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Digital inclusive finance and rural entrepreneurial survival: The moderating role of digital and financial literacy

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ABSTRACT

This study explores the impact of digital inclusive finance on the survival of rural entrepreneurs in China, with a particular emphasis on the moderating roles of digital and financial literacy. Using data from the 2017 and 2019 China Household Finance Surveys, the analysis employs a logit model to examine entrepreneurial survival among 648 rural entrepreneurs. The findings indicate that higher levels of regional digital inclusive finance significantly enhance entrepreneurial survival, with the effect being more pronounced for individuals possessing greater digital and financial literacy. Furthermore, the results reveal that digital inclusive finance improves entrepreneurial survival primarily by enhancing business performance. This research contributes to the literature by identifying digital inclusive finance as a key determinant of entrepreneurial survival, emphasizing the moderating effects of digital and financial literacy, and providing actionable insights for policymakers and rural entrepreneurs to leverage digital financial tools for sustainable business success.

1. Introduction

Entrepreneurship is widely acknowledged as an effective strategy for poverty reduction and sustainable rural economic development (Bruton et al., 2013; Kimmitt et al., 2020; Nor, 2024; Santos et al., 2022). Despite its importance, rural entrepreneurship faces significant barriers globally. Limited access to capital, geographic isolation, and institutional weaknesses lead to disproportionately high failure rates, undermining its transformative potential (Alvarez and Barney, 2014; Frankish et al., 2014). These challenges are particularly pronounced in low- and middle-income countries, where underdeveloped rural financial systems exacerbate the difficulties, highlighting the need for innovative solutions to support rural entrepreneurs and enhance their survival.

Traditionally, research on rural entrepreneurship has primarily focused on factors promoting entrepreneurial entry, such as access to finance and social networks (Romero-Castro et al., 2023; Yu and Artz, 2018). In contrast, entrepreneurial survival, which plays a critical role in long-term rural economic development (Ebert et al., 2019; Wennberg et al., 2010), has received comparatively less attention. Theories such as the resource-based view (RBV) emphasize that firm survival depends on access to essential resources (Geroski et al., 2010; Wang and Zhou, 2022), with financial capital being a key determinant (Chandler and Hanks, 1998; Linder et al., 2019). Nevertheless, rural markets often lack critical resources, including financial capital, raw materials, and customer bases (Abreu et al., 2019; Wu et al., 2021). Notably, financial exclusion is prevalent in rural areas, driven by factors such as insufficient collateral, information asymmetry between farmers and financial institutions, and inadequate financial infrastructure (Gardeva and Rhyne, 2011;

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Wang and Fu, 2021). Moreover, formal financial institutions often exclude low-income populations due to limited profitability and high transaction costs (Armendariz and Morduch, 2010; Li and Li, 2021). According to the World Bank, over 1.4 billion adults remain unbanked, with rural populations constituting a significant portion of this exclusion (Demirguc-Kunt et al., 2018b). This financial exclusion exacerbates the precarious nature of entrepreneurial survival in rural contexts.

In recent years, digital inclusive finance has emerged as a transformative solution to financial exclusion (Berg et al., 2020; Wang and Fu, 2021; Zhang et al., 2024). The G20 High-Level Principles for Digital Financial Inclusion define digital inclusive finance as innovative financial services that integrate digital technology with traditional finance to foster broader financial inclusion. By integrating financial services with digital technologies, it expands access to credit and financial tools for underserved populations (Goldstein et al., 2019; Lee et al., 2023; Li et al., 2020). Given the historical challenges rural markets face in accessing financial services, digital inclusive finance has been particularly beneficial in these regions (Banerjee et al., 2015; Li, 2018). While prior studies have examined the role of digital inclusive finance in enhancing entrepreneurial entry (Mao et al., 2023; Wu and Wu, 2023), agricultural productivity (Liu et al., 2021), poverty alleviation (Lee et al., 2023; Suri and Jack, 2016), and farmers' income (Lian et al., 2023), its effect on entrepreneurial survival remains underexplored.

This study seeks to address this gap by examining the impact of digital inclusive finance on the survival of rural entrepreneurs in China. Specifically, we propose that digital inclusive finance enhances rural entrepreneurial survival by improving access to financial services, reducing financing costs, increasing the efficiency of financing processes, and bolstering entrepreneurs' resilience to risks. These mechanisms collectively address the unique challenges rural entrepreneurs face, fostering a more supportive environment for sustained operations and growth. Furthermore, we hypothesize that rural entrepreneurs' digital and financial literacy positively moderate the impact of digital inclusive finance on entrepreneurial survival, with higher literacy levels enhancing the effective utilization of financial tools and services.

Analysis using data from the 2017 and 2019 China Household Finance Surveys reveals that higher regional levels of digital inclusive finance significantly improve rural entrepreneurial survival, with this effect being more pronounced among individuals with greater digital and financial literacy. The results further suggest that digital inclusive finance enhances survival primarily by improving business performance.

This study' s findings align with existing literature on the transformative potential of financial inclusion (Demirguc-Kunt et al., 2018b; Suri and Jack, 2016) but extend the discussion by emphasizing entrepreneurial survival rather than entry. The study highlights the importance of human capital, particularly digital and financial literacy, in maximizing the benefits of digital inclusive finance, complementing theories of financial intermediation (Levine et al., 2000) by demonstrating how individual capabilities amplify institutional interventions. Additionally, it offers practical guidance for policymakers and rural entrepreneurs on leveraging digital finance to improve survival prospects.

2. Theoretical background and hypotheses

2.1. Digital inclusive finance

Research underscores the critical role of financial inclusion in promoting economic growth and reducing poverty (Demirguc-Kunt et al., 2018b; Marcelin et al., 2022). However, traditional inclusive finance may fail to enhance the efficiency of financial capital allocation (Zhang et al., 2024). Digital inclusive finance—characterized by increased resource accessibility, efficient resource allocation, and convenient payment methods—addresses the limitations of traditional finance (He and Li, 2020; Liu et al., 2021). Furthermore, it extends financial services to groups and entrepreneurial ventures historically marginalized by the traditional financial system, which often lacks access to essential services such as credit and financing.

Studies consistently highlight the transformative potential of digital inclusive finance. Research has demonstrated its role in improving agricultural productivity (Liu et al., 2021), reducing poverty (Suri and Jack, 2016), and enhancing income (Lian et al., 2023). Additionally, studies have linked digital inclusive finance to increased entrepreneurial activity (Butticè and Vismara, 2022; Song et al., 2024; Sun and You, 2023; Wu and Wu, 2023). For example, Butticè and Vismara (2022) identified that digital inclusive finance alleviates financing constraints. Wu and Wu (2023) argue that digital inclusive finance encourages household entrepreneurial decisions. Similarly, Sun and You (2023) found that digital inclusive finance stimulates urban entrepreneurship. Despite these findings, the impact of digital inclusive finance on entrepreneurial survival, particularly in rural contexts where financial exclusion is most severe, remains underexplored. Addressing this gap is the primary focus of this study.

2.2. Entrepreneurial survival

Entrepreneurship is inherently characterized by uncertainty and intense competition (Trimi and Berbegal-Mirabent, 2012), making market survival a significant challenge (Strotmann, 2007). Understanding the determinants of entrepreneurial survival is therefore a critical area of entrepreneurship research (Cottrell and Nault, 2004; Hyytinen et al., 2015; Josefy et al., 2017). Prior studies have categorized the factors influencing survival into external and internal domains(Del Sarto et al., 2020).

External factors focus on broader economic and policy environments. For instance, Simón-Moya et al. (2016) found that the recent financial crisis limited alternatives to self-employment, unintentionally increasing entrepreneurial survival rates. Similarly, financial incentives like subsidies and grants are instrumental in promoting innovation and growth (Koengkan et al., 2024, 2023). Internal factors include personal attributes of entrepreneurs, team-level dynamics, and firm-level structures. Entrepreneurial team-level factors encompass prior experience (Van Praag, 2003), human capital and skills (Criaco et al., 2014; Koch et al., 2013), and mental health

(Hesse et al., 2018). For example, Parker (2018) highlights that education, age, and entrepreneurial experience significantly influence survival, with experienced entrepreneurs being less likely to exit the market. At the firm level, factors such as size (Agarwal and Audretsch, 2001), performance (Wennberg et al., 2010), industry (Lin and Huang, 2008), innovation investment (Ferragina and Mazzotta, 2014) and financial resources (Schäfer and Talavera, 2009) play critical roles. Notably, the lack of financial resources is a major driver of entrepreneurial failure.

This study focuses on the influence of the digital inclusive financial environment on rural entrepreneurial survival—an area that has received limited attention in the literature.

2.3. Digital inclusive finance and rural entrepreneurial survival

To ensure sustained operations, entrepreneurs require a conducive financing environment and reliable funding channels (Robb and Robinson, 2014). Digital inclusive finance, characterized by broad accessibility, cost-effectiveness, and convenience (Dutta and Sobel, 2018), enables rural entrepreneurs—historically marginalized by traditional financial systems—to access financial services (Li and Li, 2021), thereby improving their survival prospects.

First, digital inclusive finance significantly enhances rural access to financial services. By integrating digital technology with financial systems, it overcomes geographical barriers and addresses the shortcomings of traditional financial models, which often have low penetration in rural areas. This digital transformation substantially increases the supply of rural financial services (Wang and Fu, 2021). Despite the lack of physical infrastructure, such as banks and ATMs, in many rural areas, farmers can now access financial services via mobile devices, facilitating digital transactions and mitigating geographic exclusion. Hau et al. (2019) found that rural communities benefit most from digital financial services, highlighting the ability of digital finance to expand the reach and availability of financial services in underserved regions.

Second, digital inclusive finance reduces financing costs for rural entrepreneurs. Digital finance provides diverse financial services at lower costs (Wang and Fu, 2021). Advances in digital technology help address the information asymmetry prevalent in traditional financial markets by facilitating information exchange, increasing trust, and lowering transaction costs (Beck et al., 2018). Moreover, digital finance leverages the internet and mobile communication technologies to offer various online platforms and products, such as peer-to-peer (P2P) lending and crowdfunding, significantly reducing financing costs (Li and Li, 2021).

Third, digital inclusive finance improves the efficiency of rural entrepreneurs' financing processes. Rural entrepreneurship is inherently high-risk, often leading to elevated costs in risk assessment. Digital technology enhances financial institutions' ability to assess risks more accurately and cost-effectively, enabling rural entrepreneurs to secure financing more efficiently (Li et al., 2022). Specifically, digital inclusive finance employs modern information technologies, including social networks, search engines, and big data analytics, to mine and collect customers' credit data. This allows banks and financial institutions to better understand their customers' business conditions and creditworthiness, streamlining credit reviews and shortening loan approval times (Li and Li, 2021). Furthermore, digital inclusive finance optimizes the distribution of financial services, bridging the gap between financial institutions and rural customers (Demirguc-Kunt et al., 2018a).

Finally, digital inclusive finance enhances the risk resilience of rural entrepreneurs. According to Roodman and Morduch (2014), financial inclusion improves the financial stability of entrepreneurs, enhancing their resilience to business shocks. Sufficient financial resources serve as a buffer against uncertainties and unforeseen events, thereby protecting entrepreneurial ventures (Uzuegbunam et al., 2019; Wu et al., 2016). By improving financing conditions and reducing transaction costs, digital inclusive finance mitigates the uncertainty typically associated with rural entrepreneurial activities (Wang and Fu, 2021).

Based on these mechanisms, this study proposes the following hypothesis:

Hypothesis 1. Digital inclusive finance positively impacts rural entrepreneurial survival.

2.4. The moderating role of digital and financial literacy

Entrepreneurial human capital has long been recognized as a critical factor for business survival and growth (Gimeno et al., 1997). While digital inclusive finance inherently addresses the financial needs of rural entrepreneurs, its effectiveness largely depends on the engagement and capabilities of those utilizing these services (He and Li, 2020). Human capital, particularly in the form of digital and financial literacy, plays a pivotal role in determining the extent to which rural entrepreneurs can participate in and benefit from digital inclusive finance.

Differences in human capital contribute to the "digital divide," which reflects disparities in individuals' ability to use information and communication technologies. Digital literacy—the ability to effectively navigate and use digital tools—is essential for maximizing the benefits of digital inclusive finance. Since digital inclusive finance relies heavily on technology, entrepreneurs with higher digital literacy are better equipped to leverage these tools. Conversely, those with lower digital literacy may face challenges in accessing or utilizing such services. As a result, the positive impact of digital inclusive finance on rural entrepreneurial survival may vary based on entrepreneurs' levels of digital literacy. Accordingly, this study hypothesizes the following:

Hypothesis 2. Rural entrepreneurs' digital literacy positively moderates the impact of digital inclusive finance on entrepreneurial survival. Specifically, the positive effect of digital inclusive finance on entrepreneurial survival is stronger for entrepreneurs with higher digital literacy.

Variations in human capital also led to differences in financial literacy, defined as the ability to acquire and apply financial

knowledge (Lusardi and Mitchell, 2014). Research indicates that financial literacy significantly influences financial decision-making and participation in financial markets (Stango and Zinman, 2009). Entrepreneurs with higher financial literacy are more adept at understanding, selecting, and using digital inclusive finance tools effectively. They are also better prepared to secure the necessary funding for their ventures, increasing their likelihood of survival and growth (Svendsen and Svendsen, 2004).

In China, financial literacy levels vary considerably, particularly between urban and rural populations. Rural entrepreneurs with higher financial literacy are better equipped to navigate the complexities of digital financial tools, enhancing their ability to benefit from these services. Therefore, this study hypothesizes the following:

Hypothesis 3. Rural entrepreneurs' financial literacy positively moderates the impact of digital inclusive finance on entrepreneurial survival. Specifically, the positive effect of digital inclusive finance on entrepreneurial survival is stronger for entrepreneurs with higher financial literacy.

3. Method

3.1. Data

The data used in this study come from two primary sources. First, digital inclusive finance data were obtained from the China Digital Inclusive Finance Index, published by the Digital Finance Research Center of Peking University and Ant Financial Services Group. This index is widely recognized as a reliable measure of the level of digital inclusive finance across regions in China and has been extensively used in research to assess regional disparities in its development (Lian et al., 2023; Liu et al., 2021; Song et al., 2024; Xiong et al., 2023).

Second, the individual microdata was sourced from the China Household Financial Survey Project (CHFS), organized and managed by the China Household Financial Survey and Research Center at Southwestern University of Finance and Economics. The CHFS is the first micro-level dataset in China focused on household finance, providing data on both urban and rural households across 29 provinces, autonomous regions, and municipalities. Since its inception in 2011, the project has conducted six comprehensive surveys using a rigorous three-stage stratified proportional-to-population-size (PPS) sampling method to ensure data representativeness and quality (Gan et al., 2016). The survey collects detailed information on household assets, income, and family business operations, making it an invaluable resource for examining household entrepreneurship. Prior research has widely employed this dataset to explore entrepreneurship (Yin et al., 2019; Yu et al., 2023) and rural resident behaviors (Li et al., 2020; Zhao et al., 2022).

This study uses a two-year longitudinal survey spanning 2017 and 2019 to examine entrepreneurial survival. The 2017 survey covered 40,011 households in 258 cities and 1428 villages across China, including 5712 entrepreneurial households. In 2019, the survey re-interviewed 17,494 of these households, of which 2202 were entrepreneurial households initially surveyed in 2017. This study focuses on rural entrepreneurs, starting with a sample of 674 rural individuals engaged in entrepreneurship in 2017 who were also surveyed in 2019. The sample was refined by excluding businesses that closed due to temporary operations, government interventions (e.g., city authority bans, demolitions, environmental concerns, or regulatory disapprovals), force majeure events (e.g., natural disasters and social unrest), and missing data. The final effective sample consists of 648 individuals.

3.2. Measures

Dependent Variable: The dependent variable in this study is entrepreneurial survival. Entrepreneurs who were self-employed during the 2017 survey and continued to be self-employed in the 2019 survey are considered to have survived, while those who closed their businesses are classified as having exited.

Independent Variable: The independent variable is the level of digital inclusive finance in each province. The "Peking University Digital Inclusive Finance Index" is used to measure digital inclusive finance in terms of coverage, depth of use, and degree of digitization. This index is widely used in research on digital inclusive finance (Xiong et al., 2023). To reflect the impact of digital inclusive finance on entrepreneurial survival, the index is lagged by one year, using the 2018 values.

3.2.1. Moderating variables

1. **Digital Literacy:** Digital literacy reflects an individual's ability to recognize, understand, and apply digital technology. This study creates an index of Digital Literacy which is based on a principal component analysis (PCA) using the following Digital Literacy characteristics: (a) using mobile payments, (b) making online purchases, (c) using internet to obtain information, (d) using internet to sell products or services.

Our analysis identified a single principal component with an eigenvalue of 2.014, accounting for 50.3 % of the total data variation. Fig. A1 in the appendix confirms that only the first component has an eigenvalue exceeding one. Table A2 in the appendix presents the scores for each variable and the proportion of variance explained by each principal component.

2. Financial Literacy: Financial literacy is measured using three questions from the CHFS survey, modeled after the HRS 2004 module (Lusardi and Mitchell, 2007, 2008). The CHFS designed three questions on interest rate calculation, inflation understanding, and investment risk perception to examine respondents' financial literacy (see Table A1 in the appendix). A dummy variable was constructed for each question to indicate whether the response was correct. Principal component analysis was then applied to generate a composite financial literacy index for each rural entrepreneur.

Our analysis identified two principal components with eigenvalues of 1.11 and 1.057, cumulatively explaining 72.2 % of the data

variation. Fig. A2 in the appendix demonstrates that the eigenvalues of the first two components exceed one. Table A3 in the appendix presents the scores for each variable and the proportion of variance explained by each principal component.

Control Variables: This study includes a set of control variables to account for other factors that may influence the impact of digital inclusive finance on entrepreneurial survival. Individual-level variables include: entrepreneur's gender, age and education level. Household-level variables include: family size (measured by total population of family), the number of family laborers (measured by the number of people in the family between the ages of 16 and 65 years), family's extra income (measured by family income outside of self-employed business), and the family total liabilities. Firm-level variables include: the firm's size, age, performance and industry. Regional level controls for the regional level of economic development, measured by the GDP per capita index. Table 1 summarizes the definitions and measurement of variables used in the analysis.

3.3. Empirical models

In the basic regression, the dependent variable was binary variable. Therefore, the Logit model was used as follows:

$$\Pr\left(Survival_i = 1\right) = \beta_0 + \beta_1 DIF_i + \beta_2 Control_i + \varepsilon_i \tag{1}$$

In the above equation, $Survival_i$represents the dependent variable: Digital Literacy or Financial Literacy of rural entrepreneur i in year 2019. DIF_i represents the independent variable: digital inclusive finance development index in the area where rural entrepreneur i is located. β_1 is the corresponding regression coefficient, representing the marginal effect of digital inclusive finance development on entrepreneurial survival. $Control_i$ represents a series of control variables, including entrepreneur characteristics, household characteristics, regional economic development, etc. ε_i is a random disturbing term.

The moderating model was set as follows:

$$\Pr\left(Survival_i = 1\right) = \beta_0 + \beta_1 DIF_i + \beta_2 Literacy_i + \beta_3 DIF_i \times Literacy_i + \beta_4 Control_i + \varepsilon_i \tag{2}$$

In the above equation, $Literacy_i$represents the moderating variables: financial literacy or financial literacy of rural entrepreneur i. Coefficient β_3 measures the moderating effects of financial literacy or financial literacy. If in the regression results, the value of β_3 is significant and have the symbols as expected, it means that there exists a moderating effect.

The pseudo $R^2$and likelihood ratio test (LR test) results reported in Table 5 evaluate the fitness of models. Despite the relatively low Pseudo R^2 value, the LR test of the model indicates that the independent variables have significant explanatory power for the dependent variable. We also generated the ROC curve and calculated the AUC (Area Under the Curve) to evaluate the model's predictive performance. The AUC typically provides a more intuitive reflection of the model's classification or predictive capability than Pseudo R^2. The AUC values of all models exceeded 0.7, which indicates good predictive performance.

We further conducted the Durbin-Wu-Hausman test to examine the presence of endogeneity in the model. The results indicated that the null hypothesis was accepted ($p = .125$), suggesting that the independent variable can be considered exogenous.

4. Results

Table 2 presents the descriptive statistics. The results indicate that approximately half of rural entrepreneurs (mean = 0.506) survived between 2017 and 2019. The standard deviation of the digital inclusive finance level is low, indicating significant differences among provinces in terms of their digital inclusive finance levels. Except for entrepreneurial survival, family's extra income, firm performance, and regional economic level, all variables exhibit positive skewness. The kurtosis for all variables exceeds 1. Jarque-Bera tests suggest that the variables are not normally distributed.[1]

Table 3 reports the correlations among variables. The positive correlation between digital inclusive finance levels and entrepreneurial survival is notably strong, providing preliminary evidence that higher levels of digital inclusive finance may promote entrepreneurial survival. Additionally, digital literacy, financial literacy, entrepreneur education level, firm size, firm performance, firm age, and regional economic level all show significantly positive correlations with entrepreneurial survival. In contrast, entrepreneur age is significantly negatively correlated with entrepreneurial survival.

Table 4 indicates the multicollinearity test for variables. Analysis of the variance inflation factors (VIF) confirms that there are no serious multicollinearity issues, as the VIF scores are all lower than 3.

4.1. Estimate of digital inclusive finance to rural entrepreneurial survival

Table 5 presents logit regression results estimating the impact of digital inclusive finance and sub-dimensions of digital inclusive finance (breadth of coverage, depth of use, and degree of digitization) on rural entrepreneurial survival. Model 2 demonstrates that digital inclusive finance has a significant positive impact on rural entrepreneurial survival (Beta = 0.009, $p < .01$). Specifically, higher levels of regional digital inclusive finance are associated with an increased likelihood of rural entrepreneurial survival, supporting Hypothesis 1. The effects of the three sub-dimensions of digital inclusive finance—breadth of coverage, depth of use, and degree of digitization—on entrepreneurial survival were also examined. Models 3, 4, and 5 reveal that all three dimensions significantly and

[1] The logit model does not require the variables or residuals to follow a normal distribution.

Table 1
Definitions and measurement of variables.

Variables	Measures
Dependent variable	
Entrepreneurial Survival	1 = former self-employed business closed, 0 = former self-employed business not closed
Independent variable	
Digital inclusive finance level	Measured by the digital inclusive finance index in 2018 which including three dimensions: breadth of coverage, depth of use and degree of digitization
Moderating variables	
Digital literacy	Measured from four aspects: using mobile payments, making online purchases, using internet to obtain information, using internet to sell products or services.
Financial literacy	Measured from there aspects: interest rate calculation, inflation understanding and investment risk perception.
Control variables	
Entrepreneur's gender	1=Male, 0=Female
Entrepreneur's age	Actual age
Entrepreneur's education level	0 = illiterate, 1 = primary school …, 9 = doctorate
Family size	Total population of family
Number of family laborers	Population aged 16–65 in family
Family's extra income	Family income outside of self-employed business in logarithms
Family total liabilities	Family total liabilities in logarithms
Firm size	Firm's total assets in logarithms
Firm age	Years of business establishment
Firm performance	Firm's profit in logarithms
Industry	Three dummy variables for agriculture, manufacturing and services
Regional economic level	Measured by the GDP per capita index

Table 2
Descriptive statistics.

Variables	Mean	SD	Minimum	Maximum	Skewness	Kurtosis	J-B
Entrepreneurial Survival	0.506	0.500	0.000	1.000	−0.025	1.001	108.000***
Digital inclusive finance level	303.539	26.709	263.124	377.734	0.652	2.388	56.085***
Digital literacy	0.000	1.035	−0.846	3.418	1.557	5.401	417.583***
Financial literacy	0.000	0.855	−0.549	3.275	2.649	10.102	2119.981***
Entrepreneur's gender	1.082	0.274	1.000	2.000	3.052	10.315	2451.015***
Entrepreneur's age	52.063	10.570	21.000	90.000	0.330	3.372	15.48***
Entrepreneur's education level	2.875	1.003	1.000	7.000	0.693	4.274	95.736***
Family size	4.205	1.751	1.000	13.000	0.724	4.108	89.715***
Number of family laborers	3.035	1.219	0.000	8.000	0.127	3.728	16.055***
Family's extra income	9.738	3.440	−11.824	14.448	−3.990	21.889	1.14e+04***
Family total liabilities	5.660	5.722	0.000	15.538	0.098	1.150	93.439***
Firm size	10.688	1.808	6.217	17.728	0.318	3.363	14.447***
Firm performance	7.025	6.020	−14.346	15.425	−1.657	4.958	400.031***
Firm age	10.711	9.570	1.000	59.000	1.325	5.074	305.722***
Regional economic level	4.671	0.011	4.635	4.695	−0.878	5.018	193.275***

Notes: SD-standard deviation, J-B-Jarque Berra test, *** $p<.01$, ** $p<.05$, * $p<.1$.

positively influence rural entrepreneurial survival. These results suggest that policymakers should prioritize the expansion of digital financial services, especially in rural areas, by investing in infrastructure like internet connectivity and mobile payment systems.

Model 1 further shows that entrepreneur age has a significant negative effect on entrepreneurial survival, while firm size, firm age, firm performance, and regional economic development have significant positive effects. These findings suggest that older entrepreneurs are more likely to exit their businesses, whereas larger, older, and better-performing businesses are less likely to fail, consistent with real-world expectations.

4.2. The moderating effect of digital literacy

Table 6 reports regression results demonstrating the moderating effect of digital literacy on the relationship between digital inclusive finance and entrepreneurial survival. Model 2 indicates that the interaction term between digital inclusive finance and digital literacy is significantly positive (Beta = 0.006, $p < .1$), suggesting that digital literacy enhances the positive impact of digital inclusive finance on entrepreneurial survival. This finding supports Hypothesis 2. Models 3, 4, and 5 examine the interaction terms between the sub-dimensions of digital inclusive finance (breadth of coverage, depth of use, and degree of digitization) and digital literacy. The coefficients for these interaction terms are all positive, confirming that digital literacy consistently strengthens the effect of digital inclusive finance across its sub-dimensions. Moreover, Model 1 shows that digital literacy alone has a significant positive effect on entrepreneurial survival. These results suggest that policymakers and NGOs should invest in digital literacy programs, particularly in

Table 3
Pearson correlations matrix.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Entrepreneurial Survival	1													
2. Digital inclusive finance level	0.116***	1												
3. Digital literacy	0.161***	0.146***	1											
4. Financial literacy	0.152***	0.142***	0.959***	1										
5.Entrepreneur's gender	0.024	−0.041	−0.02	−0.005	1									
6.Entrepreneur's age	−0.102***	0.095**	−0.286***	−0.235***	0.045	1								
7.Entrepreneur's education level	0.114***	0.025	0.227***	0.193***	−0.098**	−0.255***	1							
8.Family size	0.029	−0.111***	0.177***	0.129***	−0.006	−0.118***	0.023	1						
9.Number of family laborers	0.036	−0.086**	0.167***	0.122***	0.001	−0.144***	0.081**	0.746***	1					
10.Family's extra income	−0.015	−0.027	0.045	0.032	−0.064*	0.01	−0.02	0.159***	0.156***	1				
11.Family total liabilities	0.035	−0.103***	0.065*	0.074*	0.031	−0.144***	0.051	0.131***	0.157***	−0.106***	1			
12.Firm size	0.149***	0.007	0.286***	0.262***	−0.079**	−0.197***	0.244***	0.157***	0.166***	0.036	0.243***	1		
13.Firm performance	0.136***	0.114***	0.119***	0.110***	−0.049	0.037	0.026	−0.011	−0.021	0.105***	−0.086**	0.056	1	
14.Firmage	0.145***	0.116***	−0.03	−0.03	−0.033	0.214***	0.070*	−0.162***	−0.158***	0.03	−0.093**	−0.069*	0.138***	1
15. Regional economic level	0.103***	0.085**	0.007	−0.006	0.031	−0.036	−0.051	0.003	0.015	−0.032	−0.025	−0.064*	−0.02	0.002

Notes: *** $p<.01$, ** $p<.05$, * $p<.1$.

Table 4
Multicollinearity test.

	Main model entrepreneurial survival VIF
Digital inclusive finance level	1.09
Digital literacy	1.26
Financial literacy	1.18
Entrepreneur's gender	1.03
Entrepreneur's age	1.22
Entrepreneur's education level	1.17
Family size	2.31
Number of family laborers	2.32
Family's extra income	1.07
Family total liabilities	1.13
Firm size	1.22
Firm performance	1.06
Firm age	1.12
Regional economic level	1.02
Mean VIF	1.3

Table 5
Estimate of digital inclusive finance to rural entrepreneurial survival.

	Dependent variable: Entrepreneurial survival				
	(1)	(2)	(3)	(4)	(5)
Entrepreneur's gender	0.369	0.397	0.394	0.395	0.409
	(0.309)	(0.311)	(0.311)	(0.311)	(0.311)
Entrepreneur's age	−0.019**	−0.021**	−0.02**	−0.021**	−0.021**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Entrepreneur's education level	0.123	0.121	0.119	0.123	0.123
	(0.089)	(0.09)	(0.09)	(0.09)	(0.09)
Family size	0.022	0.033	0.029	0.036	0.034
	(0.072)	(0.073)	(0.072)	(0.073)	(0.073)
Number of family laborers	0.023	0.022	0.026	0.016	0.02
	(0.104)	(0.105)	(0.105)	(0.105)	(0.105)
Family's extra income	−0.018	−0.015	−0.015	−0.014	−0.015
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Family total liabilities	0.005	0.01	0.01	0.01	0.009
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)
Firm size	0.178***	0.174***	0.174***	0.175***	0.174***
	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)
Firm performance	0.044***	0.041***	0.042***	0.041***	0.041***
	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
Firm age	0.038***	0.036***	0.036***	0.036***	0.036***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Regional economic level	20.514***	18.514**	20.958***	16.636**	15.042*
	(7.455)	(7.544)	(7.514)	(7.626)	(7.77)
Digital inclusive finance level		0.009***			
		(0.003)			
Breadth of coverage			0.009**		
			(0.004)		
Depth of use				0.007***	
				(0.002)	
Degree of digitization					0.013***
					(0.005)
Constant	−98.104***	−91.448***	−102.663***	−81.856**	−77.412**
	(34.919)	(35.26)	(35.237)	(35.612)	(35.937)
Pseudo R^2	0.073	0.082	0.08	0.082	0.081
LR Chi2	65.712***	73.433***	72.161***	74.033***	72.530***
AUC	0.714	0.720	0.719	0.721	0.719

Notes: *** $p<.01$, ** $p<.05$, * $p<.1$. Standard errors are in parentheses. Industry fixed effects are included. Observations = 648.

rural areas, to enhance the ability of entrepreneurs to leverage digital financial tools.

4.3. The moderating effect of financial literacy

Table 7 reports regression results demonstrating the moderating effect of financial literacy on the relationship between digital

Table 6
The moderating effect of digital literacy.

	Dependent variable: Entrepreneurial survival				
	(1)	(2)	(3)	(4)	(5)
Entrepreneur's gender	0.363	0.371	0.38	0.364	0.369
	(0.31)	(0.311)	(0.311)	(0.312)	(0.312)
Entrepreneur's age	−0.015*	−0.017*	−0.017*	−0.017*	−0.017*
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Entrepreneur's education level	0.102	0.107	0.105	0.109	0.106
	(0.09)	(0.091)	(0.091)	(0.091)	(0.091)
Family size	0.008	0.022	0.015	0.028	0.027
	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)
Number of family laborers	0.02	0.015	0.023	0.008	0.007
	(0.105)	(0.105)	(0.105)	(0.105)	(0.105)
Family's extra income	−0.018	−0.014	−0.014	−0.014	−0.015
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Family total liabilities	0.007	0.011	0.011	0.011	0.01
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)
Firm size	0.158***	0.159***	0.156***	0.161***	0.16***
	(0.053)	(0.053)	(0.053)	(0.053)	(0.053)
Firm performance	0.04***	0.039***	0.039***	0.038***	0.038***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Firm age	0.037***	0.036***	0.036***	0.036***	0.036***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Regional economic level	20.361***	19.07**	21.147***	17.328**	16.174**
	(7.494)	(7.538)	(7.515)	(7.622)	(7.777)
Digital literacy	0.19**	−10.66*	−10.804*	−0.929	−20.667
	(0.09)	(0.98)	(10.018)	(0.643)	(10.703)
Digital inclusive finance level		0.008**			
		(0.003)			
Digital inclusive finance level × Digital literacy		0.006*			
		(0.003)			
Breadth of coverage			0.008**		
			(0.004)		
Breadth of coverage × Digital literacy			0.007*		
			(0.004)		
Depth of use				0.006**	
				(0.002)	
Depth of use × Digital literacy				0.004*	
				(0.002)	
Degree of digitization					0.011**
					(0.005)
Degree of digitization × Digital literacy					0.007*
					(0.004)
Constant	−97.215***	−93.672***	−103.147***	−84.823**	−82.034**
	(35.1)	(35.228)	(35.247)	(35.588)	(35.956)
Pseudo R^2	0.078	0.089	0.088	0.089	0.087
LR Chi2	70.425***	80.256***	79.604***	80.015***	78.761***
AUC	0.719	0.724	0.724	0.725	0.723

Notes: *** $p<.01$, ** $p<.05$, * $p<.1$. Standard errors are in parentheses. Industry fixed effects are included. Observations = 648.

inclusive finance and entrepreneurial survival. Model 2 reveals that the interaction term between digital inclusive finance and financial literacy is significantly positive (Beta = 0.007, $p < .1$), indicating that financial literacy strengthens the positive effect of digital inclusive finance on entrepreneurial survival, supporting Hypothesis 3. Models 3, 4, and 5 further explore the interaction terms between the sub-dimensions of digital inclusive finance and financial literacy. All coefficients remain positive, indicating that financial literacy consistently enhances the effect of digital inclusive finance across its sub-dimensions. Additionally, Model 1 demonstrates that financial literacy has a significant positive effect on rural entrepreneurial survival.

5. Robustness checks

5.1. Test of impact mechanism

To explore the mechanism through which digital inclusive finance enhances rural entrepreneurial survival, this study tested its impact on entrepreneurial performance, using profits (logged) as a proxy for performance. Table 8 presents the results of this mediating analysis. Model 2 shows that digital inclusive finance significantly improves entrepreneurial performance, while Model 3 confirms that entrepreneurial performance partially mediates the relationship between digital inclusive finance and entrepreneurial survival. These findings suggest that digital inclusive finance enhances rural entrepreneurial survival by boosting business

Table 7
The moderating effect of financial literacy.

	Dependent variable: Entrepreneurial survival				
	(1)	(2)	(3)	(4)	(5)
Entrepreneur's gender	0.358	0.365	0.371	0.36	0.365
	(0.31)	(0.312)	(0.312)	(0.313)	(0.313)
Entrepreneur's age	−0.016*	−0.018**	−0.017*	−0.018**	−0.018**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Entrepreneur's education level	0.106	0.111	0.11	0.112	0.11
	(0.09)	(0.091)	(0.091)	(0.091)	(0.091)
Family size	0.013	0.026	0.018	0.031	0.03
	(0.072)	(0.073)	(0.073)	(0.073)	(0.073)
Number of family laborers	0.022	0.018	0.026	0.01	0.01
	(0.105)	(0.105)	(0.105)	(0.105)	(0.105)
Family's extra income	−0.018	−0.013	−0.013	−0.013	−0.014
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Family total liabilities	0.006	0.011	0.011	0.01	0.01
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)
Firm size	0.159***	0.158***	0.156***	0.161***	0.159***
	(0.053)	(0.053)	(0.053)	(0.053)	(0.053)
Firm performance	0.041***	0.039***	0.04***	0.039***	0.038***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Firm age	0.037***	0.036***	0.036***	0.037***	0.037***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Regional economic level	20.595***	19.045**	21.21***	17.297**	16.093**
	(7.492)	(7.538)	(7.514)	(7.625)	(7.778)
Financial literacy	00.233**	−2.094*	−2.315*	−1.152	−3.244
	(00.11)	(1.236)	(1.297)	(0.798)	(2.073)
Digital inclusive finance level		0.008**			
		(0.003)			
Digital inclusive finance level × Financial literacy		0.007*			
		(0.004)			
Breadth of coverage			0.008**		
			(0.004)		
Breadth of coverage × Financial literacy			0.009*		
			(0.005)		
Depth of use				0.006***	
				(0.002)	
Depth of use × Financial literacy				0.004*	
				(0.003)	
Degree of digitization					0.011**
					(0.005)
Degree of digitization × Financial literacy					0.009*
					(0.005)
Constant	−98.311***	−93.581***	−103.478***	−84.686**	−81.674**
	(35.093)	(35.229)	(35.238)	(35.601)	(35.956)
Pseudo R^2	0.078	0.089	0.089	0.089	0.088
LR Chi2	70.250***	79.873***	79.224***	79.646***	78.379***
AUC	0.718	0.725	0.725	0.725	0.723

Notes: *** $p<.01$, ** $p<.05$, * $p<.1$. Standard errors are in parentheses. Industry fixed effects are included. Observations = 648.

performance.

5.2. Estimation based on cox proportional risk model

This study further utilized the Cox proportional risk model to analyze the impact of digital inclusive finance on rural entrepreneurial survival. This model allows for the estimation of survival rates for rural entrepreneurs.

The test results are presented in Table 9. Model 1 reports the regression coefficients for each variable, while Model 2 provides the proportional hazard values, indicating the deviation of entrepreneurial exit risk for each variable from the baseline exit risk. A value <1 indicates that the corresponding variable significantly reduces the risk of entrepreneurial exit, whereas a value greater than 1 increases the risk.

The results show that the coefficient for digital inclusive finance is significantly negative, indicating that an increase in the level of digital inclusive finance reduces the risk of entrepreneurial exit. This finding further confirms the positive effect of digital inclusive finance on rural entrepreneurial survival.

Table 8
Robustness Results1: The mediating role of entrepreneurial performance.

	(1)	(2)	(3)
	Entrepreneurial survival	Entrepreneurial performance	Entrepreneurial survival
Entrepreneur's gender	0.359	−0.477	0.384
	(0.308)	(0.856)	(0.31)
Entrepreneur's age	−0.02**	0.003	−0.02**
	(0.009)	(0.024)	(0.009)
Entrepreneur's education level	0.119	−0.003	0.122
	(0.089)	(0.249)	(0.09)
Family size	0.033	0.056	0.032
	(0.072)	(0.201)	(0.072)
Number of family laborers	0.019	−0.12	0.022
	(0.104)	(0.289)	(0.104)
Family's extra income	−0.01	0.148**	−0.016
	(0.025)	(0.07)	(0.025)
Family total liabilities	0.005	−0.08*	0.008
	(0.015)	(0.043)	(0.015)
Firm size	0.184***	0.299**	0.174***
	(0.052)	(0.143)	(0.052)
Firm age	0.039***	0.071***	0.036***
	(0.009)	(0.026)	(0.009)
Regional economic level	19.997***	−2.887	20.501***
	(7.428)	(20.39)	(7.497)
Digital inclusive finance level	0.01**	0.028**	0.009*
	(0.005)	(0.013)	(0.005)
Entrepreneurial performance			0.042***
			(0.015)
Constant	−97.764***	9.796	−100.02***
	(34.809)	(95.428)	(35.139)
R^2	0.067	0.06	0.077

Notes: *** $p<.01$, ** $p<.05$, * $p<.1$. Standard errors are in parentheses. Industry fixed effects are included. Observations = 648.

Table 9
Robustness Results2: Estimation based on cox proportional risk model.

Variables	(1) Coefficient	(2) Proportional hazard
Digital inclusive finance level	−0.006**	0.999**
Entrepreneur's gender	−0.115	1.347
Entrepreneur's age	−0.011*	1.001*
Entrepreneur's education level	−0.150***	0.948***
Family size	0.039	1.143
Number of family laborers	0.023	1.172
Family's extra income	0.000	1.037
Family total liabilities	0.004	1.025
Firm size	−0.063**	1.000**
Firm performance	−0.034***	0.982***
Regional economic level	−0.022	23.227

Notes: *** $p<.01$, ** $p<.05$, * $p<.1$. Industry fixed effects are included.

5.3. Estimation using instrumental variable

To address potential endogeneity issues, such as unobserved variables or reverse causality between digital inclusive finance and rural entrepreneurial survival, this study employs an instrumental variable approach. Given that the development of digital inclusive finance, represented by Alipay, originated in Hangzhou, the city is a leading hub for its advancement. Geographically, it can be expected that regions closer to Hangzhou exhibit better development of digital inclusive finance. Accordingly, this study uses the spherical distance from the provincial capital of each entrepreneur's province to Hangzhou as an instrumental variable. In Model 1 of Table 10, the spherical distance is significantly negatively correlated with the level of digital inclusive finance in the first-stage regression, indicating that proximity to Hangzhou is associated with higher levels of digital inclusive finance. Model 2 further confirms that digital inclusive finance has a significant positive effect on rural entrepreneurial survival, even after addressing potential endogeneity issues. These findings align with our baseline regression results.

Table 10
Robustness Results3: Estimation using instrumental variable.

	(1) first stage Digital inclusive finance level	(2) second stage Entrepreneurial survival
Entrepreneur's gender	0.1943	0.0924
	(2.537)	(0.069)
Entrepreneur's age	0.0942	−0.0049**
	(0.071)	(0.002)
Entrepreneur's education level	0.7702	0.0260
	(0.737)	(0.020)
Family size	0.2742	0.0092
	(0.597)	(0.016)
Number of family laborers	−0.6115	0.0051
	(0.858)	(0.023)
Family's extra income	−0.1916	−0.0031
	(0.207)	(0.006)
Family total liabilities	−0.2607**	0.0026
	(0.128)	(0.003)
Firm size	−0.0938	0.0390***
	(0.424)	(0.011)
Firm performance	0.0393	0.0088***
	(0.118)	(0.003)
Firm age	0.0879	0.0080***
	(0.076)	(0.002)
Regional economic level	62.6943	3.8514**
	(60.745)	(1.653)
Distance to Hangzhou	−3.5423***	
	(0.129)	
Digital inclusive finance level		0.0031***
		(0.001)
Constant	43.2239	−19.0858**
	(284.352)	(7.696)
R^2	0.582	0.105
F/Wald chi^2	62.88***	79.72***

Notes: *** $p<.01$, ** $p<.05$, * $p<.1$. Standard errors are in parentheses. Industry fixed effects are included. Observations = 648.

6. Theoretical contribution

This study makes several important theoretical contributions to the fields of entrepreneurship, rural development, and digital finance.

First, this study contributes to the growing literature on digital inclusive finance by examining its effects not only on entrepreneurial entry but also on business survival. While prior research has primarily focused on how digital inclusive finance stimulates entrepreneurship entry (Mao et al., 2023; Wu and Wu, 2023), this study shifts the focus to entrepreneurial outcomes after entry. It demonstrates that digital inclusive finance enhances the survival prospects of rural entrepreneurs by reducing financial exclusion, lowering transaction costs, and improving access to credit. This broadens the theoretical understanding of the role digital financial services play across the entrepreneurial lifecycle, from entry to survival.

This study expands the research on the antecedents of entrepreneurial survival by introducing digital inclusive finance as a novel determinant in rural contexts. Factors influencing entrepreneurial survival are central to entrepreneurship research (Josefy et al., 2017). While prior studies have primarily examined macro-level factors such as the economic environment (Simón-Moya et al., 2016; Tavassoli and Carbonara, 2014), firm-level characteristics like size (Agarwal and Audretsch, 2001), performance (Wennberg et al., 2010), and individual-level factors such as entrepreneurial experience (Van Praag, 2003), human capital (Koch et al., 2013), this study highlights the transformative role of digital finance in rural markets. By examining the impact of digital inclusive finance on rural entrepreneurial survival, the research provides a fresh perspective on the financial conditions necessary for sustained entrepreneurial activity in resource-constrained environments

Third, this study underscores the critical role of human capital in moderating the relationship between digital inclusive finance and entrepreneurial survival. Specifically, it shows that digital and financial literacy amplify the positive effects of digital finance on business survival. While existing research has often emphasized financial access as a primary driver of entrepreneurial outcomes, this study highlights the importance of digital and financial literacy as essential moderators enabling entrepreneurs to maximize the benefits of digital finance. This finding aligns with human capital theory, suggesting that entrepreneurs with higher levels of digital and financial skills are better equipped to leverage digital financial services effectively. Moreover, the study complements financial intermediation theory (Levine et al., 2000) by demonstrating how individual capabilities enhance the effectiveness of institutional interventions.

7. Economic and policy implications

The findings of this study reveal significant economic and policy implications that extend beyond the immediate research context.

First, bridging financial inclusion gaps. Policymakers should prioritize the expansion of digital financial services in underserved rural areas. Enhancing infrastructure for mobile banking, fintech platforms, and internet connectivity can significantly reduce barriers to financial inclusion. Targeted subsidies or incentives for financial institutions could encourage investment in digital infrastructure and outreach programs in rural areas, addressing systemic barriers such as geographic isolation and high transaction costs.

Second, strengthening digital and financial literacy. Our findings indicate that digital and financial literacy significantly moderate the relationship between digital inclusive finance and rural entrepreneurial survival. However, it is also evident that digital literacy and financial literacy are unevenly distributed, often correlating with education levels and regional development conditions. In particular, individuals with higher levels of education tend to possess better financial literacy (Lusardi and Mitchell, 2008; Lusardi and Mitchelli, 2007), leading to more effective financial decision-making and greater benefits from digital financial services. This highlights the importance of tailoring financial education programs to rural entrepreneurs with lower levels of formal schooling, who may require simplified and context-specific training materials to bridge foundational gaps in financial literacy. Moreover, digital literacy is intricately linked to the regional availability of digital infrastructure. Entrepreneurs residing in more developed regions with robust broadband networks and mobile payment ecosystems are more likely to develop stronger digital capabilities. Therefore, policies aimed at improving rural entrepreneurial resilience through digital inclusive finance must adopt a two-pronged strategy: (1) strengthening infrastructure development in under-served rural areas to enhance digital access and (2) delivering digital skills training to empower entrepreneurs to effectively utilize these tools once access is provided.

Third, addressing digital and financial gender gap. Women face structural barriers to accessing both digital technologies and formal financial services, which can be exacerbated in rural areas. Policymakers could consider gender-specific interventions to address these gaps. This could include targeted programs to improve digital and financial literacy among women, as well as initiatives to increase their access to digital financial services. Besides, development agencies could prioritize educational programs that focus on building digital and financial skills among women entrepreneurs. This can help bridge the gap and ensure that women can fully benefit from digital financial inclusion.

Forth, integrating traditional and digital finance. Encouraging synergies between traditional banking systems and digital financial services can further enhance rural entrepreneurial survival. Traditional banks can leverage digital platforms to provide customized financial products for rural entrepreneurs. Regulatory frameworks should be adapted to foster innovation while safeguarding consumers, ensuring that digital finance solutions remain accessible and reliable.

Fifth, addressing regional disparities. Regional economic development policies must account for disparities in access to digital financial services. For example, provinces with lower levels of digital financial inclusion could benefit from targeted development funds and inter-regional collaborations.

8. Limitations and future research

This study also has some limitations, which provide directions for future research. Firstly, the findings of this study are based solely on data from rural China, comparative studies across different countries or regions may validate and generalize these findings, particularly in contexts with varying levels of financial inclusion and technological adoption. Secondly, we have not considered the differential impacts of digital financial inclusion across various sectors. Examining the impact of digital inclusive finance on specific sectors, such as agriculture or manufacturing, may provide deeper insights into its role in economic development. Thirdly, we only utilized data from the years 2017 and 2019. Expanding the dataset to cover additional years could capture long-term trends and provide a more comprehensive understanding of entrepreneurial survival dynamics.

9. Conclusion

This study investigates the impact of digital inclusive finance on the survival of rural entrepreneurs in China, with a particular focus on the moderating effects of digital and financial literacy. By shifting the focus from entrepreneurial entry to the factors influencing long-term entrepreneurial survival, the research addresses a critical gap in the existing literature on rural entrepreneurship.

Using data from the 2017 and 2019 China Household Finance Surveys, the findings demonstrate that digital inclusive finance significantly enhances entrepreneurial survival. This is achieved through improved access to financial services, reduced transaction costs, and increased financing efficiency. Entrepreneurs with higher levels of digital and financial literacy derive greater benefits from these services, underscoring the importance of skills in navigating digital platforms and understanding financial products. These findings highlight the crucial interplay between digital inclusive finance and human capital in fostering business longevity.

Additionally, the study identifies improved business performance as a key mechanism through which digital inclusive finance supports entrepreneurial survival. By facilitating access to capital, digital inclusive finance enables rural entrepreneurs to make strategic investments in their businesses, resulting in enhanced performance and, consequently, higher survival rates.

In conclusion, this research underscores the transformative role of digital inclusive finance in sustaining rural entrepreneurship and emphasizes the need to enhance digital and financial literacy among entrepreneurs to maximize the potential benefits of these financial innovations.

CRediT authorship contribution statement

Bin Li: Writing – original draft, Supervision, Resources, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Ya Pan:** Writing – original draft, Software, Investigation, Data curation.

Declaration of competing interest

All authors have contributed to the creation of this manuscript for important intellectual content and read and approved the final manuscript. We declare there is no conflict of interest.

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Appendix

Table A1
Questions for the survey items used to generate the financial literacy variable.

Interest Rate Calculation Question	[**Question**] Assuming that the bank's interest rate is 4 % per annum, if ¥100 is deposited for a fixed term of 1 year, what will be the principal and interest earned after 1 year? [**Answer**] 1. less than ¥104, 2. equal to ¥104, 3. greater than ¥104, 4. cannot calculate
Inflation question	[**Question**] Assuming that the bank's interest rate is 5 % per annum and the inflation rate is 3 % per annum, how many will you be able to buy after depositing ¥100 in the bank for one year? [**Answer**] 1. more than a year ago, 2. as much as a year ago, 3. less than a year ago, 4. can't figure it out
Investment Risk Question	[**Question**] Which do you think is generally riskier, stocks or funds? [**Answer**] 1. stocks, 2. Funds, 3. haven't heard of stocks, 4. haven't heard of funds, 5. haven't heard of either, 6. same

Table A2
Digital literacy index: Principal component analysis.

	using internet to obtain information	making online purchases	using internet to sell products or services	using mobile payments
Scores	0.52	0.538	0.361	0.558
Eigenvalue	2.014	0.85	0.628	0.508
Proportion explained	0.503	0.716	0.873	1

Notes: The table shows results from our principal component analysis for digital literacy index. The table also shows the proportion of the variation explained by the components, the eigenvalue of the components. The figure below presents the remaining components' eigenvalues and the 95 % confidence interval.

Table A3
Financial literacy index: Principal component analysis.

	interest rate calculation	inflation understanding	investment risk perception
Scores	−0.348	0.773	0.531
Eigenvalue	1.11	1.057	0.833
Proportion explained	0.37	0.722	1

Notes: The table shows results from our principal component analysis for digital literacy index. The table also shows the proportion of the variation explained by the components, the eigenvalue of the components. The figure below presents the remaining components' eigenvalues and the 95 % confidence interval.

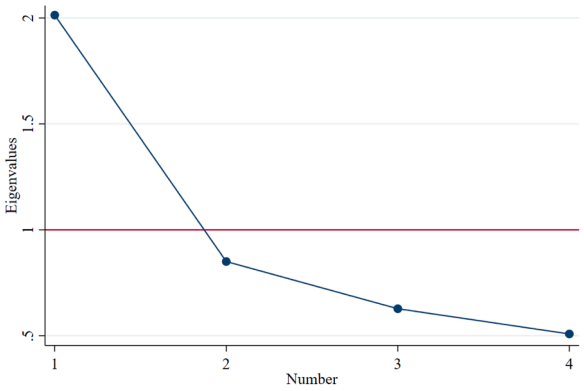

Fig. A1. Digital literacy index: Scree plot of eigenvalues.

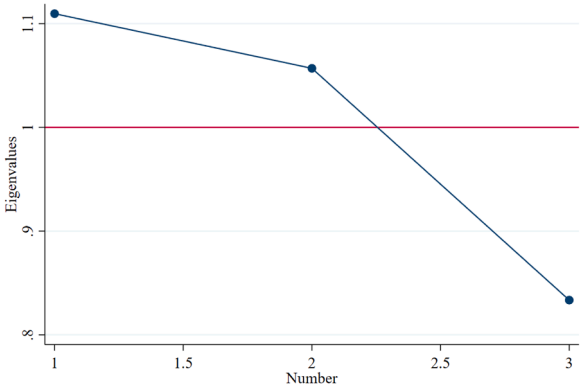

Fig. A2. Financial literacy index: Scree plot of eigenvalues.

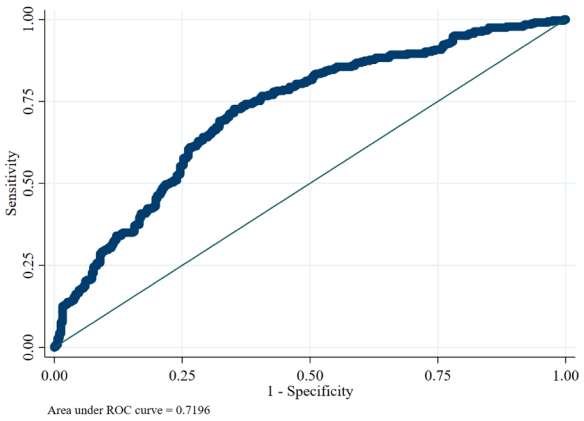

Fig. A3. ROC curve of model 2 in Table 5.

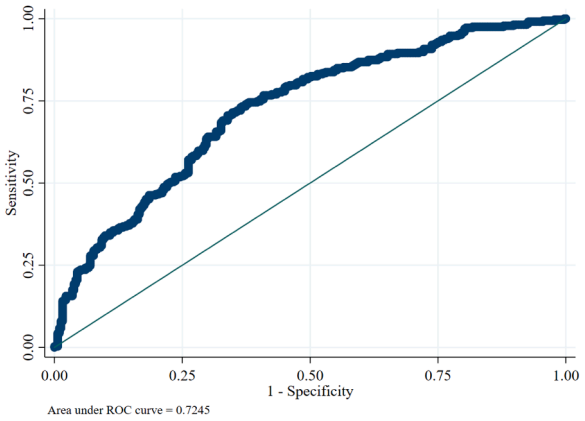

Fig. A4. ROC curve of model 2 in Table 6.

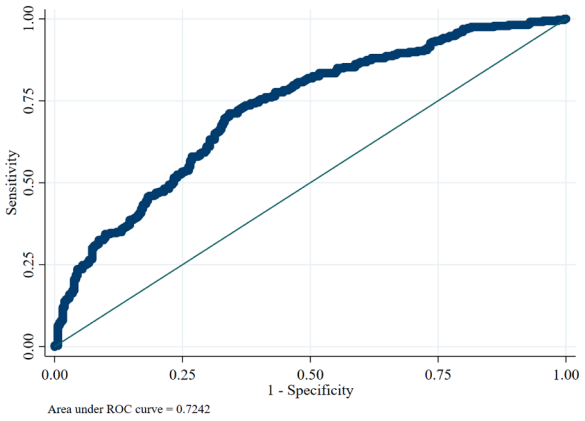

Fig. A5. ROC curve of model 2 in Table 7.

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