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# *The Impact of Digital Inclusive Finance on Rural Household Poverty Vulnerability*

**Fengwei Sui**

*Capital Normal University, Beijing, China*
*sfw0913@163.com*

***Abstract.*** With China's overall victory in the battle against poverty, consolidation and expansion of poverty alleviation results and preventing a large-scale relapse into poverty have become key problems of the new era. Rural households suffer especially significant poverty vulnerability issues as a result of their sole source of income and weak risk resistance abilities. How digital inclusive finance influences the vulnerability of rural households to poverty and what its mechanisms are need thorough theoretical research and empirical testing. Based on China Household Finance Survey data and Digital Inclusive Finance Index, this study examines the impact effects and mechanisms of digital inclusive finance on the poverty vulnerability of rural households by Probit model. It creates a set of overall indicators for the poverty vulnerability of rural households including financial margins, debt servicing capability, and risk insurance capacity, and divides it into four levels. From the empirical results, it can be seen that digital inclusive finance has played a positive role in poverty reduction risks of rural household, and it shows a strong anti-poverty effect. From the mechanism test results, it can be seen that financial asset diversification is a channel through which digital inclusive finance affects the rural poverty vulnerability, because digital inclusive finance helps the rural households to allocate their financial assets in a more diversified way, thus reducing their poverty vulnerability. The research conclusions can provide significant theoretical foundation and policy reference for consolidating and expanding the results of poverty alleviation, as well as preventing a large-scale return to poverty.

***Keywords:*** Digital Inclusive Finance, Poverty Vulnerability, Financial Asset Diversification, Rural Households

## 1. Introduction

With China's comprehensive victory in the battle against poverty, consolidating and enhancing poverty alleviation achievements and avoiding a large-scale return to poverty have become major issues of the times. The 20th Party Congress report clearly put forward to consolidate and expand the achievements of poverty alleviation and enhance the endogenous development momentum of poverty-stricken areas and people, which points out the direction of the poverty reduction work after the eradication of poverty. In this context, poverty vulnerability as a forward-looking indicator of households' risk of falling into poverty at some point in the future is increasingly attracting

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academic and policy-makers' interest. Poverty vulnerability is not a household's current poverty status but mainly reflects a household's ability to withstand and recover from a variety of shocks. Rural household's poverty vulnerability is more obvious as they are mostly single-income source with poor risk resistance. Thus, in-depth study of the factors affecting the poverty vulnerability of rural household and its mechanism has great theoretical significance and practical significance in improving the anti-poverty monitoring and help system, and promoting the implementation of rural revitalization strategy.

Due to the development of digital technology, we have another opportunity to develop a financial service. Digital inclusive finance is complete integration of old finance with new tech and it changes how we can serve our finance and on reach. Depend on cheap strength, high-efficiency characteristic, extensive coverage, digital inclusive finance surpass in crossing time and spatial restrictions which is traditional finance service and take convenient finance to remote and poverty stricken areas [1]. Rural areas digital inclusive finance can reduce the barriers for farmers to get financial service by many means such as mobile payment, on line lending, digital insurance and so on, and it also make it more convenient to get financial services [2]. However, it is still not very clear how much of an impact digital inclusive finance has on making rural households less likely to be poor and what ways this effect might work. It is also not known if the impact of digital inclusive finance is different for different kinds of farmers. These need further theoretical explanation and test. By using the China Household Finance Survey data, it is about the effect of digital inclusive finance on rural household poverty vulnerability, offering evidence for improving digital inclusive finance policies and poverty alleviation work in rural areas.

## 2. Theoretical mechanisms of digital inclusive finance's effect on rural poverty vulnerability

### 2.1. Theoretical analysis

Digital inclusive finance is the product of the deep integration of financial technology with inclusive finance, so the impact mechanisms of digital inclusive finance on rural poverty vulnerability need to be theoretically analyzed. In this paper, we establish the research theoretical framework of this paper as an analysis of financial exclusion and financial deepening based on the theoretical foundation of financial exclusion theory and financial deepening theory to explore how digital inclusive finance can reduce rural poverty vulnerability by alleviating financial exclusion and promoting financial deepening. Financial exclusion theory shows that there is a systematic exclusion of rural groups by traditional financial system, and the financial deepening theory provides theoretical basis for the promotion of digital inclusive finance to the development of rural financial market.

The theory of financial exclusion was first used from a geographical perspective to explain the phenomenon of uneven spatial distribution of financial services [3]. This theory argues that financial institutions usually decide to build outlets in the economically prosperous regions for cost-saving and improving efficiency, resulting in remote regions and poor people being excluded de facto. As the study deepened, the content of financial exclusion expanded from geographical exclusion to price exclusion, conditional exclusion, marketing exclusion, self-exclusion, etc. For farmers, the problem of financial exclusion is relatively serious, with four types of exclusion issues being mainly reflected. First, geographical exclusion, that is, the financial outlet in the countryside is far away from the farmer's home and they cannot find a financial outlet near them. Second, price exclusion, that is, the farmer bears a high cost for financing and service fees. Third, conditional exclusion, that is, farmers without collateral are difficult to meet the entry requirements of traditional financial institutions. Fourth, self-exclusion, that is, farmers lack knowledge about financial products and are

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risk-averse. financial exclusion not only restricts the chance for farmers to get financial service, it also makes the farmer more possibly be poor, so that a vicious circle will form: poverty -> exclusion from finance -> even poorer.

The theory of financial deepening suggests that excessive government intervention in financial markets should be reduced, allowing market mechanisms to play a decisive role in resource allocation, thereby improving the efficiency and depth of the financial system [4]. It reckons that the financial development could effectively facilitate the transformation of savings to investment. It thinks that such a financial development could properly allocate the capital and thus further promote the progress of economy. financial deepening is greater in the countryside as the countryside's financial market has information disparity, high transaction costs, and hard risk control, leading to low financial resource allocation effectiveness. The traditional rural financial system because of backward technical means and a single model of service can not well meet the diversified financial needs of farmers, seriously lacking financial deepening. Digital inclusive finance serves as a carrier of financial deepening. It uses big data, cloud computing, artificial intelligence, and other technical methods to address the issues encountered by traditional rural finance. From one point of view, digital technology can lower the costs for gathering and dealing with information, lessen the issue of information being unequally distributed, enhance the financial institutions' ability to figure out how well the farmers are able to repay their debts, and let the groups of farmers who used to be unable to gain financial services get into the official financial system. on the contrary, digital platforms are able to achieve standardization and scale on financial services, lower down on the transaction costs, better on the service efficiency, and give farmers a more convenient and effective financial services. Digital inclusive finance can satisfy the farmers' various financial requirements for production, consumption, investment and so on by all kinds of financial products and services, and advance the development of rural financial markets, so as to strengthen the farmers' capacity to deal with different risks and decrease their risk of falling into poverty. when digital tech is used, getting financial stuff becomes easier and more convenient, and at the same time there's an adjustment taking place in how money moves around in farmlands – some new kinds of product offerings, service methods and other types of change happening that bring something new to rural finance and also updating it with modernization.

Construct a digital inclusive finance's influence to rural poverty vulnerability theoretical research framework by taking rural poverty vulnerability as central problem and taking digital inclusive finance as an important means to deal with financial exclusion and promote financial deepening through financial exclusion theory and financial deepening theory. Traditional financial systems suffer from serious financial exclusion in rural groups, there are many exclusion barriers: geographical exclusion, price exclusion, conditional exclusion and self-exclusion. Such exclusion factors have made it difficult for farmers to access such financial services, and have further increased the probability that people will live a poverty-stricken life. Meanwhile, the development of the rural financial market is lagging behind, and financial deepening is inadequate, making the financial environment of farmers even worse. Digital inclusive finance emerging brings about a new way to escape this predicament, applying digital technology application to solve all kinds of financial exclusion conditions, promote the deepening of rural financial markets, by important mechanism like promoting diversified financial asset allocation to help farmers form diversified risk dispersion system, improve their coping ability with all kinds of shocks, then achieve the alleviation of poverty vulnerability.

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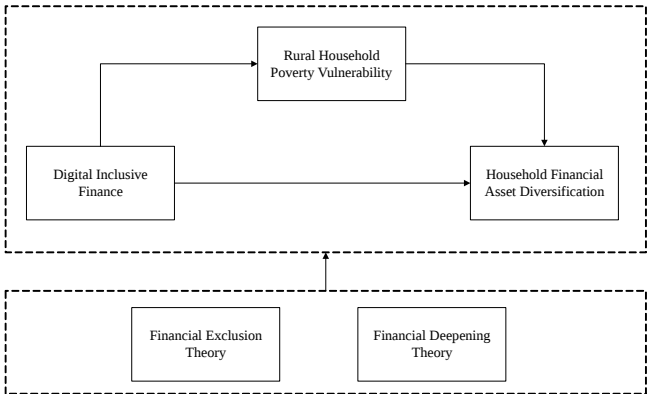


Figure 1. Theoretical framework

## 2.2. Research hypotheses

In this paper, digital inclusive finance mainly refers to when a financial service does not require providing people with financial services at a cost or at the lowest possible cost, and people can also use their mobile phones to log on online and get it anywhere and anytime as long as they can surf the web.

So in fact, digital inclusive finance is an innovation brought about by the fusion of inclusive finance and financial technology. with the technical superiority and service model can break the geographic, temporal and cost limitation of the traditional financial services. It can provide farmers with more convenient, faster and cheaper financial services [5]. Traditional financial institutions due to information asymmetry, high transaction costs, and difficulty in controlling risks, financial exclusion is shown to farmer groups, which makes it hard for farmers to get the necessary financial support to cope with all kinds of risk shocks. Digital inclusive finance based on advanced technologies like big data, cloud computing, and AI can decrease info collection and processing costs, boost risk recognition and pricing skills, and offer farmers with more exact and tailored financial services [6]. Digital inclusive finance has reduced poverty primarily by improving the service accessibility, credit supply and risk spreading. First, from the perspective of service accessibility. Digital technology breaks through the physical outlet limitations of traditional financial services, which enables farmers to enjoy financial services anytime and anywhere by using mobile terminals, thereby significantly expanding the reach and convenience of financial services [7]. Second, Digital operation models cut down the costs of operation for financial institutions, which means that the reduction of the operating costs can be transferred to farmers in the end, making it possible for farmers to get financial services with a lower cost. Third, the third is to develop digital inclusive financial products that can meet the actual needs and risk characteristics of farmers, such as microfinance products, agricultural insurance products, mobile payment products, etc., to meet the various financial needs of farmers [8]. The digital financial platform has usually better user interface and education function, so that it would be helpful to farmers to know and use all kinds of financial products, improving farmers' financial decision making level [9]. Therefore, this paper suggests the following hypothesis:

H1: Digital inclusive finance can decrease the poverty vulnerability of rural households.

Financial asset diversification allocation is an important part of modern risk management theory, it is also an important way for the family's wealth to manage the property. Based on the principle of modern portfolio theory, people believe that reasonable allocation of various kinds of financial assets can disperse the risks but without seriously lowering the expectation of the rate of return,

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which is able to improve the risk-adjustment of the invested rate of return portfolio. Rural households that are diversifying their financial assets not just for a variety of investment risks but for improving the rural households' ability to handle any sort of economic shock, thereby lessening the probability of rural households falling back into poverty [10]. Digital inclusive finance's development offers new chances to change the current state, primarily by lowering financial service entry points and transaction expenses. This makes it simpler for farmers to get access to a variety of financial items like cash market funds, wealth management goods, and insurance items, and create a diversified asset portfolio [11]. Second, Digital financial platforms also typically have strong integration and display capabilities. It can provide farmers with all-in-one financial service platforms, and compare and choose different types of financial products at the same time on the platform, greatly simplifying the asset allocation choice process [12]. Third, the intelligence of digital inclusive finance is to offer personalized asset allocation suggestions for farmers according to their risk preferences, income levels, investment purposes, and help farmers establish more scientific and reasonable investment portfolios [13]. Digital inclusive finance can offer real-time market information and investment education, helping farmers to improve their financial literacy and investment decision-making abilities so that farmers can have a better understanding of the investment risks. Rural households will gain more investment returns and keep a certain level of liquidity through diversified allocation of financial assets, which can improve their financial resilience and risk resistance. According to the above analysis, this paper put forward the following hypothesis:

H2: Digital inclusive finance reduces household poverty vulnerability through the promotion of diversified allocation of rural household financial assets.

## 3. Research design

### 3.1. Variable definition

#### 3.1.1. Dependent variable: rural poverty vulnerability measurement

The dependent variable of this article is the poverty vulnerability of rural households. This article constructs a comprehensive poverty vulnerability measurement index, which takes into account both the financial situation of households and their risk protection capabilities [14]. This article uses the ability of rural households to cope with sudden risks to determine their level of poverty vulnerability.

Table 1. Rural household poverty vulnerability components

| Indicator | Calculation Formula | Meaning | Classification Standard |
|---|---|---|---|
| Household Financial Margin (FM) | FM=Y-LC | Household income minus household expenditure | FM>0 indicates positive financial margin |
| Household Debt Service Capacity (CF) | CF= (Y+LA)/LC | (Household income + liquid assets)/household expenditure | CF>1 indicates debt service capacity |
| Household Risk Protection (IN) | IN=0/1 | Whether commercial insurance is purchased | 1=insured, 0=uninsured |
| Poverty Vulnerability (PV) | PV=0/1/2/3 | Comprehensive assessment result | 0=no vulnerability, 1=low vulnerability, 2=medium vulnerability, 3=high vulnerability |

Based on the evaluation results of the above three dimensions, this paper divides the rural household's poverty vulnerability into four levels: PV = 0 means no poverty vulnerability, that is,

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the household's income can fully meet the expenditure; PV = 1 means low poverty vulnerability, that is, the household's income cannot meet the expenditure, but there is enough liquid assets to cushion; PV = 2 means medium poverty vulnerability, that is, both the household's income and liquid assets are insufficient to meet the expenditure, but commercial insurance has been purchased; PV = 3 means high poverty vulnerability, that is, the household has defects in terms of income, assets, and insurance protection, and the risk of poverty is high.

### 3.1.2. Core explanatory variable: digital inclusive finance index

Digital Inclusive Finance index(DIFI) takes digital inclusive finance index for different area compiled by Digital Finance Research Center of Peking university to estimate the digital inclusive finance development situation of various regions from three aspects: covering, using and digitizing. Coverage breadth = the penetration of DFS. Usage depth = the actual usage of the digital financial service by the user. The digitalization degree is the extent to which digital technology is applied in financial services.

Table 2. Digital inclusive finance index components

| Primary Indicator | Secondary Indicator |
|---|---|
| Coverage Breadth | Account coverage breadth, payment service coverage breadth |
| Usage Depth | Payment service usage depth, money market fund service usage depth, credit service usage depth, insurance service usage depth, investment service usage depth, credit service usage depth |
| Digitalization Degree | Convenience, affordability, creditization, mobilization |

### 3.1.3. Mechanism variable

The household's financial asset diversity index is set up according to various kinds of financial assets that can be held by households in the CHFS questionnaire. The household's financial assets consist of 6 types: bank deposits, securities (including funds, stocks), financial wealth management products, insurance products, and other financial products. Each kind of financial products are assigned by binary variable, if one holds a certain type of the product, then it is assigned as 1; otherwise 0. Diversification index is obtained by summing up. This indicator is ordinal, 0-6. The larger the value indicates that the more diversified the household financial asset allocation, and the stronger the risk dispersion capability.

Table 3. Household financial asset diversification indicator components

| Financial Asset Category | Variable Definition | Assignment Rule |
|---|---|---|
| Bank Deposits | Whether household holds bank deposits | Holding=1, Not holding=0 |
| Funds | Whether household holds fund products | Holding=1, Not holding=0 |
| Stocks | Whether household holds stock investments | Holding=1, Not holding=0 |
| Financial Wealth Management Products | Whether household holds wealth management products | Holding=1, Not holding=0 |
| Insurance Products | Whether household holds insurance | Holding=1, Not holding=0 |
| Other Financial Products | Whether household holds other financial assets | Holding=1, Not holding=0 |

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### 3.1.4. Control variables

The individual level control variable is the basic characteristics of the head of the household. These usually affect the household's economic decisions and risk tolerance. age uses the actual age of the household head, gender 1 for males and 0 for females, education level based on educational attainment, 0 points for those who have never attended school and up to 21 points for a doctoral degree, marital status 1 for married and 0 for others.

Household level control variables are basic household economic conditions and household structure conditions. The household registration variable is assigned 1 to the urban household registration and 0 to the rural household registration, and the variables household assets and household income are standardized based on relevant CHFS questionnaires before being included in the model, and household size is taken as the actual number of household members.

Table 4. Main variable definitions and descriptions

| Variable Type | Variable Name | Measurement Method | Value Range |
|---|---|---|---|
| Dependent Variable | Poverty Vulnerability (PV) | Comprehensive assessment based on financial margin, debt service capacity, and risk protection | 0-3 |
| Core Explanatory Variable | Digital Inclusive Finance Index (DIFI) | Compiled by Peking University Digital Finance Research Center, covering coverage breadth, usage depth, and digitalization degree | Continuous variable |
| Mechanism Variable | Financial Asset Diversification | Sum of holdings of six asset categories: bank deposits, funds, stocks, wealth management, insurance, and others | 0-6 |
| Individual Control Variables | Household Head Age | Continuous variable | 18-100 |
| | Household Head Gender | Male=1, Female=0 | 0-1 |
| | Household Head Education | From never attending school=0 to doctoral degree=21 | 0-21 |
| | Marital Status | Married=1, Others=0 | 0-1 |
| Household Control Variables | Household Registration | Urban registration=1, Rural registration=0 | 0-1 |
| | Household Income | Standardized continuous variable | Continuous variable |
| | Household Assets | Standardized continuous variable | Continuous variable |
| | Household Size | Continuous variable | 0-15 |

## 3.2. Probit model specification

### 3.2.1. Baseline regression model

Probit Model is an econometric model that deals with ordered categorical dependent variable, it uses the cumulative distribution function of standard normal distribution to construct. In this study, the rural poverty vulnerability is a four-category ordered variable (0, 1, 2, 3), and the traditional linear regression cannot well reflect the ordered characteristics. Probit model deals with ordinality of dependents through introducing latent variable, thresholds, and then estimate marginal impact on each explanatory variable on probability levels of different vulnerable status. Since the dependent variable of rural household poverty vulnerability is an ordered categorical variable, the Probit model is used for empirical research in this paper. Baseline regression model:

$$PV_{i,p,t} = \beta_0 + \beta_1 DIFI_{p,t} + \beta_2 X_{i,p,t} + \mu_p + \lambda_t + \varepsilon_{i,p,t} \quad (1)$$

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Where:

$PV_{i,p,t}$ = poverty vulnerability level of the i-th rural household in province p in year t;

$DIFI_{p,t}$ = digital inclusive finance index of province p in year t;

$X_{i,p,t}$ = control variable vector, including individual-level and household-level control variables;

$\mu_p$ = province fixed effects; $\lambda_t$ = time fixed effects; $\varepsilon_{i,p,t}$ = random error term.

### 3.2.2. Mechanism testing model

In order to test the transmission channel of digital inclusive finance to rural poverty vulnerability, this paper establishes a 3-step mediation effect test model. The first step test the effect of digital inclusion finance to rural financial asset diversity. The result of significance of a significant coefficient to positive means the digital inclusion finance will contribute towards the diversified asset of rural financial. Step two adds digital inclusive finance and financial asset diversification variables at the same time to test their effects on poverty vulnerability, separately estimate the direct effects of digital inclusive finance and the mediation path coefficient of financial asset diversification. step 3, decompose effects to direct and indirect effects. The indirect effect represents the extent to which digital inclusive finance affects poverty vulnerability through financial asset diversification and can be calculated as the product of the first step coefficient and the second step mediation variable coefficient.

Step 1: Impact of independent variable on mediating variable (path a)

$$M_{i,p,t} = \alpha_0 + \alpha_1 X_{i,p,t} + \alpha_2 Controls_{i,p,t} + \mu_p + \lambda_t + \varepsilon_{i,p,t} \quad (2)$$

Step 2: Impact of independent variable and mediating variable on dependent variable (paths c' and b)

$$Y_{i,p,t} = \beta_0 + \beta_1 X_{i,p,t} + \beta_2 M_{i,p,t} + \beta_3 Controls_{i,p,t} + \mu_p + \lambda_t + \varepsilon_{i,p,t} \quad (3)$$

Step 3: Mediation effect decomposition Total effect: c = α1 × β2 + β1 Indirect effect: a × b = α1 × β2 Direct effect: c' = β1 Mediation effect proportion:

$$\frac{a \times b}{c} = \frac{\alpha_1 \times \beta_2}{c} \quad (4)$$

Where:

$X_{i,p,t}$ = Digital Inclusive Finance Index;

$M_{i,p,t}$ = Financial Asset Diversification (mediating variable);

$Y_{i,p,t}$ = Poverty Vulnerability (dependent variable);

$\alpha_1$ = path a coefficient, $\beta_2$ = path b coefficient, $\beta_1$ = path c' coefficient.

## 3.3. Data sources

The data of this paper are mainly obtained from two channels. First, the CHFS database, organized by the China Household Finance Survey and Research Center at SWUFE, containing the household financial data in 29 provinces (cities, autonomous regions) across the country. Second, the China Digital Inclusive Finance Index, compiled by the Digital Finance Research Center of PKU, based on

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a large number of transaction data from Ant Financial, which is more conducive to reflecting the development level of digital inclusive finance in different areas.

## 4. Empirical analysis

### 4.1. Descriptive statistics

From the descriptive statistics of the core variables, it can be seen that the average value of the rural household's poverty vulnerability index is 0.95 and the standard deviation is 1.12, which means that the overall poverty vulnerability level of farmers in the sample is medium, but the gap is quite large. The mean value of the digital inclusive finance index is 185.42, and the standard deviation is 68.73. The range of maximum and minimum values is also relatively large, indicating that there are significant differences in the level of digital inclusive finance development among different regions. The mean of the financial asset diversification index is 1.85, the standard deviation is 1.34, and the range of values is between 0 and 6, indicating that rural areas have a low degree of financial asset allocation, and most farmers hold only a few kinds of financial assets, there is much to improve in terms of diversification.

Sample characteristic distribution is characterized by the typical rural population structure of rural groups. Age wise middle-aged people 41 - 60 constitutes bulk (49.49%) which depicts aging of rural work force. in terms of gender, there are 77.01% as a man's home, that is also in keeping with what is usually the typical household composition in the village itself. education level is generally low, 78.97% of household heads have junior high school education or below. The income and assets distribution are a pyramid, 51.01% of the families are low-income, and 48.01% of the families are low-asset. Household size is mainly nuclear family with 3-4 people (59.98%), which shows that the family structure has been transformed to be modernized.

Table 5. Sample characteristic frequency distribution

| Variable Category | Group | Frequency | Percentage (%) |
|---|---|---|---|
| Household Head Age | 18-40 years | 1,774 | 20.98 |
| | 41-60 years | 4,186 | 49.49 |
| | Over 61 years | 2,496 | 29.53 |
| Household Head Gender | Male | 6,512 | 77.01 |
| | Female | 1,944 | 22.99 |
| Household Head Education | Primary school and below | 3,297 | 38.99 |
| | Junior high school | 3,466 | 40.98 |
| | High school and above | 1,693 | 20.03 |
| Marital Status | Married | 7,223 | 85.42 |
| | Others | 1,233 | 14.58 |
| Household Income | Low income group (≤80,000) | 4,313 | 51.01 |
| | Medium income group (80,000-200,000) | 2,455 | 29.04 |
| | High income group (>200,000) | 1,688 | 19.95 |
| Household Assets | Low asset group (≤200,000) | 4,059 | 48.01 |
| | Medium asset group (200,000-600,000) | 2,708 | 32.02 |
| | High asset group (>600,000) | 1,689 | 19.97 |
| Household Size | 1-2 people | 1,606 | 18.99 |
| | 3-4 people | 5,074 | 59.98 |
| | 5 people and above | 1,776 | 21.03 |

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## 4.2. Baseline regression results

The baseline regression model (1) has only the core explanatory variables, model (2) additionally adds individual-level control variables, model (3) further adds household-level control variables and province fixed effects, and model (4) is the full model that controls for time fixed effects at the same time. According to the regression results, from the various model specifications, the coefficient of digital inclusive finance index is all negative and is statistically significant at 1% level, which shows that digital inclusive finance will significantly alleviate the poverty rate of rural households. Control variables are continuously added and the absolute value of the core explanatory variable's coefficient decreases a little bit but still very significantly, which indicates strong robustness. From the control variables of household heads' human capital characteristics (age, education level, marital status), household economic conditions (income, asset), and household size increase poverty vulnerability risks.

From the baseline regression result, it can be seen that digital inclusive finance has a significant negative impact on rural household poverty vulnerability with a coefficient of -0.285, significant at the 1% level, which means that the development of digital inclusive finance will reduce the vulnerability of rural household poverty, and verifies the hypothesis H1. From marginal effects: With every one unit increase in digital inclusive finance index, the probability of rural household being in non-poverty vulnerable status increased by 8.2% and decreased the probability of rural household being in high poverty vulnerable status by 8.5%.

Table 6. Baseline regression results

| Variable | Model (1) | Model (2) | Model (3) | Model (4) |
|---|---|---|---|---|
| Digital Inclusive Finance Index | -0.285*** | -0.267*** | -0.251*** | -0.243*** |
| | (0.045) | (0.043) | (0.041) | (0.039) |
| Household Head Age | | -0.012** | -0.011** | -0.010** |
| | | (0.005) | (0.005) | (0.004) |
| Household Head Gender | | -0.156* | -0.148* | -0.142* |
| Household Head Education | | -0.025*** | -0.023*** | -0.021*** |
| | | (0.008) | (0.007) | (0.007) |
| Marital Status | | -0.198** | -0.185** | -0.176** |
| | | (0.089) | (0.085) | (0.082) |
| Household Income | | | -0.018*** | -0.016*** |
| | | | (0.004) | (0.004) |
| Household Assets | | | -0.003*** | -0.003*** |
| | | | (0.001) | (0.001) |
| Household Size | | | 0.067*** | 0.063*** |
| | | | (0.019) | (0.018) |
| Province Fixed Effects | No | No | Yes | Yes |
| Time Fixed Effects | No | No | No | Yes |
| Observations | 8,456 | 8,456 | 8,456 | 8,456 |
| $R^2$ | 0.125 | 0.168 | 0.195 | 0.218 |

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## 4.3. Robustness tests

### 4.3.1. Reference text and citations

By different forms of examination, the adverse impact of digital inclusion finance on rural poverty vulnerability has been evident. In terms of alternative model tests, the core variable test uses the Logit model and the coefficient of the core variable is -0.421, consistent with the basic regression direction; the alternative test of the dependent variable is the use of alternative poverty vulnerability measurement, the coefficient of -0.198, and it is still significantly negative; taking into account the delay effect, the use of one period lag of the explanatory variables as the regressor variable, the regression coefficient is -0.227, showing that the effect of poverty reduction is persistent; the use of 5% winsorization to deal with the extreme value effect, the coefficient is -0.251, and the result is still robust.

Table 7. Robustness test results

| Testing Method | Variable Coefficient | Standard Error | Observations | $R^2$ |
|---|---|---|---|---|
| Baseline Regression (Probit) | -0.243*** | -0.039 | 8,456 | 0.218 |
| Alternative Model (Logit) | -0.421*** | -0.067 | 8,456 | 0.224 |
| Alternative Dependent Variable | -0.198*** | -0.041 | 8,456 | 0.195 |
| One-period Lagged Explanatory Variable | -0.227*** | -0.045 | 6,342 | 0.203 |
| Winsorization (5% percentile) | -0.251*** | -0.042 | 8,456 | 0.215 |

## 4.4. Mechanism testing

According to the mechanism test of this paper, the first column uses OLS regression, the digital inclusive finance index has a significant positive effect on the financial asset diversification index, the coefficient is 0.234, which means that the digital inclusive finance index promotes the diversified allocation of rural financial assets; the second column shows the baseline regression results, and the third column simultaneously includes digital inclusive finance index and financial asset diversification index. Financial asset diversification has a strong negative effect on poverty vulnerability, and the coefficient is -0.231. The absolute value of the coefficient of digital inclusive finance reduces from 0.243 to 0.189, decreasing by approximately 22.2%, suggesting that the financial assets are diversified to some extent in the process of digital inclusive finance impacting rural poverty vulnerability.

Table 8. Mechanism testing results (financial asset diversification)

| Variable | Financial Asset Diversification | Poverty Vulnerability | Poverty Vulnerability |
|---|---|---|---|
| Digital Inclusive Finance Index | 0.234*** | -0.243*** | -0.189*** |
| | (0.042) | (0.039) | (0.043) |
| Financial Asset Diversification | | | -0.231*** |
| | | | (0.035) |
| Control Variables | Yes | Yes | Yes |
| Province Fixed Effects | Yes | Yes | Yes |
| Time Fixed Effects | Yes | Yes | Yes |
| Observations | 8,456 | 8,456 | 8,456 |
| $R^2$ | 0.186 | 0.218 | 0.248 |

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Note: *** indicates significance at the 1% level; robust standard errors in parentheses.

According to Bootstrap mediation effect test, the mediating role mechanism of financial asset diversification in the process of digital inclusive finance influencing rural poverty vulnerability is confirmed. Based on bias corrected Bootstrap method with 5000 repetitions, we find that the total effect of digital inclusive finance on poverty vulnerability is -0.243, the direct effect is -0.189, and the indirect effect is -0.054, the 95% confidence interval is [-0.089,-0.019], which does not contain 0, and it is significant at the 1% level. Mediation effect is 22.2%, [14.3%, 31.7%]. This means that the poverty reduction effect caused by financial asset diversification can account for about one fifth of the total effect. The Path Decomposition shows that digital inclusive finance could bring diversified distribution of rural financial assets to diversified poverty-vulnerability, i.e. digital inclusive finance helps rural financial assets diversified which leads to reduce poverty-vulnerability.

Table 9. Financial asset diversification bootstrap testing

| Path | Effect Value | Bootstrap Standard Error | Bias-corrected 95% CI | Percentile 95% CI |
|---|---|---|---|---|
| Digital Inclusive Finance → Financial Asset Diversification | 0.234 | 0.042 | [0.152, 0.316] | [0.151, 0.317] |
| Financial Asset Diversification → Poverty Vulnerability | -0.231 | 0.035 | [-0.299, -0.163] | [-0.300, -0.162] |
| Indirect Effect (a×b) | -0.054 | 0.018 | [-0.089, -0.019] | [-0.090, -0.020] |
| Path | Effect Value | Bootstrap Standard Error | Bias-corrected 95% CI | Percentile 95% CI |

## 5. Conclusion

This study adopts China household finance survey data and Digital inclusive finance index, to analyze the influence effect and the path of digital inclusive finance for rural household poverty vulnerability comprehensively. Digital inclusive finance greatly diminishes rural household poverty vulnerability, this poverty reduction effect is still meaningful after carrying out all sorts of strong testing. From the mechanism analysis we can see that financial asset diversification is a significant transmission path of digital inclusive finance to influence the rural poverty vulnerability, since digital inclusive finance improves the risk dispersion capability by promoting diverse allocation of rural financial asset and reduces poverty vulnerability.

The conclusions of the research show that the digital inclusive finance has an important role on consolidating and enlarging the poverty alleviation achievement and also it has an important role on preventing large scale of people back to poverty again. Digital inclusive finance has the features of low cost, high efficiency, and wide coverage, and it can help to overcome the constraints of space and time for traditional financial service and provide farmers with more convenient financial service and solve problems of financial exclusion and promote the deeper development of rural financial market.

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