Economic Society and Humanities Vol. 3 No. 6, 2026

The Influence Mechanism and Empirical Test of Digital Inclusive Finance on Rural Revitalization

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Abstract: Digital financial inclusion effectively promotes the rural revitalization by expanding financial services, increasing rural income and driving development of rural industries. On the basis of existing literature, this article constructs an index of rural revitalization in China, and measure the index by entropy weight method. Testing the impact of digital financial inclusion on rural revitalization, using economic level as a mediator variable to test impact mechanism of digital financial inclusion supporting rural revitalization. And Furth more, using threshold effect analysis method to test the nonlinear impact. The research show that digital financial inclusion has significantly improved rural revitalization, and the impact is non-linear, with dual threshold characteristics and significant regional heterogeneity.

Keywords: Digital Financial Inclusion; Rural Revitalization; Influencing Mechanism; Empirical Research

1. Introduction

The high-quality development of agriculture and rural areas is pivotal to building a modern powerful country and realizing common prosperity. Digital Inclusive Finance (DIF) emerges from integration of digital technology and traditional finance. On the one hand, it directly boosts rural revitalization by reducing poverty and increasing farmers' income [1-2]. In addition, it plays an indirect role in advancing rural revitalization by encouraging farmers to start businesses and improving the accessibility and feasibility of financing for relevant participants [3].

Existing studies have explored the correlation between DIF and rural revitalization from diverse perspectives, and their findings can be mainly summarized into three effects: income growth, poverty alleviation and income distribution. As for the income growth, DIF features superior spatial-temporal reach and low-cost advantages, which remedies the deficiencies of traditional finance in raising rural households' income. Scholars have proven that DIF enables more vulnerable groups to access financial services, thereby lifting the household income of disadvantaged groups, especially low-income rural residents [4-5]. Particularly in developing countries, inclusive finance plays a more prominent role in increasing income [6-7]. With regard to the poverty alleviation, DIF mitigates relative poverty in rural areas via payment, credit, insurance, income distribution and other channels, among which the payment channel delivers the most remarkable poverty reduction effect [8]. Through the trickle-down effect and optimized capital allocation mechanism, it eases wealth concentration and facilitates equitable distribution [9].

As for the income distribution effect, relevant research indicates that DIF can optimize income distribution among different groups. It bridges the income divide by stimulating employment and expanding non-agricultural jobs, and such convergence effect presents a notable threshold effect. Meanwhile, it can improve income distribution and achieve income growth while balancing efficiency and fairness. Additionally, some scholars have studied national-level income inequality using the Gini coefficient and confirmed that inclusive finance helps ameliorate income disparity.

DIF has become an effective tool to narrow the income gap, drive the transformation of agriculture, and achieve inclusive economic growth. Nevertheless, questions remain: can DIF facilitate implementation of rural revitalization strategy? What transmission mechanisms exist between the two? Most of the existing research focuses on the impacts of DIF on industrial development and rural residents' income, while

comprehensive studies on its overall influence on rural revitalization are still insufficient. Against this background, this paper makes an index with overall requirements for rural revitalization, then conducts an empirical analysis on the impact of DIF in supporting rural revitalization.

2. Influence Mechanism and Research Hypotheses

While retaining the core functions of traditional finance, DIF breaks the constraints of geography and time. With lower transaction costs and higher transaction efficiency, it addresses the bottlenecks of capital shortage and inadequate financial services in rural areas, stimulates innovation among rural enterprises and boosts rural economic growth. Meanwhile, rural finance helps improve relevant laws and regulations as well as financial education, thereby optimizing the rural financial ecosystem, fostering a sound operational environment, and advancing effective rural governance and cultural progress. Through superposition and multiplication effects, DIF amplifies the industrial driving effect, environmental improvement effect and social standardization effect of financial activities, and ultimately facilitates rural revitalization [10]. Accordingly, this paper puts forward Hypothesis 1: DIF can promote rural revitalization.

Affected by geographical location, climatic conditions, industrial layout, national policies and other factors, economic development varies across regions of China. Given uneven regional development, DIF may present significant regional heterogeneity in its coverage, innovative models and practical effects when supporting rural revitalization. There are also prominent gaps in digital infrastructure across different regions. Eastern region boasts a higher digitalization than central and western areas', which allows DIF to exert greater potential and more remarkable effects on rural revitalization. Thus, we propose Hypothesis 2: It exists regional heterogeneity in the impact of DIF on rural revitalization.

Promoting rural economics is a core part of rural revitalization. At present, rural areas still face prominent challenges including weak industrial foundations, imperfect investment mechanisms, insufficient integration of green development and economic growth, as well as difficulties and high costs in financing. The introduction of DIF can effectively improve financial services. It drives rural economic development by facilitating industrial innovation, extending industrial chains, popularizing the concept of green development, promoting data integration and providing diversified services, and further fuels rural revitalization. Hypothesis 3: The impact of DIF has a mediating effect.

The effectiveness of DIF is subject to regional development conditions. The high level of economic and sound infrastructure and balanced industrial development, DIF plays a stronger role in advancing rural revitalization. In underdeveloped regions constrained by insufficient resources, its effects are relatively limited. We can infer that the impact of DIF on rural revitalization may not be a linear relationship. Hence, we put forward Hypothesis 4: DIF exerts a non-linear impact.

3. Research Design

3.1 Data Description

The data sources based from 2011 to 2020 in 30's Chinese provinces. Due to data deficiency, data of Xizang, Hong Kong, Macao and Taiwan were not included. The data are collected from China Agriculture, Rural Areas and Farmers Database, official website of the National Bureau of Statistics, China Poverty Alleviation Database, the EPS Data Platform, China Rural Statistical Yearbook and China Civil Affairs Database. To ensure data validity, this article has performed tail indentation and logarithmic processing on some of the data. For missing values, data cleaning and processing are implemented through mathematical calculations using Stata and Excel.

3.2 Variable Selection

The DIF Index, jointly compiled by Peking University and Research Institute of Ant Group, features comprehensive data and serves as a reliable quantitative indicator for measuring digital finance. It has been widely recognized and adopted in academic circles. Therefore, this study adopts this index to measure DIF. Rural revitalization index is made by an evaluation system (Table 1) and calculated by entropy weight method.

DIF drives rural revitalization through multiple pathways. It generates industrial driving effects via model innovation, delivers ecological improvement effects by promoting green finance businesses, produces cultural advancement

effects through improving living standards and labor quality, achieves standardized governance effects by strengthening data integration, and creates poverty reduction and income growth effects with diversified financial services. Collectively, these effects underpin the advancement of rural revitalization.

Accordingly, this study adopts the ratio of regional gross domestic product to regional population to measure economics set as mediating variable to explore the influencing mechanism of DIF on rural revitalization. The variables' selection and definition are in Table 2.

Table 1. Indicator for Rural Revitalization

Primary	Secondary	Tertiary
Thriving Industries	Industrial Level	Per capita output value of agriculture, forestry, animal husbandry and fishery
		Per capita grain output
	Production Efficiency	Productivity of the primary industry
		Land productivity
	Technological Level	Per capita total power of agricultural machinery
	Technological Level	Per capita effective irrigated area
Eco-friendly Living	Natural Livability	Forest coverage rate
	Artificial Livability	Popularization rate of sanitary toilets
		Rural water supply popularization rate
	Social Livability	Per capita number of village clinics
		Per capita number of rural doctors and health workers
Rural Civilization	Education Popularization	Average years of schooling in rural areas
	Civilization Construction	Number of township cultural stations
	Cultural Development	Proportion of expenditure on education, culture and entertainment
Effective Governance	Democratic Autonomy	Number of village committees per thousand residents
		Proportion of village committee staff with college degree or above
	Grassroots Rule of Law	Crime rate
	Governance Effectiveness	Urban-rural resident income ratio
Affluent Life	Quality of Life	Engel coefficient of rural permanent residents
	Social Security	Per capita rural minimum living security expenditure
	Income Level	Per capita disposable income

Table 2. Variable

Type	Name	Symbol	Definition
Explained Variable	Rural Revitalization Index	Rural	Calculated rural revitalization index
Core Explanatory Variable	DIF Index	Difi	Index released by the Digital Finance Research Center of Peking University
Mediating Variable	Economic Development Level	Eco	Regional gross domestic product divided by total regional population
Control Variable	Industrial Structure	Is	Added value of the primary industry divided by regional GDP
	Traffic Accessibility	lnTrans	Logarithm of highway mileage
	Population Structure	Odr	Ratio of middle-aged and elderly population to working-age population
	Degree of Opening-up	Open	Total import and export volume divided by regional GDP
	Urbanization Rate	Urban	Urban population divided by total regional population
	Fiscal Support for Agriculture Ratio	Fc	Government expenditure on agriculture divided by total fiscal expenditure

3.3 Model Construction

We established a fixed-effects model to analyze the impact of inter-provincial DIF on rural revitalization:

$$Ruarl_{it}=\partial_0+\beta_0 Difi_{it}+\beta_1 Is_{it}+\beta_2 lnTrans_{it}+\beta_3 Odr_{it}+\beta_4 Open_{it}+\beta_5 Urban_{it}+\beta_6 Fc_{it}+\mu_i+\gamma_t+\varepsilon_{it} \quad (1)$$

The subscript i refers to the 30 individual samples, and the subscript t denotes the time period from 2011 to 2020. β_0 is the coefficient of the core explanatory variable, ∂_0 stands for intercept term, and β_1~β_5 represent the coefficients of control variables. μ_i indicates individual fixed effect, ε_{it} is random error term,

and γ_t denotes the time fixed effect.

We established mediating effect model [11], and chose economics as a mediating variable. The specific model specifications are presented as follows:

$$Ruarl_{it}=\partial_0+cDifi_{it}+\beta_1 Is_{it}+\beta_2 lnTrans_{it}+\beta_3 Odr_{it}+\beta_4 Open_{it}+\beta_5 Urban_{it}+\beta_6 Fc_{it}+\mu_i+\gamma_t+\varepsilon_{it} \quad (2)$$

$$lnEco_{it}=\partial_0+aDifi_{it}+\beta_1 Is_{it}+\beta_2 lnTrans_{it}+\beta_3 Odr_{it}+\beta_4 Open_{it}+\beta_5 Urban_{it}+\beta_6 Fc_{it}+\mu_i+\gamma_t+\varepsilon_{it} \quad (3)$$

$$Ruarl_{it}=\partial_0+c'Difi_{it}+blnEco_{it}+\beta_1 Is_{it}+\beta_2 lnTrans_{it}+\beta_3 Odr_{it}+\beta_4 Open_{it}+\beta_5 Urban_{it}+\beta_6 Fc_{it}+\mu_i+\gamma_t+\varepsilon_{it} \quad (4)$$

Where Eco represents the mediating variable of economic development level, and all other symbols are defined as above. Model 1 captures the total effect of DIF on rural revitalization; Model 2 reflects effect of DIF on mediating variable; Model 3 estimates effect of economics on rural revitalization after controlling impact.

To test the non-linear hypothesis, this paper takes DIF as a threshold variable:

$$Ruarl_{it}=\partial_0+\partial_1 Difi_{it}(q_i\leq\gamma)+\partial_1 Difi_{it}(q_i>\gamma)+\beta_1 Is_{it}+\beta_2 lnTrans_{it}+\beta_3 Odr_{it}+\beta_4 Open_{it}+\beta_5 Urban_{it}+\beta_6 Fc_{it}+\varepsilon_{it}$$

4. Empirical Results

4.1 Regression Results

This study conducts estimations using the pooled panel fixed-effects model (Columns 1-2 in Table 3) and random-effects model (Columns 3-4 in Table 3). The Hausman test confirms that fixed-effects model yields superior estimation results. Given potential existence of individual and time effects, the two-way fixed-effects model is adopted.

DIF significantly boosts rural revitalization, with significance test at 1% level. After incorporating control variables, the estimated coefficient remains relatively stable. That verifies Hypothesis 1.

4.2 Heterogeneity Analysis

In view of the unbalanced development between different regions, data divides into eastern and central-western regions following existing classification criteria, and uses Stata to examine the impact of DIF on rural revitalization across different regions. Noticeable disparities also exist between southern and northern regions due to geographical locations. Accordingly, this study conducts a heterogeneity analysis for the two regions divided by the 35th parallel north in accordance with the north-south division standard.

The empirical results are presented in Table 4. Columns 1 and 2 report the regression outcomes for eastern region and central-western regions respectively, while Columns 3 and 4 correspond to the northern and southern regions. The results indicate that the promoting effect of DIF is stronger in the eastern region, and more prominent in the south than in the north. The above findings confirm the existence of regional heterogeneity, which verifies Hypothesis 2.

Table 3. Benchmark Regression Results

	Rural(1)	Rural(2)	Rural(3)	Rural(4)
Difi	0.0141*** (7.07)	0.0110*** (5.38)	0.0166*** (11.08)	0.0172*** (9.10)
Is		0.0394** (3.17)		0.0264* (2.35)
lnTrans		0.608* (2.34)		-0.203* (-2.47)
Odr		-0.0299** (-2.84)		-0.0124 (-1.19)
Open		0.00461 (0.94)		0.00691 (1.23)
Urban		-0.0810*** (-8.73)		-0.0111 (-1.78)
Fc		-0.0225* (-2.03)		-0.0219 (-1.80)
_cons	1.645*** (18.00)	-0.808 (-0.27)	1.542*** (16.78)	4.510*** (3.67)

Table 4. Regression Results of Different Regions

	Rural(1)	Rural(2)	Rural(3)	Rural(4)
Difi	0.00883** (3.02)	0.00523* (2.05)	0.0103** (2.78)	0.0124*** (3.80)
Control Variables	YES	YES	YES	YES
_cons	23.36*** (4.41)	-10.20* (-2.55)	6.134 (0.94)	-6.217 (-1.79)

4.3 Analysis of Influence Mechanism

Based on the aforementioned mechanism model, Column 1 presents the total impact of DIF on rural revitalization. Column 2 reports the effect of DIF on the mediating variable of economic development. Column 3 illustrates the impact of DIF on rural revitalization after the mediating variable is incorporated (Table 5).

Furthermore, the Sobel test is applied to verify the robustness and validity (Table 6). The results confirm existence of a mediating effect between DIF and rural revitalization, which supports Hypothesis 3. Specifically, total effect is 0.00434, direct effect is 0.00349, and indirect effect is 0.00085. The mediating effect accounts for 19.59% of total effect.

4.4 Threshold Effect Analysis

Previous analyses based on panel data models assume a linear relationship between DIF and rural revitalization, which may overlook heterogeneous impacts across different development stages. Therefore, this paper adopts the bootstrap method to test single, double and triple-threshold specifications. As shown in Table 7, it presents a double-threshold characteristic. The first threshold value is 45.56 and the second is 282.2235 (Table 8).

The results of the panel threshold model (Table 9) verify Hypothesis 4. DIF does promote rural revitalization, and such influence is non-linear with evident threshold effects.

Table 5. Results of Mediating Effect

	Rural(1)	lnEco(2)	Rural(3)
Difi	0.0110*** (5.38)	0.00730*** (9.35)	0.00725** (3.12)
lnEco			0.513** (3.18)
Control Variables	YES	YES	YES
_cons	-0.808 (-0.27)	7.284*** (6.30)	-4.542 (-1.42)

Table 6. Mediating Effect Test Results

Indicator	Coefficient	Std. Error	Z-value	P>|Z|
Sobel	0.00084957	0.00020166	4.213	0.0000252
a	0.00084957	0.00020288	4.188	0.00002819
b	0.00084957	0.00020043	4.239	0.00002247
Indirect Effect	0.00085	0.000202	4.213	0.000025
Direct Effect	0.00349	0.000415	8.414	0.000000
Total Effect	0.00434	0.000396	10.971	0.000000
Proportion of Mediating Effect	19.59%	—	—	—

Table 7. Threshold Effect Test Results

Threshold Type	F-value	P-value	BS Times	10%	5%	1%
Single threshold	90.33	0.0000	300	27.1031	30.0000	39.3447
Double threshold	45.63	0.0000	300	15.1491	18.1159	24.9287
Triple threshold	22.45	0.5433	300	37.8847	44.3788	50.5809

Table 8. Threshold Estimation Results

Threshold Type	Threshold Estimate	95% Confidence Interval
Single threshold	45.56	[42.5900, 60.5800]
Double threshold	282.2235	[272.6389, 282.6460]

Table 9. Panel Threshold Model Estimation Results

Variable	Coefficient	Std. Error	t-value
Difi<45.56	0.0175764	0.0026366	6.67
45.56≤DifiI≤282.2235	0.0063015	0.000942	6.69
Difi>282.2235	0.0073138	0.0010744	6.81
_CONS	-5.336621	3.965126	-1.35

4.5 Further Tests

This paper conducts robustness tests on the above conclusions through three approaches: adopting the first-order lag of the DIF index, adjusting the sample size, and replacing the rural revitalization index with farmers' income level. The results confirm that DIF effectively facilitates rural revitalization, and it's also robust. Endogeneity in this study mainly stems from reverse causality. To mitigate endogeneity bias, we use the one-period lag of DIF. The model is then employed to examine impact of lagged core explanatory variable, and empirical results remain statistically significant.

5. Conclusion and Recommendations

Based on 30 Chinese provincial data from 2011 to 2020, this paper systematically analyzes mechanism of DIF on rural revitalization. Main research conclusions are as follows. First, DIF significantly improves overall level of rural revitalization. Second, DIF's impact on rural revitalization presents prominent regional heterogeneity. Third, economic level plays a mediating role, and the impact has obvious double-threshold characteristics.

Accordingly, the government should optimize top-level design and strengthen the implementation of DIF policies, guide capital to flow into rural markets and introduce targeted policies to support the sound development of DIF. Depended on the actual demands of rural residents, localized financial products and services should be developed to adapt to rural development characteristics.

Second, financial institutions should increase capital investment in economically underdeveloped rural areas. Meanwhile, a sound and effective regulatory system should be established to prevent and defuse potential financial risks in the development process.

Third, the government should improve the rural financial system in light of local conditions and continuously expand the development space of regional DIF. By fully leveraging internet and digital technologies, the high-quality development can be advanced, so as to effectively elevate the construction level of rural revitalization across all regions in China.

Acknowledgments

This paper is supported by Beijing Social Science Foundation "Research on the Sustainable Development and Synergistic Effects of Inclusive Finance in the Beijing-Tianjin-Hebei Region under the Background of Rural Revitalization" (No. 21JJB016).

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