

The Impact of Digital Finance Development on Urban Economic Resilience — An Empirical Study on the Mechanism and Heterogeneity Effects Based on Data from 2012 to 2022

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Abstract:

Based on balanced panel data comprising 2409 observations from prefecture-level cities in China (2012–2022), this study applies fixed-effects models, mediating effect models, and heterogeneity analysis to empirically investigate the mechanisms and differential impacts of digital finance development on urban economic resilience. Results indicate that digital finance exerts a statistically significant positive effect on urban economic resilience. Mechanism analysis demonstrates that digital finance indirectly strengthens economic resilience through fostering industrial co-agglomeration and stimulating entrepreneurial activity. Heterogeneity analysis further reveals that this enhancing effect is markedly stronger in economically advanced cities and provincial capitals.

Keywords: Digital Finance, Urban Economic Resilience, Industrial Co-agglomeration, Entrepreneurial Activity

1. Introduction

In recent years, the rapid advancement of the digital economy has amplified digital finance's pivotal role in stimulating economic expansion, optimizing resource distribution, and bolstering SME development. This investigation leverages 2012–2022 data from China's prefecture-level cities to systematically examine digital finance's influence on urban economic resilience, its transmission mechanisms, and heterogeneous effects. Through constructing a multidimensional urban economic resilience metric

and employing Peking University's Digital Inclusive Finance Index, we elucidate how digital finance fortifies urban economic resilience and explore variations across municipalities stratified by developmental tiers and administrative categories.

2. Literature Review

Urban economic resilience refers to the ability of an urban economic system to cope with, adjust to, and recover from external shocks. Some scholars

have found that digital finance has a positive effect on urban economic resilience. Wu Ye (2023), using panel data from 283 prefecture-level and above cities in China from 2015 to 2020, empirically demonstrated that digital finance, green innovation, and their synergistic effect have a significantly positive impact on urban economic resilience. Gong Qinlin and Zhang Bingbing (2023), found that digital finance reinforces urban economic resilience. Wang Yucong (2023), based on panel data from 272 Chinese cities (2011-2019), demonstrated that digital finance development substantially fortifies urban economic resilience. Lu Xuan and Wang Han (2024), examining 16 prefecture-level cities in Anhui Province, revealed that digital inclusive finance effectively uplifts urban economic resilience.

However, extant research exhibits persistent limitations. Theoretically, while numerous studies address digital finance and urban economic resilience separately, few integrate both concepts within a unified analytical framework, resulting in insufficient systematic theorization about digital finance's influence mechanisms. This gap impedes the formation of a coherent conceptual system. Methodologically, certain investigations suffer from geographically and temporally constrained samples, potentially compromising the external validity of conclusions and failing to comprehensively capture regional and developmental variations. Mechanistically, despite identifying some mediating variables, research remains inadequate in unraveling the complex causal pathways through which digital finance affects economic resilience.

3. Theoretical Analysis and Research Hypotheses

Digital finance bolsters urban financial stability, thereby cultivating urban economic resilience through reduced financial service barriers, optimized resource allocation, and enhanced management capabilities. Consequently, we postulate that more advanced digital finance development correlates with heightened urban economic resilience. Hypothesis H1 is therefore formulated: Digital finance development positively influences urban economic resilience. Cities exhibit disparate infrastructure endowments, human

capital resources, and market conditions across economic development tiers. These variations may modulate digital finance's efficacy in fortifying urban economic resilience. We thus propose heterogeneous effects, leading to Hypothesis H2: The resilience-enhancing effect of digital finance is more substantial in economically advanced municipalities and provincial capitals.

Industrial co-agglomeration can integrate the advantageous resources of different industries, improve production efficiency, and enhance the competitiveness of the overall industry. Therefore, this paper hypothesizes that digital finance indirectly strengthens urban economic resilience by promoting industrial co-agglomeration. Based on this, Hypothesis H3 is proposed: Digital finance positively impacts urban economic resilience by promoting industrial co-agglomeration.

The convenience and efficiency of digital finance provide more opportunities and convenience for entrepreneurs, lower barriers to entry, and increase the success rate of startups. Therefore, this paper hypothesizes that digital finance indirectly enhances urban economic resilience by boosting entrepreneurial activity. Based on this, Hypothesis H4 is proposed: Digital finance positively impacts urban economic resilience by enhancing entrepreneurial activity.

4. Empirical Research Design

4.1 Data Sources

The dataset for Chinese prefecture-level cities primarily originates from the China City Statistical Yearbook. The core explanatory variable, digital finance, employs Peking University Digital Finance Research Center's Digital Inclusive Finance Index. Missing observations and anomalies were cross-verified, reconciled, and augmented using provincial/municipal statistical yearbooks, while residual gaps were addressed through linear imputation.

4.2 Variable Selection

4.2.1 .Explained Variable: Urban Economic Resilience (UER)

Table 1: Comprehensive Indicator System for Urban Economic Resilience

Dimension	Component	Measurement Indicator	Nature
Urban Economic Resilience	Resistance & Recovery Capacity	Per Capita GDP (¥10,000)	+
		Unemployment Rate (%)	-
		Foreign trade dependency ratio	-
		Household savings balance (¥10,000)	+
		Per Capita Disposable Income (10,000Yuan)	+
		HHI Index	-
	Adjustment & Adaptation Capacity	Gross fixed capital formation (¥10,000)	+
		Total Retail Sales of Consumer Goods (10,000 Yuan)	+
		Fiscal Self-Sufficiency Rate (%)	+
		Local Fiscal Expenditure (¥10,000)	+
		Ratio of Financial Institution Deposits(%)	+
	Transformation & Renewal Capacity	Fiscal Expenditure on Education (¥10,000)	+
		Fiscal Expenditure on Science & Technology (¥10,000)	+
		Number of Patents Granted	+
		Industrial Sophistication	+
		Urbanization Rate (%)	+

Note: The final UER index is calculated using the Entropy Method.

4.2.2 .Explanatory Variable: Digital Finance (DIF)

The Digital Inclusive Finance Index (DIFI), developed by Peking University's Digital Finance Research Center, serves as our primary measure. This city-level index aggregates data from 6 state-owned megabanks, 12 joint-stock commercial banks, and 18 regional commercial

banks, ensuring robust sector representation. DIFI quantifies regional digital financial development through three constitutive dimensions: service penetration (breadth), engagement intensity (depth), and technological integration (digitization level).

4.2.3 .Control Variables

Table 2: Definitions of Variables

Variable Category	Variable Name	Symbol	Operational Definition
Response Variable	Urban Economic Resilience	UER	Entropy-weighted composite index
Explanatory Variable	Digital Finance	DIF	Peking University DIFI (city-level)
Control Variable	Fiscal Decentralization	ECO	Per Capita Local Fiscal Revenue / Per Capita Central Fiscal Revenue
	Government Intervention	GOV	Local General Budget Expenditure / Regional GDP
	Openness to Foreign Trade	OPEN	Total Imports & Exports / Regional GDP
	Urbanization Level	URB	Urban Population / Total Population
	Human Capital Level	HUMA	Logarithm of the Number of Students in Regular Higher Education Institutions
Mechanism Variable	Industrial Co-agglomeration	IND	Measured by indicators of agglomeration degree and synergy between producer services and manufacturing, referencing Sun Wenyan's research
	Entrepreneurial Activity	ENT	Measured using the "China Regional Innovation Index" released by the Peking University Open Database Platform

4.3 Model Construction

To examine digital finance's influence on urban econom-

ic resilience and its transmission channels, we establish baseline regression and mediation analysis models.

Baseline specification:

$$Uer_{i,t} = \alpha_0 + \alpha_1 dif_{i,t} + \sum_{j=2}^6 \alpha_j Control + \tau_t + \rho_i + \varepsilon_{i,t} \#(1)$$

Where:

$Uer_{i,t}$ Economic resilience of city i in year t

$dif_{i,t}$ Core regressor (digital finance development)

Controls Fiscal decentralization(ECO), state involvement(GOV), openness(OPEN), urbanization(URB), and

workforce quality(HUMA)

τ_i / ρ_i City/time fixed parameters mitigating unobserved heterogeneity

$\varepsilon_{i,t}$ Stochastic disturbance

Mediation pathway specification:

$$int_{i,t} = \alpha_0 + \alpha_1 digi_{i,t} + \sum_{j=2}^6 \alpha_j Control + \tau_t + \rho_i + \varepsilon_{i,t} \#(2)$$

Where $int_{i,t}$ * MERGEFORMAT represents the mediation variable, which in this paper is industrial co-agglomeration (IND) and entrepreneurial activity (ENT). Other components maintain Equation (1)'s structure.

5. Empirical Results

5.1 Descriptive Statistics

Table 3: Descriptive Statistics

Variable	N	Mean	SD	Min	Max
uer	2409	0.273	0.120	0.0591	0.815
dif	2409	208.5	65.56	62.04	361.1
eco	2409	0.467	0.212	0.0702	1.541
gov	2409	0.190	0.0815	0.0439	0.675
open	2409	0.194	0.632	0.0006	28.37
urb	2409	0.581	0.136	0.234	1.007
huma	2409	0.021	0.0263	0.0002	0.147

Descriptive statistical analysis of the sample data reveals significant disparities in digital finance development levels across cities. The minimum value is 62.04, and the maximum reaches 361.1, indicating uneven development

of digital finance among Chinese cities, with some cities being relatively advanced and others lagging behind.

5.2 Baseline Regression

Table 4: Baseline Regression

	(1)	(2)
	uer	uer
dif	0.0006*** (5.62)	0.0006*** (6.02)
eco		0.1454*** (14.97)
gov		-0.0304*

		(-1.71)
open		0.0010
		(1.03)
urb		-0.0881***
		(-5.36)
huma		-0.2634**
		(-2.18)
_cons	0.1990***	0.1759***
	(19.95)	(11.70)
ID Fixed	YES	YES
YEAR Fixed	YES	YES
N	2409	2409
R ²	0.6151	0.6598

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The baseline regression estimates indicate a statistically significant coefficient of 0.0006 for digital finance (DIF) at the 1% significance level (***), demonstrating that digital finance advancement substantially strengthens urban economic resilience. These results validate Hypothesis H1.

5.3 Robustness Checks

Table 5: Robustness Checks

	(1)	(2)	(3)	(4)
	uer	uer	uer	uer
dif				0.0004***
				(3.17)
coverage	0.0003***			
	(2.97)			
Usage		0.0003***		
		(3.62)		
digi			0.0002***	
			(4.96)	
eco	0.1404***	0.1421***	0.1462***	0.1526***
	(14.41)	(14.59)	(14.96)	(12.86)
gov	-0.0470***	-0.0474***	-0.0468***	-0.0417*
	(-2.67)	(-2.71)	(-2.70)	(-1.84)
open	0.0009	0.0009	0.0008	-0.0628***
	(0.92)	(0.93)	(0.86)	(-6.91)
urb	-0.0892***	-0.0802***	-0.0888***	-0.0911***
	(-5.38)	(-4.83)	(-5.39)	(-4.37)
huma	-0.2643**	-0.2261*	-0.2235*	-0.1041
	(-2.16)	(-1.86)	(-1.84)	(-0.61)
_cons	0.2161***	0.2055***	0.2201***	0.2027***
	(16.28)	(14.45)	(19.24)	(10.55)
ID Fixed	YES	YES	YES	YES

YEAR Fixed	YES	YES	YES	YES
N	2409	2409	2409	1752
R ²	0.6556	0.6563	0.6581	0.4594

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The findings demonstrate that across all dimensions of the digital finance index—coverage breadth, usage depth, and digitization level—coefficients remain statistically significant and positive, aligning with baseline regression out-

comes. This robustness check confirms digital finance's facilitative effect on urban economic resilience, thereby strengthening empirical support for Hypothesis H1.

5.4 Heterogeneity Analysis

Table 6: Heterogeneity Analysis

	(1)Low Econ Dev UER	(2)High Econ Dev UER	(3)Non-Capital UER	(4)Provincial Capital UER
	uer	uer	uer	uer
dif	0.0001	0.0016***	0.0004***	0.0014***
	(1.16)	(5.90)	(4.26)	(2.86)
eco	0.1451***	0.1971***	0.1412***	0.1800***
	(12.99)	(11.17)	(14.16)	(5.53)
gov	-0.0077	-0.1673**	-0.0219	-0.1827
	(-0.47)	(-2.30)	(-1.28)	(-1.26)
open	0.0017**	-0.0540***	-0.0438***	0.0021*
	(2.06)	(-4.47)	(-6.56)	(1.83)
urb	-0.0615***	-0.1059***	-0.0627***	-0.1769***
	(-3.54)	(-3.07)	(-3.75)	(-2.97)
huma	-0.3879**	-0.2969*	-0.0047	-0.5417***
	(-2.15)	(-1.84)	(-0.03)	(-2.70)
_cons	0.1651***	0.1709***	0.1700***	0.3147***
	(11.58)	(4.17)	(11.70)	(3.81)
ID Fixed	YES	YES	YES	YES
YEAR Fixed	YES	YES	YES	YES
N	1657	752	2178	231
R ²	0.6819	0.6992	0.6791	0.7017

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Regression outcomes reveal substantial heterogeneity: Digital finance's catalytic effect on economic resilience intensifies markedly in economically advanced cities, evidenced by a coefficient of 0.0016 (***) that substantially eclipses the 0.0001 estimate for less developed counter-

parts. Similarly, provincial capitals exhibit significantly amplified responsiveness ($\beta=0.0014$, ***), surpassing non-capital cities' coefficient (0.0004) by considerable magnitude. This empirical evidence corroborates Hypothesis H2.

5.5 Mediating Effect Analysis

Table 7: Mediating Effect Analysis

	(1)	(2)	(3)
	uer	IND (Mediator)	ENT (Mediator)
dif	0.0006***	0.0001***	0.0102***
	(6.02)	(3.44)	(10.80)

eco	0.1454*** (14.97)	-0.0004 (-0.15)	-0.1373 (-1.53)
gov	-0.0304* (-1.71)	0.0010 (0.20)	-0.5878*** (-3.59)
open	0.0010 (1.03)	-0.0004 (-1.54)	0.0419*** (4.77)
urb	-0.0881*** (-5.36)	-0.0050 (-1.12)	0.0018 (0.01)
huma	-0.2634** (-2.18)	0.0205 (0.63)	1.3407 (1.20)
_cons	0.1759*** (11.70)	0.0054 (1.33)	9.3076*** (67.12)
ID Fixed	YES	YES	YES
YEAR Fixed	YES	YES	YES
N	2409	2409	2409
R ²	0.6598	0.4686	0.7081

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Results confirm digital finance directly strengthens urban economic resilience while indirectly fostering it through industrial co-agglomeration (IND) and entrepreneurial vitality (ENT). For IND, DIF's coefficient of 0.0001*** indicates significant facilitation of industrial clustering, validating H3. Regarding ENT, the 0.0102*** coefficient demonstrates digital finance's catalytic role in entrepreneurship, confirming H4.

6. Conclusions and Implications

This study establishes that digital finance exerts a robust positive influence on urban economic resilience. This core finding persists through robustness checks including:

Alternative variable specifications, Pandemic-era sample exclusion and Endogeneity mitigation procedures. Thereby validating H1.

Heterogeneity analysis reveals disproportionately stronger resilience effects in economically advanced municipalities and provincial capitals (vs. counterparts), supporting H2. The mediation pathway analysis affirms H3-H4, demonstrating digital finance indirectly bolsters resilience via industrial co-agglomeration promotion and entrepreneurial activity stimulation.

Three constraints merit acknowledgment:

(1)Dimensional heterogeneity: Differential impacts across digital finance's subdomains (coverage depth, usage intensity, digitization) remain unexplored.

(2)Temporal dynamics: Insufficient examination of long-term digital finance-resilience interdependencies.

(3)Mechanistic breadth: Potential undiscovered transmission channels warrant future investigation.

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