

Study on the Impact of Digital Inclusive Finance on The Level of Entrepreneurship in The Yellow River Basin

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Abstract: Based on the number of new enterprises registered for business each year to define the level of entrepreneurship, fixed effects are applied to study the mechanism of the impact of digital inclusive finance development on the level of entrepreneurship in the Yellow River Basin provinces from 2011 to 2020. It is found that: digital inclusive finance development as a whole is beneficial to enhance the entrepreneurship level of the provinces in the basin, mainly through three dimensions: breadth of coverage, depth of use and digitalization; further, it is found that the level of external openness and the level of resident consumption play a moderating role in the process of digital inclusive finance for entrepreneurship development. Therefore, it is suggested that achieving the level of entrepreneurship development in the Yellow River Basin requires the joint efforts of the government and market players, improving the level of external openness, and promoting the coordinated development of the upper, middle and lower reaches of the basin.

Keywords: Digital inclusive finance, Entrepreneurship level, Yellow River Basin, Openness to the outside world.

1. Introduction

In China, the Yellow River is the mother river of China, but also the ecological corridor for the provinces in the Yellow River Basin. The Yellow River Basin is the area through which the Yellow River flows in China, which connects the Qinghai-Tibet Plateau, the Loess Plateau and the North China Plain, and flows through nine provinces (regions) including Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shaanxi, Shanxi, Henan and Shandong [1]. The quality of economic development in the Yellow River basin has a pivotal role in the development of the national economy, and by 2020, the regional GDP within the basin was 2,262,422 billion yuan, accounting for 22.36% of the total national GDP. At present, under the impact of the epidemic and the background of the era of achieving the great rejuvenation of the Chinese nation, the transformation, upgrading and high-quality development of the economy cannot be achieved without the support and contribution of various regions in the country. General Secretary Xi Jinping, at the symposium on ecological protection and high-quality development of the Yellow River basin, clearly proposed the development direction of high-quality development in the Yellow River basin and promoted high-quality development in the basin [2], whose matter is a thousand-year plan for the great rejuvenation of the Chinese nation. Entrepreneurial activities have long been considered as a "powerful assistant" to promote economic development [3]. Innovative entrepreneurship usually has the function of helping residents to find employment and driving economic development. The state has introduced a series of policies to support innovation and entrepreneurship to bring into play the economic effects of dual innovation in order to achieve the high-quality development of China's economy. The high-quality development and transformation of the Yellow River Basin economy cannot be achieved without the support and contribution of dual innovation. However, entrepreneurship has always been constrained by financial constraints [4]. The emergence of digital inclusive finance has truly alleviated the problem of financial constraints faced by entrepreneurship of disadvantaged groups such as small and micro enterprises and

farmers.

The contributions of this paper are: first, it provides further empirical support for the study of the relationship between digital inclusion finance and entrepreneurship levels. Based on the panel data of 2011-2020 in the basin, the study of the impact of digital inclusive finance on entrepreneurial activities enriches the relevant theoretical foundation. Second, the research on entrepreneurship in the Yellow River Basin is relatively weak, and the study is used to provide some references for the economic development of the Yellow River Basin. This paper analyzes the study of the relationship between digital inclusive finance on the level of entrepreneurship using a two-way fixed effect model to make some scientific references for its economic transformation and high-quality development.

2. Literature Review and Research Hypothesis

Digital inclusive finance is developed on the basis of inclusive finance. Inclusive finance is defined as a new type of financial service that provides preferential and convenient access to groups with financial needs based on the principle of sustainability. In recent years, the impact of digital inclusive finance on regional entrepreneurship levels has received wide attention from scholars. Specifically, two main aspects have been studied: macro and micro. From the macro level, scholars such as Ju Qiong et al. (2023) [5] have found that digital inclusive finance has a significant role in promoting entrepreneurial activities in different regions of China from a macro perspective, accompanied by a threshold effect. At the micro level, digital inclusive finance helps to promote resident entrepreneurship, especially for groups such as rural residents and micro and small enterprises. Zeng Zhiming (2018) [6] and He Jing et al. (2019) [7] argue that digital inclusive finance, which is attached to the rapid development of digital technology, has created a new model of financial services and provided great help to alleviate the financing constraints of rural households, which has strongly promoted entrepreneurial vitality and entrepreneurial

performance. In summary, the development of digital inclusive finance has alleviated the financial constraints of the disadvantaged entrepreneurial groups with financial needs, reduced the financial pressure and the threshold of access to finance, and proved its contribution to the improvement of entrepreneurship from both macro and micro perspectives.

Based on this, the following hypotheses are proposed in this paper:

H1: The development of digital inclusive finance helps to promote the level of entrepreneurship in the basin.

The path of digital inclusive finance affecting entrepreneurial activity in the basin is influenced by other factors besides financial constraints. The degree of openness to the outside world, as one of the key factors affecting the short- and long-term development of regional economies (Liang, Roubing, 2015; Zhang, Chuanchuan et al., 2021) [8] [9], is also inextricably linked to entrepreneurship. On the one hand, more openness to the outside world brings the creation and development of entrepreneurial culture (Yang Huan, 2023) [10], entrepreneurial culture is spread in the region to inherit, and entrepreneurial skills are accumulated and developed in this cultural atmosphere, which in turn creates good conditions for entrepreneurial activities. On the other hand, openness implies an increase in the number of foreigners, including highly educated people (Jia, 2014) [11], and a corresponding increase in the level of human capital in the region, which further indicates that the increase in talent provides talent support for entrepreneurship; at the same time, human capital is long-lasting in the regional spatial agglomeration (Andersson, 2011) [12]. Thus, opening up to the outside world has brought about a favorable entrepreneurial environment and human resources. Digital financial inclusion increases the strength and level of openness to the outside world through transmission paths such as technological progress and accumulation of various resources, which in turn affects the level of entrepreneurship.

Based on this, the following hypotheses are proposed in this paper:

H2: Digital inclusive finance acts on entrepreneurial activities in the basin through the level of regional outreach.

3. Study Design

3.1. Data sources

This paper uses the Peking University Digital Inclusive Finance Index and entrepreneurship level as explanatory and explanatory variables to test the theoretical and empirical aspects of the impact of China's digital inclusive finance development on entrepreneurship level in the Yellow River basin by selecting panel data of each province from 2011 to 2020. The digital inclusive finance index was obtained from the Digital Inclusive Finance Research Center of Peking University, and the entrepreneurship data were obtained from the annual set of business registration information of mainland enterprises, and the unpublished data were obtained by referring to enterprise information query platforms, such as Enterprise Search. Other data are obtained from the statistical yearbooks of each province.

3.2. Variable description

In this paper, the Digital Inclusive Finance Development Index is selected as the explanatory variable, covering the three first-level indicators of the total index of digital

inclusive finance: the breadth of coverage (COV), the depth of use (USE), and the degree of digitization (DIG) of digital financial services. To facilitate the follow-up study, some of the data were standardized. Referring to the study by Li, Xiaoyuan and others, each index is divided by 100 as a measure in this paper. Referring to the study by Feng Yongqi (2021) [13] and other scholars, since the resident population is considered to be the largest contributor to the economy in economics, the proportion of private and self-employed employment to the resident population is chosen as the explanatory variable in this paper. The level of foreign openness (FDI) and the level of resident consumption (CON) are used as the moderating variables. (1) The level of foreign openness is measured by the ratio of total imports and exports to the regional GDP of each province. (2) The level of resident consumption is measured by the consumption index of the region. With reference to previous studies, the control variables selected are: (1) Level of economic development (PGDP): take the GDP per capita of each province and use the logarithm to measure it. The China Entrepreneurship Monitor Report shows that the entrepreneurship index in the southern coastal cities is substantially ahead of the western and northeastern regions, indicating that the level of economic development is an important influencing factor on the level of regional entrepreneurship, so the per capita GDP is used as a control variable. (2) Regional education level (HC): measured by the average number of students enrolled in higher education schools per 100,000 population. The level of education in a region influences to some extent the amount of talent in the region, and it is a source of talent for business entrepreneurship providers [14]. (4) Traffic network density (TRA): the ratio of traffic miles in the region to the area of the province is selected as a measure to reflect the accessibility of the region. (4) Labor force level (LAB): the number of people employed in each region, taken as a logarithm, is used as a measure. (5) Industrial structure (IS): the value added of secondary and tertiary industries and the gross regional product are selected as measures. The descriptive statistics of the relevant variables are shown in Table 1.

3.3. Model construction

To explore the impact of digital financial inclusion on the level of entrepreneurship in the watershed, the following base model is set based on the previous hypothesis:

$$Y_{it} = \alpha_0 + \alpha_1 DIFI_{it} + \beta X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (1)$$

$$Y_{it} = \alpha_0 + \alpha_1 DIFI_{it} + \alpha_2 OPEN_{it} + \alpha_3 DIFI_{it} \cdot OPEN_{it} + \beta X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (2)$$

Among them, the explanatory variable Y indicates the level of entrepreneurship, and the explanatory variable DIFI indicates the level of development of digital inclusive finance and includes three sub-indices of breadth of coverage, depth of use, and degree of digitization. The moderating variable OPEN denotes the level of openness of each province to the outside world, and X denotes the control variables, including GDP per capita, human capital level, labor force level, transportation network density, and industrial structure upgrading. i denotes province; t denotes year; and are regression coefficients; i denotes province fixed effects and t denotes year fixed effects; denotes a random disturbance term.

Table 1. Descriptive statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Y	90	0.169	0.0639	0.0775	0.430
DIFI	90	2.031	0.924	0.183	3.478
COV	90	1.870	0.940	0.0196	3.317
USE	90	1.844	0.889	0.0676	3.449
DIG	90	2.901	1.123	0.390	4.537
PGDP	90	10.70	0.319	9.883	11.24
HC	90	7.730	0.270	6.987	8.327
LNLABOR	90	7.447	1.035	5.631	8.802
TRANS	90	0.968	0.756	0.0380	3.274
IS	90	0.902	0.0225	0.861	0.954
ISM2	90	0.462	0.0525	0.327	0.553
OPEN	90	0.161	0.534	0.00568	5.112
CONSUME	90	109.3	16.41	99.80	166.6

4. Empirical Study

4.1. Benchmark regression of the impact of China's digital inclusive finance development on regional entrepreneurship

Before the benchmark regression, individual effects and the Hausman test were conducted successively, and when the Hausman test chose a fixed effect or random effect, the fixed effect model was found to be more appropriate by the test, so the fixed effect model was chosen in this paper. The four models in Table 2 represent the effects of the total digital inclusive finance index and the three sub-indices on the level of entrepreneurship in each region. It is found that the

development of digital inclusive finance has a significant contribution to the level of entrepreneurship (coefficient 0.348), which is positively correlated at the 1% level, and the breadth of coverage, depth of use, and digitalization are also significantly and positively correlated to the level of entrepreneurship at the 5% level, which means that the higher the level of digital inclusive finance development, the higher the level of entrepreneurship in the region will be accordingly. This is consistent with the findings of Zhao Tao (2020) [15] and others. The significance of the three sub-indices is the same, but the coefficient of the breadth of coverage, 0.266, is higher than the other two dimensions, indicating that the breadth of coverage has the greatest impact on the level of entrepreneurship within the watershed.

Table 2. Baseline regression results for the impact of digital inclusion and financial development on the level of entrepreneurship.

	(1) modell	(2) model2	(3) model3	(4) model4
DIFI	0.348*** (0.068)			
COV		0.266** (0.099)		
USE			0.138** (0.047)	
DIG				0.067** (0.020)
PGDP	-0.163** (0.051)	-0.087 (0.055)	-0.153* (0.058)	-0.120* (0.054)
HC	-0.037 (0.073)	-0.058 (0.089)	0.046 (0.079)	0.031 (0.078)
TRANS	0.029 (0.023)	0.028 (0.026)	0.031 (0.026)	0.022 (0.026)
LNLABOR	-0.230* (0.094)	-0.201 (0.106)	-0.210* (0.105)	-0.257* (0.103)
IS	-0.720 (0.493)	0.330 (0.533)	-0.342 (0.542)	-0.663 (0.559)
_cons	4.532*** (1.002)	2.838** (1.049)	3.428** (1.074)	3.866*** (1.085)
Province fixed	yes	yes	yes	yes
Time fixed	yes	yes	yes	yes
N	90	90	90	90
adj. R ²	0.839	0.795	0.799	0.807

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

4.2. Robustness test

To ensure the stability and reliability of the results, the following methods were used for robustness testing:

(1) Instrumental variable method. Considering the possible reverse causality problem between digital financial inclusion itself and entrepreneurship level, this paper selects Internet penetration as an instrumental variable for validation based on previous studies. On the one hand, digital inclusive finance arises on the basis of the development of the Internet, and the instrumental variable Internet penetration has a correlation with the explanatory variable digital inclusive finance development level, and the WALD F value is much greater than 10, so there is no weak instrumental variable. On the other hand, after controlling for variables such as regional economic development level and education level, the level of digital inclusive finance development will not have much

influence relative to the level of entrepreneurship in a specific region, so the Internet penetration rate meets the criteria of the instrumental variable.

(2) The independent variables are lagged by one period. The digital financial inclusion index is lagged by one period to study its effect on the level of entrepreneurship.

(3) Substitution of the dependent variable. The sum of the number of employed individuals and the number of employed private enterprises will be used as the dependent variable for replacement.

The specific robustness test results are shown in columns (1)-(3) of Table 3, and the revalidated results are still significantly positive, which is consistent with the regression results above, indicating that the development of digital inclusive finance has a positive contribution to the improvement of entrepreneurship levels in the basin. Thus, hypothesis 1 is further validated and supported.

Table 3. Robustness results

	Instrumental Variables Method	Independent variable lagged by one period	Substitution of dependent variable
Y	(1)	(2)	(3)
DIFI	0.42** (1.87)		2791.9*** (4.64)
L.DIFI		0.33*** (4.12)	
_cons	4.497** (2.91)	3.76*** (3.49)	26408.6** (3.08)
Controls	yes	yes	yes
Province fixed	yes	yes	yes
Time fixed	yes	yes	yes
N	90	90	90
R-sq	0.9981	0.8669	0.94
adj. R-sq	0.9975	0.8165	0.91
F	2398.78	17.18	42.31

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

4.3. Transmission mechanism

To further explore the channels through which digital inclusion finance affects the level of entrepreneurship in the basin, this paper introduces the level of external openness for analysis. Table 4 shows the test results for the role of digital inclusive finance through the level of external openness with entrepreneurial activities. The total index of digital inclusive finance is significantly positive at the 1% level, and the sub-indexes are also significantly positive at the 5% and 10% levels. The cross-products of the total index and sub-indexes of digital inclusive finance and the level of external openness are mostly significantly positive at the 1% level, indicating that the more significant the promotion effect of digital inclusive finance on the level of entrepreneurship in regions with a high level of external openness, the more the hypothesis 2 above is verified. The level of external openness is measured by the total annual import and export of each province, which reflects the degree of external communication and openness of each province. The construction of the Belt and Road and the Free Trade Zone are typical cases; the higher the degree of external openness, the richer the resources brought and the more beneficial it is to the development of entrepreneurial activities in the region (Yang Huan, 2023) [10]. The development of digital inclusive

finance in regions with higher levels of openness allows more disadvantaged groups to enjoy the convenience and efficiency of modern financial services, driving the level of entrepreneurship in themselves and neighboring provinces (Sun Yong, 2021) [14].

5. Conclusions and Recommendations

5.1. Conclusion of the study

Using the digital inclusive finance index and entrepreneurship level of the Yellow River Basin provinces from 2011 to 2020 as research data, this paper explores the total and moderating effects of digital inclusive finance on the entrepreneurship level of the upper and middle provinces in the basin using a fixed effects model based on theoretical combing and draws the following conclusions: Firstly, the total and sub-indexes of digital inclusive finance cover breadth, depth, and digitization on This further indicates that the broader the coverage and the broader the beneficiary group, the more it can alleviate credit constraints and the more it is conducive to improving entrepreneurship in the basin. Second, digital financial inclusion not only directly promotes entrepreneurial activities but is also influenced by the degree of external openness. The promotion effect of inclusive digital

finance development on the level of entrepreneurship is more significant in regions with a high level of external openness. This indicates that only regions with a high degree of

openness to the outside world receive the "inclusive" dividend of digital inclusion policies.

Table 4. Transmission effects of the level of external openness

Variables	Y			
	(1)	(2)	(3)	(4)
DIFI	0.280*** (0.064)			
COV		0.265** (0.082)		
USE			0.097* (0.041)	
DIG				0.046* (0.020)
OPEN	-0.314*** (0.086)	-0.430*** (0.082)	-0.404*** (0.089)	-0.260** (0.096)
DIFIOPEN	0.122*** (0.033)	0.173*** (0.033)	0.173*** (0.038)	0.076** (0.027)
_cons	3.577*** (0.948)	1.777* (0.818)	2.156* (0.903)	2.696** (0.985)
Controls	yes	yes	yes	yes
Province fixed	yes	yes	yes	yes
Time fixed	yes	yes	yes	yes
N	90	90	90	90
adj. R ²	0.866	0.855	0.848	0.821

Standard errors in parentheses

* p < 0.05, ** p < 0.01, *** p < 0.001

5.2. Policy Recommendations

Based on the above findings, this paper makes the following recommendations:

Firstly, giving full play to the service advantages of digital inclusive finance, including broadening the scope of services, diversifying financial products, and improving service efficiency, and actively promoting its advantages. On the one hand, national policies give support and affirmation to vigorously develop digital inclusive finance so that it can benefit more regions and make entrepreneurial groups with capital needs understand and be willing to participate in and use digital finance. On the other hand, traditional financial institutions and other entities should also continue to innovate financial service products so that they can meet the service needs of entrepreneurs.

Secondly, creating a good entrepreneurial environment and strengthening collaboration with other regions. The entrepreneurial environment and cultural atmosphere of a region also play a very important role in whether entrepreneurs start a business. The formation and development of the innovation and entrepreneurship economy in the Yellow River Basin does not only rely on policy support but also requires the support of the innovation and entrepreneurship capacities of the upstream, midstream, and downstream regions. On the one hand, it is important to increase the level of openness in the region to attract more entrepreneurial resources and create an entrepreneurial environment conducive to entrepreneurship. The dual-innovation environment in the middle and downstream regions is relatively backward, but they can innovate advantageous products according to their geographical advantages, increase the added value of products, develop special industries, and build industrial chains. While giving play to the leading industries, focus on synergistic

development with downstream regions and southeast coastal areas, absorbing their favorable resources and carrying out industrial cooperation and other measures, while upstream regions with relatively dense innovation and entrepreneurship further optimize entrepreneurial resources and environments to form spatial clustering advantages. On the other hand, both upstream and downstream regions should pay attention to the cultivation of talents and improve the level of local human capital. In addition to responding positively to the national policy of attaching importance to education, it is also necessary to integrate the education of innovation and entrepreneurship spirit and ability. In addition to financial resources, human resources are also one of the essential conditions for entrepreneurship; therefore, improving the level of human capital in the region is crucial to the region's innovation and entrepreneurship.

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