

The Impact of Digital Inclusive Finance on Agricultural Economy: An Empirical Study Based on Provincial Data

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Abstract. With the transformation and upgrading of agricultural economy, finance becomes the core of developing modern agricultural economy. Under the background of vigorously promoting digital inclusive finance, digital inclusive finance plays an increasingly prominent role in promoting agricultural economic development. This paper uses the panel data of 31 provinces from 2011 to 2020 from China Statistical Yearbook and provincial yearbooks. Starting from the impact of digital inclusive finance development on agricultural economy, this paper first explains the internal mechanism of the impact of inclusive finance development on agricultural economy through theoretical analysis. Then, the dual fixed effect model is used to estimate the impact of digital inclusive finance development on agricultural economy in China, and further analyze the heterogeneity of its impact. It is found that the development of digital inclusive finance can significantly promote the growth of agricultural economy, but the promotion effect of digital inclusive finance on the development of agricultural economy is differentiated. Compared with the backward areas of agricultural economy, the promotion effect of digital inclusive finance on the development of agricultural economy is stronger. In addition, digital inclusive finance only promotes agricultural economy from three dimensions of financial breadth, payment and insurance, and there is still a lot of room for development in financial depth, credit and digitalization. This study has important policy implications for the formulation of digital inclusive finance policies and the high-quality development of agricultural economy.

Keywords: Digital inclusive finance; Agricultural economy; Differentiation effect.

1. Introduction

Since the reform and opening up, China's agricultural economy has made great achievements that are obvious to all and has generally solved the problem of insufficient supply of agricultural products in China (Huang et al., 2018). With the transformation and upgrading of agricultural economy, finance has become the core of the development of modern agricultural economy. Rural financial development plays a vital role in promoting agricultural innovation, promoting agricultural modernization and increasing farmers' income. Since 2003, in order to promote the development of financial industry in rural areas, China has successively reformed formal financial institutions such as rural credit cooperatives and Agricultural Bank of China, and gradually opened up the rural financial market. (Xie and Xu, 2013) Although some achievements have been made after more than ten years of development, due to the late start of financial development in rural areas, traditional finance has problems such as high threshold, narrow coverage and single service, which fails to effectively realize the virtuous matching and coupling of rural financial demand and supply (Liu et al., 2021), and has become a weak link in the development of agricultural economy. In recent years, with the popularization of the Internet, a series of emerging information technology and digital technology have developed rapidly. With the development opportunity of emerging digital technologies such as big data and mobile Internet, the deep integration of finance and digital technology has successfully bred the emerging business form of "digital finance". Compared with traditional finance, digital finance has greatly made up for the lack of traditional financial service capabilities. On the one hand, digital finance promotes the transparency of financial information, reduces the risk of financial market regulation failure and rent-seeking caused by information asymmetry and market uncertainty, and thus reduces the cost of information search and transaction.

On the other hand, with the help of the Internet platform, digital finance can accelerate the storage and dissemination of information, break the restriction of space and geography, greatly reduce the threshold of financial services, provide the possibility for rural residents, farmers and township enterprises to provide appropriate and feasible financial services, and bring new opportunities for rural financial development to promote agricultural economic growth.

In March 2021, The State Council issued the Outline of the 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Vision for 2035, which emphasized the need to accelerate the digital transformation of financial institutions and enhance financial inclusion. In May 2021, the People's Bank of China and other six departments issued the Opinions on Financial Support for the Development of New Agricultural Business Entities (hereinafter referred to as the Opinions). ①It clearly stated that the pilot reform of rural inclusive finance should be steadily expanded, and pilot areas for financial services for rural revitalization should be established in accordance with procedures. The development of digital finance in rural areas is not only one of the important tasks of inclusive finance reform, but also an inherent requirement for promoting agricultural economic development and narrowing the gap between urban and rural areas. Therefore, under the background of China's strong support for rural revitalization and digital rural development, it is of great significance to study whether digital inclusive finance can promote the development of rural areas and thus drive the growth of agricultural economy.

2. Literature review

According to early theories abroad, insufficient agricultural financing is the main reason affecting agricultural activities and agricultural economy (Harangus D, 2006). When the financing sources available to farmers increase, the quantity of agricultural products will increase, which is conducive to the sustainable development of agriculture. (Kotane I, 2006) However, due to the special characteristics of both natural and social economy in agriculture, farmers' access to formal financing has been severely restricted (Daoudi A and Wampfler B, 2010). Since the concept of inclusive finance was put forward in 2005, foreign scholars have gradually paid attention to the development of inclusive finance. A large number of studies have found that inclusive finance plays a positive role in financing and economic growth. Inclusive finance not only improves farmers' willingness to finance by affecting their income expectations (Aisaiti, G et al., 2019), but also provides affordable financial products for marginalized families, promotes the fairness of financial markets, and is conducive to sustainable economic development (Corrado, 2017). Garg A K and Pandey N (2007) believe that the development of inclusive finance is a crucial step to help people in extremely poor areas to get out of poverty. About 40% of the reduction in income inequality is facilitated by inclusive finance (Beck et al., 2007). However, some scholars believe that the development of inclusive finance is not a good thing for the rural poor. On the one hand, the poor face many financial risks when they are exposed to inclusive finance; on the other hand, the benefits brought by the development of inclusive finance to the poor are only short-term, not long-term (Ozili P K., 2020).

With the development of digital inclusive finance in China, more and more scholars in China have paid attention to the impact of digital inclusive finance in China. At the macro level, existing studies have shown that the development of digital inclusive finance in China is promoting the growth of the real economy (Cheng and Gong, 2020), increasing income and reducing poverty (Chen et al., 2021), smoothing the domestic and international double circular economy (Hu and Shen, 2022), and narrowing the income gap between urban and rural residents (Zhou and Chen, 2022; Yang et al., 2022), and the realization of common prosperity (Liu et al., 2022), thus contributing to the growth of the national economy. At the micro level, a large number of scholars have examined the impact of China's digital inclusive finance development on small and medium-sized enterprises and found that digital inclusive finance can effectively alleviate the financing difficulties of small and medium-sized enterprises, promote the scientific and technological innovation of small and medium-sized enterprises

(Liu and Yang, 2022), and facilitate the export of small and medium-sized enterprises (Zhang et al., 2022).

Specifically in terms of agricultural development, Guo et al. (2020) used the system GMM method to study the impact of digital inclusive finance development on rural residents' consumption, and found that expanding the coverage of digital finance, using digital payment services and digital investment services can effectively improve rural residents' consumption. Wen Tao and Chen Yiming (2020), based on the experience of foreign rural financial development, believed that the integrated development of digital economy and agricultural and rural economy could promote agricultural upgrading, rural progress and farmers' development from various aspects. Zhang et al. (2019) found that the development of digital inclusive finance can help improve the entrepreneurial behavior of rural residents and bring about the equalization of entrepreneurial opportunities. Wang Wei et al. (2018) pointed out through research that inclusive finance can help farmers increase their income to achieve targeted poverty alleviation and poverty alleviation. Sun et al. (2018) found that different factors have different effects on the development of inclusive finance and put forward suggestions for using inclusive finance to promote rural economic development. In addition, a large number of studies have shown that digital inclusive finance plays a significant role in promoting agricultural science and technology investment (Huang et al., 2018) and technological innovation (Hou and Li, 2020) without being affected by severe financial exclusion, which can improve the level of agricultural mechanization (Yan et al., 2022) and avoid excessive transaction costs (Yuan et al., 2020). It can contribute to rural revitalization (Li and Ma, 2021), and thus may become an effective new driving force for promoting agricultural economic growth.

However, it is worth paying attention to that many problems existing in the integrated development of digital inclusive finance and agriculture cannot be ignored. Some scholars believe that the current development level of inclusive finance and rural industry integration in China is generally low, and there are huge differences in the integration between different regions (Zhang Lin and Zhang Wenqing, 2021). Limited by regional conditions, there are many deep-seated problems in the settlement and development of rural digital finance in western China. Long Haiming et al. (2022) found that the development of digital inclusive finance will widen the gap between the disadvantaged groups with low education level and low-income level and the mainstream groups. Digital inclusive finance has risk boundary, cost boundary, ability boundary and talent boundary, which restricts the integrated development of rural industries to a certain extent (He, 2020). In addition, under the influence of different factors, serious financial exclusion has emerged in rural areas of China (Huang, 2018; Su & Fang, 2016; Dong Xiaolin and Xu Hong, 2012).

To sum up, scholars' research mainly focuses on the relationship between traditional finance and agricultural economy, while the research on digital inclusive finance is still in its infancy, mainly analyzing the impact of digital inclusive finance on a certain aspect of agriculture, but not systematically studying the impact of digital inclusive finance on the overall agricultural economy from a macro perspective. In order to make up for the shortage of existing literature, this paper uses the fixed effect model to study the direct impact of China's digital inclusive finance development on China's agricultural economy from a macro perspective, and on this basis, discusses the impact heterogeneity, and puts forward relevant suggestions according to the conclusions, so as to provide a reference for the relevant government departments to make policy.

The marginal contributions of this paper are as follows: (1) at the theoretical level, it enriches the research framework of the impact mechanism and economic consequences of digital inclusive finance, and discusses the internal mechanism between digital inclusive finance and agricultural economy; (2) In terms of research methods, based on theoretical analysis, this paper constructs an econometric model, and empirically investigates the impact of digital inclusive finance development on agricultural economy through multiple regression, robustness test and heterogeneity analysis, making up for the gap in agricultural economy research. (3) In practice, the research results of this paper, At the practical level, the research results of this paper have important implications for the formulation of national digital inclusive finance policy in the future.

3. Theoretical analysis

In 2005, the United Nations first proposed the concept of financial inclusion and promoted it worldwide. Since then, the concept of financial inclusion has been introduced in China and recognized by the government. In December 2015, The State Council issued the Plan for Promoting the Development of Inclusive Finance (2016-2020), which clarified the definition of inclusive finance. Inclusive finance, from a macro perspective, is to improve the penetration rate of financial services through continuous improvement of the financial system, based on the requirements of equal opportunity and the principle of sustainable business. At the micro level, it means to break the dilemma of underdeveloped areas, rural areas, low-income people in society and small and micro enterprises with high financial services threshold. The practice of inclusive finance in China shows a strong correlation with innovative digital finance. Therefore, in recent years, the new digital finance model has become an important source of power and growth point of inclusive finance. The so-called digital inclusive finance refers to all the behaviors that promote inclusive finance through the use of digital means, which enables the groups that cannot obtain financial services previously to obtain affordable financial services through digital technology. Compared with the high cost and limited-service scope and content of traditional inclusive finance, digital inclusive finance has many advantages. In terms of transaction costs, digital inclusive finance, based on the network platform, accelerates the storage and dissemination of information, which is conducive to the early understanding of the transaction object, reduces the cost of information search and the cost of rent-seeking of traditional financial intermediaries, and further reduces financial risks. In addition, traditional financial institutions provide financial services in the form of physical outlets, which need to pay high operation and maintenance costs, while digital inclusive finance breaks geographical restrictions and greatly reduces operating costs. In terms of service content and scope, digital inclusive finance has greatly improved the efficiency of financial services because it is not limited by geography and space. Therefore, its technology application scenarios are becoming more and more diversified, gradually expanding from the traditional main financing services to investment, payment, insurance and other types of services. At the same time, the reduction of the threshold of digital inclusive financial services improves the coverage of financial services, promotes the competition between digital financial products and services, expands the space for the choice of financial services, and then forces the comprehensive upgrading of financial products and services from the demand side.

The impact of the development of digital inclusive finance on agricultural economy is mainly reflected in the following aspects:

Firstly, digital inclusive finance improves the circulation of financial system in rural areas. On the one hand, traditional financial institutions usually use non-price mechanisms such as mortgage and guarantee as risk management means, but the insufficient effect of rural land and property rights mortgage has become one of the reasons for the limited development of rural finance (Fu Qiong and Guo Jiaju, 2021). The development of digital inclusive finance has improved the credit investigation system, relaxed the high asset guarantee conditions, and the Internet of Things, face recognition and other technologies have increased the default cost, making financial products affordable for rural residents and reducing the default risk borne by financial institutions (Li et al., 2020), realizing the mutual promotion between rural digital finance and traditional finance. The financial development in rural areas provides strong support for the investment in agricultural science and technology and the entrepreneurship of rural floating population, which promotes the employment of rural population and the income of rural population while promoting the growth of agricultural economy. On the other hand, the convenience of payment brought by digital inclusive finance alleviates the liquidity constraints of consumption, and the improvement of credit and insurance markets reduces the cautious behavior and precautionary saving of rural residents to cope with uncertainty. With the increase of rural residents' income and the convenience of transforming savings and investment income into consumption at any time, the restriction of cash consumption is relaxed, which stimulates

the overall rural consumption and promotes the upgrading of the overall consumption structure, thus contributing to the growth of agricultural economy (Zhang et al., 2020).

Secondly, digital inclusive finance promotes the digital transformation of rural industries. The development of digital inclusive finance has further strengthened the awareness of rural residents to rely on Internet technology and digital technology to develop agriculture. In recent years, rural e-commerce driven by the development of the Internet has become the representative application of information technology in rural areas. The development of digital inclusive finance has promoted the digital upgrading represented by rural e-commerce, and the development of rural e-commerce has typical aggregation, and digital upgrading can produce greater supply-side economies of scale (Dunt and Harper, 2002; Zhang et al., 2018). From the commercialization of agricultural products to the expansion of sales channels, the integration of logistics and transportation, and finance, the synergistic effect of economic growth is generated, and the Internet supply and marketing chains and financial chains such as Taobao Village and e-commerce village are derived, so that farmers' income increase, and agricultural economic growth have stronger sustainability.

According to the above analysis, digital inclusive finance can affect the development of agricultural economy through two aspects: financial system circulation and industrial digital transformation. Based on this, this paper puts forward the following hypothesis.

Hypothesis 1: Digital inclusive finance will significantly promote agricultural economic growth under the role of financial system circulation and industrial digital upgrading.

Although digital inclusive finance can play a significant role in promoting agricultural economic growth according to the above analysis, the development limitations of rural areas cannot be ignored. Due to the great differences in economic development level, population size, residents' education status, credit environment and transportation convenience among regions in China (Dong and Xu, 2012; Tan et al., 2014; Su and Fang, 2016), digital inclusive finance puts forward certain requirements for the cognitive ability and education level of rural residents, so the uneven popularization of digital technology and development obstacles may easily lead to the lack of resource endowments such as Internet tools and financial literacy among some vulnerable groups. New financial exclusion such as "tool exclusion" and "assessment exclusion" (Bei and Mo, 2019) have been formed, further widening the income gap between the rich and the poor (Cheng and Zhang, 2019), especially for low-income groups in rural areas (Hu et al., 2018). Compared with the areas with more developed agricultural economic development level, the areas with less developed agricultural economic development level have more poor people in rural areas, so the phenomenon of financial exclusion is more serious, which leads to obvious regional differences in the degree of financial exclusion in rural areas.

Hypothesis 2: There is a differentiation effect of digital inclusive finance, which plays a more significant role in promoting the regions with a higher level of agricultural economy.

4. Model construction

Based on the above analysis of the impact of digital inclusive finance on agricultural economy, this paper first constructs the benchmark regression model as follows:

$$\ln val_{jt} = \beta_0 + \beta_1 \ln index_{jt} + \lambda X_{jt} + \sigma_j + \eta_t + \varepsilon_{jt} \quad (1)$$

Where j is the province, t is the year. In order to reduce the influence of collinearity and heteroscedasticity, this paper performs logarithmic processing on each variable, $\ln val_{jt}$ is the development level of agricultural economy, represented by the logarithm of the total output value of agriculture, forestry, animal husbandry and fishery, $\ln index_{jt}$ is the logarithm of the digital inclusive finance index, X_{jt} is the control variable, and is the fixed effect of the province. Is the control variable, is the province fixed effect, is the time fixed effect is the random disturbance term.

4.1. Variable description

Explained variable. The explained variable in this paper is the development level of agricultural economy. Referring to the research of Huang Hongguang et al. (2018) and the availability of data, the logarithm of the total output value of agriculture, forestry, animal husbandry and fishery is selected as the explained variable. And rural per capita disposable income is used as the proxy variable of agricultural economic development level.

Explanatory variables. The explanatory variable in this paper is the development of digital inclusive finance.

Control variables. This paper selects control variables from four aspects based on data correlation and availability. In terms of agricultural factor input, a large number of studies have shown that agricultural factor input directly determines agricultural production (Li, 2016; Gao Jingjing, Shi Qinghua, 2021). In this paper, the total sower area of crops (lnarea) is used to measure the input of land factors, and the total power of agricultural machinery (lnpower) is used to measure the input of agricultural machinery. Human capital accumulation is the fundamental source of agricultural economic growth, so this paper selects the number of employees in the primary industry (lnpeo) and the urbanization rate (lnurb) to measure the stock of human capital. The investment in fixed assets of rural households (lninv) is selected to measure the physical capital of rural areas. Government expenditure plays a significant role in promoting agricultural economic growth, so this paper selects the government's local financial expenditure on agriculture, forestry and water (lnexp) to represent the scale of government expenditure on agriculture.

4.2. Data description and descriptive statistics

This paper takes 31 provinces, municipalities and autonomous regions from 2011 to 2020 as the research samples. Among them, the total output value of agriculture, forestry, animal husbandry and fishery are from China Statistical Yearbook, the digital inclusive financial index is from the Financial Research Center of Peking University, and the main sources of control variables are China Statistical Yearbook, China Rural Statistical Yearbook and the Statistical yearbooks of prefecture-level cities. Some data are missing, so this paper uses the imputation method to process, and the descriptive statistics of each variable after processing are shown in Table 1.

Table 1. Descriptive statistics of main variables

Variable	Variable meaning	Observed value	Mean	Standard deviation	Minimum	Maximum
lnval	Gross production value of agriculture, forestry, animal husbandry and fishery (logarithm)	310	7.739	1.092	4.695	9.229
lnindex	Digital Financial Inclusion Index (logarithm)	310	5.212	0.677	2.786	6.068
lnarea	Total sown area of crops (logarithm)	310	8.109	1.221	4.484	9.610
lnpower	Total power for agricultural machinery (logarithm)	310	7.637	1.125	4.543	9.499
lninv	Fixed assets of rural households Investment amount (logarithm)	310	5.368	1.132	0.742	6.874
lnpeo	Primary industry employment Number of employees (logarithm)	310	6.232	1.109	3.296	7.701
lnexp	Local finance Agriculture, forestry and Water Expenditure (logarithm)	310	6.137	0.584	4.519	7.200
lnurb	Urbanization rate (logarithm)	310	4.034	0.233	3.127	4.495

5. Empirical analysis

5.1. Benchmark regression

Table 2 shows the benchmark regression results. Among them, only core explanatory variables are added in Column (1), and control variables are added in Column (2) based on the core explanatory variables. The results show that when control variables are not added, the coefficient of $\ln index$ is significantly positive at the level of 5%, while when control variables are added, the coefficient of $\ln index$ is significantly positive at the level of 1%, indicating that the control variables selected in this paper are reasonable. Column (3) and column (4) report the estimation results of adding core explanatory variables and control variables after controlling provincial level and time fixed effects. It can be seen that the estimated results of the development of digital inclusive finance on the agricultural economy are very robust, and the addition of other variables enhances the explanatory power of the model. This paper takes the estimated results in Column (4) as the benchmark for analysis. After controlling the influence of other factors, for every 1% increase in the digital inclusive financial index, the agricultural economy will increase by 0.061%, which passes the significance level test of 1%. The development of digital inclusive finance effectively promotes the growth of agricultural economy, which verifies Hypothesis 1. For other control variables, the total sown area of crops and the total power of agricultural machinery are significantly positively correlated with the agricultural economy. The larger the total sown area of crops is, the more agricultural machinery is required, and the higher the corresponding agricultural economic development level is. It can be seen from the results that the estimated coefficient of rural household fixed asset investment is positive, but it fails the significance test. The estimated coefficient of the number of employees in the primary industry is significantly negative, while the estimated coefficient of the urbanization rate is significantly positive. The possible explanation is as follows: With the development of agricultural mechanization, agricultural productivity has been greatly improved, while the number of employees in the primary industry has been decreasing year by year with the increase of modern equipment. Therefore, the decrease of the number of employees in the primary industry indicates that the improvement of the level of rural equipment and the overall production efficiency are conducive to promoting the growth of agricultural economy. The local financial expenditure on agriculture, forestry and water is significantly positively correlated with the growth of agricultural economy. The local financial subsidy for agriculture alleviates the problem of capital flow of farmers and enhances the ability of farmers to resist risks, so it has a positive role in promoting the agricultural economy.

Table 2. Benchmark regression

Variabls	(1)	(2)	(3)	(4)
lnindex	0.196** (0.0913)	0.200*** (0.0407)	0.209*** (0.0105)	0.0610*** (0.0185)
lnarea		0.352*** (0.0657)		0.428*** (0.0665)
lnpower		-0.148** (0.0664)		0.190*** (0.0455)
lninv		0.133*** (0.0408)		0.0239 (0.0272)
lnpeo		0.502*** (0.0637)		-0.336*** (0.0558)
lnexp		0.196*** (0.0610)		0.209*** (0.0427)
lnurb		0.600*** (0.0956)		0.121* (0.0666)
Constant term	6.720*** (0.480)	-2.491*** (0.350)	6.650*** (0.0549)	2.698*** (0.717)
Province fixed effects	No	No	Yes	Yes
Year fixed effects	No	No	Yes	Yes
Observations	310	310	310	310
R ²	0.015	0.914	0.590	0.749

Note: Robust standard errors in parentheses ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively.

5.2. Robustness test

In order to verify the reliability of the benchmark regression results, this paper uses two methods of replacing indicators to conduct robustness tests, 1. Referring to Ding et al. (2014), the ratio of the total output value of the primary industry to the number of employees in the primary industry is used to measure the level of agricultural economic development. (2) The per capita disposable income of rural population is used to measure the level of agricultural economic development. The first two columns of Table 3 report the regression results of Method 1, and columns (3) and (4) report the regression results measured by rural per capita disposable income. It is found that the coefficients of lnindex are significantly positive at the level of 1%, which indicates that digital inclusive finance significantly promotes the development of agricultural economy and supports the robustness of the basic conclusion of this paper.

Table 3. Robustness test: changing the measurement of agricultural economic development level.

Variabls	(1)	(2)	(3)	(4)
lnindex	0.364*** (0.0171)	0.0610*** (0.0186)	0.371*** (0.0100)	0.137*** (0.0126)
Constant term	-0.393*** (0.0897)	2.727*** (0.726)	7.425*** (0.0527)	9.034*** (0.488)
Control variables	No	Yes	No	Yes
Province fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	308	308	310	310
R ²	0.015	0.914	0.590	0.749

Note: Robust standard errors in parentheses ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively.

Referring to Wang et al. (2019), the 31 provinces were divided according to the eastern, central and western regions, and the regression tests were conducted in different samples. The eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan. The central region includes Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan; And the western region includes Inner Mongolia, Shaanxi, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Gansu, Qinghai, Ningxia and Xinjiang. Table 4 reports the results of grouped regression test, and it is found that the regression results are all positive correlation and significant at least at the level of 5% in the eastern region, the central and western regions. This further confirms the robustness of the conclusion that digital inclusive finance significantly promotes the development of agricultural economy in this paper.

Table 4. Robustness test: regression of different samples

Variabls	(1) East	(2) Middle	(3) Western
lnindex	0.0868*** (0.0294)	0.105** (0.0414)	0.0613** (0.0258)
Constant term	2.900*** (0.964)	12.82*** (2.883)	7.748*** (1.676)
Control variables	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	110	80	120
R ²	0.721	0.733	0.880

Note: Robust standard errors in parentheses ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively.

6. Heterogeneity analysis

As pointed out in the previous theoretical analysis, digital inclusive finance puts forward higher requirements for digital infrastructure and consumers' cognitive ability. When the development of rural education system, scientific and technological innovation system and financial system is not coordinated well, either side may become a weak link in the development of local agricultural economy. In addition, as a new reform policy, digital inclusive finance may bring new differentiated effects according to the above analysis. Demir A et al. (2022) found that although financial inclusion significantly reduced income distribution inequality, these effects were mainly related to high-income countries, and the effect was not significant for lowincome countries. Regions with backward agricultural economic development are usually accompanied by backward education system, financial infrastructure and science and technology system. Therefore, even if digital inclusive finance reform is carried out in regions with backward agricultural economic development level, it is difficult to achieve the coordinated development of financial system and science and technology system and achieve the expected reform effect. Echoing the logic of the theoretical analysis part, this paper intends to further explore whether there is heterogeneity in the promotion effect of digital inclusive finance on agricultural economic development in regions with different levels of agricultural economic development. Specifically, when the level of agricultural economic development of the region itself is low, the role of digital inclusive finance in promoting regional agricultural economy is limited. When the level of agricultural economic development of the region itself is high, the role of digital inclusive finance in promoting regional agricultural economy is more significant. To this end, this paper divides 31 provinces, municipalities and autonomous prefectures according to the ratio of the total value of the primary industry to the number of employees in the

primary industry. The regions whose ratio of the total value of the primary industry to the number of employees in the primary industry is higher than the national average are the developed regions of agricultural economy (Zhejiang, Jiangsu, Heilongjiang, Hainan, Fujian, Tianjin, Shanghai, Guangdong, Beijing, Xinjiang and Liaoning). The regions with the ratio of the total value of the primary industry to the number of employees in the primary industry lower than the national average are equally divided into the medium agricultural economy region (Shandong, Jiangxi, Inner Mongolia, Henan, Hubei, 15Ningxia, Chongqing, Hebei, Jilin, Hunan) and the backward agricultural economy region (Sichuan, Guizhou, Shaanxi, Qinghai, Anhui, Guangxi, Shanxi, Yunnan, Tibet, Gansu). Table 5 reports the regression results of different regions.

Table 5. Heterogeneity test: impact of agricultural economic development level

Variabls	(1) Developed	(2) Middle	(3) Falling behind
lnindex	0.109*** (0.0263)	0.0806** (0.0319)	0.0401 (0.0254)
Constant term	3.032*** (0.862)	14.99*** (1.883)	-8.964*** (3.126)
Control variables	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	110	100	100
R ²	0.799	0.762	0.896

Note: Robust standard errors in parentheses ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively.

In Table 5, the results of column (1) and column (2) show that the coefficient of lnindex is 0.109 and significant at the level of 1% in the areas with developed agricultural economy, and 0.0806 and significant at the level of 5% in the areas with medium agricultural economy; On the contrary, in the backward areas, the coefficient of lnindex is positive but not significant. This shows that compared with the backward areas of agricultural economy, the promotion effect of digital inclusive finance on agricultural economy is mainly reflected in the developed areas and the medium areas of agricultural economy. This may be due to the fact that digital inclusive finance still has a certain threshold effect on rural consumers and may cause serious financial exclusion in the backward areas of agricultural economy. This further verifies Hypothesis 2 of this paper. In order to further explore the heterogeneity of the impact of various indicators of digital inclusive finance on agricultural economy, This paper refers to (05) that the first-level indicators of digital inclusive financial index after logarithmic treatment --coverage breadth (lnwidth), coverage depth (lndep) payment index (lnpay), insurance index (lnins), credit index (lnloan) and digitalization degree (ln dig) are used as explanatory variables (lnindex) respectively), and the results are shown in Table 6.

Table 6. Heterogeneity analysis: Impact of first-level indicators of digital inclusive financial index

Variabls	(1) lnwidth	(2) lndep	(3) lnpay	(4) lnins	(5) lnloan	(6) lndig
lnwidth	0.0412*** (0.0118)					
lndep		-0.000990 (0.00670)				
lnpay			0.0340* (0.0197)			
lninsu				0.00395 (0.00783)		
lnloan					0.0335*** (0.0118)	
lndig						0.00620 (0.0118)
lnwidth	0.0412*** (0.0118)					
Constant term	2.808*** (0.721)	1.964*** (0.699)	2.236*** (0.739)	1.922*** (0.695)	2.151*** (0.686)	1.963*** (0.693)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	310	310	308	310	310	310
R ²	0.750	0.739	0.736	0.739	0.746	0.739

Note: Robust standard errors in parentheses ***, ** and * indicate significance at the level of 1%, 5% and 10%, respectively.

It can be seen from Table 6 that after replacing the first-level indicators in the regression, the influence coefficients of the coverage breadth lnwidth and the credit index lnloan in columns (1) and (5) are significantly positive at the level of 1%, indicating that the improvement of the coverage breadth of digital finance and the improvement of the credit system can significantly promote the growth of agricultural economy. In Column (3), the influence coefficient of payment index ln timer is significant at the level of 10%, and the influence coefficient of payment index ln timer is 0.034. However, coverage depth ln timer, insurance index ln timer and digitalization degree lndig have no significant effect on promoting agricultural economy, and the regression coefficient of coverage depth is even negative. It can be seen that the service depth, insurance and digitalization of digital inclusive finance are obviously underdeveloped at present. The depth of digital inclusive financial services mainly refers to the frequency of consumers' use of relatively complex financial services (Xing Yan, 2021). The degree of digitalization is mainly reflected in the deep integration of digital technology and agricultural industry. At present, the lack of terminal equipment proficiency and financial literacy of rural residents has become the biggest restriction factor for the development of digital inclusive financial services and digital degree. Insurance mainly refers to agricultural insurance, which is an effective means to disperse and transfer agricultural risks and stabilize farmers' income (Zhang et al., 2019). However, the overall coverage rate of agricultural insurance in China is still insufficient. According to the Financial Supervision Administration, 180 million rural households in China were covered by agricultural insurance in 2020, a coverage rate of only 32 percent based on 560 million rural households that year. The current insurance participation rate is largely dependent on government subsidies, and farmers' awareness of taking the initiative to participate in agricultural insurance still needs to be improved.

7. Conclusions and suggestions

With the development of information technology and digital technology, the integration of digital finance and economic development has become an inevitable trend. Based on the panel data of 31 provinces in China from 2011 to 2020, this paper constructs a dual fixed effect model to discuss the impact of digital inclusive finance on agricultural economy and its heterogeneity from both theoretical and empirical aspects. The results show that the development of digital inclusive finance can significantly promote the growth of agricultural economy, but there is a Matthew effect in the promotion effect of digital inclusive finance on the development of agricultural economy. Compared with the backward areas of agricultural economy, the promotion effect of digital inclusive finance on the developed areas of agricultural economy is stronger. In addition, the promoting effect of digital inclusive finance on agricultural economy is limited to the three dimensions of financial breadth, payment and insurance, and there is still a lot of room for development in financial depth, credit and digitalization degree.

Based on the above research conclusions, this paper puts forward the following policy recommendations:

Firstly, we should continue to promote the development of digital inclusive finance and further improve the coverage of digital finance. Although more than 98 percent of administrative villages have access to optical fiber and 4G, the Internet usage rate among rural residents is still low. ② Therefore, to promote the development of digital inclusive finance in rural areas, we must first solve the "last mile" problem of Internet supply. In this process, the government should play a guiding role, through policies, subsidies and other means, improve the construction of Internet and other infrastructure in rural areas, and attract social capital and even foreign capital to enter the agricultural field. For traditional rural institutions, they should strive to improve their own digital infrastructure, use digital technology to optimize the organizational structure and actively expand digital financial services, expand digital channels and application scenarios, and introduce or develop a comprehensive digital system integrating management, operation, transaction and other functions. In addition, they should increase the investment in the research and development and application of digital finance, pay attention to the mining and analysis of their own massive data, develop new financial products, and speed up the improvement of operation efficiency.

Secondly, we should pay attention to the construction of digital finance in the backward areas of agricultural economy. Compared with the developed areas of agricultural economy, the development of digital inclusive finance in the backward areas of agricultural economy is the weakness and difficulty of China's digital inclusive finance reform. Therefore, the government should provide sufficient policy and financial support, focus on improving the coverage rate of digital accounts in the backward areas of agricultural economy, and provide differentiated digital inclusive financial products based on the diversified needs of farmers in the backward areas of agricultural economy, so as to help the regions transform from the backward areas of agricultural economy to the medium or even developed areas of agricultural economy. And then rely on their own digital financial development to drive the agricultural economy and form a virtuous development cycle.

Finally, financial institutions should strengthen the introduction and training of digital financial talents, actively carry out training on digital technology, and improve the overall quality of employees. Promote the improvement of operational efficiency, increase the publicity of digital finance while providing traditional financial services, reduce operating costs and enhance their own competitiveness, so as to improve the coverage breadth of digital inclusive finance. In addition, the fundamental reasons for financial exclusion, the development depth of digital inclusive finance, the development level of insurance and the lack of digitalization in rural areas lie in the limited educational level of some people in rural areas and the lack of financial related knowledge. As farmers lack corresponding financial knowledge and have poor acceptance ability to new things, the development of digital finance is affected. The self-exclusion of farmers is aggravated. Therefore, on the one hand, the government should strengthen the improvement of rural education system and improve the education level of farmers. On the other hand, the government should cooperate with

financial departments to increase the publicity and training of financial knowledge, regularly arrange financial professionals to disseminate financial knowledge to farmers, as well as relatively complex financial service teaching, so as to reduce farmers' financial exclusion and improve the depth of digital financial services; At the same time, the strength of farmers can be concentrated, rural enterprises or agricultural cooperatives can be set up to carry out large-scale operation, which is convenient for financial institutions to reduce the cost of information screening and alleviate information asymmetry, so as to reduce financial evaluation and conditional exclusion.

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