Digital Inclusive Finance and Urban Entrepreneurial Activity

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Abstract. In the context of the burgeoning digital economy, digital inclusive finance plays a crucial role in fostering regional innovation, entrepreneurship, and economic restructuring. Findings indicate that digital inclusive finance substantially boosts urban entrepreneurial activity, with this impact being particularly pronounced in cities possessing high administrative classifications, substantial economic scales, advantageous geographical positions, and those focused on non-productive service sectors. Its mechanism of action is mainly reflected in enhancing urban innovation capability, stimulating residents' consumption, and expanding credit supply. Further analysis reveals considerable heterogeneities across various urban characteristics and industry types. Concurrently, digital inclusive finance stimulates entrepreneurial activity via mechanisms such as factor concentration and spatial spillovers. This research offers a theoretical foundation for refining digital inclusive finance policies and invigorating urban entrepreneurial dynamism. Moreover, it holds significant implications for fostering green and innovative economic growth and contributing to the achievement of "dual carbon" objectives.

Keywords: Digital inclusive finance, urban entrepreneurial activity; transmission path; two-way fixed effect model.

1. Introduction

Current research indicates that driven by the "mass entrepreneurship and innovation" policy, China's entrepreneurial activity has significantly increased. However, newly established enterprises generally face multiple challenges such as resource constraints, insufficient intellectual property protection, unfair competition, and exclusion from traditional finance (Ren et al., 2022; Zhang, 2014)[1][2]. As a crucial financial innovation offers new solutions to overcome these entrepreneurial challenges through its advantages of broad coverage and low cost (Guo et al., 2020)[3]. A large body of empirical research has found that digital inclusive finance not only significantly boosts overall entrepreneurial levels but also exhibits distinct group differences and regional heterogeneity. Specifically, its promoting effect is particularly prominent for household entrepreneurship, female entrepreneurship, and rural entrepreneurship, and its impact is more significant in regions with higher administrative levels and more developed economies (Li et al., 2022)[4]. Its mechanisms of action are primarily manifested in four dimensions: first, by empowering through digital technology, it lowers the threshold for financial services, alleviating entrepreneurs' financing constraints (Liang et al., 2018) [5]; second, it promotes the improvement of regional innovation levels, creating more opportunities for entrepreneurial activities (Feng et al., 2021)[6]; third, it drives household consumption growth, expanding market demand; and fourth, it promotes industrial structure upgrading, optimizing the entrepreneurial environment (Tang et al., 2019)[7].

However, existing research still presents certain limitations in terms of sample coverage, depth of mechanism analysis, and spatial spillover effects. Future research needs to construct a more systematic theoretical framework and conduct more in-depth empirical tests, integrating multi-dimensional urban characteristics, to provide more precise theoretical bases for policy formulation. Consequently, this study aims to investigate the influence of digital inclusive finance on urban entrepreneurial dynamism, considering its underlying mechanisms and diverse impacts, utilizing data collected from 285 prefecture-level cities across China.

2. Hypotheses

2.1. The effect on urban entrepreneurial activity

Entrepreneurship serves as a key driver for stimulating employment and invigorating the real economy, proving instrumental in overall economic development. As noted earlier, newly established enterprises in China face multifaceted challenges. The progression of digital inclusive finance can effectively address this challenge: First, the development of digital inclusive finance can compensate for the shortcomings of traditional finance, improve payment efficiency, reduce financial service costs, and, to a certain extent, optimize the financing environment, thereby easing financing constraints for new ventures and increasing entrepreneurial opportunities (Feng et al., 2021)[6]. Second, the development of digital inclusive finance promotes the improvement of regional innovation levels, concentrating excellent human resources and knowledge reserves, providing essential factors and resources for regional entrepreneurship, and enhancing entrepreneurial levels. Third, digital inclusive finance facilitates regional credit supply, broadens funding avenues and modalities for small and micro enterprises, encourages the proliferation of varied financing strategies, and enhances the funding effectiveness for these enterprises, reduces financing risks and costs, alleviates their credit pressure, and increases entrepreneurial opportunities. It is thus evident that digital inclusive finance has a certain promoting effect on urban entrepreneurship. Figure 1 illustrates the evolutionary trajectories of China's digital inclusive finance and urban entrepreneurial activity from 2011 to 2020, with both exhibiting a consistent upward pattern throughout the period.A correlational analysis reveals a strong interrelationship between the two, statistically significant at the 1% level. Consequently, the subsequent hypothesis is put forward:

H1: The progression of digital inclusive finance substantially stimulates urban entrepreneurial activity.

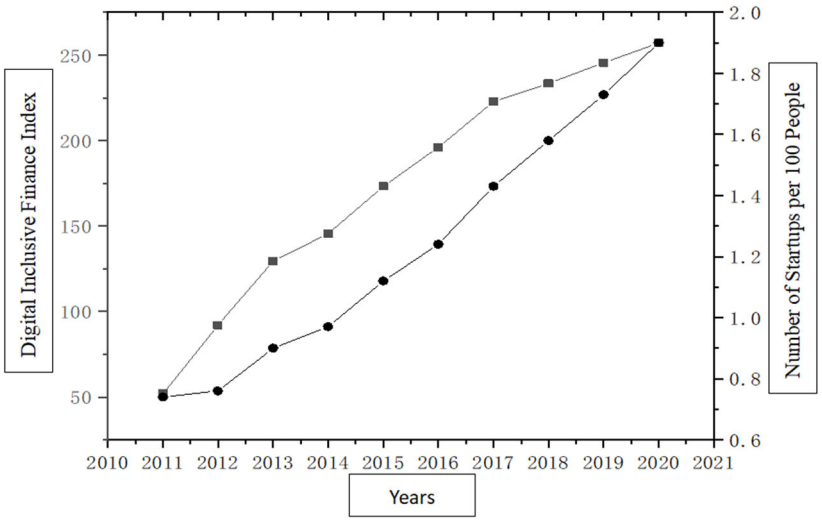

Figure 1. Trend of Urban Entrepreneurial Activity

2.2. The promoting effect on urban entrepreneurial activity is heterogeneous

Entrepreneurial activity is also influenced by other factors. China is a vast country with significant disparities in development levels among regions. Currently, the development of digital inclusive finance in China is still in its nascent stage, with differences in development levels across the eastern, central, western, and northeastern regions, generally showing a decreasing trend from the eastern coast towards the west and northeast (Li et al., 2022)[8]. The eastern regions boast higher economic development levels, more complete industrial chains, and market systems. Being adjacent to the ocean, they possess rich port resources, making it easier to integrate with international markets. In terms of educational resources and policy support, the eastern regions have a large number of higher

education institutions and research organizations, along with more abundant fiscal and tax preferential policies and entrepreneurial funds, which help reduce entrepreneurs' risk costs and stimulate their enthusiasm for entrepreneurship. Therefore, in terms of entrepreneurial levels, the eastern coastal regions exhibit the highest entrepreneurial activity and offer more entrepreneurial opportunities.

Furthermore, factors such as city administrative level and city size also affect the promoting effect of digital inclusive finance. Significant disparities exist in financial development, urbanization rates, and infrastructure construction among cities of different administrative levels and sizes, leading to differences in entrepreneurial environments and resources. Cities with higher administrative levels and larger scales typically possess more complete infrastructure, resources, and service systems, including financial, legal, and consulting support services, as well as robust social networks. These provide more resources and conveniences for entrepreneurship. Simultaneously, such cities often serve as regional core cities, featuring more comprehensive policy support and entrepreneurial ecosystems, larger market demand, a greater labor force, and a friendly entrepreneurial environment, which can better stimulate people's entrepreneurial enthusiasm and innovative spirit. Therefore, the promoting effect of digital inclusive finance on urban entrepreneurship may be influenced by city administrative level and size (Yang et al., 2022) [9]. Based on this, the following hypothesis is proposed:

H2: The promoting effect of digital inclusive finance development on urban entrepreneurial activity exhibits heterogeneity based on city administrative level, city size, and city regional location.

2.3. The Mechanism of Digital Inclusive Finance Affecting Entrepreneurial Activity

Digital inclusive finance can influence urban entrepreneurship from multiple perspectives. From an industrial perspective, it can promote industrial structure upgrading, thereby stimulating entrepreneurship. From a consumption perspective, it can boost household consumption, stimulate product demand, and increase employment opportunities. From an innovation perspective, digital inclusive finance drives the technological advancement of the financial industry, improving the level and quality of financial services, and thus fostering entrepreneurship. The mechanisms by which digital inclusive finance promotes entrepreneurship are as follows:

First,Innovation and entrepreneurship are inseparable topics. The improvement of enterprise innovation levels boosts their product supply and the conduct of internal and external activities, leading to differentiated innovation and promoting healthy enterprise development. An increase in regional innovation levels is more conducive to industrial structure upgrading, foreign capital inflow, and the development of higher education, which can provide entrepreneurial resources and an entrepreneurial environment for entrepreneurs, increasing entrepreneurial opportunities. Furthermore, the development of digital inclusive finance can foster the growth of technology-driven enterprises, provide guarantees for governmental institutional designs that incentivize talent innovation and achievement transformation, boost the design and R&D of enterprise products, enhance enterprises' market competitiveness, and thereby promote urban entrepreneurial activities.

Second, digital inclusive finance enhances entrepreneurial levels by boosting household consumption. Digital inclusive finance alleviates liquidity constraints. The use of digital payment technologies improves payment efficiency, reduces financial service costs, shortens consumers' shopping time, and thus enhances their willingness to consume (Yi et al., 2018; Zhang et al., 2020) [10][11]. Consumption, as one of the "troikas" driving economic growth, is a potential factor promoting entrepreneurship. An increase in household consumption levels, to a certain extent, indicates an adjustment in residents' income proportions, benefiting national wealth distribution, and thus incentivizing residents to engage in innovation and entrepreneurship. Furthermore, an increase in household consumption levels suggests an increase in their disposable income, which is a key factor determining the success of household entrepreneurship (Zhang et al., 2020)[12].

Third, digital inclusive finance enhances entrepreneurial levels by expanding credit supply. In the credit market, traditional banks primarily decide whether to lend based on borrowers' collateral and financial information. SMEs often lack sufficient financial information and collateral, making

financing difficulties a key obstacle to their growth (Lu et al., 2022)[13]. The development of digital inclusive finance can enhance the technological level of financial institutions, allowing them to collect SME data and conduct financial inquiries using big data analytics, machine learning, and other methods. This improves efficiency in lending decisions. Such efficiency gains can lead to a quantitative increase, thereby expanding credit supply, alleviating credit funding issues for SMEs, and promoting urban innovation and entrepreneurship. Based on this, the following hypothesis is proposed:

H3: The development of digital inclusive finance promotes the enhancement of urban entrepreneurial activity by improving regional innovation levels, boosting regional household consumption, and expanding regional credit supply.

3. Research Design

3.1. Models

3.1.1. Baseline Regression Model

This paper primarily investigates the impact of digital inclusive finance development on urban entrepreneurial activity in China. Drawing upon the research of domestic scholars, a two-way fixed-effects model is constructed as follows:

$$Enter\_act_{i,t} = \alpha + \beta Dig\_fin_{i,t} + \gamma Controls_{i,t} + \lambda_i + \mu_t + \varepsilon_{i,t} \quad (1)$$

3.1.2.Mechanism Test Model

To investigate how digital inclusive finance affects urban entrepreneurial dynamism, regional innovation capacity, household consumption rates, and credit provision levels are identified as mediating variables for confirming the underlying mechanism. The mediation effect model is then formulated as follows:

$$M_{i,t} = \alpha_1 + \beta_1 Dig\_fin_{i,t} + \gamma_1 Controls_{i,t} + \lambda_i + \mu_t + \varepsilon_{i,t} \quad (2)$$

$$Enter\_act_{i,t} = \alpha_2 + \beta_2 Dig\_fin_{i,t} + \delta M_{i,t} + \gamma_2 Controls + \lambda_i + \mu_t + \varepsilon_{i,t} \quad (3)$$

Where M represents the mediating variable, which is replaced by three distinct variables: innovation level (patent), household consumption (aconsume), and credit supply (afin_load). All other variables are consistent with the aforementioned baseline regression model. The regression coefficients β_1, β_2, and δ determine the presence of a mediating effect. If a mediating effect exists, then both regression coefficients β_1 and δ must be significant. If a partial mediating effect is present, then β_2 must also be significant, and its sign should be consistent with that of $\beta_1 \times \delta$. The contribution rate of the partial mediating effect to the total effect is calculated as $\beta_1 \times \delta / (\beta_1 \times \delta + \beta_2)$.

3.2. Variable Description

3.2.1. Dependent Variable

Urban entrepreneurial activity (Enter_act) is a key factor in measuring the level of urban entrepreneurship. Entrepreneurial activity contributes to high-quality development and is an intrinsic driver of economic growth (Zhao et al., 2020)[14]. Generally, the number of new enterprises and their growth rate are important indicators for measuring urban entrepreneurial activity. A higher number of startups and a stable growth rate indicate a favorable entrepreneurial environment in the city. For the study of urban entrepreneurial activity, many scholars have adopted different research methods, such as observing the number of new enterprises established in a region or standardizing the number of new enterprises in the region against the labor force population to measure regional entrepreneurial

activity (Ye et al., 2018)[15]. This paper primarily examines urban entrepreneurial activity. Referring to the research by Bai et al. (2022)[16], we use the urban population as the standardization base and the number of new enterprises per hundred people in the city as the indicator to measure urban entrepreneurial activity. This approach can, to a certain extent, eliminate measurement bias caused by the heterogeneity of firm size within the region.

3.2.2. Core Explanatory Variable

Dig_fin. This paper uses the city-level Digital Inclusive Finance Index from the *Peking University Digital Inclusive Finance Index (2011-2021)*, compiled by the Institute of Digital Finance, Peking University, as the core explanatory variable to examine the impact of digital inclusive finance development on urban entrepreneurial activity. Additionally, initial regression analyses are performed, employing the three constituent sub-dimensions of the Digital Inclusive Finance Index as key explanatory variables to ascertain the effect of digital inclusive finance on urban entrepreneurial activity. These three sub-dimensions encompass:*fin_bre*, *fin_deep*, and *digitization_level*. To facilitate analysis, the values of these indicators are scaled by dividing them by 100.

3.2.3. Control Variable

Due to the potential influence of other factors on urban entrepreneurial activity, this study controls for the following variables: (1) Economic Development Level (lngdp). A higher level of economic development in a city provides more entrepreneurial resources and opportunities, thus promoting entrepreneurial activity. In this study, the city's economic development level is measured by the logarithm of the city's Gross Domestic Product. (2) Venture Capital Attraction Level (vent). A higher level of venture capital attraction in a city provides more financial support to entrepreneurs, thereby enhancing entrepreneurial activity. This study uses the Venture Capital Attraction Index from the *China Regional Innovation and Entrepreneurship Index*, compiled by the Peking University Corporate Big Data Research Center, to measure the level of venture capital attraction in a region. (3) Industrial Structure Upgrading (instr.up). Industrial structure reflects the relative importance and development status of different industries within an economy, measuring the resource endowment of a city. Differences in industrial structure influence the investment of entrepreneurial resources and, in turn, the ease or difficulty of entrepreneurship. Following Bai Junhong et al. (2022), industrial structure upgrading is measured using the Industrial Structure Upgrading Index, with the formula as follows:$\text{instru\_up} = \sum_{\text{i}}^{3} \text{instru}_{\text{i}} \times \text{i}$.Among these, $instru_i$ indicates the weight of industry in the total output value of the region [16]. (4) Fiscal Revenue (fiscal_re). Government fiscal investment increases, providing more funds and resources to support entrepreneurship, thus promoting entrepreneurial activity by reducing business costs and improving business services, the business environment, and offering entrepreneurial resources. This study uses fiscal revenue in the region and the logarithm of GDP to measure fiscal revenue. (5) Digitalization Level (dig_level). The digitization level indicates the extent to which information technology is integrated into the economy, thus enhancing market efficiency and supporting the digital economy. In this study, we measure the level of digitalization based on information flow and IT application development. (6) Foreign Direct Investment (FDI). The region's openness to foreign investment offers more market opportunities for entrepreneurs, providing financial and technological support, thus enhancing entrepreneurial activity. (7) Fixed Investment (fix). Fixed investment provides funds for the creation of new businesses, which can significantly impact the local market and improve the region's investment in entrepreneurship. (8) Technological Investment(tech_in). Technological investment boosts the local economy's technological capabilities, supporting industrial upgrading, thus enhancing entrepreneurial activity.

3.3. Data Sources

This paper primarily conducts an empirical analysis of the panel data from 285 cities at or above the prefecture level in China from 2011 to 2020. The dependent variable, the number of newly established enterprises in a city, is mainly sourced from Tianyancha, urban business information, and various city statistical yearbooks. The core explanatory variable, the level of digital inclusive finance

development, comes from the *Peking University Digital Inclusive Finance Index (2011-2021)*. The regional venture capital attraction index is derived from *the China Regional Innovation and Entrepreneurship Index.*

4. Empirical Analysis Results and Tests

4.1. Descriptive Statistics of Variables

A descriptive statistical analysis of the variables used in this study is presented, as shown in Table 1.

Table 1. Descriptive statistical analysis

Var.	SS.	Mea.	SD.	MV.	MV.
Entrepreneurial Activity	2850	1.238	1.122	0.160	13.982
Digital Inclusive Finance Index	2850	1.747	0.682	0.170	3.345
Coverage Index	2850	1.655	0.672	0.019	3.265
Usage Depth Index	2850	1.718	0.700	0.043	3.498
Digital Support Index	2850	2.107	0.825	0.027	5.812
Regional Economic Development Level	2850	16.592	0.931	14.106	19.774
Regional Venture Capital Attraction Level	2850	78.156	14.095	57.060	100.000
Industrial Structure Upgrading	2850	2.299	0.146	1.831	2.836
Fiscal Revenue	2850	0.078	0.028	0.023	0.239
Digital Infrastructure Construction Level	2850	2.208	2.383	0.151	20.740
Degree of Openness	2850	0.013	0.044	0.000	0.790
Fixed Asset Investment	2850	0.183	0.091	0.039	0.761
Technological Investment	2850	0.017	0.017	0.000	0.207
Labor Force	2850	11.995	1.224	5.980	16.070

4.2. Test for Multicollinearity of Variables

Multicollinearity has the potential to introduce bias into regression coefficients and yield inaccuracies in the estimation outcomes. To evaluate this, the Variance Inflation Factor (VIF) was computed for each variable. The findings indicate that the VIF scores for all variables are situated within the range of [1.20, 4.14], which remains below the standard critical VIF threshold of 10 for multicollinearity. Furthermore, the mean VIF value registered at 2.39, thereby providing ample confirmation that no multicollinearity issue exists among the variables.

4.3. Baseline Regression Results

Table 2 outlines the regression findings concerning the influence of digital inclusive finance advancement on urban entrepreneurial activity. Specifically, column (1) displays the outcomes from the regression without fixed effects controls, column (2) presents the results with fixed effects applied to the explanatory variables, column (3) illustrates the findings with uncontrolled explanatory variables, and column (4) demonstrates the results incorporating both controlled explanatory variables and fixed effects. The analysis consistently indicates that, irrespective of the particular model employed, *dig_fin* exhibits a significant positive correlation with urban entrepreneurial activity at the 1% significance level. This implies that the progression of digital inclusive finance is instrumental in stimulating urban entrepreneurship by offering increased resources like financial backing and policy assistance, which subsequently enhances the entrepreneurial confidence of city residents and boosts the overall rate of entrepreneurial engagement.

Table 2. Baseline Regression Results

Variable	(1) Enter_act	(2) Enter_act	(3) Enter_act	(4) Enter_act
Dig_fin	0.7772***	2.5870***	0.5329***	2.2139***
	(28.6193)	(7.7327)	(14.2897)	(6.9427)
lngdp			-0.2018***	0.0283
			(-5.8369)	(0.1629)
vent			0.0093***	-0.0015
			(5.7175)	(-0.8735)
indust_up			0.6807***	-1.3776***
			(3.8309)	(-2.6216)
fiscal_re			0.9204	3.8021***
			(1.3189)	(3.8306)
dig_level			0.0929***	0.0493
			(8.0722)	(0.8536)
fdi			2.3611***	-0.5618
			(6.0253)	(-0.4950)
fix			-1.3433***	-0.7770
			(-5.3287)	(-1.2971)
tec*h*			13.2541***	3.3006*
			(10.9090)	(1.6714)
lnlab			0.1054***	0.0624**
			(4.8732)	(2.5124)
City Fixed Effects	N	Y	N	Y
Year Fixed Effects	N	Y	N	Y
Observations	2,850	2,850	2,850	2,850
R^2	0.2234	0.4053	0.4371	0.4235

Note: The values in parentheses are t-values, ***p<0.01, **p<0.05, *p<0.1.

Table 3 reports the regression results on the impact of digital inclusive finance's three dimensions on urban entrepreneurial activity. In these regressions, control variables and city fixed effects were added. The results show that *fin_bre*, *fin_deep*, and *digitization_level* all significantly promote urban entrepreneurship.

Table 3. Regression results of the sub-dimensions of digital inclusive finance

Variable	(1) Coverage breadth Enter_act	(2) Usage depth Enter_act	(3) Digital support level Enter_act
fin_bre	1.7234***		
	(4.0244)		
fin_deep		1.0856***	
		(5.4394)	
digitization_level			0.2011***
			(2.6814)
Control variables	Y	Y	Y
City Fixed Effects	Y	Y	Y
Year Fixed Effects	Y	Y	Y
Observations	2850	2850	2850
R^2	0.4119	0.4133	0.4007

Note: The values in parentheses are t-values, ***p<0.01, **p<0.05, *p<0.1.

4.4. Robustness Test

4.4.1. Replacement of the Dependent Variable

This paper uses the number of new enterprises per 100,000 people as the indicator of urban entrepreneurial activity. To ensure the robustness of the model, the paper also tests the regression with *Enter_n* as the dependent variable and the percentage of *Self_employ* as a measure of regional entrepreneurial activity. The self-employment rate represents individuals who are self-employed or engaged in household business activities. This rate is low in regions with higher labor force participation, but it can reflect a greater entrepreneurial spirit in areas where self-employment is more common.Results are shown in Column (1). The self-employment rate is used as a key control variable. The regression results in Column (2) indicate that there is no significant correlation between the self-employment rate and entrepreneurial activity when we control for other factors. This suggests that self-employment and entrepreneurial activity do not exhibit a significant direct relationship when considering other variables.

4.4.2. Replacement of the Core Explanatory Variable

Adding the base regression model, the calculation results are presented in Column (3) of Table 4, showing the regression results for fin_score, where the regression model is well-specified.

4.4.3. Deletion of Special City Samples

The results in Column (4) of Table 4 report the regression results after excluding these cities. The coefficient of *Dig_fin* remains significantly positive, showing that the developmentpromotes urban entrepreneurial activity, even in cities that are not special cities, confirming its positive effect on entrepreneurial activity.

Table 4. Robustness Test(1)

Variable	(1) New Enterprise Count Enter_n	(2) Self-Employment Rate Self_employ	(3) Entropy Weight Method Score Enter_act	(4) Excluding Special Cities Enter_act
Dig_fin	128068.7408*** (6.5550)	0.0923** (2.1165)		2.2360*** (6.6434)
fin_score			7.7634*** (6.4533)	
Control variables	Y	Y	Y	Y
City Fixed Effects	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y
Observations	2850	2565	2850	2490
R^2	0.4256	0.2605	0.4205	0.4161

Note: The values in parentheses are t-values, ***p<0.01, **p<0.05, *p<0.1.

4.4.4. Lagged One-period Core Explanatory Variable

The above analysis examines the impact of digital inclusive finance development on current urban entrepreneurial activity, considering that the development of digital inclusive finance may influence the urban entrepreneurial activity in the subsequent period. Therefore, this paper uses the core explanatory variable, digital inclusive finance development (*L.Dig_fin*), and conducts a baseline regression to test whether the development of digital inclusive finance in the current period affects entrepreneurial activity in the next period. The results, as shown in Column 5 of Table 1, indicate that after controlling for variables, the development of digital inclusive finance still has a positive effect

on entrepreneurial activity in the subsequent period, with a certain degree of persistence. The results remain stable.

4.4.5. Exclusion of the Impact of Other Policies

The implementation of innovation policies encourages entrepreneurs to innovate independently. However, the effects have been uneven across regions. To address this, China has adopted an innovation-driven development strategy to enhance entrepreneurial capabilities. To test the effect of national innovation policies on urban entrepreneurship, we introduce the annual variation in city-specific innovation policy (*inno_policy*) to control for its impact. The regression results in Column (2) of Table 5 indicate that Dig_fin remains significantly positive. This suggests that the development of digital inclusive finance, by enhancing resource concentration and focusing on key entrepreneurial factors, promotes urban entrepreneurial activity, confirming the results.

4.4.6. Regression after Data Winsorization

To examine whether the development of digital inclusive finance still promotes urban entrepreneurship after data trimming, this study trims the core explanatory and dependent variables by 1% at both ends and then conducts regression analysis with the trimmed data. The regression results after trimming are reported in Column (3) of Table 5.

Table 5. Robustness Test(2)

Variable	(1) Lagging of Explanatory Variables Enter_act	(2) Excluding Policy Influence Enter_act	(3) Data Truncation Treatment Enter_act
Dig_fin		2.1254*** (6.8058)	1.9866*** (7.9038)
L. Dig_fin	2.1942*** (6.9170)		
inno_policy		0.3759** (2.5339)	
Control variables	Y	Y	Y
City Fixed Effects	Y	Y	Y
Year Fixed Effects	Y	Y	Y
Observations	2565	2850	2850
R^2	0.3922	0.4299	0.5073

Note: The values in parentheses are t-values, ***p<0.01, **p<0.05, *p<0.1.

4.4.7. Discussion on Endogeneity Issues

(1) Potential Sources of Endogeneity:1) Bidirectional Causality: As analyzed above, the development of digital inclusive finance can concentrate city resources, accelerate the aggregation of entrepreneurial factors, promote regional innovation, and increase regional residents' income, thus boosting entrepreneurs' confidence and enhancing entrepreneurial activity in the region. At the same time, increased entrepreneurial activity in the region may stimulate the development of digital inclusive finance, such as driving digital finance innovation, encouraging businesses to enter the digital finance field, expanding financial inclusion, creating more job opportunities, and extending the coverage of traditional financial services, which in turn facilitates the formation of a financial entrepreneurial ecosystem and the emergence of more financial start-ups. The bidirectional causality introduces endogeneity, which is complex and difficult to estimate accurately.2)Omitted Variable Bias: This study uses panel data from Chinese cities, which has relatively lower availability and completeness compared to provincial-level panel data. This may lead to the omission of variables that affect urban entrepreneurial activity, causing bias in the regression coefficients. Omitting positively

influential variables may lead to an overestimation of the coefficients, while omitting negatively influential variables may cause an underestimation.

(2) Instrumental Variable Method to Solve Endogeneity Issues: To address the regression bias caused by the aforementioned endogeneity issue, this paper uses the instrumental variable method to correct the bias. The selection of the instrumental variable must satisfy strict exogeneity and be highly correlated with the explanatory variable. A strictly exogenous variable, geographic distance, is used as the instrumental variable for the problem studied in this paper.

Since the distance variable does not change over time, individual fixed effects fail, causing the second-stage regression to fail. Following the approach of Zhang Xun et al. (2022), we use the average digital inclusive finance index at the national level (excluding the city itself) and the interaction term with the instrumental variable as a time-varying instrument[11]. In this paper, the value of the interaction term divided by 10,000 is used as the instrumental variable in the two-stage least squares regression.

Table 6. Instrumental Variable Two-Stage Least Squares Regression

Variable	(1) First-stage regression Dig_fin	(2) Second-stage regression Enter_act
Dig_fin		2.5285*** (3.7952)
Mdig_fin × dis_*hz*	-0.0043*** (-11.4600)	
Control variables	Y	Y
City Fixed Effects	Y	Y
Year Fixed Effects	Y	Y
Observations	2850	2850
R^2	0.9956	0.8090

Note: The values in parentheses are t-values, ***p<0.01, **p<0.05, *p<0.1.

Thus, Hypothesis H1 is supported.

5. Further Analysis

5.1. Heterogeneity Analysis

5.1.1. Heterogeneity in Urban Administrative Levels

Considering whether the development of digital inclusive finance affects urban entrepreneurial activity differently across cities with different administrative levels, this paper classifies cities according to their administrative status, including provincial cities, centrally administered cities, planning cities, and ordinary cities, with ordinary cities having a value of 0 and other cities having a value of 1. The model introduces the variable of administrative rank (rank) and the digital inclusive finance index (Dig_fin), as well as their interaction term (Dig_fin × rank), to test whether the impact of digital inclusive finance on entrepreneurial activity varies due to different administrative levels. The results, reported in Column (1) of Table 7, show that the interaction term (Dig_fin × rank) is significantly positive, indicating that digital inclusive finance plays a greater role in promoting urban entrepreneurial activity in cities with higher administrative levels. Provincial cities, as the leaders in regional development, have advantages in terms of policy support, industrial concentration, and human resources, which further enhances their development. In comparison, digital inclusive finance develops more slowly in general cities with lower administrative levels, where there is less policy support and talent resources. As a result, it has a smaller effect on promoting entrepreneurial activity.

5.1.2. Heterogeneity in Urban Population Size

The impact of digital inclusive finance on urban entrepreneurial activity may vary due to differences in city size. We classify cities according to their population size, treating cities with large populations as 'super large cities', 'large cities', 'medium cities', and 'small cities', where 'super large cities' and 'large cities' are assigned the value 1, and other cities the value 0. The scale variable (scale) is introduced as the proxy for city size, and the interaction term (Dig_fin × scale) is used to test if the effect of digital inclusive finance on entrepreneurial activity differs due to city size. Column (2) of Table 7 reports the regression results, which show that the coefficient for Dig_fin × scale is significantly positive, indicating that the development of digital inclusive finance has a greater effect on promoting urban entrepreneurial activity in larger cities. Specifically, larger cities with more concentrated resources, policies, and talent pools have more opportunities for entrepreneurship, which enhances entrepreneurial activity. In contrast, smaller cities have fewer resources and less policy support, leading to a weaker effect on entrepreneurship and thus a lower impact of digital inclusive finance.

5.1.3. Heterogeneity in Urban Regional Locations

In conclusion, the promoting effect of digital inclusive finance on urban entrepreneurial activity exhibits heterogeneity based on urban administrative level, city size, and regional location. Thus, Hypothesis H2 is supported.

Table 7. Heterogeneity Analysis (1)

Variable	(1) Administrative Level	(2) City Size	(3) Eastern Cities	(4) Central Cities	(5) Western Cities
	Enter_act	Enter_act	Enter_act	Enter_act	Enter_act
Dig_fin	1.9341***	1.8569***	2.1671***	1.4619***	1.7113***
	(5.7069)	(5.7190)	(3.1697)	(3.9698)	(2.8387)
Dig_fin × rank	0.3722***				
	(3.6747)				
Dig_fin × scale		0.2524***			
		(4.4700)			
Control variables	Y	Y	Y	Y	Y
City Fixed Effects	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y
Observations	2850	2850	1000	1000	850
R^2	0.4384	0.4368	0.5159	0.4242	0.4041

Note: The values in parentheses are t-values, ***p<0.01, **p<0.05, *p<0.1.

5.1.4. Heterogeneity in Industry Types

Different industry types utilize urban entrepreneurial resources differently, so the impact of digital inclusive finance development on entrepreneurial activity may exhibit heterogeneity across industries. Based on the classification by Bai Junhong et al. (2022), industries are divided into services and manufacturing, with services further subdivided into productive and non-productive services[16]. The entrepreneurial activity in different types of industries in cities during the study period is calculated and regressed, as shown in Table 7. During the development of digital inclusive finance, more attention should be paid to the manufacturing sector's real economy, enhancing urban entrepreneurial activity from multiple perspectives.

Table 8. Heterogeneity Analysis (2)

Variable	(1) service	(2) manuf	(3) proserv	(4) unproserv
Dig_fin	2.0835***	0.0391	0.5307***	1.5528***
	(6.9700)	(1.6454)	(4.4231)	(6.6810)
Control variables	Y	Y	Y	Y
City Fixed Effects	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y
Observations	2850	2850	2850	2850
R^2	0.4090	0.0648	0.2939	0.3534

Note: The values in parentheses are t-values, ***p<0.01, **p<0.05, *p<0.1.
Thus, Hypothesis H2 is supported.

5.2. Mechanism Test

5.2.1. Enhancing Innovation Level

The results are reported. The promotion of innovation by digital inclusive finance leads to the creation of new products and services, encouraging more competition among entrepreneurs and continuously supporting their growth. At the same time, it helps reduce risk investment and entrepreneurship costs, adjusts the market, and stimulates the entrepreneurial activity in cities. These findings further confirm the positive influence of digital inclusive finance on urban entrepreneurial activity.

5.2.2. Enhancing Innovation Level

Urban entrepreneurship is closely linked to consumer spending, and to test the effect of digital inclusive finance on urban entrepreneurial activity through the expansion of consumer spending, we refer to the study by Pan Zhenyu et al. (2014), using the change in per capita consumer spending (consum) as a measure[17].According to the regression, the impact rate of consumer spending on total market demand is 38.85%. The increase in consumer spending leads to more opportunities for entrepreneurs, stimulating innovation and further increasing market competition, thus enhancing urban entrepreneurial activity

5.2.3. Expanding Credit Supply

The increase in credit supply provides financial support to entrepreneurs, thereby promoting entrepreneurship. To examine the effect of credit supply on the promotion of urban entrepreneurial activity, we refer to the study by Lu Fengzhi et al. (2022), using the per capita year-end loan balance from each financial institution as the indicator of credit supply (afin_load)[13]. The development of digital inclusive finance increases household loan efficiency, reduces bank loan risks and borrowing costs, expands enterprise financing channels, optimizes capital allocation, and promotes financial innovation, providing more options for borrowers. In Column (6), the interaction term of afin_load and Dig_fin is also significantly positive, confirming the existence of this mediating effect. The increase in credit supply provides entrepreneurs with funding support, alleviating the financial pressure on new start-ups, lowering the entrepreneurial threshold, and promoting urban entrepreneurial activity, thus enhancing urban entrepreneurial activity. The impact mechanism of expanding credit supply has been verified.

Table 9. Mechanism Test Regression Results

Variable	(1)	(2)	(3)	(4)	(5)	(6)
	Enhancing Innovation Levels		Stimulating Consumer Spending		Expanding Credit Supply	
	patent	Enter_act	aconsume	Enter_act	afin_load	Enter_act
Dig_fin	0.0297*** (3.4445)	2.0115*** (6.5024)	2.3784*** (7.8251)	1.3538*** (5.1390)	13.6150*** (7.1680)	1.5742*** (5.7850)
patent		6.8229*** (3.9476)				
aconsume				0.3616*** (6.7107)		
afin_load						0.0470*** (6.8883)
Control variables	Y	Y	Y	Y	Y	Y
City Fixed Effects	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	2850	2850	2850	2850	2850	2850
R^2	0.1774	0.4352	0.6356	0.4731	0.4923	0.4589

Note: The values in parentheses are t-values, ***p<0.01, **p<0.05, *p<0.1.
Thus, Hypothesis H3 is supported.

6. Conclusions

In conclusion, this study confirms the important role of digital inclusive finance in driving urban entrepreneurial activity. Based on these findings, future policies should prioritize optimizing digital financial infrastructure and expanding service coverage. Furthermore, special attention should be given to underdeveloped areas and lower-tier cities. Differentiated policies should be tailored to the characteristics of different cities and industry needs, strengthening the coordination between digital finance, innovation, consumption, and credit systems.

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