Digital Finance and New Quality Productivity: Theoretical Logic and Mechanism Test

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Abstract: Based on panel data from 30 provinces in China from 2011 to 2022, this paper explores the impact of digital finance on new quality productivity and its mechanisms. The study finds that digital finance significantly promotes new quality productivity. The mechanism analysis reveals that digital finance enhances new quality productivity by facilitating industrial structure upgrading and technological innovation. The threshold effect results indicate that the development of digital finance has a dual threshold effect on new quality productivity, with the promotion effect showing an increasing marginal effect as the level of digital finance rises. Heterogeneity analysis further shows that the promoting effect of digital finance on new quality productivity exhibits significant regional differences. The research conclusions of this paper provide valuable insights for boosting high-quality economic development in China and improving the level of new quality productivity development.

Keywords: Digital Finance, New Quality Productivity, Industrial Structure Upgrading, Technological Innovation Level

1.   Introduction

The 2024 Central Economic Work Conference emphasized the need to lead the development of new quality productivity through technological innovation and to build a modern industrial system. Currently, China's economy is at a critical stage of economic transformation and upgrading. New quality productivity, as an advanced form of productive forces, plays a crucial role in driving the innovative allocation of production factors and the deep transformation and upgrading of industries.

As an emerging form of finance, digital finance has become an important engine accelerating the formation of new quality productivity. By 2023, the scale of China's digital finance market had reached 41.7 trillion yuan, ranking first in the world. With the development of digital technologies in China, the extent to which these technologies empower new quality productivity and promote the high-quality development of the real economy is increasingly deepening. This paper focuses on the impact of digital finance on new quality productivity and its transmission mechanisms, systematically studying the relationship between them from both theoretical and empirical perspectives.

2.   Literature Review

Research on digital finance and new quality productivity is relatively limited in scope. Scholars have approached the topic from various perspectives. From the perspective of factor allocation, they point

out that the development of new quality productivity cannot be separated from the empowerment of digital finance, and optimizing factor allocation is its primary influence pathway. From the perspective of risk control, it is emphasized that financial institutions need to promote stable development through intelligent risk control. From the perspective of the dual circulation linkage, it has been found that this is the transmission mechanism through which digital finance innovation drives the development of new quality productivity [1-3].

In summary, scholars have conducted systematic research on digital finance and new quality productivity from different perspectives. The marginal contributions of this paper are as follows: First, it further studies the transmission mechanisms of industrial structure upgrading and technological innovation in the development of new quality productivity; second, it explores the nonlinear effects of digital finance on the development of new quality productivity; and third, it examines the regional differences in how digital finance affects new quality productivity. This paper expands the depth and breadth of research on the relationship between the two.

3.   Theoretical Mechanism and Research Hypotheses

As a new form of finance, digital finance promotes the rational and efficient flow of market resource elements. Supported by digital technology, digital finance integrates advanced production factors into precise and convenient digital services, facilitating a leap in productivity levels. The current "Internet + Finance" industrial integration model has effectively enhanced the added value of finance, thereby contributing to the improvement of new quality productivity levels. Based on this, the following hypothesis is proposed:

H1: Digital finance significantly promotes the development of new quality productivity.

By leveraging the advantages of digital technology, digital finance breaks regional information silos, improves the accessibility and convenience of funds, and constructs an efficient financial ecosystem to assist in the development of new quality productivity. At the micro level, it can reduce corporate financing constraints, guide the optimal allocation of financial resources to science and technology enterprises, and promote technological progress. At the macro level, it can drive the integration of information technology and traditional industries, optimize production models, cultivate innovation capabilities, and empower new quality productivity. Based on this, hypotheses H2 and H3 are proposed:

H2: Digital finance enhances new quality productivity through industrial structure upgrading.

H3: Digital finance promotes new quality productivity through technological innovation.

In the early stages of digital finance, the development of digital technology and information and communication infrastructure is insufficient, which limits service scope and efficiency. As digital technology matures in the financial sector, it can quickly respond to financial demands, achieve efficient fund circulation and allocation, and provide a platform for the development of new quality productivity. Based on this, the following hypothesis is proposed:

H4: Digital finance has a nonlinear effect on the development of new quality productivity with an increasing marginal effect.

4.   Empirical Test

4.1.   Model Construction

In order to verify the mechanism of digital finance's impact on new quality productivity, this paper constructs a double fixed effects econometric model for empirical testing after a robust Hausman test (p = 0.0001), with the specific model as follows:

$$nap_{i,t} = \alpha_1 + \phi df_{i,t} + \beta_i Z_{i,t} + \lambda_i + \mu_t + \varepsilon_{i,t} \tag{1}$$

Where: $nqp_{i,t}$ represents the new quality productivity level in region i for year t, $df_{i,t}$ represents the digital finance level in region i for year t, $Z_{i,t}$ represents the control variable set, ϕ is the coefficient of digital finance level, β_i represents the coefficients of control variables, λ_i represents individual fixed effects, μ_t represents time fixed effects, the constant term coefficient is represented by α, and $\varepsilon_{i,t}$ represents the random disturbance term.

This paper constructs a mediation effect model to verify the relationship between industrial structure upgrading, technological innovation, and new quality productivity in the context of digital finance [4]. The model is constructed as shown in equation (2):

$$M_{i,t} = \alpha_2 + \gamma gfin_{i,t} + \beta_i Z_{i,t} + \lambda_i + \mu_t + \varepsilon_{i,t} \tag{2}$$

In model (2), $M_{i,t}$ represents the mediator variable for the industrial structure upgrading and technological innovation levels in region i for year t.

To study the nonlinear relationship between digital finance and new quality productivity, this paper introduces a panel threshold regression model [5], constructed as follows:

$$nap_{i,t} = \alpha_3 + \Omega_1 df_{i,t} \bullet I(te_{i,t} \le \varphi_1) + \Omega_2 df_{i,t} \bullet I(\varphi_1 < te_{i,t} \le \varphi_2) + \Omega_3 df_{i,t} \bullet I(te_{i,t} \ge \varphi_2)$$
$$+ \Omega_4 X_{i,t} + \varepsilon_{i,t} \tag{3}$$

Where: $te_{i,t}$ is the threshold variable, φ_1 and φ_2 are the corresponding threshold values, and $I(\bullet)$ is an indicator function that takes the value 1 when the condition in the parentheses is satisfied, otherwise 0.

The construction of each variable is summarized in the table below:

Table 1: Variable Definitions

Variable Name	Variable Name	Symbol	Variable Definition
Dependent Variable	New-Quality Productivity	nqp	Calculated using the entropy method [6]
Independent Variable	Digital Finance	df	Digital Inclusive Finance Index published by Peking University / 100
Mediating Variables	Industrial Structure Upgrading	isu	Ratio of the added value of the tertiary industry to the added value of the secondary industry
	Technological Innovation	te	R&D internal expenditure / GDP
Threshold Variable	Digital Finance	df	Digital Inclusive Finance Index published by Peking University / 100
	Urbanization Level	urb	Urbanization rate
Control Variables	Foreign Direct Investment	fdi	Actual utilized foreign direct investment / GDP
	Government Intervention	gov	General budget expenditure / GDP
	Capital Investment Level	fa	Fixed asset investment / GDP

4.2. Data Description

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std	Min	Max
nqp	360	0.110	0.097	0.018	0.648
df	360	2.439	1.076	0.183	4.607
isu	360	2.399	0.123	2.132	2.836
te	360	0.018	0.012	0.004	0.068
urb	360	0.601	0.121	0.350	0.896
fdi	360	0.020	0.018	0.000	0.121
gov	360	0.113	0.032	0.058	0.245
fa	360	0.823	0.285	0.201	1.597

This study uses panel data from 30 provinces of China (excluding Hong Kong, Macao, Taiwan, and Tibet) from 2011 to 2022 as the research sample. Missing data is filled using interpolation. The final dataset includes 360 observations. Data is primarily sourced from the China Statistical Yearbook and the China Energy Statistical Yearbook. The Digital Finance Index comes from the Digital Finance Research Center at Peking University. Table 2 reports the descriptive statistics of each variable.

4.3. Empirical Test

Benchmark Regression

Table 3: Benchmark Regression

	(1) nqp	(2) nqp
df	0.2881***	0.2121***
	(11.2718)	(7.2209)
Control Variables	NO	YES
Individual Fixed	YES	YES
Time Fixed	YES	YES
cons	-0.0561***	0.2269***
	(-4.6109)	(3.1110)
N	360	360
adj. R^2	0.577	0.606

This paper reports the results of regressions with both individual and time fixed effects, using only the core explanatory variable in column (1), and with control variables included in column (2). Column (2) shows that the level of digital finance has a significant positive effect on the development of new-quality productivity (0.2121, $p<0.01$). Digital finance promotes the development of new-quality productivity by expanding financial inclusivity, providing funding support for technological innovation. To ensure the robustness of the results, the paper also performs robustness checks by replacing the core explanatory variable and excluding direct-controlled municipalities. Digital finance is replaced by three indicators: the breadth of digital finance coverage (*cov*), the depth of use (*dep*), and the level of digital inclusive finance (*dig*), and the lag of digital finance is introduced as an instrumental variable. The results remain robust.

Heterogeneity Analysis

Table 4: Heterogeneity Analysis

	(1) Eastern Region nqp	(2) Central Region nqp	(3) Western Region nqp
df	0.2440***	0.1613***	0.0968***
	(3.4979)	(3.0126)	(3.6141)
Control Variables	YES	YSE	YES
Individual Fixed	YES	YES	YES
Time Fixed	YES	YES	YES
cons	-0.0179	0.0184	0.0484
	(-0.0856)	(0.0894)	(0.8635)
N	132	96	132
adj. R^2	0.691	0.546	0.805

To explore the regional heterogeneity of the effect of digital finance on new-quality productivity, the 30 provinces are divided into Eastern, Central, and Western regions. As shown in Table 4 (1)-(3), the coefficient for the Eastern region is the largest (0.2440, $p<0.001$), followed by the Central region (0.1613, $p<0.004$), and the smallest for the Western region (0.0968, $p<0.001$). This could be because the Western region is economically less developed than the Eastern and Central regions, with poorer digital finance infrastructure and limited resources such as capital and talent, leading to a smaller impact of digital finance on new-quality productivity. On the other hand, the Eastern region, with its resource endowment advantages and "siphoning effect," concentrates high-end production factors, thus having a more significant impact on high-tech industries. Therefore, digital finance plays a more prominent role in promoting new-quality productivity in the Eastern region.

Mediating Effect

Table 5: Mediating Effect

	(1) npq	(2) isu	(3) te
df	0.2121***	0.0680***	0.0114***
	(7.2209)	(3.4796)	(7.2756)
Control Variables	YES	YES	YES
Individual Fixed	YES	YES	YES
Time Fixed	YES	YES	YES
cons	0.2269***	2.2283***	-0.0053
	(3.1110)	(45.8989)	(-1.3655)
N	360	360	360
adj. R^2	0.606	0.796	0.556

The mediating variable test results are shown in Table 5. Column (1) indicates that digital finance is significantly positively correlated with new quality productivity development at the 1% level (0.2121). Column (2) shows that digital finance has a significantly positive correlation with industrial structure upgrading at the 1% level (0.0680). This can be achieved by providing innovative financial products and services that promote the development of the economy toward a green, low-carbon, and circular economy, aiding industrial upgrading. Industrial upgrading can improve resource utilization efficiency, reduce waste and pollution emissions, and ultimately enhance new quality productivity.

In summary, industrial structure upgrading plays a mediating role in the effect of digital finance on new quality productivity, as does technological innovation.

Threshold Regression

Table 6: Threshold Effect Test Results

Threshold Number	Threshold Value	F-Value	P-Value	$crit10$	$crit5$	$crit1$
One Threshold	2.6485	23.55	0.0000	34.0507	43.3047	56.6607
Two Thresholds	3.7883	18.31	0.0000	17.8000	20.3661	31.1138
Three Thresholds	—	5.17	0.3367	46.2589	52.8237	97.3486

To further examine the nonlinear effect of digital finance on new quality productivity, digital finance was used as a threshold variable for regression. The "bootstrap sampling method" was repeatedly applied 300 times, with results shown in Table 6. The model contains two threshold values: 2.6485 and 3.7883. The threshold effect is further analyzed.

Table 7: Threshold Model Estimation Results

	nqp
df(df≤2.6485)	0.0225***
	(4.2727)
df(2.6485<df≤3.7883)	0.0379***
	(7.9159)
df(df>3.7883)	0.0545***
	(12.7642)
Control Variables	YES
cons	0.1926***
	(3.1658)
N	360
adj. R^2	0.616

The regression results from Table 7 show that when digital finance is below 2.6485, the green finance coefficient is 0.0225, which has a positive impact on the development of new quality productivity. When digital finance is between 2.6485 and 3.7883, the estimated coefficient rises to 0.0379. When digital finance exceeds 3.7883, the coefficient reaches 0.0545. In summary, digital finance plays a dual-threshold role in the development of new quality productivity, with its promoting effect increasing nonlinearly as the level of digital finance rises.

5. Conclusions and Policy Recommendations

5.1. Empirical Conclusions

The conclusions of this study are as follows: First, digital finance has a promoting effect on new quality productivity, which remains robust after a series of robustness and endogeneity tests. Second, industrial structure upgrading and technological innovation levels are effective paths to improve new quality productivity. Third, the threshold effect indicates that digital finance has a dual-threshold

effect on new quality productivity, manifesting as a nonlinear increasing effect. Fourth, regional heterogeneity shows that the promoting effect of digital finance on new quality productivity varies significantly across regions, being greatest in the eastern region, followed by the central region, and smallest in the western region.

5.2. Policy Recommendations

Based on the above conclusions, the following policy recommendations are proposed:

First, improve digital infrastructure and enhance digital literacy among residents. Optimize the digital finance service environment and promote its in-depth application to provide infrastructure support for new quality productivity. At the same time, enhance residents' awareness, trust, and willingness to use digital finance from the demand side, expanding the depth and breadth of digital finance services to advance new quality productivity.

Second, establish a new innovation system and guide industrial upgrading. Increase investment in technological innovation through fiscal subsidies, harness the innovative power of enterprises, and unleash vitality. Build cooperative platforms, strengthen industry-university-research collaboration, drive industrial transformation, and promote high-quality economic development.

Third, develop new quality productivity based on local conditions to effectively improve the overall efficiency of financial services. For different regions, targeted differentiated support policies should be introduced. The eastern region should fully leverage local digital resource endowments to promote industrial agglomeration and drive the development of surrounding areas. The central and western regions should capitalize on their late-mover advantages.

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