Research on the Impact of Digital Inclusive Finance on Rural Economic Development

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Abstract. Digital technology significantly enhances the efficiency, user experience, coverage, and accessibility of financial services. It effectively addresses the issue of imbalanced and inadequate financial services, provides strong support for the advancement of inclusive finance, and facilitates high-quality development of the real economy. Currently, rural rejuvenation and digital inclusive finance are two prominent topics in China. The objective of this article is to identify and address issues by examining the correlation between digital inclusive finance credit and the rural economy. This paper employs a fixed effects model to examine the correlation between digital inclusive financial credit business and the additional value generated by the primary industry. The results indicate a strong negative association between the digital inclusive financial lending business and the added value of the primary industry. The government should prioritize the simultaneous progress of digitalization and finance in rural areas in order to establish a more comprehensive rural economic and financial system.

Keywords: Digital inclusive finance, Rural economy, Rural credit.

1. Introduction

China is a world-class agricultural nation with a long history, and its government places a high value on rural rejuvenation. In China, reviving rural areas is crucial to constructing a contemporary economic structure. Enhancing the supply-side structural reform of agriculture, encouraging the growth of rural industries, and boosting agricultural innovation and competitiveness are the goals of rural rejuvenation. In a similar vein, China's national strategy is thought to be building inclusive finance. In 2016, the notion of digital financial inclusion was initially put forth. The notion of digital inclusive finance encompasses the specifics of digital inclusive finance, such as the integration of digital technology with conventional financial tools like credit reporting, electronic currency, wealth management, securities, insurance, and payment.

The Chinese government's development concept of digital inclusive finance in rural areas was first proposed in the No. 1 central document in 2021. Three years later, the No.1 Central Document of 2024 proposed again to "develop rural digital inclusive finance" and called for "promoting the construction of rural credit system". Therefore, the policy has given strong support to the development of rural credit. According to the data of the State Financial Supervisory Commission, the rural credit business has developed rapidly. By the end of November 2023, the national balance of agriculture-related loans was 56.22 trillion yuan, up 15.1% year on year. At the same time, inclusive finance credit business in rural areas is also developing rapidly. According to data released by the China Financial Supervisory Commission, by the end of 2023, the balance of inclusive agricultural loans reached 12.59 trillion yuan, showing a year-on-year increase of 20.34%. This growth rate is 10.2 percentage points higher than the growth rate of all loans. Of course, China's agricultural credit has also encountered problems such as insufficient funds, information asymmetry, and an unreasonable agricultural credit structure in the development process. To optimize and improve the rural financial service system, studying the relationship between digital inclusive financial credit and the development of the rural primary industry can solve the problems that arise and help with the formulation of relevant policies.

Many scholars hold a positive view on the role of digital inclusive finance in the rural economy. Zhang et al. found that digital financial inclusion effectively promoted the prosperity of rural

industries through the relaxation of financing restrictions; In economically underdeveloped areas, this effect is more significant [1]. The research conducted by Ge et al. indicates that the implementation of digital inclusive finance policies has effectively enhanced the integration of rural tertiary industry by fostering agricultural modernization, driving technological innovation, and establishing mechanisms for risk sharing [2]. Yu et al. studied the impact of digital inclusive finance on rural consumption in China and demonstrated how to promote the upgrading of rural consumption structure through digital inclusive finance [3].

The findings of a study by Liang et al. on the influence of digital inclusive finance on county-level enterprises indicated that this type of finance positively encourages the formation of county-level enterprises, primarily through enhanced financing and mobile payments [4]. According to Xie et al.'s research, encouraging rural entrepreneurship requires furthering the development of digital inclusive finance [5]. According to Song et al.'s analysis, inclusive green development is positively impacted by the expansion, depth, and degree of digital inclusive finance [6].

Both in urban and rural regions, academics have given digital inclusive finance favorable reviews. Li et al.'s research indicates that digital inclusive finance functions as a paradigm for financial development that improves the distribution of credit resources, which in turn promotes urban innovation [7]. According to Xiong et al., by reducing the income disparity between urban and rural areas, the digital universal benefit can help reduce rural poverty indirectly [8]. According to Dupas and Robinson, inclusive finance has the potential to increase financial resources, encourage investment and consumption, and eventually spur economic growth [9]. While taking regional variations into account, Zhao et al.'s findings suggest that digital inclusive finance (DIF) contributed to the closing of China's urban-rural income gap [10].

This study aims to explore the driving role and specific reasons for the development of the primary industry through digital inclusive finance. By analyzing data from various cities and counties in China, it can better reflect changes in rural economic conditions.

2. Method

2.1. Assumption

Inclusive finance refers to financial services aimed at the public, with farmers and small and micro-enterprises being its main clients. Digital inclusive finance can provide credit to rural residents, alleviate funding difficulties in production and operation, and promote sustainable development of the rural economy. The development of rural credit is an important foundation and strong support for the development of digital inclusive finance in rural areas. This paper proposes the following hypothesis:

H1: Digital inclusive finance credit business can promote the development of the primary industry.

2.2. Formula

To study digital inclusive finance, this paper chooses to use fixed effect model for research. Five models are selected in this paper.

$$pi_{value_{i,t}} = \alpha+\beta_0 index_{a_{i,t}} + \beta_1 loan_{i,t} + \beta_2 highway_{i,t} + \beta_3 internetuser_{i,t} + \beta_4 employee_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

$$pi_{value_{i,t}} = \alpha+\beta_0 index_{i_{i,t}} + \beta_1 loan_{i,t} + \beta_2 highway_{i,t} + \beta_3 internetuser_{i,t} + \beta_4 employee_{i,t} + \mu_i + \varepsilon_{i,t} \quad (2)$$

$$pi_{value_{i,t}} = \alpha+\beta_0 index_{b_{i,t}} + \beta_1 loan_{i,t} + \beta_2 highway_{i,t} + \beta_3 internetuser_{i,t} + \beta_4 employee_{i,t} + \mu_i + \varepsilon_{i,t} \quad (3)$$

$$pi_{value_{i,t}} = \alpha+\beta_0 index_{c_{i,t}} + \beta_1 loan_{i,t} + \beta_2 highway_{i,t} + \beta_3 internetuser_{i,t} + \beta_4 employee_{i,t} + \mu_i + \varepsilon_{i,t} \quad (4)$$

$$pi_{value_{i,t}} = \alpha + \beta_0 index_{d_{i,t}} + \beta_1 loan_{i,t} + \beta_2 highway_{i,t} + \beta_3 internetuser_{i,t} + \beta_4 employee_{i,t} + \mu_i + \varepsilon_{i,t} \quad (5)$$

2.3. Factor Interpretation

2.3.1 Dependent variable

This paper chooses the value added of primary industry (pi_value) to describe the rural economic development. Choosing the value-added of the primary industry can reflect the market value of the final products or services produced by the main rural industries.

2.3.2 Explanatory variables

The Digital Inclusive Finance Composite Index (index_a) encompasses three key aspects: the extent of coverage, the level of utilization, and the degree of digitalization within the realm of digital inclusive finance. When considering the construction process, careful thought is given to the extensive range of digital financial services and the unique challenges of digital inclusive finance in terms of space and time. The index provides a comprehensive overview of the digital inclusive finance landscape, showcasing its development and overall status.

The scope of digital inclusive finance (index_b) indicates the availability of digital financial services, specifically measured by the number of electronic accounts and the percentage of users with connected bank cards.

Digital inclusive finance (index_c) encompasses a wide range of services, including credit, payment, investment, insurance, money market funds, and credit businesses in the digital finance sector. It portrays the state of affairs regarding the different services offered by digital inclusive finance.

The level of digitization in digital inclusive finance (index_d) is influenced by factors such as convenience, affordability, and trustworthiness, which impact users' willingness to adopt digital financial services.

The digital inclusive finance credit business index (index_i) mainly consists of individual consumer loans and small and micro-enterprise loan situations, including both the total usage indicators, as well as the activity indicators reflecting transaction volume and amount. Overall, it reflects the credit business of digital inclusive finance.

The explanatory variables for these indices are released by the Peking University Digital Inclusive Finance Research Center.

2.3.3 Control variables

Financial institutions in the year-end loan balances (loans) reflect the quantity of loans, credit support for borrowers, and the level of activity in the loan market.

Highway mileage (highway): an important indicator reflecting the scale of highway construction development, describing regional transportation accessibility and its relation to regional economic development.

Internet user(internet user): describes the Internet usage in the region.

Primary industry employee(employee): describes the labor force in the primary industry.

2.3.4 Other factors:

μ_i is the individual fixed effect, which controls some variables at the city level that do not change with time but have an impact on agricultural output, such as infrastructure construction of towns and townships, cultural differences among residents, and other variables. $\varepsilon_{i,t}$ is the error term.

2.4. Data Interpretation

The research focuses on data collected from different cities and counties in China spanning from 2014 to 2021. The China county database offers information on the added value of the primary industry and the year-end balance of loans provided by financial institutions. The data for the digital inclusive finance index is derived from the report of the Peking University Digital Inclusive Finance

Index, which is published by the Peking University Digital Finance Research Centre [11]. The road miles, Internet user count, and principal industry employment count are derived from the CSMAR database.

3. Results

Descriptive statistics are shown in Table 1.

Table 1. Descriptive statistical results of the variables

Variable		Mean	Std. dev.	Min	Max	Observations
pi_value	overall	276463.8	223532.7	52	1758423	N = 15609
	between		218395.5	123	1414179	n = 2171
	within		54356.99	-129007.1	810668.6	T-bar = 7.18977
index_i	overall	94.55275	23.4575	10.24	145.609	N = 15609
	between		11.13873	67.95477	138.6004	n = 2171
	within		21.07473	27.64288	123.4763	T-bar=7.18977
loan	overall	1720432	3594650	732	1.12e+08	N = 14738
	between		3891520	15923.14	7.36e+07	n = 1971
	within		1097546	-5.38e+07	4.00e+07	T-bar = 7.47742
highway	overall	1771.47	1228.052	7.31	9310	N = 4812
	between		1191.27	7.31	8679.658	n = 1037
	within		211.8212	-1267.022	4087.72	T-bar = 4.64031
internetuser	overall	3288.723	17626.04	.13	277262	N = 1788
	between		6349.88	.39	55469.08	n = 503
	within		16036.04	-52161.22	225081.6	T-bar = 3.55467
employee	overall	6.676931	5.336376	.01	40.07	N = 2059
	between		5.180602	.0575	27.075	n = 534
	within		.9070806	.0785972	37.3686	T-bar = 3.85581

Next is the variable correlation test, and the results are as follows. From Table 2, the correlation between the variables is relatively small, which meets the standard.

Table 2. Correlation results

Variables	pi_value	index_i	loan	highway	internetuser	employee
pi_value	1.0000					
index_i	0.1835	1.0000				
loan	0.2431	0.2606	1.0000			
highway	0.6396	0.1490	0.2959	1.0000		
internetuser	0.4455	0.2189	0.7883	0.4222	1.0000	
employee	0.5830	0.0238	-0.1570	0.4782	0.0663	1.0000

For model selection purposes, the Hausman test was employed to validate both the fixed effects model and the random effects model. Here are the obtained results (Table 3). A fixed effects model was chosen.

Table 3. Results of Hausman test

Testing	p-Value	Conclusion
Hausman test	0.000	FE_model is better than RE_model

The benchmark regression results of the comprehensive indicators of digital inclusive finance and the digital inclusive finance credit business index on the added value of the primary industry are as follows (Table 4):

Table 4. Results of regression

Variables	(1) pi_value	(2) pi_value	(3) pi_value	(4) pi_value	(5) pi_value
index_a	-81.67061 (-0.31)				
index_i		-444.5427*** (-4.02)			
index_b			2715.695** (2.08)		
index_c				-87.35463 (-0.71)	
index_d					-29.05535 (-0.23)
Loan	0.120579*** (11.94)	0 .011920*** (2.91)	0.009255*** (3.17)	.0127218*** (3.96)	0.0118899*** (3.75)
Highway	43.58433*** (3.21)	2.150399 (0.07)	39.94564*** (2.99)	44.52562*** (3.29)	43.37215*** (3.20)
Internetuser	258.6312 (0.87)	-370.5498 (-1.22)	245.2313 (0.83)	267.1338 (0.90)	257.4696 (0.86)
employee	-6886.593*** (-3.01)	-5054.679* (-1.92)	-6454.233*** (-2.83)	-6927.988*** (-3.04)	-6875.547*** (-3.01)
_cons	290656.9 (7.76)	384159.2 (6.99)	42456.75 (0.35)	289458.3 (8.69)	286034.5 (8.66)
N adj.R^2 F	652 0.0885 48.65	491 0.0712 40.81	652 0.0965 48.56	652 0.0893 48.20	652 0.0884 50.96

Note: The value of t is enclosed in parentheses, ***, **, and* represent significant levels at 1%, 5%, and 10%, respectively.

Based on the findings, it was determined that the comprehensive index of digital inclusive finance did not meet the required standards. However, the index of digital inclusive finance credit business displayed a strong positive correlation with the added value of the primary industry, passing the significance test with a high level of confidence. Based on the regression results of model (1), the coefficient between digital inclusive finance and the added value of the primary industry is -81.67. However, it did not show statistical significance at the 10% level. Thus, digital inclusive finance does not have a substantial impact on the development of the primary industry. Based on Model (2), it can be observed that there is a significant negative correlation between digital inclusive finance credit business and the value added to the primary industry. The coefficient between these two variables is -444.54, which passes the significance test at the 1% level. The results from model (3) indicate a positive correlation between the coverage breadth of digital inclusive finance and the value added by the primary industry. The coefficient is 2715.695, which passes the significance test at the 5% level. Based on the regression results for Model (4) and Model (5), it can be observed that the depth of use and degree of digitization in digital inclusive finance did not show significant effects on the development of the primary industry. These findings indicate that these factors do not play a significant role in promoting industry growth. Based on the evidence, it can be concluded that hypothesis H1 is not supported.

4. Discussion

4.1. Reasons Why Index_a is Not Significant

The following explains the reasons why the composite index of digital inclusive finance has no significant relationship with the development of the primary industry at a given level.

By comparing the regression results of models (1), (3), (4), and (5), it is found that the insignificant estimated coefficients between the composite index of digital inclusive finance and the value added of the primary industry mainly reflect that neither the degree of digitization nor the depth of use in digital inclusive finance significantly affect the development of the primary industry. The development of digitization may prevent rural areas from fully benefiting from its advantages. The widespread adoption and usage of digital technology may be limited by factors such as infrastructure, education levels, and technological capabilities, leading to farmers being unable to integrate into the digital economy, thus resulting in an insignificant relationship.

Through analysis of these five models, taking as an example the regression coefficient for employees in primary industries, all five models yield a negative correlation between employees in primary industries and value-added in those industries. One possible reason for this could be that as digitization deepens, farmers face unemployment or occupational transition risks. Alternatively, labor supply may not keep pace with growth in primary industries due to imbalances between labor demand and supply caused by deepening digitization. Therefore, it appears that there is no clear relationship between digitization and development within primary industries; further consideration may be needed regarding labor or other omitted factors' influence on this relationship.

The next issue is that the coverage breadth indicator of digital inclusive finance is singular and does not provide a comprehensive description. Describing the coverage breadth of digital inclusive finance services solely through account coverage rates results in monotonous data, which fails to comprehensively depict all aspects of the coverage breadth of digital inclusive finance, thereby leading to inaccuracies in the composite index. Coverage breadth should consider the following aspects for construction:

(1) The product range of digital financial services: Digital financial services can offer various financial products to customers, including but not limited to payment services, lending services, investment services, insurance services, credit services etc. When selecting indicators, user numbers or usage frequency for each service can be used to describe the coverage breadth of digital financial service products.

(2) Target users of digital inclusive finance: Different user groups for digital financial services include individual users, small and micro enterprises (SMEs), medium-sized enterprises (MSEs), large enterprises, government agencies, etc., and their quantities should be categorized and counted.

(3) Range of channels for digital financial service delivery: Digital financial services can be provided through multiple channels such as online banking platforms, mobile applications, third-party payment platforms fintech company software, etc. The number of registered users for each software could serve as an indicator describing the coverage breadth of digital inclusive finance.

The above suggestions also face challenges such as difficulty in collecting and organizing data comprehensively; incomplete data; and difficulties in assigning weights; further consideration is required.

4.2. Other Factors and Significant Reasons

The negative correlation between digital inclusive finance credit business and primary industry value added may be the negative effect caused by the problems exposed by digital financial credit business in rural development. The reasons for the negative correlation between digital inclusive finance credit business and agricultural value added can be considered in the following aspects:

Agricultural risks and uncertainties: agricultural operations face many risks and uncertainties, such as weather disasters, market fluctuations, and diseases. Digital inclusive finance credit business may

not be able to provide sufficient risk management tools and protection measures, resulting in farmers' inadequate support and protection in the face of risks, thus affecting agricultural value added.

Digital divide and information asymmetry: digital inclusive finance credit business may be affected by the digital divide, that is, the relatively low popularity of digital technology and financial services in rural areas. This may make it difficult for farmers to access digital financial information and services, limiting their production, thus affecting primary industry value added.

Capital flow and resource allocation: digital inclusive finance credit business may have problems in capital flow and resource allocation. Credit funds in rural areas mainly flow to other industries or regions, rather than the primary industry, which may lead to the limited development of the primary industry, thus affecting the primary industry value added. Education and skills: Digital inclusive finance credit services may require farmers to have certain digital technology and financial knowledge to effectively use these services. If farmers lack relevant education and skills, they may not be able to fully utilize digital inclusive finance credit services, thus affecting the value added of the rural primary industry.

Further research and analysis are needed to determine the specific reasons for the negative correlation between digital inclusive finance credit services and agricultural value added, combined with relevant data and field investigations. This will help formulate corresponding policies and measures. The relationship between digital inclusive finance credit services and the primary industry may also be caused by incomplete sample data, insufficient quantity, quality problems, or omitted variables in this paper.

4.3. Proposal

Credit funds play a crucial role in providing financial support for the development of the primary industry, promoting rural investment, mitigating industrial risks, and offering positive assistance. Therefore, it is essential to recognize the significance of credit in the primary industrial development. To address challenges within rural digital inclusive finance, the following suggestions and measures can be considered:

(1) Infrastructure Development Support: Enhance network coverage and infrastructure construction in rural areas to improve farmers' access to digital financial services. This includes advocating for broadband network installation, deploying intelligent terminal devices, and facilitating electronic payment systems.

(2) Provision of Digital Technology Training and Support: Implement digital technology training programs for farmers to enhance their proficiency in utilizing digital tools such as knowledge of digital finance, mobile payment applications, and network security protocols among other aspects.

(3) Strengthening Financial Education and Awareness: Conduct targeted financial education initiatives aimed at enhancing farmers' understanding of financial knowledge and products through organizing financial knowledge training sessions, creating concise informational materials on finance that are easy-to-understand as well as conducting personalized financial consultations.

(4) Enhancement of Security Mechanisms: Establish a robust security mechanism for digital inclusive finance including reinforcing network security protection measures; improving personal information protection laws and regulations; and establishing mechanisms for complaint resolution thereby enhancing trust levels among farmers regarding digital finance.

(5) Innovative Financial Products and Services: Innovatively design financial products and services tailored to the diverse financial needs of farmers, aligning with rural and agricultural production characteristics. For instance, developing financial tools such as agricultural insurance, microloans for rural areas, and e-commerce platforms for agricultural products to meet the practical requirements of farmers.

(6) Policy Support and Collaboration Mechanisms: Strengthen government policy support by formulating measures conducive to the development of rural digital inclusive finance. Simultaneously, foster collaboration among financial institutions, agricultural departments, technology companies,

and social organizations to establish a multi-stakeholder cooperation mechanism aimed at collectively driving the development of rural digital inclusive finance.

The implementation of these recommendations and measures outlined above can promote widespread adoption and advancement in rural digital inclusive finance while enhancing financial inclusion among farmers as well as improving agricultural productivity.

5. Conclusion

This study investigates the role and specific factors contributing to the influence of digital inclusive finance on the development of the primary industry, with a particular emphasis on the impact of digital inclusive finance loans. The research findings suggest that there is a negative relationship between loan operations in digital inclusive finance and the added value of the primary industry. Furthermore, it was noted that there is no statistically significant correlation between the digital inclusive finance composite index and the added value of the primary industry. Similarly, there is no significant association between the level and extent of digitization in digital inclusive finance and its influence on the development of the primary industry.

The paper provides recommendations to enhance both digital inclusive finance and primary industry development, including supporting infrastructure construction, offering digital technology training and support, strengthening financial education and awareness efforts, enhancing security mechanisms, as well as providing relevant policy support. In China's context, rural financial development has been integrated with poverty alleviation initiatives to promote rural financial inclusion. Measures such as establishing rural financial poverty alleviation funds and implementing special loans for rural financial poverty alleviation have been undertaken to provide tailored financial products and services for impoverished areas to facilitate their economic empowerment.

It is imperative to emphasize sufficient attention towards achieving better alignment between rural economic growth objectives and those related to rural financial development within the realm of digital inclusive finance.

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