

Digital Inclusive Finance and New Quality Productivity in Enterprises: A Study on Impact Effects and Mechanisms

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Abstract: Exploring the impact of digital inclusive finance development on firms' new-quality productivity is instrumental in offering insights for promoting high-quality enterprise development from the perspective of the digital economy. Drawing on firm-level panel data of Chinese A-share listed companies on the Shanghai and Shenzhen stock exchanges from 2011 to 2023, this study investigates the impact of digital inclusive finance development on enterprises' new-quality productive forces, with a particular focus on the mediating roles of corporate digital transformation intensity and technological innovation capabilities. Research findings indicate that the development of digital inclusive finance contributes to fostering new-quality productive forces in enterprises. Heterogeneity analysis results indicate that the development of digital inclusive finance exerts a greater driving effect on the new productive forces of non-state-owned enterprises. The impact of digital inclusive finance on promoting the development of new productive forces in enterprises exhibits regional variations. Mechanism analysis indicates that the development of digital inclusive finance will enhance enterprises' new-quality productive forces by accelerating their digital transformation and driving technological innovation. Accordingly, this paper offers targeted policy advice to foster high-quality corporate development, organized around three actors: government, financial institutions, and firms.

Keywords: Digital Inclusive Finance; New Quality Productivity of Enterprises; Enterprise Digital Transformation; Enterprise Technological Innovation Level

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1 Introduction

A new wave of technological revolution has arrived in our era, industries are undergoing continuous transformation. In the face of these changes, we must develop new forms of productive forces, tap into new drivers of economic growth, and advance high-quality development. How to scientifically and efficiently advance the development of new productive forces within enterprises has gradually become a critical issue for both businesses and governments as they adapt to and drive high-quality economic development.

Digital inclusive finance, which integrates digital technology with inclusive finance, has expanded the coverage of financial services, enhanced the financial service network, reduced the risks and costs of financial services, and improved the accessibility of financial services at the individual level. In the mechanism analysis section, this paper focuses on corporate digital transformation and technological innovation. In the empirical analysis section, this paper uses data from Chinese listed companies between 2011 and 2023 as the sample, it employs a panel fixed-effects model to quantitatively analyze the impact of digital inclusive finance development on corporate new-quality productivity and its underlying mechanisms.

The marginal contribution of this paper lies in the following aspects: It analyzes the development of enterprises' new quality productive forces from the perspective of digital inclusive finance. Taking enterprise digital transformation as the entry point, this paper delves into the mechanism through which the development of digital inclusive finance impacts enterprises' new quality productive forces. Based on the level of technological innovation within enterprises, this paper explores the mechanism by which the development of digital inclusive finance influences enterprises' new quality productive forces.

2 Literature Review

New-quality productive forces signifies a transformative leap in productive capacity. This form of productivity is driven by scientific and technological innovation. From a systems theory perspective, new-quality productive forces constitute an "element-structure-function" system composed of interconnected and interacting productive elements, productive structures, and productive functions. Jiang Yongmu et al. point out that the operational mechanism of new-type productive forces revolves around technological innovation as its core. It channels the driving force of factor system innovation through the medium of the technology system to the industrial system, ultimately achieving a comprehensive restructuring of the three major systems of traditional productive forces. Wang Jue proposed the 1-2-3-4 theoretical framework for new-quality productive forces, laying the foundation for subsequent research on productive forces.

Regarding the construction of new-quality productivity indicators and level measurement, Li Xinru drew upon the research of Song Jia et al. and Zhang Xiu'e et al. Then the entropy method was employed to calculate the "new-quality productivity" variable. Zhou Wen et al. pointed out that the digital economy, integrating information technology, artificial intelligence, and big data, serves as a new engine for economic growth.

Scholar Guo Feng proposed that digital inclusive finance is closely linked to household economic activities, corporate economic activities, traditional finance and monetary policy. Research by Song Xiaoling et al. indicates that the development of digital inclusive finance can significantly narrow the income gap between urban and rural residents. Ren Xiaoyi specifically highlighted that digital inclusive finance demonstrates a more pronounced effect in alleviating targeted financing constraints for small-scale enterprises and high-tech companies.

3 Theoretical Analysis and Research Hypotheses

3.1 Digital Inclusive Finance and New Quality Productivity in Enterprises

Digital inclusive finance leverages digital technologies such as the internet, big data, and cloud computing to overcome the spatial and temporal constraints of traditional financial services, providing businesses with more convenient, efficient, and low-cost financial solutions.

From the perspective of financing channels, digital inclusive finance leverages big data analytics to assess corporate operations, thereby lowering financing barriers and expanding access to capital for businesses—particularly small and micro enterprises.

In terms of financial products and services, digital inclusive finance platforms leverage big data and risk assessment technologies to tailor personalized financial solutions for enterprises. This, in turn, drives the advancement of new-quality productive forces.

Additionally, digital inclusive finance platforms leverage intelligent algorithms and big data technology to enable precise allocation of financial resources. Then promote the development of new productive forces. Based on the above discussion, Hypothesis 1 is proposed:

Hypothesis 1 (H1): The development of digital inclusive finance promotes the advancement of new-quality productive forces within enterprises.

3.2 Digital Inclusive Finance, Corporate Digital Transformation, and New Quality Productivity in Enterprises

The rapid development of digital inclusive finance has injected strong momentum into enterprises' digital transformation efforts. On the one hand, it effectively alleviates the financial constraints and risk challenges faced by enterprises during their digital transformation by streamlining financial service processes and reducing financing barriers and costs. On the other hand, the supply chain financial services provided by digital inclusive finance pave the way for the digital transformation of corporate supply chains.

Enterprise digital transformation has demonstrated remarkable effectiveness in driving the development of new-quality productive forces. From the perspective of technological innovation, this process has significantly enhanced both production efficiency and product quality standards. Digital transformation empowers enterprises to collect, store, and deeply mine data resources more rapidly. Digital transformation accelerates the iteration of products and services, injecting robust momentum into the long-term sustainable development of enterprises. Based on the above discussion, Hypothesis 2 is proposed:

Hypothesis 2 (H2): Digital inclusive finance promotes enterprise digital transformation, thereby driving the development of new quality productive forces within enterprises.

3.3 Digital Inclusive Finance, Corporate Technological Innovation, and New Productive Forces in Enterprises

In today's fiercely competitive market environment, technological innovation has become the core driver of enterprises' new quality productive forces. Digital inclusive finance plays a pivotal role in this process, providing robust support for corporate technological innovation across multiple dimensions, thereby effectively enhancing enterprises' new quality productive forces.

On the one hand, digital inclusive finance meets the funding needs of enterprises at different stages of technological innovation by providing diversified and flexible financial services. On the other hand, the technological tools underpinning digital inclusive finance—such as big data and artificial intelligence—provide robust data support and intelligent decision-making capabilities for corporate technological innovation.

Moreover, through digital means, digital inclusive finance enables rapid assessment of innovative projects and risk control, providing enterprises with more professional and targeted financial services. Based on the above discussion, Hypothesis 3 is proposed:

Hypothesis 3 (H3): Digital inclusive finance enhances enterprises' new-quality productive forces by driving technological innovation.

4 Research Design

4.1 Sample Selection and Data Sources

This empirical analysis examines a sample of A-share listed companies on the Shanghai and Shenzhen stock exchanges in China from 2011 to 2023. The sample excludes companies with PT, ST, or *ST designations, IDS-listed companies, financial enterprises, firms with insufficient listing duration, and companies with severe data deficiencies. The specific data source is the Guotai An CSMAR database.

4.2 Variable Declaration

4.2.1 Explanatory Variable: Digital Inclusive Finance

The Digital Inclusive Finance Index employs the “Peking University Digital Inclusive Finance Index” for measurement. Its indicator system is constructed across three dimensions: the breadth of digital financial coverage, the depth of digital financial usage, and the degree of digitalization in inclusive finance.

4.2.2 Dependent variable: Enterprise New Quality Productivity (NPRO)

New-type productive forces fundamentally involve qualitative transformations in workers, objects of labor, means of labor, and their optimized combinations. Therefore, this study draws upon methodologies proposed by scholars such as Li Xinru, Zhang Xiu'e. Subsequent empirical analysis was conducted using the newly established evaluation index system for new enterprises and new-quality productive forces, along with the weightings for each tier of indicators determined through the entropy method.

Table 1 New Quality Productivity Indicators for Enterprises

Factor	Subfactor	Indicator	Measurement Method
New-type workers	Competency	Highly qualified employees	Percentage of individuals holding a master's degree or higher
		Percentage of R&D personnel	The proportion of R&D personnel among the total workforce
	Management Competency	Management's international background	The variable is set to 1 if any executive has an overseas background, otherwise it is 0.
		Green Awareness Among Executives	ln(frequency of green development keywords in annual reports + 1)
New-type labor objects	Ecological Environment	Environmental Governance Score	The E indicator in Huazheng ESG Rating assigns values from 1 to 9 across nine levels.
		Fixed Assets Ratio	Fixed Assets / Total Assets
	Future Development	Capital Accumulation Rate	Increase in Owners' Equity for the Year / Owners' Equity at Beginning of Year
		Technological means of production	Corporate Innovation Level
New-type means of production	Green means of production		Green Technology Level
		Proportion of Green Patents	Number of green patents applied for per enterprise / Number of patents applied for per enterprise
	Digital means of production	Level of Intelligence	ln(frequency of digital keywords in annual reports + 1)
		Proportion of Intangible Assets	Intangible Assets / Total Assets

4.2.3 Mediating variables

(1)Enterprise Digital Transformation: Drawing upon the research of scholars such as Wu Fei, this paper utilizes keyword frequency measurements from annual reports published by listed companies. These keywords are categorized and grouped into artificial intelligence technology, big data technology, cloud computing technology, blockchain technology, and digital technology applications, ultimately forming a consolidated frequency count.After applying a logarithmic transformation, an overall metric characterizing the digital transformation of enterprises is obtained.

(2)Level of Technological Innovation in Enterprises: In practice, fluctuations in corporate R&D expenditure provide a direct reflection of the level of activity in their technological innovation efforts.Therefore, this study adopts the methodology proposed by Wang Gang and other scholars for measuring corporate technological innovation levels, selecting R&D intensity (the ratio of corporate R&D expenditures to operating revenue) as an indicator of technological innovation capabilities.

4.2.4 Control variables

This paper draws upon the research of scholars such as Sun Xianzhen and Liu Peidong to identify the following control variables:Enterprise Scale, Debt-to-Asset Ratio,Return on Equity, Revenue Growth rate, Board size, Equity concentration, and Dual-role positions.

Table 2 Variable Definitions and Measures

Type	Name	Symbol	Definition
Dependent variable	Enterprise New Quality Productivity	NPRO	See the preceding text
Explanatory Variable	Digital Inclusive Finance	index	See the preceding text
Mediating variables	Enterprise Digital Transformation	DIG	See the preceding text
	Level of Technological Innovation in Enterprises	S_RD	R&D Expenditure / Total Assets of Enterprises
	Enterprise Size	Size	Total Assets
	Debt-to-Asset Ratio	Lev	Total Liabilities / Total Assets
Control variables	Return on Equity	ROE	Net Profit / Shareholders' Equity at the End of the Period
	Revenue Growth rate	Growth	(Current Year Operating Revenue - Previous Year Operating Revenue) / Previous Year Operating Revenue
	Board size	Board	Number of Board Members
	Equity concentration	Top10	Top Ten Shareholders' Shareholdings / Total Shares
	Dual-role positions	Dual	Chairman and CEO is the same person(Yes1,No0)

4.3 Model Configuration

In this study, a panel fixed-effects model was employed to conduct an in-depth investigation of the relationships among the relevant variables.In examining the explanatory variables' impact on the dependent variable—namely, the effect of digital inclusive finance on enterprises' new quality productive forces—the specific model is as follows:

$$NPRO_{i,t} = c + \beta index_{i,t} + \sum_{j=1}^7 \alpha^j X_{i,t} + \gamma_i + \theta_i + \epsilon_{i,t}$$

In Equation (1), the dependent variable NPRO represents a firm's new-type productive capacity, while the independent variable index represents digital inclusive finance.The control variables is set to X.To control for time effects and individual effects, a dual fixed-effects

model was employed, γ and θ control for firm-specific effects and year-specific effects, respectively.

On the other hand, to further examine the mechanism through which intermediate variables mediate the relationship, drawing on the research of Jiang Ting and colleagues, the following model is established:

$$DIG_{i,t} = c + \beta index_{i,t} + \sum_{j=1}^7 \alpha^j X_{i,t} + \gamma_i + \theta_i + \varepsilon_{i,t}$$

$$S_RD_{i,t} = c + \beta index_{i,t} + \sum_{j=1}^7 \alpha^j X_{i,t} + \gamma_i + \theta_i + \varepsilon_{i,t}$$

In Equation (2), the intermediate variable is corporate digital transformation; in Equation (3), the intermediate variable is corporate technological innovation level. The control variables are identical to those in Equation (1), controlling for both time effects and individual effects, employing a dual fixed-effects model, γ and θ control for firm-specific effects and year-specific effects, respectively.

5 Empirical Results and Analysis

5.1 Descriptive Statistics

Table 3 summarizes the statistical characteristics of variables relevant to the empirical analysis. It indicates significant disparities in enterprises' levels of new quality productivity and the uneven distribution of financial digitalization across regions.

Table 3 Descriptive Statistics

VarName	Obs	Mean	SD	Min	Median	Max
NPRO	36309	0.1274	0.075	0.0001	0.12	0.53
index	36309	256.0698	79.790	21.2600	275.20	373.22
Size	36309	22.2444	1.307	19.5850	22.04	26.44
Lev	36309	0.4144	0.207	0.0319	0.41	0.92
ROE	36309	0.0597	0.135	-0.9616	0.07	0.41
Growth	36309	0.1495	0.382	-0.6535	0.09	3.81
Board	36309	2.1137	0.199	1.6094	2.20	2.71
Top10	36309	0.5856	0.154	0.2083	0.59	0.91
Dual	36309	0.2956	0.456	0.0000	0.00	1.00

5.2 Baseline regression results

The benchmark regression results of Model (1) in Table 4 indicate that digital inclusive finance exerts a significant positive impact on enterprises' new quality productivity. The conclusion remains robust after controlling for factors such as enterprise scale, debt-to-asset ratio, and return on net assets. H1 is validated.

Table 4 Benchmark Regression Results

	(1) NPRO	(2) NPRO
index	0.0002*** (0.0001)	0.0002** (0.0001)
Size		0.0124***(0.0011)
Lev		-0.0110***(0.0040)
ROE		-0.0110***(0.0029)
Growth		-0.0017** (0.0007)
Board		0.0108*** (0.0033)
Top10		-0.0028 (0.0049)
Dual		-0.0028** (0.0011)
_cons	0.0762*** (0.0062)	-0.1993*** (0.0240)
Fixed effects for firms	Control	Control
Year Fixed Effect	Control	Control
R-sq	0.131	0.143
N	36309	36309

Note: Values in parentheses indicate t-values; *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. The same applies to the table below.

5.3 Mechanism Analysis

This paper proceeds to analyze the mechanism effects of corporate digital transformation and technological innovation levels, employing a two-step approach as referenced in Jiang Ting (2022).

5.3.1 Enterprise Digital Transformation

According to the regression results of Model (1) in Table 5, the development of digital inclusive finance will accelerate the digital transformation of enterprises, thereby fostering the growth of new productive forces within businesses. Hypothesis H2 is thus validated.

5.3.2 Level of Technological Innovation in Enterprises

This paper proceeds to analyze the mechanism effects of enterprise digital transformation and technological innovation levels. According to the regression results of Model (2) in Table 5, digital inclusive finance enhances enterprises' new-quality productive forces by driving

technological innovation. Hypothesis H3 is validated.

Table 5 Mediating Effects Results

	(1) DIG	(2) S RD
index	0.0048***(0.0013)	0.0069***(0.0022)
Size	0.2550***(0.0199)	0.6769***(0.0509)
Lev	-0.0992(0.0741)	-0.7077***(0.1122)
ROE	-0.0391(0.0492)	0.1490**(0.0691)
Growth	0.0256**(0.0119)	-0.0495***(0.0154)
Board	0.2317***(0.0559)	-0.0348(0.1000)
Top10	-0.3575***(0.0987)	0.5445***(0.1925)
Dual	-0.0001(0.0201)	0.0363(0.0267)
_cons	-5.4822***(0.4462)	-15.0614***(1.1486)
Fixed effects for firms	Control	Control
Year Fixed Effect	Control	Control
R-sq	0.314	0.228
N	36309	36309

5.4 Robustness Test

First, the core explanatory variable is lagged. This paper further lags the independent variable, the Digital Inclusive Finance Index, by one period to examine the long-term dynamic effects of digital inclusive finance. As shown in column (1) of Table 6, the promotion of digital inclusive finance on corporate productivity exhibits a certain time lag effect.

Second, replace the high-dimensional fixed effects. Fixing provinces, individuals, and years separately, as well as industries, individuals, and years separately, as shown in columns (2) and (3) of Table 6, the results remain robust.

Table 6 Robustness Tests

	(1) NPRO	(2) NPRO	(3) NPRO
L.index	0.0002**(0.0001)		
index		0.0002***(0.0001)	0.0002***(0.0001)
Size	0.0122***(0.0008)	0.0123***(0.0007)	0.0124***(0.0007)
Lev	-0.0134***(0.0032)	-0.0106***(0.0028)	-0.0107***(0.0028)
ROE	-0.0099***(0.0027)	-0.0106***(0.0025)	-0.0103***(0.0025)
Growth	-0.0013*(0.0007)	-0.0018***(0.0007)	-0.0017**(0.0007)
Board	0.0102***(0.0027)	0.0106***(0.0024)	0.0107***(0.0024)
Top10	0.0031(0.0040)	-0.0027(0.0035)	-0.0018(0.0035)
Dual	-0.0028***(0.0009)	-0.0027***(0.0009)	-0.0029***(0.0009)
_cons		-0.2054***(0.0208)	-0.2032***(0.0262)
Fixed effects for firms	Control	Control	Control
Provincial Fixed Effects		Control	
Industry Fixed Effects			Control
Year Fixed Effect	Control	Control	Control
R-sq	0.012	0.697	0.698
N	30715	36051	36050

Third, replace the core explanatory variable. Replacing the overall digital inclusive finance index in the main regression with three primary indicators—coverage breadth, usage depth, and digitalization level. And conducting separate regressions for each yields the results shown in Table 7.

Table 7 Robustness Tests

	(1) NPRO	(2) NPRO	(3) NPRO
coverag	0.0002*** (0.0001)		
depth		0.0000 (0.0000)	
degree			0.0000* (0.0000)
Size	0.0124***(0.0011)	0.0125***(0.0011)	0.0125***(0.0011)
Lev	-0.0109***(0.0040)	-0.0108***(0.0040)	-0.0108***(0.0040)
ROE	-0.0113***(0.0029)	-0.0111***(0.0030)	-0.0110***(0.0029)
Growth	-0.0017**(0.0007)	-0.0017**(0.0007)	-0.0017**(0.0007)
Board	0.0108***(0.0033)	0.0109***(0.0033)	0.0108***(0.0033)
Top10	-0.0031(0.0049)	-0.0032(0.0049)	-0.0030(0.0049)
Dual	-0.0027**(0.0011)	-0.0027**(0.0011)	-0.0027**(0.0011)
_cons	-0.2029***(0.0239)	-0.1891***(0.0238)	-0.1894***(0.0235)
Fixed effects for firms	Control	Control	Control
Year Fixed Effect	Control	Control	Control
R-sq	0.143	0.142	0.142
N	36309	36309	36309

Fourth, exclude samples from municipalities directly under the central government. Then performs regression analysis again to test robustness. Fourth, the regression results are shown in Table 8.

Table 8 Robustness Tests

	(1) NPRO	(2) NPRO
index	0.0004*** (0.0001)	0.0003*** (0.0001)
Size		0.0116***(0.0012)
Lev		-0.0083***(0.0045)
ROE		-0.0099***(0.0032)
Growth		-0.0021***(0.0008)
Board		0.0103***(0.0037)
Top10		-0.0034(0.0056)
Dual		-0.0031***(0.0013)
_cons	0.0636***(0.0068)	-0.1938***(0.0265)
Fixed effects for firms	Control	Control
Year Fixed Effect	Control	Control
R-sq	0.135	0.145
N	28370	28370

5.5 Heterogeneity Analysis

This paper's heterogeneity analysis examines two key dimensions: ownership structure (state-owned enterprises versus private enterprises) and regional characteristics (eastern versus western regions). Table 7 presents the results of the heterogeneity analysis under different ownership structures, indicating that the effects are more pronounced in non-state-owned enterprises.

Table 9 Property Rights Nature

	(1)	(2)
	State-owned enterprises NPRO	Non-state-owned enterprises NPRO
index	0.0002(0.0001)	0.0003***(0.0001)
Size	0.0111***(0.0022)	0.0137***(0.0014)
Lev	-0.0158*(0.0081)	-0.0078(0.0050)
ROE	-0.0130***(0.0056)	-0.0148****(0.0036)
Growth	-0.0012(0.0011)	-0.0018***(0.0009)
Board	0.0036(0.0060)	0.0179****(0.0043)
Top10	-0.0202*(0.0110)	-0.0032(0.0066)
Dual	-0.0050***(0.0023)	-0.0021(0.0014)
_cons	-0.1547****(0.0478)	-0.2424****(0.0311)
Fixed effects for firms	Control	Control
Year Fixed Effect	Control	Control
R-sq	0.120	0.154
N	11997	21388

Table 8 reports the results of the heterogeneity analysis across different regions. The results indicate that the digital inclusive finance initiatives in the eastern region have not yielded significant promotional effects. Digital inclusive finance in the central region has significantly boosted NPRO.

Table 10 Regional Characteristics

	(1)	(2)	(3)
	Eastern NPRO	Central NPRO	Western NPRO
index	0.0001(0.0001)	0.0006****(0.0002)	0.0003(0.0002)
Size	0.0118****(0.0014)	0.0128****(0.0025)	0.0126****(0.0029)
Lev	-0.0088*(0.0048)	-0.0025(0.0099)	-0.0200*(0.0112)
ROE	-0.0081***(0.0036)	-0.0170***(0.0072)	-0.0192***(0.0078)
Growth	-0.0019***(0.0009)	-0.0025(0.0017)	-0.0000(0.0017)
Board	0.0112****(0.0041)	0.0109(0.0072)	0.0000(0.0093)
Top10	-0.0040(0.0062)	-0.0007(0.0118)	0.0012(0.0124)
Dual	-0.0019(0.0014)	-0.0027(0.0027)	-0.0065***(0.0031)
_cons	-0.1779****(0.0310)	-0.2421****(0.0529)	-0.2026****(0.0638)
Fixed effects for firms	Control	Control	Control
Year Fixed Effect	Control	Control	Control
R-sq	0.146	0.149	0.127
N	25846	5691	4545

6 Conclusions and suggestions

In the era of rapid digital economic development, researching the role of digital inclusive finance in enhancing enterprises' new-quality productive forces can provide digital economic insights to elevate such productive capacities.

Based on the conclusion of the previous text, this paper proposes the following three recommendations from three key perspectives,

aiming to advance the steady development of new-quality productive forces in enterprises.

First, the government must establish a unified national regulatory framework for digital finance, strengthen institutional provisions, and integrate multi-departmental oversight. Second, financial institutions should establish targeted service models and develop financial products tailored to the characteristics of the central region. Financial institutions in the east should focus on the “hard innovation” needs of technology-based enterprises. Third, State-owned enterprises should invigorate their digital transformation efforts, while non-state-owned enterprises need to enhance resource integration and fully leverage the benefits of digital finance.

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