

Is Digital Financial Inclusion a New Driving Force for Rural Revitalization: Empirical Evidence Based on Provincial Panel Data

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Abstract. Firstly, based on using the entropy weight method to construct the evaluation index of rural revitalization level, this paper cites the digital financial inclusion index measured by Peking University, constructs a fixed-effect model, and uses the method of gradually adding control variables to evaluate the country's 31 years in 2014-2018. The panel data of each province, city, and autonomous region are tested empirically. Secondly, through the systematic clustering method, the country is divided into high-level and low-level regions, with the development level of digital finance as the standard to discuss the heterogeneity. Finally, the economic development level is included as the threshold variable, and the nonlinear relationship between inclusive digital finance and rural revitalization is discussed. The results are shown that inclusive digital finance has a role in promoting the development of rural revitalization. It mainly drives rural revitalization and development through the breadth of coverage and the degree of digitalization; second, the development of inclusive digital finance from the perspective of regions. A place with a high level has a greater role in promoting rural revitalization. Thirdly, factors affecting the level of economic development are included. There is a nonlinear relationship between inclusive digital finance and rural revitalization, and there is a threshold effect. When the level of economic development crosses the threshold and the value is reached. The promotion effect of inclusive digital finance on rural revitalization will be enhanced.

Keywords: Rural revitalization, digital financial inclusion, panel data, threshold effect model.

1. Introduction

As a product of the integration of big data technology and inclusive finance, inclusive digital finance has greatly reduced the cost of financial services by providing financial services with lower thresholds and more convenience and contributed to better financial services for disadvantaged groups. According to previous research results, we found that the impact of digital financial inclusion on rural revitalization has not been discussed much. With the development of big data, inclusive digital finance will positively impact social development, and its impact on the overall development level of rural areas cannot be underestimated. Therefore, studying whether inclusive digital finance has an impact on rural revitalization and what kind of impact will better guide various regions to accelerate the improvement of rural revitalization level by promoting the development of inclusive digital finance, narrow the gap between urban and rural areas in many aspects, and achieve common development. Therefore, based on the perspective of promoting rural revitalization, this paper empirically studies the impact of inclusive digital finance on the development level of rural revitalization.

Research method: this paper first searches for many kinds of literature on the connotation of inclusive digital finance and rural revitalization, which is based on the research content. The construction of a rural revitalization evaluation index system and the impact of inclusive digital finance on rural revitalization. The empirical analysis is as follows: First, select the indicators to construct the rural revitalization index, assign weights to the corresponding indicators according to the objective weighting method, and use this weight to calculate the level of rural revitalization and development. Secondly, it is used to study the impact of digital financial inclusion on rural revitalization and development. This paper establishes an individual fixed effect model and gradually adds control variables for analysis. Then, this paper conducts a heterogeneity analysis and further

uses the threshold effect model to analyze the influence of external factors, which further studies the relationship between digital financial inclusion and rural revitalization and development. Finally, a robustness test is carried out in this paper to confirm the stability of the results.

2. Rural revitalization level measurement and current situation analysis

2.1. Selection of indicators

There have been many related studies on the evaluation index system of rural revitalization in recent years. Many scholars take the overall goals of industrial prosperity, ecological livability, rural civilization, effective governance, and affluent life in the rural revitalization strategy proposed by the 19th National Congress of the Communist Party of China as the primary indicators, and by selecting many secondary indicators, give the corresponding weights are calculated to obtain the level of rural revitalization [15-17]. In terms of weighting methods, Mao Jinhua and Wang Lintao (2020) adopted a comprehensive weighting method combining subjective weighting method-analytic hierarchy process and objective weighting method-entropy weighting method. The comprehensive weight of the class secondary indicators [18]. Therefore, based on a comprehensive reference to relevant evaluation research, this paper selects relevant indicators from five aspects to construct a rural revitalization evaluation index system.

2.2. Determination of Evaluation Index Weight Based on Entropy Method

In order to evaluate the research object objectively and accurately, this paper uses the entropy value method in the objective weighting method to calculate the three-level indicators determined above for weighting:

1) The range standard method is dimensionless for each indicator in the indicator system Processing:

For positive indicators: $Z_{tij} = (x_{tij} - x_{min}) / (x_{max} - x_{min})$ For reverse indicators:

$$Z_{tij} = (x_{max} - x_{tij}) / (x_{max} - x_{min})$$

Where x_{max} , x_{min} are different indicators j in all evaluation objects. The maximum and minimum values of, and x_{tij} is the index value of the j th index of the i th city in the t th year.

2) Normalization of indicators

$$P_{ij} = Z_{tij} / \sum_{t=1}^h \sum_{i=1}^m Z_{tij}$$

3) Calculate the entropy value of each index

$$E_j = -k \sum_{t=1}^h \sum_{i=1}^m P_{ij} \ln P_{ij}$$

$$k = 1 / \ln(h \cdot m)$$

4) Calculate the redundancy of the entropy value of each index

$$D_j = 1 - E_j$$

5) Calculate the weight of each indicator

$$W_j = D_j / \sum_{j=1}^n D_j$$

2.3. Analysis of the status quo of rural revitalization level

After calculating the weights of the above 16 indicators by the entropy method, this paper uses $x_{t1}, x_{t2}, x_{t3} \dots$ The value after the impact of the evaluation model of rural revitalization and development level can be finally obtained: $V_t = \sum_j (W_j \times x_{tj})$. According to the evaluation model, the comprehensive scores of the rural revitalization and development levels in each province are calculated and detailed in Appendix II. Moreover, use this data to draw a map of the rural

revitalization level of different provinces from 2014 to 2018. The darker the color, the higher the rural revitalization level, and the lighter the color, the lower the development level.

The development speed of rural revitalization level has obvious regional heterogeneity. The results in Figure 3 show that the Chengdu-Chongqing region, the middle reaches of the Yangtze River, the Bohai Rim region, the Yangtze River Delta region, and the Pearl River Delta region have developed the most rapidly. And, in the year 2017 to 2018, the most significant change. The group believes that this is affected by factors such as the level of regional economic development and policy implementation. The country's "13th Five-Year Plan" proposed in March 2016 proposed to speed up the construction and development of urban agglomerations, listed the above five regions as the core of urban agglomeration construction, and made every effort to build urban agglomerations in the Yangtze River Delta, Pearl River Delta, Beijing. The Tianjin-Hebei urban agglomeration, the urban agglomeration in the middle reaches of the Yangtze River, and the Chengdu-Chongqing urban agglomeration is the five major urban agglomerations. Therefore, since 2016, the national policy has been inclined toward these areas. Many talents and materials have been sent to these areas so that the rural areas in these areas. Then, the level of revitalization increased rapidly in 2017-2018.

3. Model establishment and data description

3.1. Variable description

1) Core explanatory variable: Digital Financial Inclusion (Diff). With regard to this indicator, the measurement of the digital financial inclusion index requires a large amount of data, many of which are not available to the group. Therefore, this paper uses the provincial-level data of the Peking University Digital Financial Inclusion Index (Guo Feng et al., 2020) as the core explanatory variables. It is shown in Appendix 3 for details. The data of the core explanatory variables in the model is obtained [19]. In the process of regression, this paper takes the logarithm of it.

2) Explained variable: rural revitalization (Rural). From the perspective of the above-mentioned connotation of rural revitalization, this paper draws on the research results of a comprehensive evaluation of rural revitalization construction since the 19th National Congress of the Communist Party of China. It selects relevant indicators from five aspects and builds a rural revitalization evaluation index system. Similarly, this paper also takes the logarithm.

3) Control variables: According to the research of Li Jigang et al. (2021), select control variables that may be related to rural revitalization [13], including the elderly dependency ratio (the number of rural elderly population and labor force Age-to-population ratio, or ODR), urbanization level (ratio of urban population to total population, or URBAN), economic development level (regional per capita GDP, logarithmically processed, or ECONOMY), foreign trade dependence (Denominated in RMB, the ratio of the total import and export trade of service goods in the region to the regional GDP, namely OPENING).

4) Threshold variables: Select the old-age dependency ratio (ODR), urbanization level (URBAN), economic development level (ECONOMY), and foreign trade dependence (OPENING) as the threshold variables in turn, and perform a regression on each threshold variable. Meanwhile, in order to ensure the rationality of the model after adding the threshold variable, the corresponding threshold variable will no longer be included in the control variable.

3.2. Data source and description

The data used in this study come from the statistical yearbooks provided by the CNKI platform, including the China Rural Statistical Yearbook, China Health Statistical Yearbook, China Social Statistical Yearbook, China Household Survey Yearbook, and China Statistical Yearbook" and the 2014-2018 Peking University Digital Financial Inclusion Index released by the National Bureau of Statistics website and the research group of the Digital Finance Research Center of Peking University in April 2019. Moreover, for the few missing values in the above data, use the Lagrangian interpolation method to fill up. The data samples from 2014 to 2018 cover the residents living in rural

areas in 31 provinces across the country, including indicators such as the elderly dependency ratio, urbanization level, per capita GDP, and foreign trade dependence.

3.3. Variable Descriptive Statistics

The country's rural old-age dependency ratio has a large gap in different provinces at different times, and the minimum, average and maximum values are all different by about 7 units. The country's per capita annual gross domestic product is 57,340 yuan, about 4,770 yuan per month, and the minimum value is about 2,000 yuan per month. There are large differences in economic levels between provinces in the country. The Digital Financial Inclusion Index focuses on the level of digitalization in the financial sector to support rural areas. Based on the overall index, it is subdivided into coverage, depth of use, and digital support services. Table X illustrates that the country's digital financial inclusion index has certain differences in subdivision fields, and there is a large variance in the depth of use. The sink space is still large.

3.4. Model settings

1) Benchmark regression model First, establish a benchmark regression model of the impact of digital financial inclusion on rural revitalization. The following is an individual fixed-effect model.

$$\text{Rural}_{it} = \alpha_i + \beta_1 \text{Diff}_{it} + \beta \text{Control}_{it} + \varepsilon_{it}$$

Among them: Rural is the rural revitalization index, Diff is digital financial inclusion, Control is the control variable, β is the coefficient to be estimated, ε_{it} is an independent random interference term, and α_i is the intercept term. In regression analysis, the group will use cluster standard errors in an attempt to address heteroskedasticity

2) Threshold effect model

Hansen (1999) proposed an individual fixed-effect variable-intercept panel threshold model, which minimizes the residual sum of squares as the condition, uses grid search to determine the threshold value, and tests the significance of the threshold value. This method overcomes the subjective setting and the bias of the threshold value [20]. When the threshold variable crosses the threshold value, the relationship between the variables will change accordingly. Taking the level of economic development as the threshold variable, this study established a single-threshold effect model of inclusive digital finance on rural revitalization.

$$Y_{it} = \beta_1 \text{Diff}_{it} \times I(\text{Economy}_{it} \leq \gamma) + \beta_2 \text{Diff}_{it} \times I(\text{Economy}_{it} > \gamma) + \beta \text{Control}_{it} + \varepsilon_{it} + \beta_0$$

Among them: Y_{it} is the explained variable, representing the rural revitalization index; Diff is the core explanatory variable, the digital financial inclusion index; Economy is the level of economic development, measured by the logarithm of GDP per capita; Control is the control variable; β is Parameters to be estimated; β_0 is the intercept, ε_{it} is an independent random disturbance term; I is an indicator function, the true value is 1. Otherwise, it is 0, and γ is the threshold value.

4. Analysis of Empirical Results

4.1. Benchmark regression model

Referring to Zhang Xiaoyan (2021) practice, this study uses the method of gradually adding control variables to regress the level of digital financial inclusion and rural revitalization [21]. By gradually adding control variables, this study can test the robustness of the model to a certain extent. Models (1)-(5) successively added control variables: the level of old-age support, the level of urbanization, economic development, and the degree of opening to the outside world. According to the results, it can be found that the influence coefficient of digital financial inclusion is always positive, and all of them have passed the significance test with a 95% confidence level. Meanwhile, the goodness of fit of the model is also gradually improved, from 0.572 to 0.655. It is shown that digital financial inclusion does positively impact rural revitalization.

It can be found from the results that both the coverage breadth and the degree of digitization have a positive effect on rural revitalization, and they have passed the 5% significance level test. Meanwhile, by comparing the size of the coefficients, it can be concluded that the coverage breadth has a stronger positive effect on rural revitalization. The depth of use did not pass the significance test. Therefore, the driving effect of inclusive digital finance on rural revitalization is mainly reflected in the breadth of coverage and the degree of digitalization. This group believes that the depth of use is based on coverage development. Recently, digital financial inclusion is still in the promotion stage, and there are still some areas that have not been exposed to digital financial inclusion, so its driving effect is not significant. The driving effect of the degree of digitalization is smaller than the breadth of coverage may indicate that today's inclusive finance is still dominated by traditional finance, and the promotion effect of digital finance is not obvious.

4.2. Heterogeneity Analysis

Here, the group wants to observe whether different levels of digital financial inclusion will have a different impact on the level of rural revitalization. However, the traditional classification method of eastern, central, and western cannot reflect the different development levels of digital financial inclusion. Therefore, referring to the practice of Hu Jinxing (2017), firstly, using the digital financial inclusion index of 31 provinces and cities to conduct a systematic cluster analysis on the level of digital financial inclusion in various regions, and using the square sum of deviation method [24], the country is divided into two groups. Two regions: regions with high digital financial inclusion and regions with low digital financial inclusion levels. Then, the distance discrimination method is used to check that the result is valid. This calculation was done using the SPSS software.

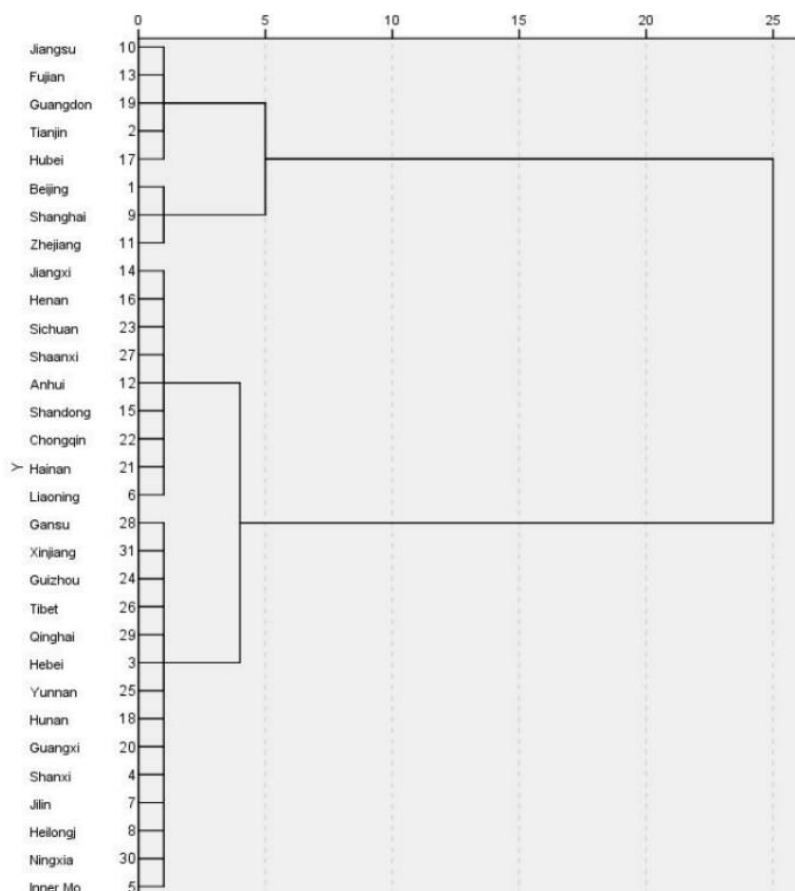


Figure 1. Cluster analysis results

According to the results, Jiangsu, Fujian, Guangdong, Tianjin, Hubei, Beijing, Shanghai, and Zhejiang are classified as regions with a high digital financial inclusion development level, and the rest are regions with low digital literacy financial inclusion development level.

The results show that the promotion effect of inclusive digital finance on rural revitalization is heterogeneous. Whether in high-level or low-level regions, digital financial inclusion has promoted rural revitalization, and the promotion effect in high-level regions is strong. This group believes that digital financial inclusion has a higher level of development and greater popularization, enabling it to provide financial services to disadvantaged groups in rural areas, thereby contributing to rural revitalization. Furthermore, this paper also believes that this heterogeneity stems from the differences in the development level of digital financial inclusion in various regions and may also stem from differences in external factors.

4.3. Threshold effect analysis

Referring to the practice of Luo Xinyu and Zhang Lin (2021) [25], this paper selects the elderly dependency ratio (ODR), urbanization level (URBAN), and economic development level (ECONOMY) and foreign trade dependence (OPENING) as the thresholds in turn. Variables are used to explore whether the impact of digital financial inclusion on rural revitalization changes significantly when the above threshold variables are located in different ranges. In order to make the regression results reasonable, the threshold variable is not regarded as a control variable in this paper.

1) Threshold effect test

First, a Hausman test was performed, and a fixed-effects model was chosen. Before establishing the specific model of the threshold effect, it is necessary to use the Bootstrap method to test the existence of the threshold effect. The following tests are all implemented by STATA16.0. After testing, when the elderly dependency ratio, urbanization level, and foreign trade dependence are used as threshold variables, they all fail the single threshold test. That is, there is no threshold effect. Therefore, this paper focuses on the impact of inclusive digital finance on rural revitalization when the level of economic development is used as the threshold variable.

It can be seen that the single threshold effect test and the double threshold effect test have passed the 5% level significance test and the 10% level significance test, respectively, indicating that there is a threshold effect on the impact of economic development level. Here, choose to establish a single threshold effect model with a higher significance level. However, in the triple threshold effect test, the P-value was 0.735, which did not pass the significance test, so the single threshold effect model was finally selected.

It can be seen from Table 7 that the threshold value of the model is 10.751, and Table 7 also gives the confidence interval of the threshold value below the 95% confidence probability. Therefore, this paper divides the samples of provinces and cities from 2014 to 2018 into two intervals, which are lower than 10.751. Meanwhile, it is higher than 10.751 according to the level of economic development.

Table 8 shows the model estimation results. When the economic development level is at a low level ($DIFF \leq 10.751$), the coefficient is 0.577, which passes the 1% significance level test. The coefficient increases to 0.610 when the level of economic development exceeds 10.751. The above results show that there is a nonlinear relationship between digital financial inclusion and rural revitalization under the influence of economic level. With the improvement of the level of economic development, the income-increasing effect of inclusive digital finance shows an increasing trend.

4.4. Robustness check

This paper will test the robustness of the main regression model from the following aspects.

1) Change the estimation method based on the static panel regression model. This paper uses a random effect model different from the fixed-effect model, namely model (8), and mixed regression, namely model (9), to re-estimate to test the robustness of this model. The results show that digital financial inclusion has a promoting effect at the 1% significance level.

2) In the discussion of endogeneity, all explanatory variables are treated with a lag of one period, and regression analysis is performed on them, that is, model (10). The results showed that the direction and significance of the core explanatory variables did not change.

3) Delete some data. Considering that there are specific differences in Internet penetration and spatial characteristics in different regions, this paper deletes the data of Beijing, Tianjin, Chongqing, and Shanghai and uses model (4) to perform regression again to obtain model (11). This result is the same as the conclusion, and digital financial inclusion still positively affects rural revitalization.

5. Research Conclusions and Policy Recommendations

5.1. Research conclusions

Due to the combination of a series of emerging digital technologies such as big data analysis, Internet technology, and cloud computing with financial products, inclusive digital finance has played a role in solving the problems of high cost, low coverage, and slow development in traditional inclusive finance. Positive effect. Therefore, based on the data from 31 provinces and cities in the country from 2014 to 2018, the index of rural revitalization and development levels was constructed using the entropy weight method (TOPSIS). The model and threshold effect model conduct an empirical study on the relationship between digital financial inclusion and rural revitalization. Through the research, the main conclusions are as follows: 1) The level of rural revitalization in the country has increased year by year, but rural revitalization and its development speed are different in different regions. Among them, the rural revitalization level and development speed in the southeastern region are better than those in the northwestern region. 2) Digital inclusive finance can drive rural revitalization, and inclusive digital finance mainly drives rural revitalization through the depth of use and the degree of digitization. The driving effect of the depth of use is stronger than that of the degree of digitization. 3) The promotion of rural revitalization by inclusive digital finance has regional heterogeneity. First, the level of inclusive digital finance itself will affect this promotion. Second, when the level of economic development crosses the threshold, inclusive digital finance. The impact on rural revitalization will become stronger as the threshold variable increases.

5.2. Policy suggestion

1) Improve the construction of digital infrastructure and provide hardware support to develop inclusive digital finance. Through the previous empirical analysis of this paper, inclusive digital finance has a promoting effect on improving the level of rural revitalization and increasing the income of rural residents, among which the breadth of coverage has the strongest driving effect. Therefore, in order to give better play to the driving effect of inclusive digital finance on rural revitalization, the group recommends establishing a digital sound infrastructure in each region to increase coverage. We should speed up the construction of rural information infrastructure and realize the coverage of rural broadband and 4G networks as soon as possible. Meanwhile, it should also accelerate the transformation and upgrading of traditional infrastructure empowered by information technology, such as intelligent campuses, intelligent hospitals, etc. The rural residents can adapt to digital life and create an environment for farmers to use inclusive digital finance.

2) Implement a regionally differentiated digital financial inclusion development strategy. According to the discussion on the heterogeneity of different regions in the previous article, it can be known that in regions with different levels of economic development, the impact of digital financial inclusion on them is different, and the more developed the region, the greater the impact of digital financial inclusion. Therefore, for regions with different levels of economic development, financial measures should be taken according to local conditions to promote rural revitalization and development. For economically developed areas with a complete market and a sound financial system, the development of inclusive digital finance can be led by the market, and the government can play a supervisory role. Moreover, provide personalized financial products for farmers at different income levels, provide rural residents with better financial services, and improve rural revitalization.

3) Develop diversified business models and promote the deep integration of inclusive digital finance and big data at the technical level. Digital inclusive finance uses digital technologies such as big data to serve customers more conveniently than traditional financial models. For example, using

big data to profile people to judge a person's credit level greatly reduces the need for financial institutions to identify customers. For consumption cost, big data is used to create better digital inclusive financial products, develop various business models, and give full play to the new kinetic energy of data in the economy.

4) Improve the regulatory mechanism for digital financial inclusion. According to the "white paper" issued by the China Academy of Information and Communications Technology, digital financial fraud is widespread in China, which seriously disrupts the order of my country's financial market and inhibits the healthy development of digital financial inclusion. The existing financial supervision system is mainly aimed at the supervision system of traditional financial institutions such as banks and securities and lacks the supervision mechanism for the mixed operation model of inclusive digital finance. The country should strengthen the protection of consumers' rights and interests, improve the regulatory mechanism, create complaint handling channels, and enhance the credibility of inclusive digital finance.

5) Do a good job in propaganda to popularize digital finance among farmers. The advantage of digital financial inclusion lies in using science and technology such as big data. However, this also creates a "gap" for residents in areas with a low level of digitalization, creating a "dividend" for them to enjoy digital financial inclusion. Recently, the development of inclusive digital finance in the country has a high level of coverage and electronic services, but the depth of use by farmers is insufficient. Therefore, it is necessary to increase the publicity of inclusive digital finance and carry out some digital financial knowledge literacy activities, and incorporate financial courses into the compulsory courses of primary and secondary schools to incorporate more economic entities into the financial service system and enjoy the "bonus" of the development of inclusive digital finance. Relevant technology financial companies should also consider more in-depth products, optimize user experience, and not regard inclusive digital finance as only a means to occupy users.

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