of 0.02, indicating significant differences in the level of high-quality development among different companies. The maximum value of the core explanatory variable, patient capital, is 0.875, and the minimum value is -0.286; there is a significant difference, suggesting the presence of outliers. The statistical results for other control variables are generally consistent with the conclusions of mainstream literature and will not be discussed in detail here. The remaining data are presented in Table 4.

Table 4. Descriptive Statistics.

Variable	N	Mean	SD	Min	Max
HQD	7430	0.164	0.0840	0.0200	0.564
Debt	7,430	0.121	0.154	-0.286	0.875
Equity	7,430	0.391	0.235	0	1
BOARD	7,430	38.05	5.791	0	75
TBQ	7,430	2.314	1.632	0	29.17
DUAL	7430	0.287	0.452	0	1
ato	7430	0.577	0.444	0.00600	12.37
balance	7,430	0.801	0.629	0.0140	3.914
mshare	7,430	12.36	16.90	0	90.55
Liquid	7,430	2.599	3.031	0.106	76.46

4.2. Benchmark Regression Analysis

This study utilizes Stata 17 software to investigate the impact of patient capital on the high-quality development of enterprises in strategic emerging industries. Table 5 presents the basic regression results of this study, where columns (1) and (3) show the regression results without control variables, and columns (2) and (4) show the regression results with control variables. The empirical results indicate that patient capital has a significant positive impact on the high-quality development of enterprises in strategic emerging industries, thereby validating Hypothesis 1 of this study.

4.3. Endogeneity Tests and Robustness Tests

4.3.1. Endogeneity Tests

To ensure greater accuracy in the empirical results and eliminate the disturbance caused by endogeneity on the empirical conclusions of this study, this paper employs a two-stage least squares method. Specifically, the mean values of relational debt and stable equity in the same industry, region, and year are selected as instrumental variables for regression, respectively. As shown in Table 6, the results in Column (1) indicate that the first-stage regression of the instrumental variable (Tool) on the dependent variable (Debt) is significantly positive at the 1% level, suggesting that the instrumental variable selected in this study is valid; Column (2) presents the regression of the dependent variable (Debt) on the independent variable (HQD) in the second stage; the regression coefficient remains significantly positive at the 1% level, ruling out the interference of endogeneity and demonstrating the robustness of the study's results. Columns (3) and (4) present the regression results of the instrumental variable (Tool1) on the explanatory variable (Equity) and of the explanatory variable (Equity) on the dependent variable (HQD), respectively; the regression coefficients are both significantly positive.

Table 5. Baseline Regression Results.

	(1)	(2)	(3)	(4)
	HQD	**HQD**	**HQD**	**HQD**
Equity	0.059***	0.072***		
	(0.004)	(0.005)		
Debt			0.061***	0.067***
			(0.007)	(0.007)
BOARD		0.000		0.000
		(0.000)		(0.000)
TBQ		0.000		0.001**
		(0.001)		(0.001)
DUAL		-0.003		-0.005**
		(0.002)		(0.002)
ato		0.009***		0.014***
		(0.002)		(0.002)
balance		0.000		-0.003*
		(0.001)		(0.002)
mshare		0.000***		-0.000***
		(0.000)		(0.000)
Liquid		0.000		0.000
		(0.000)		(0.000)
_cons	0.141***	0.122***	0.156***	0.149***
	(0.002)	(0.007)	(0.001)	(0.007)
ind	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes
N	7430	7430	7430	7430
r2_a	0.146	0.150	0.131	0.140

Table 6. Endogeneity Test Results.

	(1)	(2)	(3)	(4)
Variable	**Debt**	**HQD**	**Equity**	**HQD**
Tool	0.978***			
	(0.018)			
Tool1			0.651***	
			(0.016)	
Debt		0.070***		
		(0.012)		
Equity				0.031**
				(0.013)
_cons	0.014	0.061***	0.236***	0.052***
	(0.021)	(0.014)	(0.030)	(0.016)
Controls	Yes	Yes	Yes	Yes
Ind	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes
N	7430	7430	7430	7430
R-squared	0.4380	0.1435	0.5544	0.1464

4.3.2. Robustness Tests

Table 7. Robustness Test Results.

	(1)	(2)	(3)	(4)	(5)
	OP	**OP**	**LP**	**LP**	**HQD**
Equity	1.204***		1.906***		
	(0.038)		(0.049)		
Debt		0.420***		0.654***	
		(0.050)		(0.067)	
PC					0.002***
					(0.001)
_cons	5.903***	6.462***	8.026***	8.914***	0.156***
	(0.051)	(0.050)	(0.066)	(0.067)	(0.007)
Controls	Yes	Yes	Yes	Yes	Yes
ind	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
N	7287	7287	7287	7287	7430
r2_a	0.492	0.426	0.502	0.405	0.130

In the robustness analysis, following the approach of Lu Xiaodong and Lian Yujun [40], total factor productivity (TFP) estimated using the OP and LP methods was used as the dependent variable. The regression results are shown in Tables 7(1), (2), (3), and (4), patient capital has a significant positive impact on the high-quality development of enterprises in strategic emerging industries. This

further validates the promotional role of patient capital in enhancing the high-quality development of such enterprises, indicating that the conclusions of this study are robust. By replacing the explanatory variables, as proposed by Zheng Meng [41], patient capital (PC) is measured as the sum of the "insurance holding ratio" and the "social security fund holding ratio" of listed companies. Given that investments by insurance funds and social security funds typically exhibit a long-term holding intention and high-risk tolerance, which align with the typical characteristics of patient capital, this study substitutes the sum of the insurance holding ratio and the social security fund holding ratio for patient capital. As shown in Table 7(5), the regression results indicate that patient capital has a significant positive impact on the high-quality development of enterprises in strategic emerging industries, further proving that patient capital plays a promotional role in the high-quality development of such enterprises.

4.4. Testing for Mediating Effects

First, based on Equations (3) and (4), we conduct a mechanism test on the synergy of digital-green transformation using the synergy calculated via the coupling coordination model. As shown in Table 8, the result is significantly positive at the 1% confidence level, indicating that patient capital enhances the synergy of digital-green transformation (DGS) in strategic emerging industries, thereby promoting high-quality corporate development. Second, we construct the comprehensive information asymmetry index (ASY) to represent information asymmetry and conduct a mechanism test on this index. As shown in Table 8, the result is significantly negative at the 1% confidence level, indicating that patient capital promotes the high-quality development of enterprises in strategic emerging industries by alleviating information asymmetry. Finally, a mechanism test was conducted for financing constraints (FC). As shown in Table 8, the result was significantly negative at the 1% confidence level, indicating that patient capital promotes high-quality development by alleviating financing constraints. In summary, hypotheses H2a, H2b, and H2c were verified, and the null hypothesis was rejected.

Table 8. Results of the mediation effect test.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	**HQD**	**HQD**	**DGS**	**DGS**	**ASY**	**ASY**	**FC**	**FC**
Equity	0.072***		0.119***		-0.509***		-0.490***	
	(0.005)		(0.009)		(0.035)		(0.014)	
Debt		0.067***		0.047***		-0.621***		-0.392***
		(0.007)		(0.011)		(0.044)		(0.019)
_cons	0.122***	0.149***	0.183***	0.238***	-0.047	-0.221***	0.549***	0.356***
	(0.007)	(0.007)	(0.012)	(0.011)	(0.048)	(0.045)	(0.019)	(0.019)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	7430	7430	7430	7430	7413	7413	7180	7180
r2_a	0.150	0.140	0.162	0.143	0.172	0.170	0.354	0.292

4.5. Test of Moderating Effects

Based on Equations (5) and (6), we tested the moderating effect of a firm's AI application level on the relationship between patient capital and the high-quality development of strategic emerging industry firms. As shown in Table 9, the interaction coefficient is significantly positive, indicating that a firm's AI application level positively moderates the relationship between patient capital and the high-quality development of strategic emerging industry firms. In summary, Hypothesis H3a is supported, and the hypothesis is accepted.

Table 9. Results of the Moderation Effect Test.

	(1)	(2)	(3)	(4)
Variable	**HQD**	**HQD**	**HQD**	**HQD**
Equity	0.0729***	0.0733***		
	(0.005)	(0.005)		
Debt			0.068***	0.072***
			(0.007)	(0.007)
AI	0.004***	0.004***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
interact		0.005*		0.018***
		(0.003)		(0.005)
_cons	0.118***	0.118***	0.146***	0.147***
	(0.007)	(0.007)	(0.007)	(0.007)
Controls	Yes	Yes	Yes	Yes
ind	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes
N	7390	7390	7390	7390
r2_a	0.151	0.151	0.141	0.142

4.6. Heterogeneity Analysis

This paper first groups the sample enterprises into Eastern, Central, and Western regions for regression analysis based on regional characteristics. Second, following the classification standards for strategic emerging industries, the sample enterprises are grouped into nine sub-industries—including high-end equipment manufacturing and energy conservation and environmental protection—for regression analysis. The regression results are presented in Tables 10 and 11. Empirical findings indicate that, in both the central and eastern regions, patient capital significantly promotes the high-quality development of strategic emerging industries at the 1% significance level, with this effect being more pronounced in the central region; The effects of the two forms of patient capital—stable equity and relationship-based debt—are more pronounced in promoting the high-quality development of the new energy vehicle industry, the energy conservation and environmental protection industry, the biotechnology industry, the new materials industry, and the next-generation information technology industry. Compared to relationship-based debt, stable equity significantly promotes the high-quality development of the high-end equipment manufacturing and new energy industries. Patience capital has a negative impact on the high-quality development of strategic

emerging industries in the digital industry and related service sectors. An analysis of the underlying reasons suggests that the rapid iteration of business models and frequent changes in technological pathways in these industries may cause the long-term lock-in nature of patience capital to conflict with the industry's need for flexible adjustments. Furthermore, the post-investment management interventions associated with patience capital may limit the efficiency of corporate decision-making in responding to market changes, ultimately inhibiting the process of high-quality development. In summary, research hypotheses H3b and H3c are validated, and the hypotheses are established.

Table 10. Results of Heterogeneity Analysis (Regional Heterogeneity).

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Eastern	East	Central	Central	West	West
Debt	0.080***		0.085***		-0.017	
	(0.008)		(0.018)		(0.017)	
Equity		0.072***		0.118***		0.024
		(0.006)		(0.013)		(0.015)
_cons	0.147***	0.123***	0.150***	0.105***	0.110***	0.096***
	(0.008)	(0.009)	(0.016)	(0.016)	(0.017)	(0.019)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
ind	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes
N	5421	5421	1159	1159	762	762
r2_a	0.128	0.133	0.279	0.314	0.242	0.243

Table 11a. Heterogeneity Analysis Results (Sub-industries).

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	High-end equipment	Energy Conservation and Environmental Protection	Biotechnology	Digital Industry	New Materials Industry	New Energy Industry	New Energy Vehicles	Next-Generation Information Technology Industry	Related Services
Debt	0.031	0.147***	0.036**	-0.002	0.079***	0.024	0.225***	0.101***	-0.202
	(0.020)	(0.024)	(0.014)	(0.032)	(0.018)	(0.017)	(0.073)	(0.013)	(0.196)
_cons	0.107***	0.277***	0.090***	0.120***	0.259***	0.181***	-0.050	0.145***	-0.610*
	(0.016)	(0.027)	(0.017)	(0.035)	(0.020)	(0.019)	(0.068)	(0.012)	(0.298)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1050	530	1160	330	990	790	80	2470	29
r2_a	0.147	0.262	0.173	0.237	0.245	0.249	0.502	0.140	0.934

Table 11b. Heterogeneity Analysis Results (Sub-industries).

Variable	(1) High-end equipment	(2) Energy Conservation and Environmental Protection	(3) Biotechnology	(4) Digital Industry	(5) New Materials Industry	(6) New Energy Industry	(7) New Energy Vehicles	(8) Next-Generation Information Technology Industry	(9) Related Services
Equity	0.085***	0.060***	0.108***	-0.042	0.119***	0.078***	0.176***	0.057***	-0.025
	(0.013)	(0.023)	(0.013)	(0.027)	(0.014)	(0.014)	(0.048)	(0.010)	(0.322)
_cons	0.079***	0.297***	0.055***	0.145***	0.188***	0.149***	-0.080	0.125***	-0.728**
	(0.016)	(0.029)	(0.017)	(0.038)	(0.021)	(0.019)	(0.067)	(0.013)	(0.288)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ind	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1050	530	1160	330	990	790	80	2470	29
r2_a	0.179	0.220	0.217	0.243	0.284	0.277	0.530	0.132	0.928

5. Research Findings and Policy Recommendations

5.1. Research Findings

Based on data from listed companies in China's strategic emerging industries from 2014 to 2023, this study empirically examines the impact of patient capital on the high-quality development of enterprises in strategic emerging industries and its underlying mechanisms. The findings reveal that patient capital promotes the high-quality development of enterprises in strategic emerging industries by enhancing the synergy between digital and green transformation; patient capital significantly promotes the high-quality development of enterprises in strategic emerging industries by providing long-term, stable financial support and reducing information asymmetry; Patience capital promotes the high-quality development of enterprises in strategic emerging industries by alleviating their financing constraints; simultaneously, the application of artificial intelligence technology can reinforce the positive impact of patience capital on the high-quality development of these enterprises. Finally, the promotional effect of patience capital on the high-quality development of enterprises in strategic emerging industries is particularly pronounced in central China and among new energy vehicle enterprises. The above conclusions remain valid after robustness tests and endogeneity treatments, revealing the key role of patience capital in driving innovation-driven development and industrial upgrading.

5.2. Policy Recommendations

To fully leverage the role of patient capital in promoting the high-quality development of strategic emerging industries, a multi-dimensional support system must be established: At the macro level, mechanisms for guiding long-term capital should be improved, institutional funds such as

insurance and social security should be encouraged to invest in strategic emerging industries, and information disclosure regulations should be optimized to reduce market information asymmetry; At the industrial level, efforts should focus on the deep integration of artificial intelligence applications with the real economy, providing targeted support to high-potential sub-sectors, fostering an ecosystem for the coordinated development of digital and green transitions, and increasing technical support and policy inclination for key industries; at the enterprise level, governance structures should be optimized, R&D investment and long-term strategic orientation strengthened, while actively utilizing digital tools to enhance transparency and resource allocation efficiency; regarding financial regulation, incentive and risk control mechanisms compatible with long-term investment must be established to create an institutional environment conducive to the formation and operation of patient capital.

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