



An Empirical Study on Digital Inclusive Finance in Anhui Province Promoting Rural Revitalization

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SUMMARY: *Rural revitalization, a pivotal national initiative, has far-reaching consequences for both the advancement of rural economies and societies and the sustained peace and stability of the nation. Rural revitalization is greatly aided by digital inclusive financing. Five sub-indicators are chosen for this paper: industrial prosperity, ecological habitability, rural civilization, effective governance, and affluent living standards, from 2011 to 2022. It builds an index of rural revitalization using the entropy method. In Anhui Province, through the construction of a panel regression model connecting rural revitalization with digital financial inclusion, as well as external openness and the urbanization rate, it is found that the improvement of the index of digitally inclusive finance in 16 prefecture-level cities substantially advances rural revitalization. In light of this, corresponding policy proposals are proposed in the hope of providing a reference for other regions.*

KEYWORDS: *Digital Inclusive Finance, Rural Revitalization, Entropy Method*

1 Introduction

As a material strategic initiative of the State, the revitalization of the rural has far-reaching significance not only in terms of fostering agricultural productivity growth and rural landscape revitalization, but also in terms of its profound relevance to the blueprint for the overall development of the country and its future (Liu, Zang&Yang, 2022). This strategy is not only directly related to the optimization and upgrade of the agricultural construction, advancements in rural infrastructure and substantial improvements in farmers' living standards, but also from a more macroscopic point of view, it is a key step to promote China's advancement towards the destination of building a modernized socialist country in a comprehensive manner, which is of immeasurable value and importance (ibid, 2022). By providing convenient financial service, digital technology helps farmers obtain loans, insurance and payment services, thus promoting agricultural modernization and economic advance (Guo& Liang, 2023). Taking Anhui Province as an example, this paper examines in detail how digital financial inclusion affects rural revitalization.

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2 Literature Review

2.1 Digital financial inclusion

According to Sarma (2012), the concept of inclusive finance, which aims to provide effective financial services to people from all walks of life, was introduced by the UN. To ensure the equitable and efficient provision of financial services across diverse societal strata, with a particular focus on neglected rural areas, poverty-stricken groups, small enterprises, micro-businesses, and other marginalized communities. According to Zhang *et al.* (2022), the cornerstone of financial inclusivity lies in establishing formal financial avenues tailored to socially marginalized groups. The continuous progress in digital technology has facilitated the integration of financial inclusion, giving rise to a novel model of digital financial inclusion (Gomber, Kauffman, Parker, & Weber, 2018). The convenience and efficiency of financial services have been significantly enhanced by digital inclusive finance, which eliminates time and location restrictions (*ibid.*, 2018). Demirgüç-Kunt *et al.* (2017) consider that digital inclusive finance will still develop with the financial market's evolution even in the absence of government promotion, while he believes that financial institutions should meet demand of market and exploit new financial production in order to serve all kinds of groups more broadly, in order to expand the financial services' reach. According to Li *et al.* (2022), digital inclusive finance enables disadvantaged groups to receive fair financial services and can effectively help impoverished groups escape poverty. Microfinance is being provided to farmers in broad rural areas as a type of inclusive finance. As a result of the state and government's focus on digital inclusive finance, Huang *et al.* (2021) contend that a key instrument for accomplishing rural revitalization is digital inclusive finance, as more and more economically disadvantaged people are now obtaining financial help and access to financial services.

2.2 Rural revitalization

Johnson (1989) emphasized that notable advancements in the economic status, infrastructure, and public service provisions in rural regions have been achieved due to the implementation of the rural revitalization initiative across France. In China, rural development is lagging behind, and the "three rural" problems still exist, therefore, the full execution of the rural revitalization policy was suggested in the document presented at the 19th Party Congress (Liu, Zang & Yang, 2020). Liu *et al.* (2020) elaborated the development direction and five objectives of the rural revitalization initiative, which can successfully encourage the modernization and enduring growth of rural regions under governmental stewardship. Urban and rural areas' unequal development can be addressed through the comprehensive execution of the rural revitalization program (Zhang, Yang & Wang, 2020). Li & Wang (2022) consider that the role of e-commerce business should be given full play to their role in revitalizing rural industries. E-commerce provides a broader market and more sales channels for the selling of agricultural goods, and advocates the construction of a trinity system chain of farmers, sales platforms and enterprises, which promotes the comprehensive transformation and upgrading of the rural economy (*ibid.*, 2022). Zhang *et al.* (2020) maintain that the degree of rural revitalization and villagers' satisfaction are positively correlated. Liu *et al.* (2022) developed an assessment system for the rural revitalization index using the entropy value approach and discovered a notable rising trend in China's rural revitalization level.

2.3 Digital inclusive finance's effects on rural revitalization

Honohan (2004) advocates that increasing the rural financing supply can evidently raise the

income standard of the impoverished, and then foster holistic economic growth across countryside areas. Digital inclusive finance, according to Huang et al. (2023), offers a diverse array of financial services, spurs the expansion of various associated sectors within countryside regions, and aids in the growth of the rural economic landscape. Zhang et al.(2022) consider that expanding the coverage of rural financial services enables more rural households, groups returning to their hometowns and new agricultural business entities to access financial services, and enables them to obtain more development opportunities. Huang et al.(2021) consider that the rural economy is substantially undergirded by the vigorous expansion of the economy, and the effective application of inclusive finance can more successfully encourage the flow of resources to the countryside, boost the economy's vitality, address the unique requirements of rural economic advancement, and facilitate holistic rejuvenation in rural economic systems. Research by Zhang et al. (2022) demonstrates that digital financial inclusion in rural areas reduces obstacles to accessing financial services, spurs rural modernization efforts, and simultaneously supports the expansion of individual entrepreneurs and small and micro businesses, giving the industrial economy a fresh boost. The problem of limited reach of conventional financial services is resolved through the facilitation of digital financial inclusion, which concurrently lowers financial service costs and boosts service effectiveness, allowing more rural residents and small and microbusinesses to access convenient and lower-cost financial services (Zhang, Yang & Wang, 2020). In their study of the impact of digital financial inclusion on rural revitalization, Huang et al. (2023) confirm that, despite some variations in the methods used to promote rural revitalization in various Chinese regions, digital financial inclusion has generally played a crucial role in supporting the rural revitalization endeavor by steadily enhancing the comprehensive revitalization of rural areas. This underscores the significance that digital financial inclusion holds in attaining the rural revitalization objective.

3 Establishment of an indicator system for rural revitalization

3.1 Indicator system

Table 1: Indicator system

Primary Indicator	Secondary Indicator	Tertiary Indicator
Rural Revitalization Index	Industrial Prosperity	Per capita total mechanical power in agriculture
		Overall grain - producing capability
		Productivity of agricultural labor
		Major operational income of sizable agricultural product processing businesses
	Ecological livability	Pesticide and fertilizer application
		Sanitation facility penetration
		Countryside green space proportion
	Rural Civilization	Rural dwellers' average number of years of education
		Rate of broadband penetration among administrative villages
		The quantity of cultural stations in rural areas
	Effective governance	The share of administrative villages with formulated village plans
		The fraction of administrative villages that have undergone village improvement
	prosperous	Farmers' earnings per capita
		The ratio of urban to rural citizens' incomes

3.2 Constructing rural revitalization index of Anhui Province based on entropy value method

(1) Data normalization: standardized values for positive indicators:

$$\frac{x_{ij} - \text{MIN}(x_{ij}, \dots, x_{nj})}{DV}$$

Normalized value of the reverse indicator:

$$\frac{\text{MAX}(x_{ij}, \dots, x_{nj}) - x_{nj}}{DV}$$

(2) Normalized value panning: panning of all normalized values

$$(3) \text{ Calculations } p_{ij} = \frac{x'_{ij} + 0.0001}{\sum_1^n x'_{ij}}$$

(4) Calculate the entropy value $e_j = -k * \sum_1^n p_{ij} \ln(p_{ij})$, where $k=1/\ln(n)$, the

$$(5) \text{ Calculations } d_j = 1 - e_j$$

$$(6) \text{ Calculation of the weights of the indicators } w_j = \frac{d_j}{\sum_1^n d_j}$$

(7) Based on the weights of the calculated indicators, the annual rural revitalization index for the 16 prefectural - level cities is computed in Anhui Province.

$$\text{CREI} = \sum_1^n w_j * x'_{ij}$$

where x_{ij} denotes the j th value of the i th indicator, x'_{ij} denotes the value after normalization, MAX and MIN refer to the highest and lowest values of the indicator respectively, and DV denotes the difference between the highest and lowest values.

Shown in the following content, the weights of the 14 third-level indicators of rural revitalization in 16 municipalities in Anhui Province were determined using the aforementioned procedures:

Table 2: Weighting ratio of indicators of Anhui Province Rural Revitalization Index

Primary Indicators	Secondary Indicators	Tertiary Indicators	Weights
Rural Revitalization Index	Industry prosperity	Per capita total mechanical power in agriculture	0.088642
		Overall grain - producing capability	0.071833
		Productivity of agricultural labor	0.068817
		Major operational income of sizable agricultural product processing businesses	0.091823
	Ecological livability	Pesticide and fertilizer application	0.064504
		Sanitation facility penetration	0.065410
		Countryside green space proportion	0.068209
	Rural Civilization	Rural dwellers' average number of years of education	0.076185
		Rate of broadband penetration among administrative villages	0.057201
		The quantity of cultural stations in rural areas	0.077470
	Effective governance	Proportion of administrative villages with completed village planning	0.065689
		Proportion of administrative villages implementing rural improvement projects	0.069255
	prosperous	Farmers' earnings per capita	0.080130
		The ratio of urban to rural citizens' incomes	0.054832

Anhui Province's 16 prefecture-level cities' rural revitalization index can be computed using the weights mentioned above as follows:

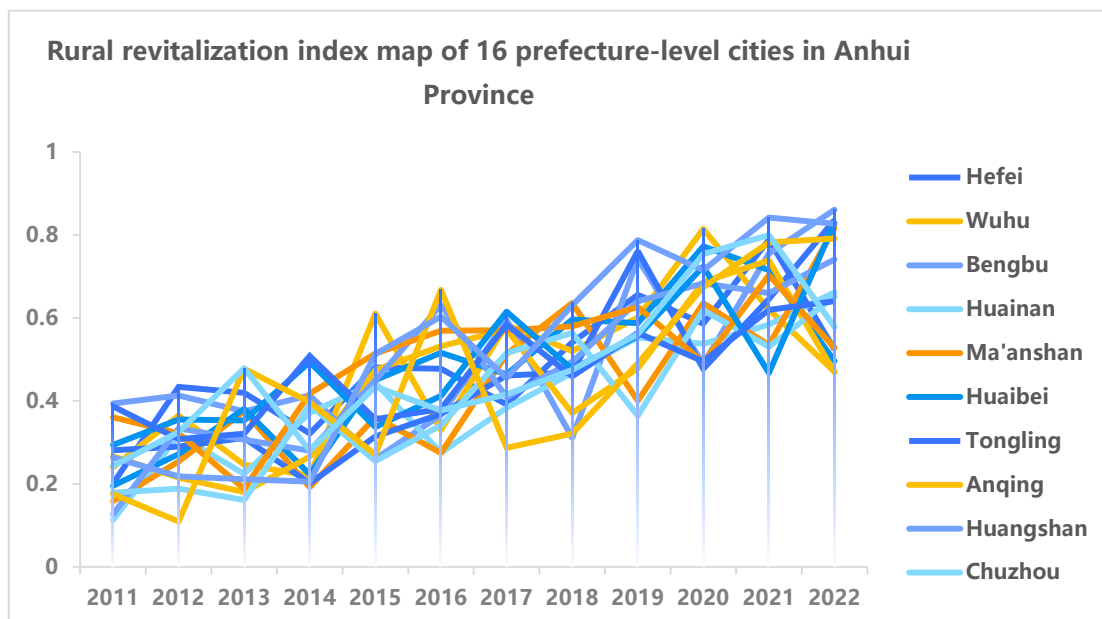


Figure 1: Line graph of rural revitalization levels in 16 prefecture-level cities in Anhui Province

The rural revitalization index for 16 prefecture-level cities, which exhibited fluctuations between 2011 and 2022, is illustrated in Figure 1, specifically for Anhui Province. On the whole, the overall rural revitalization index indices of Anhui Province's 16 prefectures and cities vary, but all of them show an upward trend, which indicates that Anhui Province has achieved positive results in promoting rural revitalization. Among them, the rural revitalization index of Hefei, Wuhu and Bengbu shows a steady increase, indicating that rural revitalization has been effective, while the indexes of Suzhou, Fuyang and Bozhou are low in some years, indicating that the implementation of rural revitalization has encountered some challenges, which suggests that rural revitalization is progressing slowly.

4 Empirical analysis

4.1 Theoretical analysis

By providing innovative and accessible financial products and services, digital financial inclusion effectively mitigates barriers to financial access during rural revitalization, thereby fostering equitable economic participation among underserved populations. When assessing how digital inclusive finance impacts rural revitalization expansion, these core elements are mainly covered: First, digital inclusive finance supports the expansion of rural industries. Industrial progress needs financial support, and rural industries are based on agriculture, mostly small in scale, weak in market competitiveness, and high in financing costs, so digital inclusive finance alleviates the funding challenges faced by rural businesses. Second, digital financial inclusion can be achieved by using digital technology to enable rural small and microbusinesses to offer affordable and convenient financial services. This can help to upgrade and transform rural businesses, steer their development in a greener direction, and lower pollution levels, which will in turn help to build a new ecological livable environment.

Third, digital financial inclusion elevates rural civilization to a new level while simultaneously fostering economic development in rural areas. Digital inclusive finance raises farmers' income and improves their economic conditions through diversified financial products. More farmers are now interested in building rural civilization as a result of rising living standards, and the ongoing optimization of rural educational resources has produced favorable conditions for raising rural inhabitants' cultural literacy. Fourth, digital financial inclusion is crucial for boosting the efficiency of rural governance systems. Digital inclusive finance accelerates village information's digital management by analyzing rural economic activity using big data and modern digitized technology. The evolution of a credit system in villages has been facilitated by digital financial inclusion, which also makes it possible for financial institutions to more efficiently gather credit data. Fifth, digital financial inclusion enables rural people to live in prosperity. Digital inclusive finance enables residents to have more convenient access to rural financial services. By means of delivering financial products like microcredit, finance and investment, insurance and more financial products, rural people can better manage their own finances, enhance the effectiveness of capital utilization, boost rural incomes, narrow urban-rural disparities, and improve farmers' well-being.

4.2 Selection of variables and data sources

4.2.1 Explained variable: Rural Revitalization Index

Employing entropy value methodology, the Countryside Revitalization Index (CREI) is determined by using 14 three-level variables from five perspectives: industry prosperity, ecological livability, rural civilization, effective governance and prosperous.

4.2.2 Explanatory variables: digital financial inclusion index

The Digital Financial Inclusion Index (FCI) draws upon the prefecture - level Digital Financial Inclusion Indices released by the Institute of Digital Finance, Peking University. Figure 2 presents the Digital Financial Inclusion Indices of Anhui Province's 16 cities.

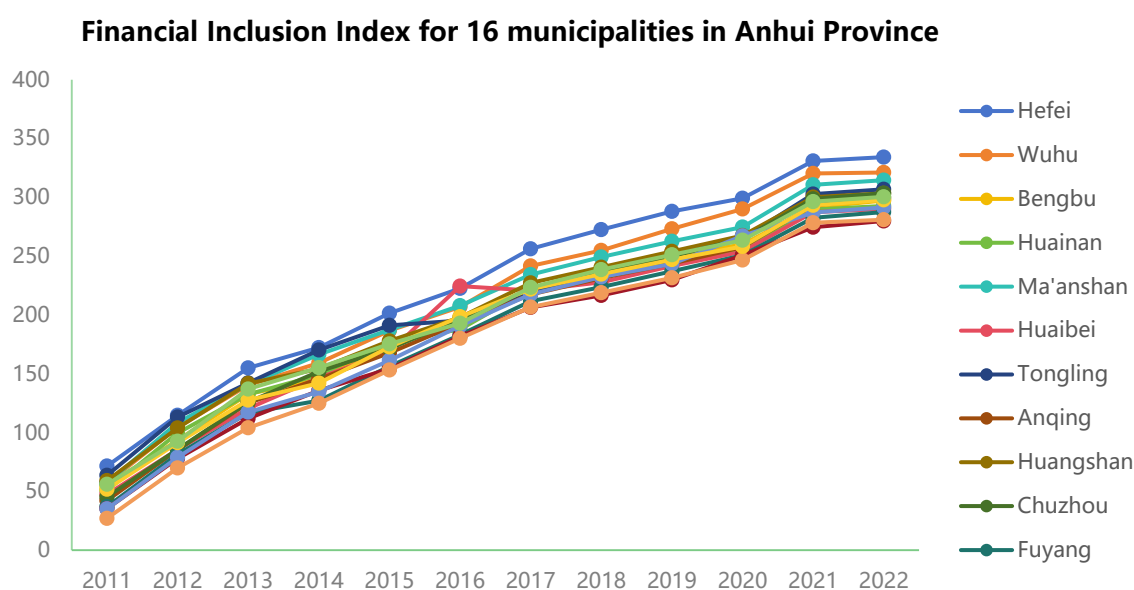


Figure 2: Line graph of financial inclusion index for 16 prefecture-level cities in Anhui Province

Figure 2 reveals a higher level of financial inclusion within Anhui Province, which demonstrates that the financial inclusion index of 16 municipalities in the province generally exhibits an increasing trend between 2011 and 2022. Among them, the starting point of inclusive finance index in Hefei region is high, demonstrating that financial inclusion has achieved a high level, while Fuyang and Suzhou have a lower starting point of the index, but they also show a rising trend year by year, indicating that these municipalities are also improving.

4.2.3 Control variables

The urbanization rate (UR) and each city's extent of opening to the outside world (OUL) were chosen as control variables to more precisely explore the tie of rural revitalization to the evolution of digital - inclusive financial systems in Anhui Province.

4.3 Data sources

In Anhui Province, the data of 16 prefectural-level cities is the article's research object from 2011 to 2022. Anhui Province's statistical yearbook, the statistical bulletins of 16 prefectural-level cities, and data disclosed by Peking University's Digital Finance Research Center served as the foundational data references. Each indicator's level is ascertained using the mathematical technique outlined in the previous article, and the subsequent table displays the quantitative summaries pertaining to each and every indicator:

Table 3: Descriptive statistics results for each indicator

	CREI	FCI	OUL	UR
Average value	0.464614	196.7783	0.035044	0.543173
Median value	0.467985	209.7992	0.032506	0.5412
Maximum value	0.861114	334.1811	0.093172	0.8464
Minimum value	0.10967	27.08	0.004912	0.309
Standard deviation	0.180334	77.71974	0.019517	0.117537
Skewness	0.198515	-0.36943	0.835851	0.18823
Kurtosis	2.258243	2.149438	3.364921	2.388062
JB test value	5.662691	10.15486	23.42203	4.129518
P-value	0.058934	0.006236	0.000008	0.126849
Observed value	192	192	192	192

Table 3 presents the descriptive statistics of four key indicators across 16 prefecture-level cities in Anhui Province from 2011 to 2022: the Composite Rural Revitalization Index (CREI), Digital Financial Inclusion Index (FCI), Openness to the Outside World (OUL), and Urbanization Rate (UR). First, regarding the mean values, the CREI averaged 0.465, indicating moderate overall performance in rural revitalization across Anhui's cities. The FCI showed a notably high mean of 196.778, reflecting strong regional financial competitiveness. In contrast, the OUL's mean was relatively low (0.035), suggesting room for improvement in openness. The UR's mean of 0.543 demonstrates significant progress in urbanization. Second, the substantial disparities between maximum and minimum values reveal marked regional imbalances. For instance, the FCI ranged from 27.08 to 334.181, highlighting extreme variations in financial development among cities. Similarly, the UR spanned from 0.309 to 0.846, underscoring uneven urbanization progress. The standard deviations further confirm these divergences, particularly for FCI (77.720) and UR (0.118). The skewness and kurtosis statistics suggest generally symmetric distributions for CREI and UR (skewness ≈ 0.2), while

FCI exhibits slight left-skewness (-0.369). The Jarque-Bera tests indicate non-normal distributions for FCI ($p = 0.006$) and OUL ($p < 0.001$) at the 5% significance level. These findings provide critical baseline characteristics for subsequent empirical analysis, emphasizing the need to account for regional heterogeneity when examining rural-urban development linkages in Anhui Province.

4.4 Model selection

Taking logarithmic treatment of indicators can eliminate the implications of heteroskedasticity. This study employs a panel regression model to investigate how digital inclusive financial development impacts rural revitalization in Anhui Province. The model specification is outlined below:

$$\ln\text{CREI}_{it} = \beta_0 + \beta_1 \ln\text{FCI}_{it} + \sum_{i=1}^n \gamma_i \text{control}_{it} + u_i + \varepsilon_{it} \quad (1)$$

where i and t denote city dimension and time dimension, $\ln\text{CREI}$ is the explanatory variable, standing for the magnitude of the rural revitalization index, $\ln\text{FCI}$ represents Anhui Province's digital financial inclusion index, β represents the explanatory variable's coefficient, γ is the control variable's coefficient, control_{it} is the control variable, ε_{it} is the random error term and u_i is the individual fixed effect.

4.5 Smoothness test of variables

The article employs the LLC and PP-Fisher test for smoothness testing in order to prevent the impact of pseudo-regression. The empirical outcomes are compiled and presented in the following table:

Table 4: Results of LLC and PP-Fisher tests for variables

Variable	LLC Test (p-value)	PP-Fisher Test (p-value)	Conclusion
LNCREI	0.0126	0.0589	smoothly
LNRFCI	0.0816	0.0000	smoothly
LNUR	0.0000	0.0000	smoothly
LNOUL	0.9995	0.9552	uneven
D(LNCREI)	0.0000	0.0000	smoothly
D(LNFCI)	0.0000	0.0000	smoothly
D(LNUR)	0.0000	0.0000	smoothly
D(LNOUL)	0.0000	0.0000	smoothly

The test findings showed that the original series of the variable LNOUL failed the test and is non-smooth, but the variables LNCREI, LNFCI, and LNUR passed the smoothness test at the 10% significance level. All variables have smooth first order difference series.

4.6 Panel regression model selection

4.6.1 F-test

Before building a panel regression model between variables, a model setting test is required. In the initial stage, the F - test is employed to conduct a comparison among the fixed effects model and the mixed effects model, aiming to determine the more appropriate model. The F-value is computed as follows:

$$F = \frac{(SSE_R - SSE_F)/(N-1)}{SSE_F/(NT-N-K)} \sim F(N-1, NT-N-K)$$

Let N stand for the cross-section count, T represent the chronological series, and K signify the predictors. The residual sum of squares for the mixed-effects and fixed-effects models are denoted by SSE_R and SSE_F , respectively. The calculated F-statistic is 1.7232, with 16 cross-sectional units (N), 12 temporal observations (T), and 3 predictors (K). The residual sum of squares (RSS) for the fixed-effects model is 14.22361. The mixed effects model's residual sum of squares is 16.34877. At the 5% significance level, the F value must be greater than the crucial value, 1.69, in order to dismiss the null hypothesis in favor of the fixed-effects model.

4.6.2 Hausman test

The Hausman specification test was employed to assess whether the model follows a fixed or random effects structure. Table 5 presents the test results.

Table 5: Hausman test results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	10.890543	3	0.0123

Given the rejection of the null hypothesis at the 5% level, the fixed-effects model is the appropriate choice.

4.7 Regression results

Results from (4.6) suggest employing a panel regression with individual fixed effects to analyze Anhui's rural revitalization index alongside digital financial inclusion, urbanization rate, and external openness. The table below shows the regression results:

Table 6: Regression results of the individual fixed effects model between variables

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.371697	0.494679	-8.837438	0.0000
LNFCI	0.581889	0.053585	10.859150	0.0000
LNOUL	-0.218332	0.076222	-2.864437	0.0047
LNUR	0.406872	0.272788	1.491532	0.1376

In Anhui Province, the aforementioned test results demonstrate that the enhancement of rural revitalization is remarkably aided by improved digital financial inclusion throughout 16 prefecture-level cities. The rural revitalization index grows by 0.581889 units with each unit improvement in digital financial inclusion.

5 Conclusion and Recommendation

5.1 Conclusion

Investigating digital financial inclusion's role on rural revitalization is both theoretically and practically meaningful, considering its rapid expansion in rural areas. This paper employs Anhui Province's provincial data from 2014 to 2022 for empirical analysis, elucidating how digital inclusive finance and rural revitalization are interconnected. Statistical analysis

demonstrates that Anhui Province has achieved sustained growth in both digital financial inclusion and rural revitalization, with the former's development actively facilitating the latter's progress.

5.2 Recommendations

5.2.1 Enhancing rural financial infrastructure

Financial service points should be built and improved, mobile payments and digital financial services should be promoted, and farmers' access to financial services should be lowered through the use of contemporary methods. In rural areas, not only can the issue of insufficient financial services be successfully resolved, but the level of financial services may also be efficiently increased through infrastructure improvement.

5.2.2 Innovate rural financial products and services

Considering rural economic features, financial institutions ought to design products and services to meet local communities' varied monetary needs. This approach expands both the reach and level of satisfaction of financial provisions while stimulating accelerated rural economic development. To advance rural economies, they have offered substantial assistance by creating financial instruments including micro credit, agricultural insurance and agricultural futures. Simultaneously, Internet financial technology and mobile payment systems have been used to streamline transactions, lower financial service costs, and increase service effectiveness.

5.2.3 Increase policy support dynamics

Rural regions have witnessed inclusive finance expansion due to supportive policies. The government encourages institutions to enlarge resources and capital investment in rural areas by offering tax breaks, financial aid, and other incentives. Simultaneously, it has improved early warning and monitoring of financial institution hazards in rural areas to guarantee the healthy growth of the rural economy. Additionally, by implementing pertinent laws and regulations, such as creating a dedicated inclusive financial development fund, the government can lower funding barriers by offering low-interest loans to farmers and small and microenterprises in rural areas.

5.2.4 Establishing a sound rural credit system

First of all, improving the rural credit system requires enhancing the cultivation of farmers' credit awareness and increasing their understanding of the crucial role of credit through different publicity and education activities. Second, the government and financial institutions should collect and integrate farmers' credit information, such as basic personal information, loan and repayment records, to build a comprehensive and accurate credit file, and to set up and improve the rural credit information database, so as to assist financial organizations in evaluating loan risks more accurately. Lastly, the relevant laws and regulations must be improved in order to enhance the rural credit system. To guarantee that the credit system is both lawful and equitable, the collection, use, and protection of credit information should be precisely specified through the creation and application of pertinent laws and regulations.

5.2.5 Strengthening financial education for farmers

Through financial education, farmers can learn how to borrow, invest and save wisely, thereby improving their families' economic security and living quality. Improving the

financial literacy of rural residents not only helps farmers increase their personal wealth, but also reduces the risk of financial fraud. The Government and banking facilities should collaborate to promote customized financial literacy training programs and widely disseminate financial literacy through various media, such as radio, television and the Internet, to ensure that farmers acquire basic financial management skills and enhance their ability to combat financial risks.

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