Impact of digital inclusive finance development on rural industry revitalization—Observations of rural China

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Abstract: Based on provincial panel data from 2012-2021, this paper focuses on the impact of digital inclusive finance development on rural industry revitalization in China. Distinguish from existing research, we not only analyzes the impact of digital inclusive finance on the revitalization of rural industry revitalization in general terms, but also analyze the structural characteristics of the impact of digital inclusive finance on rural industrial revitalization regarding the breadth of coverage, depth of use, degree of digitization, different levels of development, and different regions. The results show that, the development of digital inclusive finance in general can significantly promote the rural industry revitalization; The impact is mainly manifested in the depth of use and the degree of digitization, but the impact of the degree of coverage is unstable; this conclusion is consistent across subgroups of different levels of digital inclusive finance; in addition, digital inclusive finance can affect rural industrial revitalization by promoting the rural industrial integration pathway; and there is heterogeneity between regions in the impact of digital inclusive finance on rural industrial revitalization. To further promote the revitalization of rural industries, the development of digital inclusive finance in rural areas should be continued and intensified, and Measures to promote the integrated development of primary, secondary and tertiary industries, and design development paths tailored to local conditions.

1. Introduction

The lagging development of agriculture and rural areas is still a prominent manifestation of the imbalance and insufficiency of China's current social development, so it is necessary to adhere to the strategy of rural revitalization to lead the work on Rural areas in the new era as a general grasp to promote the modernization of agriculture and rural areas. As a foundation and critical element of rural revitalization, industrial revitalization is related to the overall situation of the strategy. The promotion of industrial revitalization in the countryside aims at deepening the development of the rural industry. Promoting the rural industry revitalization aims at deepening the structural reform of the agricultural supply side, focusing on building a modern agricultural industrial system/production system/business system, promoting the integrated development of primary, secondary and tertiary industries in the countryside, reshaping the multifunctionality of agriculture, extending the

industrial chain, and enhancing the value chain. However, the realization of rural industrial revitalization requires substantial financial support. Although Chinese government has continued to increase financial support for agricultural and rural undertakings, financial expenditure is naturally characterized by public nature, so the funds for agriculture are more often used for rural infrastructure construction. That means the market under the guidance of policy have to fill the funding gap other than infrastructure construction in rural revitalization. However, agriculture is naturally weak, so commercial financial institutions, whose fundamental goal is to make a profit, lack incentives to engage in rural financial business. The inclusive financial services that are able to break through the many barriers to land in rural areas have long suffered from relatively poor quality of service. With the superposition of many factors, financial constraints have become one of the main constraints to developing rural industries.

Digital inclusive finance, as a product of the combination of financial services and digital technology, has the characteristics of lower service threshold, lower transaction cost, and lower credit risk. So digital inclusive finance theoretically can effectively break through the shackles of the traditional financial service model, include more rural groups in the scope of financial services, open up the long-tailed market of rural finance, effectively alleviate the financing constraints of the rural areas, and help revitalize the rural industry. However, the development of digital inclusive finance, based on digital technology, puts forward higher requirements for the construction of digital infrastructure in the region, the financial ecological environment and cognitive level of the main body. Therefore, it remains to further validate whether digital inclusive finance can open up the "last kilometer" of rural financial services, and inject financial vitality into the revitalization of rural industries. Therefore, this paper puts digital inclusive finance and rural industrial revitalization into one structure, and based on empirically testing the effect of digital inclusive finance on rural industrial revitalization, further discusses the mechanism path of digital inclusive finance on rural industrial revitalization and the heterogeneity of the impact of digital inclusive financial development on rural industrial revitalization, with a view to provide a possible reference for the practice of rural financial development to help rural industrial revitalization.

2. Theoretical analysis

2.1 Analysis of the impact of digital inclusive finance on the revitalization of rural industries

Industrial revitalization is the primary task of the rural revitalization strategy. Previous studies have shown that the development of rural industries is comprehensively affected by regional resource endowment, location conditions, development foundation, industrial policy, financial development and other factors. As China's rural financial development has long been relatively lagging, rural business subjects generally face different degrees of financial exclusion, and the lack of financial services has become an essential constraint on the development of rural industries. Under the traditional financial model, it is difficult to find an effective way to break through the obstacles.   One of the major reasons is that it is impossible to find a way to effectively mitigate the moral hazard caused by information asymmetry, however commercial financial institutions pursuing profit maximization are inherently sensitive to risk. The rapid development of digital inclusive finance based on digital technology has brought new solutions to alleviate the financial exclusion problem faced by rural areas and thus promote rural industrial revitalization. Compared with traditional financial services, digital inclusive finance relying on digital technology can effectively alleviate the impact of rural finance in the attribute mismatch, field mismatch and stage mismatch and other problems, reduce the cost and threshold of financial services, improve the coverage of rural financial services, alleviate the financing constraints faced by rural business entities, and thus promote the revitalization of rural industries; on the other hand, the development of digital inclusive

financial services in villages where the development of the financial industry is relatively backward can promote the level of rural technological innovation, empowering rural production technology improvement and innovation with the digital technology on which digital inclusive finance itself relies, guiding the development of rural industries to broaden the scope of business, extending the rural supply chain and industrial chain, and promoting the revitalization of rural industries. Based on the above analysis, this paper proposes:

Hypothesis 1: Digital inclusive financial development can significantly contribute to the revitalization of rural industries.

2.2 Path analysis of the impact of digital inclusive finance on rural industry revitalization

Industrial integration is considered one of the strategies to develop multifunctional agriculture, and the integration process includes scientific integration, technological integration, market integration and industry integration in non-agricultural context. Rural industrial integration development plays an essential role in promoting rural industrial revitalization, which refers to taking the agricultural industry as the primary basis, taking the moderate development of large-scale operation of new agricultural and rural business subjects as the core, and promoting the organic integration, cross-interaction and synergistic development of rural primary, secondary and tertiary industries by extending the agricultural industry chain, reshaping the multifunctionality of agriculture, developing the farm service industry, and fostering the new forms of agriculture. Previous studies have shown that the integrated development of rural industries helps to enhance agricultural competitiveness, lead to the generation of new enterprises, shape the brand of the farm industry, effectively improve farm efficiency and return on investment through the expansion of diversified functions and the promotion of advanced technologies, cultivate new growth points in the countryside through the expansion of agricultural functions, and promote the value-added of the industrial chain, which has the characteristics of forming the industrial chain, promoting the integration and innovation of factors, building a community of interests, and promoting the sustainable development of the industry. However, many factors such as fiscal and financial support, natural environment, geographic patterns, and changes in the agricultural labor force can affect rural industrial integration. Among all the constraints, the problem of financial constraints is undoubtedly one of the most critical constraints. The development of digital inclusive finance can, to a certain extent, alleviate the constraints faced by rural industrial integration, promote rural industrial integration, and thus promote rural industrial revitalization. First of all, to break the obstacles to the development of rural industrial integration, financial support is the critical driving force. The development of digital inclusive finance, under its own advantages, can relieve the financial constraints in rural industrial integration, thus promoting rural industrial integration as well as rural industrial revitalization; secondly, digital inclusive financial development can promote rural industrial integration by enhancing the entrepreneurial willingness of farmers, improving the market environment, and increasing the activity of rural entrepreneurship, thus promoting rural industrial revitalization. Based on the above analysis, this paper proposes:

Hypothesis 2: Rural industrial integration has a mediating effect on digital inclusive finance for rural industrial revitalization

3. Model Setting and Data Selection

3.1 Model setting

This paper uses data from 30 provinces, autonomous regions and municipalities in China from 2012 to 2021 for empirical evidence. Model (1) is constructed according to Hypothesis 1 to test the

impact of digital inclusive financial development on rural industrial revitalization:

$$Rural_{it} = \alpha_0 + \alpha_1 Difi_{i,t-1} + \alpha_x Control_{it} + \mu_i + \vartheta_t + \varepsilon_{i,t} \tag{1}$$

Further, according to hypothesis 2, model (2)(3) are constructed based on model (1) to investigate whether there is a mediating effect of rural industrial integration in the impact of digital inclusive financial development on rural industrial revitalization:

$$Idri_{it} = \beta_0 + \beta_1 Difi_{it-1} + \beta_2 Control_{it} + \mu_i + \vartheta_t + \varepsilon_{i,t} \tag{2}$$

$$Rural_{it} = \gamma_0 + \gamma_1 Difi_{it-1} + \gamma_2 Idri_{it} + \gamma_3 Control_{it} + \mu_i + \vartheta_t + \varepsilon_{i,t} \tag{3}$$

Where subscripts i and t denote region and time; the dependent variable $Rural_{it}$ denotes the level of rural industrial revitalization; the independent variable $Difi_{i,t-1}$ denotes the level of digital inclusive finance development lagged by one period; $Idri_{it}$ denotes the level of rural industrial integration; $Control_{it}$ denotes the control variables, including the level of economic growth (pGDP), the urbanization rate (Urban), the level of traditional financial development (Fd), the degree of opening up to the outside world (Open), the industrial structure (Is), the level of informatization (Ifd), the level of transportation development (Td), and the strength of financial support for agriculture (Afe); the μ_i denotes individual effect, and ϑ_t denotes time effect, and, $\varepsilon_{i,t}$ denotes the residual.

3.2 Description of variables and data selection

Table 1: Names of variables and calculation method

Variable classification	variable name	calculation method
explanatory variable	Rural Industry Revitalization (Rural)	See 1 for details
explanatory variable	digital inclusive finance (Difi), Breadth of Coverage (Breadth), Depth of Use (Depth), Level of Digitization (Level)	Total digital inclusive finance Index, Breadth of Coverage Index, Depth of Use Index, Digitization Degree Index (for details, see:Guo Feng et al., 2020)
intermediary variable	Rural Industrial Integration (Idri)	See 3 for details
control variable	Level of economic development (pGDP)	Logarithmic GDP per capita
	Industrial structure (Is)	Share of secondary and tertiary industries in GDP
	Level of traditional financial development (Fd)	Financial industry value added/GDP
	Degree of openness to the outside world (Open)	Total exports and imports of goods/GDP
	Level of transportation development(Td)	Total road mileage in logarithms
	Informatization level (Ifd)	Internet broadband access in logarithmic terms
	Financial support for agriculture (Afe)	Agriculture, forestry and water expenditure/financial expenditure
	Urbanization level (Urban)	Regional urban population/total regional population

The raw data used in this paper are mainly from China Statistical Yearbook, statistical yearbooks of provinces, autonomous regions and cities, China Rural Statistical Yearbook, China Industrial Statistical Yearbook, the National Bureau of Statistics, and the Digital Finance Research Center of Peking University. The selection of each variable shows in Table 1.

3.2.1 Explained variable: rural industrial revitalization (Rural)

Table 2: Evaluation index system for rural industry revitalization

Level one indicators	Secondary indicators	Tertiary indicators	Description of indicators	orientations
Rural industrial system	Agricultural production capacity	Agricultural labor productivity	Value added in primary sector per capital	+
		Comprehensive food production capacity (per capital)	(Food + oil production)/total number of people in the village	+
		Agricultural mechanization capacity	Gross power of agricultural machinery per mu	+
	industrial structure	Share of gross agricultural output	Gross value of agricultural output/gross value of agricultural, forestry, animal husbandry and fishery output	+
		Share of agricultural services	Agriculture, forestry, animal husbandry and fishery services/total agricultural output	+
Multifunctional agricultural industrial system	economic function	Percentage of rural non-farm income	Wage income/net income of rural residents	+
	social function	Non-farm payroll ratio	(Rural employment - primary sector employment) / Rural employment	+
	ecological function	Average agricultural fertilizer application per acre	Pesticide application/area planted	-
		forest cover		+
	cultural function	Number of township cultural stations per capital	Number of cultural stations/persons	+
Agricultural support industry system	Agricultural information service system	Broadband access	Number of rural Broadband access subscribers/number of rural households	+
	System of investment in agricultural fixed assets	Per capital fixed asset investment in rural areas	Rural fixed asset investment/total rural population	+

In previous studies, the measurement of the level of rural industrial revitalization can broadly divides into two categories: first, rural industrial revitalization as a system to measure the level of rural industrial revitalization in a particular region; second, under the proposition of "rural revitalization", industrial revitalization is measured as one of the sub-dimensions of rural revitalization. In this paper, concerning Shen Yun et al. (2020)[1] and other scholars, the paper constructs a rural industrial revitalization evaluation index system with 12 three-level indicators (Table 2), taking into full consideration the principles of scientificity and comparability of the indicators, as well as the availability of data. The period for the compilation of the indicator system is 2012-2021, and use the entropy weight method.

3.2.2 Explanatory variable: level of development of digital inclusive finance (DIFI)

This paper cites the "digital inclusive finance Index" published by the Digital Finance Research Center of Peking University (Guo Feng et al., 2020)[2]as a proxy variable for the development level of digital inclusive finance. The index follows the principles of comprehensiveness, balance, comparability, continuity, feasibility and integrates digital technology into inclusive finance, which can use to measure the development level of digital inclusive finance in China. The index includes

three sub-dimensions: Breadth, Depth and Level. Breadth reflects the ability of digital inclusive finance to reach customers, Depth examines the depth of development of digital inclusive finance in terms of actual usage, and Level of digitization reflects the lowering of thresholds and the degree of convenience of digital inclusive finance.

3.2.3 Mediating variable: rural industrial integration (Idri)

Relevant scholars, according to the different research purposes, objects and needs, some specialize in measuring the level of integrated development of rural industries in a specific region, and some measure the level of integrated development of rural industries following the need to study the influencing factors of integrated development of rural industries or economic and social effects and other issues, but so far there has not yet been formed a comprehensive evaluation index system. In this paper, we comprehensively consider the scientific and extensive nature of indicators and the availability of data, referring to the methods of Zhang Lin and Wen Tao (2022)[3], Li Yun et al. (2017)[4], constructs the evaluation index system of rural industrial integration development index containing 11 specific indicators (as shown in Table 3), and applies the entropy weight method to measure the level of rural industrial integration development.

Table 3: Indicator system of rural industrial integration level

goal	Secondary indicators	Tertiary indicators	calculation method	orientations
Rural Industrial Integration	Extension of the agricultural industry chain	Percentage of gross output in primary sector	Value added of primary sector/GDP	-
		Gross value of agricultural and sideline product processing per capital	Gross output value of agricultural and sideline products processing industry above large scale/total rural population	+
	Expansion of Agricultural Functions	Percentage of Rural non-farm employment	Number of people working in Secondary and tertiary Industries in villages/total number of people working in villages	+
		Operating income as a percentage	Net business income/disposable income of rural residents	+
	Integration of agricultural services	Per capital value of agricultural, forestry and fishery services	Value of agricultural, forestry, livestock and fishery services/total rural population	+
	New business in agriculture	Characteristic agricultural development	Number of geographical Indications for agricultural products	+
	Agricultural technology development	Degree of agricultural mechanization	Total power of agricultural machinery/total cultivated area	+
		Agricultural labor productivity	Gross output value of primary industry/number of employees in primary industry	+
	Benefits of industrial integration	Increased income for farmers	Per capital disposable income of farmers	+
		Increased agricultural production	Value added of primary industry/total cultivated area	+
		Per capital Investment in agriculture	Rural investment in fixed Assets in agriculture, forestry,livestock and fish/total rural population	
		Ratio of income of urban and rural residents	Per capital disposable Income of urban residents/per capital disposable income of rural residents	-

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3.2.4 Control variables

Including a series of other factors that may have an impact on the revitalization of rural industries: (1) the level of economic development (pGDP), measured by GDP per capital; (2) the level of urbanization (Urban), calculated by the regional urban population/total population of the region; (3) the level of development of traditional finance (Fd), measured by the share of the value-added of the financial industry in GDP; (4) the degree of openness to the outside world (Open) , measured by the total amount of regional imported and exported goods as a share of GDP; (5) industrial structure (Is), measured by the share of the secondary and tertiary industries in GDP; (6) level of informatization (Ifd), measured by the logarithm of the number of households with broadband access to the Internet; (7) level of development of transportation (Td), measured by the logarithm of the total mileage of highways;(8)strength of financial support for agriculture (Afe), measured by the share of expenditure on agriculture, forestry, and water utility expenditures as a share of fiscal expenditures is measured. The basic information of each variable gives in Table 4.

Table 4: Descriptive statistics of main variables

variant	notation	Number of observations	average value	standard error	minimum value	maximum values
Revitalization of rural industries	Rural	300	0.2484	0.0778	0.1178	0.6067
digital inclusive finance index	Difi	300	5.4495	0.4096	4.1185	6.1290
-Breadth of development	Breadth	300	5.3421	0.4823	3.8527	6.0717
-Use depth	Depth	300	5.4198	0.4166	3.9484	6.2358
-Level of digitization	Level	300	5.7376	0.3473	4.6735	6.1361
Rural Industrial Integration	Idri	300	0.2220	0.0905	0.0655	0.6500
Level of economic development	pGDP	300	10.871	0.4350	9.8494	12.1417
industrial structure	Is	300	0.4016	0.0786	0.1597	0.5865
Level of development of traditional finance	Fd	300	0.1651	0.0588	-0.0169	0.4162
Egypt's open-door policy towards the outside world	Open	300	0.0026	0.0037	0.12400	0.0216
Level of transportation development	Td	300	2.4942	0.8500	0.2231	3.6861
Informatization level	Ifd	300	6.6647	0.9019	3.9100	8.3612
Financial support for agriculture	Afe	300	0.1149	0.0336	0.0411	0.2038
urbanization level (of a city or town)	Urban	300	0.6023	0.1181	0.3630	0.8958

4. Empirical analysis

4.1 Impact of digital inclusive finance on the revitalization of rural industries

Table 5: Impact of digital inclusive finance development on rural industry revitalization

variant	return to baseline	mediation effect test	
	Model 1 (Rural)	Model 2 (Idri)	Model 3 (Rural)
Difi	0.00104 *** (0.000307)	0.000819*** (0.000299)	0.000389** (0.000203)
Idri			0.796284*** (0.087149)
Constants	-1.975242*** (0.560934)	-2.788466*** (0.428915)	-0.076439*** (0.409742)
time effect	containment	containment	containment
individual effect	containment	containment	containment
N	270	270	270
F	112.66	204.44	135.33
R2	0.9197	0.9539	0.9564

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; robust standard errors are in parentheses.We did not show the control variables for space reasons

According to the results of LM and Hausman test, we choose the fixed effect model for regression analysis. To eliminate the possible reverse causation problem, lagged the core explanatory variables by one period, and to avoid the effects of individual differences or time variation, we controls for both individual and time effects. In addition, considering the heteroskedasticity problem, the regressions are all clustered with robust standard errors. The results of the benchmark regression are given in model (1) in Table 5. The results of the benchmark regression show that the regression coefficient of digital inclusive finance is positive and significant at the 1% level. This indicates that the impact of digital inclusive finance development on rural industrial revitalization shows statistically considerable promotion, and hypothesis 1 is verified.

4.2 Mechanism of action tests

In order to analyze whether the development of digital inclusive finance can affect the revitalization of rural industries through the channel of rural industrial integration, this paper constructs a mediation effect model based on the benchmark regression to carry out empirical tests. The results shows in Table 5, and the regression coefficients all pass the significance level test. When the intermediary variable rural industrial integration introduced into the model, the marginal effect of digital inclusive finance on rural industrial revitalization decreases from 0.00104 to 0.000389. At the same time, the regression coefficients of digital inclusive finance and rural industrial integration on rural industrial revitalization in the model (2) and model (3) are positive and significant. That means rural industrial integration is the intermediary path for digital inclusive finance to affect rural industrial revitalization. The empirical evidence shows that digital inclusive finance, as a more convenient and efficient rural financial service, can not only directly promote the revitalization of rural industries, but also promote the revitalization of rural industries through the indirect path of promoting rural industrial integration, and then promote rural revitalization. The empirical conclusions are consistent with the previous inference.

4.3 Endogeneity discussion and robustness tests

This paper assesses whether there is a statistically significant impact between the digital inclusive finance index and the level of rural industry revitalization, intending to examine whether the development of digital inclusive finance can promote the revitalization of rural industries. However, endogeneity problems are always unavoidable in the macro impact of digital finance, so identifying the endogeneity of the impact of digital inclusive finance on rural industry revitalization and stripping out the unidirectional impact is an important task in the empirical part of this paper. Three types of possible endogeneity problems are deal with below: Firstly, the reverse causality problem. The development of digital inclusive finance may promote the revitalization of rural industries. In turn, the revitalization of rural industries may further stimulate the demand for digital inclusive finance products and thus promote the development of digital inclusive finance, so there is a specific reverse causality in the regression. Therefore, all regressions in this paper lag the core explanatory variables by one period to alleviate the impact of reverse causality. Secondly, the measurement error problem. The digital inclusive finance index used in this paper adopts the method of combining subjective and objective assignment to determine the weights, which has a relatively high degree of robustness; we use the entropy weighting method in the objective assignment method to determine the weights of the rural industrial revitalization and the rural industrial integration index, which excludes the influence of subjective factors, so that the measurement error is very weak. Finally, the problem of omitted variables: when there exists factors in the residual term that affect both the development of digital inclusive finance and the revitalization of rural industries, it may lead to biased coefficient estimation. In this paper's model,

the problem of omitted variables mainly reflects in two aspects: first, there may be province-specific qualities that do not change over time, or time factors that do not change over time with the province; second, although this paper has controlled for several regional control variables, such as local economic development, industrial structure, etc., variables such as similar local customs, perceptions, habits, and so on, may still be omitted. For the former problem of omitted variables, this paper uses a two-way fixed-effects model for regression to control for inter-provincial level factors that do not vary over time and year characteristics that do not vary over provinces. On this basis, the paper does further processing through the following methods:

For the latter omitted variable problem, this paper controls the endogeneity of the model by finding suitable instrumental variables. Referring to Li Muchen et al. (2020)[5] 's method, use the product of the spherical distance of the sample area from Hangzhou, Zhejiang Province and the corresponding digital inclusive finance index of the sample area, as the instrumental variable. The study shows that the degree of digital finance development is affected by geospatial factors, and characterized by more incredible difficulty in promotion the farther the distance from Hangzhou. Therefore, the "spherical distance between the sample area and Hangzhou" is directly related to the level of digital financial development in the area, but will not directly affect the revitalization of rural industries, so it meets the two conditions of the instrumental variable. Instrumental variables test results show that for the original hypothesis "insufficient identification of instrumental variables" test Kleibergen-Paap rk LM statistic is 15.454, p-value 0.0001, Kleibergen- Paaprk Wald F statistic is 16.647, more significant than the Stock-Yogo weak identification test. Stock-Yogo weak identification test critical value of 16.38 at the 10% level, indicating that the instrumental variables are reasonable. Two-stage least squares and GMM estimation performed simultaneously using the instrumental variables (results shows in Table 6) and compared to the baseline regression results.

Table 6: Instrumental variables regression results

(Rural)	return to baseline	2SLS	GMM
Difi	0.001040*** (0.000307)	0.0019151** (0.000943)	0.002507** (0.001052)
Constants	-1.975242*** (0.560934)	-2.13872*** (0.536203)	-2.013262*** (0.562419)
time effect	containment	containment	containment
individual effect	containment	containment	containment
N	270	270	270
R2	0.9197	0.9159	0.9092

From the results of instrumental variable regression, both 2SLS and GMM regression results show that the coefficient of digital inclusive finance is significantly positive and consistent with the results of benchmark regression, indicating that the results of the benchmark regression are robust. That means the development of digital inclusive finance has a statistically significant positive impact on the revitalization of the rural industry.

4.4 Heterogeneity analysis

4.4.1 Impact of different dimensions of digital inclusive finance

The index used in this paper to measure the degree of digital inclusive finance development is synthesized by three sub-indicators: breadth of coverage, depth of use, and degree of digitization. So we further explores the structural impacts of the different dimensions of digital inclusive finance on the revitalization of rural industries. In this paper, each dimension of digital inclusive finance regress separately, and use instrumental variables control the endogeneity. Table 7 demonstrates the impact of the different dimensions of digital inclusive finance on rural industry revitalization.

Table 7: Impact of different dimensions of digital inclusive finance

(Rural)	different dimension			2SLS		
Breadth	0.000056 (0.000430)			0.003977* (0.002149)		
Depth		0.000547*** (0.000185)			0.001453* (0.000819)	
Level			0.000433*** (0.000111)			0.000898** (0.000400)
Constants	-2.398798*** (0.582123)	-2.194499*** (0.509173)	-2.127343*** (0.486963)	-1.931829*** (0.717340)	-2.248505*** (0.543676)	-2.169949*** (0.514433)
time effect	containment	containment	containment	containment	containment	containment
individual effect	containment	containment	containment	containment	containment	containment
N	270	270	270	270	270	270
R2	0.9144	0.9188	0.9213	0.8791	0.9067	0.9133
LM(p)				3.193	4.077	3.729
Wald F				13.775	16.185	16.977

Note: LM(p) is the Kleibergen-Paap rk LM test p-value; Wald F-test critical values are16.38 (10% level), 8.96 (15% level), 6.66 (20% level), and 5.53 (25% level). Same below.

The results show that the impact of digital inclusive finance on rural industry revitalization is heterogeneous in the sub-dimensions, which is manifest in the fact that the two dimensions of depth of use and degree of digitization significantly contribute to the revitalization of the rural industry. Still the contribution of the breadth of coverage dimension is not stable. Specifically, the two dimensions of depth of use and degree of digitization are statistically significant, and the model coefficients of the benchmark regression and instrumental variable test are both homoscedastic and significant. Though the model coefficients of the breadth of coverage dimension become significant after adding instrumental variables to control endogeneity, the model coefficients of the benchmark regression are insignificant, and its impact is not stable. In terms of significance alone, it is clear that depth of use and digitization are statistically more significant than breadth of coverage in promoting rural industrial revitalization.

4.4.2 Impact of different levels of digital inclusive finance development

To avoid the influence of Simpson's paradox on the reliability of the conclusions, we further investigates whether the promotion effect of digital inclusive finance on the revitalization of rural industries is significant under different levels of development. Using the median of the Digital Inclusion Index as a criterion, we divide the sample into high-level and low-level zones of digital inclusion development to test the heterogeneity of its impact on rural industry revitalization under different subgroups of digital inclusion development levels. The regression results of digital inclusive finance and its different dimensions on rural industry revitalization in different development level groupings of digital inclusive finance are given in Table 8 and 9.

In the high-level group, the impact of digital inclusive finance development on the revitalization of rural industries exhibits a statistically significant facilitating effect. Still there are heterogeneity in the sub-dimensions of digital inclusive finance. The depth of use and degree of digitization dimensions also exhibit statistically significant facilitating impacts, consistent with the previous regression results, indicating the robustness of the regression results. However, the breadth of coverage dimension is not significant in the baseline regression but turns to significant after adding instrumental variables, suggesting an unstable facilitation effect.

Table 8: Impact of digital inclusive finance in the high-level group

(Rura)	High- Level Group				2SLS			
Difi	0.001503** (0.000725)				0.003552*** (0.001469)			
Breadth		0.001873 (0.001135)				0.005178*** (0.001862)		
Depth			0.000242* (0.000112)				0.003833* (0.002269)	
Level				0.000432* (0.000231)				0.001637*** (0.000638)
Constants	-0.798394 (1.23210)	-1.011499 (1.238756)	-1.107590 (1.146368)	-1.341594 (1.214875)	- 1.716484* (1.015006)	-3.110516** (1.252529)	0.713750 (2.840569)	-2.142702 (1.437400)
time effect	containment	containment	containment	containment	containment	containment	containment	containment
individual effect	containment	containment	containment	containment	containment	containment	containment	containment
N	72	72	72	72	72	72	72	72
R2	0.1643	0.1112	0.1709	0.2233	0.8993	0.9019	0.6778	0.8605
LM(p)					2.862	3.535	0.908	2.512
Wald F					19.719	22.973	2.393	8.333

Table 9: Impact of digital inclusive finance in low-level groups

(Rura)	Low- Level Group				2SLS			
Difi	0.001828** (0.000771)				0.003552*** (0.001469)			
Breadth		0.002449 (0.003351)				0.005178*** (0.001862)		
Depth			0.001151** (0.000552)				0.003833* (0.002269)	
Level				0.000526*** (0.000136)				0.001637*** (0.000638)
Constants	-1.543012* (0.772575)	-1.332313 (1.566162)	-1.98910** (0.721906)	-1.860655** (0.763115)	- 1.716484* (1.015006)	-3.110516** (1.252529)	0.713750 (2.840569)	-2.142702 (1.437400)
time effect	containment	containment	containment	containment	containment	containment	containment	containment
individual effect	containment	containment	containment	containment	containment	containment	containment	containment
N	198	198	198	198	198	198	198	198
R2	0.0214	0.0484	0.0622	0.2233	0.8993	0.9019	0.6778	0.8605
LM(p)					6.006	2.901	4.773	5.799
Wald F					23.998	13.586	8.049	10.299

In the low-level group, the regression results are broadly consistent with those of the overall as well as the high- level group, i.e., digital inclusive finance as a whole can significantly contribute to the revitalization of rural industries. Still there are heterogeneity in the digital inclusive finance sub-dimensions, with depth of use and degree of digitization showing statistically significant contributions, and the breadth-of-coverage dimension showing unstable contributions.

4.4.3 Impact of digital inclusive finance on different regions

As mentioned above, the regression conclusions under the grouping of different development levels of digital inclusive finance remain consistent with the whole, i.e., the development of digital inclusive finance can significantly promote the revitalization of rural industries. Additionally, to further test the robustness of the results by changing the basis of the grouping, we use the regional division of the National Bureau of Statistics (NBS) to categorize the 30 provinces, autonomous regions and municipalities into eastern, central and western regions. At the same time, we would like to know whether there is any heterogeneity in the impact of digital financial inclusion and its sub-dimensions on rural industrial revitalization across regions. The regression results shown in

Tables 10-12.

Table 10: Impact on the East

(Rural)	The east				2SLS			
Difi	0.000866* (0.000443)				0.003694* (0.002066)			
Breadth		0.000417 (0.000662)				0.005621* (0.003013)		
Depth			0.000136 (0.000211)				0.003999 (0.003932)	
Level				0.000461** (0.000162)				0.001626* (0.000860)
Constants	-0.544255 (0.78335)	-1.050276 (0.837018)	-1.096918 (0.807655)	-0.920144 (0.606534)	0.627370 (1.537032)	-0.454831 (1.252529)	3.706412 (5.700345)	-0.612188 (0.995719)
time effect	containment	containment	containment	containment	containment	containment	containment	containment
individual effect	containment	containment	containment	containment	containment	containment	containment	containment
N	99	99	99	99	99	99	99	99
R2	0.4063	0.4015	0.4009	0.3941	0.8813	0.8658	0.6327	0.8726
LM(p)					2.125	2.131	0.688	1.916
Wald F					6.438	5.094	1.568	4.727

Table 11: Impact on the center

(Rural)	The center				2SLS			
Difi	0.002574* (0.001215)				0.002712*** (0.000817)			
Breadth		0.002002 (0.001822)				0.003740*** (0.001374)		
Depth			0.001826** (0.000770)				0.001937*** (0.000612)	
Level				0.001015* (0.000493)				0.002300** (0.001001)
Constants	0.289052 (0.896115)	-0.039804 (1.092425)	-0.367334 (0.663186)	-0.830724* (0.424264)	-0.300823 (0.772625)	0.334073 (1.215813)	-0.816920 (0.713503)	-0.476754 (0.877451)
time effect	containment	containment	containment	containment	containment	containment	containment	containment
individual effect	containment	containment	containment	containment	containment	containment	containment	containment
N	72	72	72	72	72	72	72	72
R2	0.0117	0.0084	0.0250	0.3667	0.9793	0.9696	0.9795	0.9641
LM(p)					6.072	4.596	5.782	3.839
Wald F					6.141	3.951	5.740	1.946

From Tables 10-12, we can found that the impact of digital inclusive finance on rural industry revitalization exhibits statistically significant promotion in the eastern, central, and western regions. But there is heterogeneity in the sub-dimensions. The result is consistent with the overall findings, further illustrating the reliability of this paper's conclusions. Specifically, in the eastern region, digital inclusive finance development can considerable promote rural industrial revitalization, but only the degree of digitization of the sub-dimensions is statistically significant; In the central region, digital inclusive finance promotes a considerable role, and the sub-dimensions depth of use and degree of digitization are also significant, but the breadth of coverage promotes an unstable role; In the western region, the contribution of digital financial inclusion is significant, but only the sub-dimension of digitization is significant.

In summary, under different grouping bases, the development of digital inclusive finance is shown to have a significant contribution to the revitalization of rural industries. It proves that the regression results have relatively high reliability. Meanwhile, the study finds that the impact of digital inclusive finance on rural industry revitalization is heterogeneous. Heterogeneity mainly stems from the digital inclusive finance sub-dimensions, as shown by the fact that the depth of use

and the degree of digitization can significantly contribute to the revitalization of rural industries in general, while the contribution of the breadth of coverage is unstable. Under different levels of digital inclusive finance development, the two dimensions of depth of use and digitization are statistically significant in promoting the revitalization of rural industries, but the promotion of breadth of coverage is unstable; from the perspective of different regions, breadth of coverage has an unstable promotion effect in the east and central China, while the effect in the west is insignificant, depth of use is a significant promotion in the central China, and an unstable one in the west, and the effect in the east is statistically insignificant, and the effect in the east is statistically insignificant, and the effect in the east is statistically insignificant. And digitization is statistically insignificant in the East, Central and West.

Table 12: Impact on the West

(Rural)	The west				2SLS			
Difi	0.002102** (0.000874)				0.010346*** (0.003439)			
Breadth		-0.001518 (0.001373)				-0.498648 (4.030029)		
Depth			0.001184 (0.000673)				0.005659*** (0.002146)	
Level				0.000417*** (0.000124)				0.003614*** (0.001386)
Constants	-3.85892*** (0.953628)	-4.76867*** (1.300201)	-4.35778*** (1.058054)	-4.02478*** (1.109238)	-3.025105** (1.522239)	43.956080 (409.762)	-4.63279*** (1.457363)	-0.035969 (2.084605)
time effect	containment	containment	containment	containment	containment	containment	containment	containment
individual effect	containment	containment	containment	containment	containment	containment	containment	containment
N	99	99	99	99	99	99	99	99
R2	0.1528	0.2436	0.1886	0.1865	0.6855	0.6418	0.6418	0.4423
LM(p)					3.311	0.004	2.065	2.853
Wald F					8.606	0.007	6.690	4.550

5. Conclusions and recommendations

The main conclusions of this paper are (1) digital inclusive financial development can significantly promote rural industrial revitalization; (2) rural industrial integration is an effective way for digital inclusive financial development to promote rural industrial revitalization; (3) the impacts of the sub-dimensions of digital inclusive finance are heterogeneous, with the depth of use and the degree of digitization being able to significantly promote the revitalization of rural industries, but the promotional effect of the breadth of coverage is unstable; and in different digital inclusive financial development level subgroups, the impact of digital inclusive financial development on rural industry revitalization remains consistent with the whole; in addition, the impact of digital inclusive financial development on rural industry revitalization is heterogeneous across regions, mainly manifested in the unstable promotion of breadth of coverage for the East and the Center, while the impact on the West is insignificant, the depth of use is a significant promoter for the Center, and the promotion of the West is unstable, but statistically insignificant effect on the east, and the degree of digitization shows a significant promotion effect on the east, central and west.

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