

# Research on the Impact of Digital Inclusive Finance on Farmers' Income Increase and Spatial Spillover Effect

## Based on Panel Data Analysis of 29 Provinces and Cities in China

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### ABSTRACT

The year 2024 is the 75th anniversary of the founding of New China, and also a key year to achieve the goals and tasks of the “14th Five-Year Plan”, and an important year for rural revitalization, high-level recovery and high-quality development of the cultural and tourism industry. At this stage, the problem of unbalanced and insufficient development in rural areas is still very obvious, and the most arduous and burdensome task is still in the countryside in order to promote common prosperity. Therefore, increasing the disposable income of rural households and enabling rural residents to enjoy more of the fruits of economic development is the key to promoting the strategy of rural revitalization and promote the common prosperity of all people. This paper uses the disposable income of rural residents in 29 provinces and cities and the digital financial inclusion index of Peking University from 2013 to 2021 to set up a panel regression model, discusses the correlation and spatial effect of the digital financial inclusion index on the income increase of rural households from the theoretical level and the empirical analysis level, reveals the shortcomings of the traditional finance in the promotion of rural households' income increase, and provides new ideas for the further study of the promotion of rural households' income increase by the digital financial inclusion index. Provide new ideas for further research on digital inclusive finance to promote income increase of farm households.

**Keywords:** *Rural revitalization, Inclusive finance, Farm household income increase.*

## 1. INTRODUCTION

### 1.1 Background

Through advanced technologies such as big data, cloud computing, and artificial intelligence, digital inclusive finance has lowered the threshold of entry, improved the accessibility and convenience of financial products and services, and enabled the disadvantaged groups, who have always been denied access by traditional financial institutions, to receive financial services at a reasonable price. As a combination of digital technology and financial inclusion, digital financial inclusion not only enhances the degree of rural financial service coverage. Its value is also reflected in the precise alleviation of poverty in rural areas, so promoting the development of digital inclusive finance is of

great significance in promoting the income of rural households [1].

Digital financial services in rural areas in China started relatively late, but the digital inclusive infrastructure and digital technology that corresponds to it are also relatively mature. Digital inclusive financial infrastructure and products such as online banking use, online sales of agricultural products, Internet financial products purchase, Internet lending and other digital inclusive financial infrastructure and products have been laid in various townships, so whether digital inclusive finance can really effectively solve the three rural issues and promote the increase of farm household income is a question worth exploring.

## ***1.2 Purpose and Significance***

In order to build a prosperous new countryside, the first thing to do is to establish a long-term mechanism for financial poverty alleviation. 2021 One line of the two committees, the Ministry of Finance, the Ministry of Agriculture and Rural Affairs, and the Bureau of Rural Revitalization, made it clear that they should tilt financial resources to the helping counties and consolidate the results of poverty alleviation, so as to make rural revitalization come to fruition, so it can be seen that the study of digital financial inclusion is crucial to rural revitalization.

The results of the seventh national census show that [2], the population living in the countryside is 509.79 million people, accounting for 36.11%, possessing a huge potential to release the demographic dividend. Therefore, the study of the development of digital inclusive finance in major economic regions is conducive to testing the results of the development of the regional pattern of "one group, two centers and three circles", and driving the regional integration and development of the three major economic circles. In 2018, the "Guiding Opinions on Accelerating the Development of Internet Finance" clearly pointed out that the enhancement of the ability of financial services to the real economy. The implementation of inclusive finance, microfinance, financial guarantees, financial leasing business should be carried out in an orderly manner, the reform and pilot regional inclusive finance, and grasp the addition of a new rural cooperative financial pilot, so it can be seen that digital inclusive finance is a new kinetic energy, and the development of digital inclusive finance is conducive to the test of the results of the transformation of old and new kinetic energy.

It should be noted that inclusive finance is not a lasting one-way financial assistance and policy subsidies, and commercial financial institutions are not allowed to violate the enterprise system and the laws of the market. Relying on advanced information technology and digital technology, digital finance breaks the time and geographical restrictions of traditional financial services, reduces the costs of financial institutions, and provides users with cross-space, cross-territory, and cross-homogenized financial products, which makes it possible to break the dilemma faced by the construction of the inclusive financial system, and realizes the in-depth advancement of digital inclusive finance to rural areas.

## **2. THEORETICAL RESEARCH ON THE EFFECT OF DIGITAL FINANCIAL INCLUSION AND FARMERS' INCOME INCREASE**

### ***2.1 Overview of Digital Inclusive Finance***

#### ***2.1.1 Early Stage of Digital Financial Inclusion***

In the early stage of the development of digital inclusive finance, traditional financial institutions began to handle relevant businesses online through the Internet, compared with the manual processing of business through physical business outlets. At the same time, with the development of network technology and the use of a large number of smart phones, mobile payment was born, and a large number of financial services can be completed with the help of Internet platforms and mobile terminals. The early stage of the emergence of online banking, mobile banking and other emerging modes of financial services, the earlier use of digital payment methods of commercial banks, Have begun to provide customers with credit loans, insurance and finance, life payment and many other financial services through the bank's electronic platform. [3]

#### ***2.1.2 The Current Stage of Digital Financial Inclusion***

In recent years, with the gradual application of emerging technologies such as the Internet, cloud computing, big data and other emerging technologies in the banking and securities industries, expanding the channels and means of traditional finance and reducing operating costs, the combination of technology and finance is becoming increasingly close. Non-financial institutions will gradually become the main force of financial innovation, taking technology as the driving force to reshape the financial service model, meet more demands and design more personalized financial products. For this stage of financial innovation, we are more familiar with the name "financial technology", and the key goal of this stage is to make financial services no longer have blind spots, so that people with financial service needs can get professional services.

## **2.2 Theoretical Foundations of Digital Financial Inclusion**

### **2.2.1 Trickle-down Effect Theory**

Trickle-down effect (Trickle-down effect), also known as the diffusion effect, in the economic growth does not have a direct impact on the economic situation of farmers, economic growth will make other groups of income growth, so that through the overall situation of other groups to improve, to lead to the improvement of the economic situation of farmers. The way the trickle-down effect works is essentially market behavior, with drawbacks such as spontaneity, often requires government regulatory support, so the trickle-down effect often leads to "pro-poor growth". As a result of increased investment in the construction and maintenance of rural infrastructure, the infrastructure, education, and health care of rural households will be improved. The trickle-down effect works firstly by restructuring the industry, and secondly by easing the financing constraints of small and medium-sized enterprises (SMEs), as well as promoting employment and entrepreneurship. Empirical studies have found that digital inclusive finance, more than traditional inclusive finance, is able to accelerate the adjustment of industrial structure, ease SME financing constraints, and promote employment and entrepreneurship.[4]

### **2.2.2 Long Tail Theory**

The term "Logistic Tails" originates from the Pareto Model, i.e. in 1897, an Italian scholar proposed the "Pareto's Law of Distribution", which is considered to be "twenty percent of the population owns eighty percent of the wealth", that is, "a very small number of people have a great deal of influence". The so-called logistic Tails effect refers to a market with a very small but large number of people, and the effect is a market with a very small but large number of people, the sum of which is larger than that of the main market. Due to the physical limitations and cognitive limitations of underdeveloped and remote rural populations, formal finance often neglects to build markets for such financial groups. Digital financial inclusion through the Internet to play the long-tail effect of nearly 200 million farmers, 70 million micro-enterprises and merchants, as well as 150 million wage earners, the special financial needs of these

groups can not be met by the business of formal financial institutions.

## **2.3 Mechanisms of Digital Inclusive Finance in Increasing Farmers' Income**

### **2.3.1 Direct Impact Mechanism**

With the rapid development of emerging digital technology, nowadays, we can use the Internet and smartphone terminals to quickly access the financial services we want. This digital approach allows financial institutions to reduce operating costs and time costs, and improve operational efficiency. In this case, due to the significant drop in bank loan fees, the access criteria for bank loans have also dropped, which provides more affordable loans to the general farmer population, benefiting more disadvantaged groups.

With the continuous development of micro and small enterprises, more and more employment opportunities are released, and these low-income people can also get the opportunity to change their poverty situation in their work. Improve their income situation and reduce the occurrence of poverty [5]. In conclusion, the development of digital inclusive finance can reduce the threshold effect and alleviate the exclusion effect, so that financial resources can be better allocated, while financial institutions can provide inclusive financial services for low-income people. While reducing poverty, it expands the coverage of finance and provides more sources of income for farmers.

### **2.3.2 Indirect Impact Mechanisms**

This section will focus on the role of developing digital financial inclusion in promoting growth. The development of inclusive finance can not only effectively integrate resources from all aspects of society, but also improve the efficiency of the use of resources from all aspects of society and guide the development of financial services in the direction of specialization. Financial services play an increasingly important role in people's daily lives, leading to an increase in aggregate social demand and thus promoting economic development. In addition, inclusive digital finance can expand the coverage of finance and provide financial support to small and microenterprises, thereby expanding their scope of production and operation, increasing their employment opportunities, giving them new

room for development and raising their income levels.

## 2.4 Indicator Selection and Data Description

This paper uses more macroscopic provincial data, due to the small size of Tibet, Ningxia data, the representative significance is not very large, and in the number of indicators other provinces have differences, easy to affect the regression results, then it will be removed.

The year selected in this paper is 2013-2021 data, most of the existing literature research is in the last ten years, due to the statistical yearbook is only updated to 2021, can't take the data of 2022, then select the 2013-2021 data. ("Table 1", "Table 2")

In order to ensure the credibility of the analysis results, the text also normalizes the synthesized raw data, that is, the integrated data are processed by logarithmic method.

Table 1. Selection of indicators

| Variable Name                                     | Variable Measurement  |
|---|---|
| Disposable income of farm households (INC)        | Consumption level of rural residents for robustness test  |
| Digital inclusive finance development level (INX) | Peking University inclusive finance index   |
| Level of agricultural economic development (DEV)  | Agricultural GDP (billion yuan)/number of rural population (10,000 people)                        |
| Level of financial support to agriculture (FIN)   | Financial expenditure on agriculture within the government budget/total agricultural output value |
| Income Distribution Indicator (ALL)               | Per capita disposable income of urban residents/per capita disposable income of rural residents   |
| Level of Rural Fixed Asset Investment(FIX)        | Total Rural Fixed Asset Investment by Provinces / Total Agricultural Output Value                 |
| Level of education development (EDU)              | Local financial expenditure on education/local financial general budget expenditure               |

Table 2. Digital financial inclusion index of 29 provinces in China from 2013 to 2021

| Province                                  | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | 2020   | 2021   |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Beijing                                   | 215.62 | 235.36 | 276.38 | 286.37 | 329.94 | 368.54 | 399.00 | 417.88 | 445.44 |
| Anhui                                     | 150.83 | 180.59 | 211.28 | 228.78 | 271.60 | 303.83 | 330.29 | 350.16 | 384.62 |
| Fujian                                    | 183.10 | 202.59 | 245.21 | 252.67 | 299.28 | 334.44 | 360.51 | 380.13 | 410.31 |
| Gansu                                     | 128.39 | 159.76 | 199.78 | 204.11 | 243.78 | 266.82 | 289.14 | 305.50 | 341.16 |
| Guangdong                                 | 184.78 | 201.53 | 240.95 | 248.00 | 296.17 | 331.92 | 360.61 | 379.53 | 406.53 |
| Guangxi<br>Zhuang<br>Autonomous<br>Region | 141.46 | 166.12 | 207.23 | 223.32 | 261.94 | 289.25 | 309.91 | 325.17 | 355.11 |
| Guizhou                                   | 121.22 | 154.62 | 193.29 | 209.45 | 251.46 | 276.91 | 293.51 | 307.94 | 340.80 |
| Hainan                                    | 158.26 | 179.62 | 230.33 | 231.56 | 275.64 | 309.72 | 328.75 | 344.05 | 375.35 |
| Hebei                                     | 144.98 | 160.76 | 199.53 | 214.36 | 258.17 | 282.77 | 305.06 | 322.70 | 352.44 |
| Henan                                     | 142.08 | 166.65 | 205.34 | 223.12 | 266.92 | 295.76 | 322.12 | 340.81 | 374.37 |
| Heilongjiang                              | 141.40 | 167.80 | 209.93 | 221.89 | 256.78 | 274.73 | 292.87 | 306.08 | 341.14 |
| Hubei                                     | 164.76 | 190.14 | 226.75 | 239.86 | 285.28 | 319.48 | 344.40 | 358.64 | 391.90 |
| Hunan                                     | 147.71 | 167.27 | 206.38 | 217.69 | 261.12 | 286.81 | 310.85 | 332.03 | 362.36 |
| Jilin                                     | 138.36 | 165.62 | 208.20 | 217.07 | 254.76 | 276.08 | 292.77 | 308.26 | 339.41 |
| Jiangsu                                   | 180.98 | 204.16 | 244.01 | 253.75 | 297.69 | 334.02 | 361.93 | 381.61 | 412.92 |

| Province          | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019   | 2020   | 2021   |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Jiangxi           | 146.13 | 175.69 | 208.35 | 223.76 | 267.17 | 296.23 | 319.13 | 340.61 | 372.17 |
| Liaoning          | 160.07 | 187.61 | 226.40 | 231.41 | 267.18 | 290.95 | 311.01 | 326.29 | 357.23 |
| Inner Mongolia    |        |        |        |        |        |        |        |        |        |
| Autonomous Region | 146.59 | 172.56 | 214.55 | 229.93 | 258.50 | 271.57 | 293.89 | 309.39 | 344.76 |
| Qinghai           | 118.01 | 145.93 | 195.15 | 200.38 | 240.20 | 263.12 | 282.65 | 298.23 | 329.89 |
| Shandong          | 159.30 | 181.88 | 220.66 | 232.57 | 272.06 | 301.13 | 327.36 | 347.81 | 380.68 |
| Shanxi            | 144.22 | 167.66 | 206.30 | 224.81 | 259.95 | 283.65 | 308.73 | 325.73 | 359.70 |
| Shaanxi           | 148.37 | 178.73 | 216.12 | 229.37 | 266.85 | 295.95 | 322.89 | 342.04 | 374.16 |
| Shanghai          | 222.14 | 239.53 | 278.11 | 282.22 | 336.65 | 377.73 | 410.28 | 431.93 | 458.97 |
| Sichuan           | 153.04 | 173.82 | 215.48 | 225.41 | 267.80 | 294.30 | 317.11 | 334.82 | 363.61 |
| Tianjin           | 175.26 | 200.16 | 237.53 | 245.84 | 284.03 | 316.88 | 344.11 | 361.46 | 395.73 |
| Xinjiang Uygur    |        |        |        |        |        |        |        |        |        |
| Autonomous Region | 143.40 | 163.67 | 205.49 | 208.72 | 248.69 | 271.84 | 294.34 | 308.35 | 341.77 |
| Yunnan            | 137.90 | 164.05 | 203.76 | 217.34 | 256.27 | 285.79 | 303.46 | 318.48 | 346.93 |
| Zhejiang          | 205.77 | 224.45 | 264.85 | 268.10 | 318.05 | 357.45 | 387.49 | 406.88 | 434.61 |
| Chongqing         | 159.86 | 184.71 | 221.84 | 233.89 | 276.31 | 301.53 | 325.47 | 344.76 | 373.22 |

### 3. EMPIRICAL ANALYSIS OF DIGITAL FINANCIAL INCLUSION ON INCOME GROWTH OF FARM HOUSEHOLDS

#### 3.1 Model Construction

To test the previous hypothesis, the following regression model is set:

$$\ln INC_{it} = \beta_0 + \beta_1 \ln INX_{it} + \delta \ln X_{it} + \mu_i + \varepsilon_{it}$$

Among others,  $\ln INC_{it}$  is the level of farm household income increase in province  $i$  in period  $t$ ;  $\beta_1$  is the regression coefficient,  $\ln INX_{it}$  is degree of

development of inclusive financial services;  $\ln X_{it}$  is the control variable;  $\mu_i$  is a fixed effect;  $\varepsilon_{it}$  is the error term.

#### 3.2 Descriptive Statistical Analysis

Before doing the regression analysis, all data were analyzed with descriptive statistics and the results are shown in "Table 3". The results for the other variables also indicated that there were no extreme outliers for subsequent analysis.

Table 3. Regression results obtained after applying the base regression on the logarithmized panel data

| INC            | Regression coefficient | Standard deviation | Z        | P> z   | [Confidence interval] |
|----------------|------------------------|--------------------|----------|--------|-----------------------|
| INX            | 0.6003                 | 0.0309             | 19.4500  | 0.0000 | 0.5395 0.6610         |
| DEV            | 0.0157                 | 0.0105             | 1.5100   | 0.1330 | -0.0048 0.0363        |
| FIN            | 0.3864                 | 0.0287             | 13.4800  | 0.0000 | 0.3299 0.4428         |
| ALL            | -0.4763                | 0.0204             | -23.3600 | 0.0000 | -0.5164 -0.4361       |
| FIX            | -0.0407                | 0.0575             | -0.7100  | 0.4800 | -0.1539 0.0725        |
| EDU            | 1.9164                 | 0.3327             | 5.7600   | 0.0000 | 1.2611 2.5717         |
| intercept term | 6.9485                 | 0.1832             | 37.9400  | 0.0000 | 6.5878 7.3093         |

The basic regression results show that: the regression coefficient mainly depends on the positive and negative, p-value<0.01, three-star significant, <0.05 two-star significant, <0.1 one-star

significant, three-star significant is the best, here we want to study the digital financial inclusion is 0.000, three-star significant, indicating that the positive impact of the effect is very significant.

### 3.3 A Study of the Role of Spatial Spillovers

In order to test the spillover effect, this paper constructs a model based on what has been learned in econometrics:

$$\ln INC_t = \alpha + \beta \ln X_t + \theta W \ln X_t + \varepsilon$$

Among others,  $\ln INC_t$  Represents the increase in farm household income in year t of the explanatory variable INC,  $\beta \ln X_t$  represents the province's explanatory variables (digital financial inclusion and control variables) in year t, indicating the direct impact of the province's explanatory variables on the INC of its farm households' income

increase,  $\theta W \ln X_t$  Indicates the indirect effect of the explanatory variables of neighboring provinces on the INC of farm household income in this province, i.e., the spatial spillover effect.

#### 3.3.1 Spatial Correlation Test

In this paper, the spatial correlation test is conducted using the Moran index test method, and the spatial correlation test is conducted using the Moran test for the farm household income increase and digital financial inclusion indices of 29 provinces from 2013 to 2021, and the results of the spatial correlation test are reported in the following "Table 4".

Table 4. Results of spatial correlation test of income increase of farm households

| Year | Moran's I | E(I)   | sd(I) | z     | p-value* |
|------|-----------|--------|-------|-------|----------|
| 2013 | 0.171     | -0.036 | 0.033 | 6.222 | 0.000    |
| 2014 | 0.169     | -0.036 | 0.033 | 6.191 | 0.000    |
| 2015 | 0.173     | -0.036 | 0.033 | 6.324 | 0.000    |
| 2016 | 0.163     | -0.036 | 0.033 | 6.012 | 0.000    |
| 2017 | 0.161     | -0.036 | 0.033 | 5.963 | 0.000    |
| 2018 | 0.160     | -0.036 | 0.033 | 5.939 | 0.000    |
| 2019 | 0.158     | -0.036 | 0.033 | 5.913 | 0.000    |
| 2020 | 0.159     | -0.036 | 0.033 | 5.932 | 0.000    |
| 2021 | 0.159     | -0.036 | 0.033 | 5.929 | 0.000    |

It can be seen that the Moran's test of INC of farm household income increase in 2013-2021 is significant (p-value of  $0.00 < 0.01$ ), Moran's index Moran's I of farm household income increase is positive in 2013-2021, which indicates that there is

a strong spatial positive correlation of farm household income increase, and that farm household income increase passes the Moran's test, i.e., the explanatory variable passes the test of spatial autocorrelation. ("Table 5")

Table 5. Spatial correlation test results of digital financial inclusion

| Year | Moran's I | E(I)   | sd(I) | z     | p-value* |
|------|-----------|--------|-------|-------|----------|
| 2013 | 0.102     | -0.036 | 0.033 | 4.116 | 0.000    |
| 2014 | 0.103     | -0.036 | 0.033 | 4.158 | 0.000    |
| 2015 | 0.087     | -0.036 | 0.033 | 3.667 | 0.000    |
| 2016 | 0.095     | -0.036 | 0.033 | 3.939 | 0.000    |
| 2017 | 0.104     | -0.036 | 0.033 | 4.209 | 0.000    |
| 2018 | 0.112     | -0.036 | 0.033 | 4.397 | 0.000    |
| 2019 | 0.116     | -0.036 | 0.033 | 4.526 | 0.000    |
| 2020 | 0.122     | -0.036 | 0.033 | 4.684 | 0.000    |
| 2021 | 0.129     | -0.036 | 0.033 | 5.932 | 0.000    |

It can be seen that the Moran's test for INX of digital financial inclusion index in 2013-2021 is significant (p-value of  $0.00 < 0.01$ ) and Moran's I of digital financial inclusion index is positive in 2013-2021, which indicates that there is a strong spatial

positive correlation of digital financial inclusion, and that digital financial inclusion passes the Moran's test, i.e., the explanatory variables pass the spatial autocorrelation test.

### 3.3.2 Spatial Durbin Model Analysis

On this basis, a spatial econometric study of the relationship between the level of financial inclusion development and farmers' incomes was carried out

using the two-way fixed-effects Durbin model, yielding the following spatial Durbin model regression results of the level of numerical financial inclusion development on the increase in farmers' incomes. ("Table 6")

Table 6. Spatial Durbin model regression results

|         | INC | Regression coefficient | Standard deviation | Z       | P> z   | [Confidence interval] |        |
|---------|-----|------------------------|--------------------|---------|--------|-----------------------|--------|
| Wx      | INX | 0.1865                 | 0.0642             | 2.9000  | 0.0040 | 0.0607                | 0.3124 |
|         | Dev | 0.0309                 | 0.0170             | 1.8200  | 0.0690 | -0.0024               | 0.0642 |
|         | Fin | 0.0419                 | 0.0644             | 0.6500  | 0.5150 | -0.0842               | 0.1681 |
|         | All | 0.0713                 | 0.0380             | 1.8700  | 0.0610 | -0.0033               | 0.1458 |
|         | Fix | -0.0574                | 0.0316             | -1.8200 | 0.0690 | -0.1193               | 0.0046 |
|         | Edu | 0.2168                 | 0.6342             | 0.3400  | 0.7330 | -1.0263               | 1.4598 |
| Spatial | rho | 0.7456                 | 0.0687             | 10.8500 | 0.0000 | 0.6109                | 0.8802 |
| Robust  | rho | 0.1734                 | 0.1025             | 1.69    | 0.09   | -0.0274               | 0.3743 |
| Spatial |     |                        |                    |         |        |                       |        |

It can be seen that the p-value of the coefficient of the spatial lag term of the explanatory variable digital financial inclusion INX is significantly positive, indicating that there is a spatial transmission effect of digital financial inclusion, and that the positive impact of the level of digital financial inclusion development in the province on the increase in income of farm households will spill over to the neighboring provinces, which will promote the increase in income of farm households in the neighboring provinces. It is further shown that the positive impact of the increased level of digital inclusive finance development in the province on the income increase of farm households will spill over to neighboring provinces, so that farm households in neighboring provinces

will also benefit from it, resulting in an increase in the income of farm households in both the province and the neighboring provinces.

### 3.3.3 Analysis of Decomposition Effects

The parameter estimation results of the spatial Durbin model confirm the positive impact of the level of digital financial inclusion development in each province on the income increase of farmers, but its regression coefficient contains the feedback effect of the level of digital financial inclusion development in neighboring provinces affecting each other, and thus it is necessary to remove the feedback effect and decompose it into the direct effect and the spatial spillover effect.

Table 7. Spatial Durbin model decomposition effect results

|                           | INC | Regression coefficient | Standard deviation | Z       | P> z   | [Confidence interval] |        |
|---------------------------|-----|------------------------|--------------------|---------|--------|-----------------------|--------|
| Direct effects            | INX | -0.0453                | 0.0457             | -0.9900 | 0.3210 | -0.1348               | 0.0441 |
| Spatial spillover effects | INX | 0.5362                 | 0.1307             | 4.1000  | 0.0000 | 0.2800                | 0.7923 |
| Total effect              | INX | 0.4908                 | 0.1169             | 4.2000  | 0.0000 | 0.2617                | 0.7200 |

As can be seen from "Table 7", the direct effect, although not significant, can be disregarded as the regression coefficient is negative according to the model results. This shows that the development of financial inclusion in the nearby provinces has a positive effect on the growth of farm household income.

The total effect shows that, considering the effect of spatial correlation, on the whole, the level of digital financial inclusion development has a positive effect on the income growth of farm households, and the mutual competition and cooperation among the provinces in the region, as well as the coordinated development of digital

financial inclusion, contribute to the increase in the income of farm households.

### 3.3.4 Robustness Test

This paper adopts the index replacement method to carry out the robustness test of the model,

replacing the inclusive financial development index with the breadth of coverage of digital inclusive financial development and the depth of use of digital inclusive financial development, which are logarithmized respectively, and then regressed, resulting in the regression results shown in the “Table 8” and “Table 9” below:

Table 8. Breadth of coverage regression results for digital financial inclusion development

| INC            | regression coefficient | standard deviation | Z        | P> z   | [Confidence interval] |         |
|----------------|------------------------|--------------------|----------|--------|-----------------------|---------|
| INX            | 0.4818                 | 0.0267             | 18.0200  | 0.0000 | 0.4291                | 0.5345  |
| DEV            | 0.0182                 | 0.0109             | 1.6700   | 0.0970 | -0.0033               | 0.0398  |
| FIN            | 0.4010                 | 0.0298             | 13.4600  | 0.0000 | 0.3424                | 0.4597  |
| ALL            | -0.4921                | 0.0211             | -23.2900 | 0.0000 | -0.5337               | -0.4505 |
| FIX            | -0.0428                | 0.0601             | -0.7100  | 0.4770 | -0.1612               | 0.0756  |
| EDU            | 2.0800                 | 0.3464             | 6.0000   | 0.0000 | 1.3978                | 2.7622  |
| Intercept term | 7.6562                 | 0.1628             | 47.0400  | 0.0000 | 7.3357                | 7.9767  |

Table 9. Depth of use regression results for digital financial inclusion development

| INC            | regression coefficient | standard deviation | Z        | P> z   | [Confidence interval] |         |
|----------------|------------------------|--------------------|----------|--------|-----------------------|---------|
| INX            | 0.5238                 | 0.0268             | 19.5700  | 0.0000 | 0.4711                | 0.5765  |
| DEV            | 0.0273                 | 0.0101             | 2.6900   | 0.0080 | 0.0073                | 0.0472  |
| FIN            | 0.3849                 | 0.0286             | 13.4700  | 0.0000 | 0.3287                | 0.4412  |
| ALL            | -0.4355                | 0.0210             | -20.7100 | 0.0000 | -0.4769               | -0.3941 |
| FIX            | 0.0227                 | 0.0579             | 0.3900   | 0.6960 | -0.0913               | 0.1366  |
| EDU            | 1.5560                 | 0.3365             | 4.6200   | 0.0000 | 0.8933                | 2.2186  |
| intercept term | 7.3202                 | 0.1658             | 44.1500  | 0.0000 | 6.9936                | 7.6467  |

It can be seen that after replacing the indicators, there is still a strong positive impact of digital financial inclusion development on farmers' income, indicating that the empirical results are robust and pass the robustness test.

## 4. CONCLUSION

Using panel data from 29 provinces and municipalities from 2013-2021, this study finds that there is a close link between digital financial inclusion and rural residents' income growth through empirical research on the relationship between financial inclusion and rural residents' income growth. This study finds that, first, the higher the level of digital financial inclusion development, the better the income growth of rural households. Second, the results of the Moran test and the decomposition effect of the spatial Durbin model show that inter-regional competition and cooperation are important for improving the level

of income increase of rural households, and neighboring provinces influence each other.

To this end, this paper puts forward the following suggestions: first, the construction of the rural financial system should be further strengthened, and preferential policies in terms of financial subsidies and tax exemptions should be provided to agricultural financial institutions, so as to further improve the ecological environment of the financial market. Collaboration between rural government departments and rural credit unions and rural guarantee companies should be strengthened in order to realize the effective transfer of financial risks. Second, localities should seize the opportunity to increase investment in rural revitalization and support relevant rural departments to improve inclusive financial policies for rural revitalization in accordance with local realities; promote the development of rural small and micro enterprises and private characteristic



economy, and give full play to the role of financial science and technology to provide financial services through the Internet. Third, it is necessary to enable the development of inclusive finance to be effectively synergized among different channels, thus benefiting more rural households. On this basis, appropriate income-generating policies should be formulated separately for farmers at different income levels.

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