The Role of E-commerce Development in Promoting Farmers' Income Growth through Digital Inclusive Finance: An Intermediary Effects Perspective

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Abstract. This paper explores the role of e-commerce development in promoting the growth of farmers' income through digital financial inclusion and verifies the existence of the mediating effect and its mechanism based on Chinese provincial panel data from 2014-2021. It is found that digital financial inclusion has a positive impact on farmers' income, and digital financial inclusion promotes farmers' income growth through the mediating effect of the level of e-commerce development. Eventually, based on the results of the study, policy recommendations are made.

Keywords: e-commerce development; digital inclusive finance; farmers' income growth; intermediary effect

1   Introduction

With the development of e-commerce, digital inclusive finance plays an important role in promoting farmers' income growth. Scholars agree that digital inclusive finance can provide farmers with better financial services and bring a positive impact on the majority of rural areas and farmers' income growth[1-4]. Studied from a spatial perspective, digital inclusive finance has a spatial spillover effect on farmers' income[5-6]. From the path of e-commerce to promote farmers' income, scholars generally believe that the level of e-commerce development has a significant positive effect on farmers' income[7-9]. In summary, there are gaps in the existing research on the mechanism of action and interrelationship between the three. Therefore, The aim of this paper is to fill the research gap in this area, to identify the impact of e-commerce and digital financial inclusion on the farm economy from the perspective of mediating effects, and promote the sustainable development of agriculture.

2   Theoretical Analysis and Research Hypothesis

Digital financial inclusion provides channels and opportunities for farmers to engage in operational self-employment entrepreneurial behaviour[10]. In addition, through technological innovation and data analytics, it provides farmers with the opportunity to personalise their credit services as well as insurance services. Based on this, this paper proposes hypothesis 1.

Hypothesis 1: The development of digital financial inclusion can contribute to the growth of farmers' income to some extent.

The development of e-commerce facilitates the broadening of markets for agricultural products, providing channels and opportunities for quick sales. Through the promotion of digital platforms, the information asymmetry is broken, which is enhancing farmers' trust in the market and achieving income growth. Therefore, this paper proposes hypothesis 2 and 3.

Hypothesis 2: e-commerce favours the growth of farmers' income.

Hypothesis 3: Digital financial inclusion influences farmers' income growth through e-commerce.

3   Variable Selection and Data Description

3.1   Selection of Variables

The explanatory variable in this paper is the disposable income per capita of the rural population (INCOME).

The core explanatory variable of this paper is the overall index of digital financial inclusion (INDEX).

The mediatng Variables in this paper is the level of e-commerce development. Considering the research of scholars and the availability of data, this paper finally adopts the sales of e-commerce (SALE) as a measurement indicator.

The control variables in this paper included The value added of primary industry (GDP), Government financial support (FIN), The level of urbanization (TOWN), The growth rate of investment in fixed assets by rural agricultural households (INV).

3.2   Data Sources and Descriptive Statistics

The research object of this paper is 31 provincial-level administrative regions in China, excluding Hong Kong, Macau, and Taiwan, from 2014 to 2021. The research data mainly come from the China Statistical Yearbook, the China Rural Statistical Yearbook, and the Digital Inclusive Finance Index regularly published by the Digital Finance Research Center of Peking University. Individual missing data have been filled by linear interpolation to ensure data availability and consistency. Table 1 shows the descriptive statistics for each variable conducted using Stata 17.0.

Table 1. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
INDEX	248	280.0039	68.18463	143.91	458.97
INCOME	248	14884.68	5770.829	6277	38521
SALE	248	4628.55	6429.106	31.4	37886
GDP	248	2145.673	1484.287	88.1	6029
FIN	248	622.052	278.6177	134.91	1339.36
TOWN	248	58.73823	12.90259	22.65	89.58
INV	248	-0.375	15.06173	-50.1	61

4 Empirical Analysis.

4.1 Baseline Empirical Model

Three regression equations are made up to develop the stepwise approach of mediation model based on Wen Zhonglin's study[11]11. This is how the benchmark model is put up:

$$INCOME_{ij} = \alpha_{11} + \gamma_{11}INDEX_{ij} + \theta_{11}GDP_{ij} + \rho_{11}FIN_{ij} + \varphi_{11}TOWN_{ij} + \mu_{11}INV_{ij} + \varepsilon_{ij} \quad (1)$$

$$SALE_{ij} = \alpha_{21} + \gamma_{21}INDEX_{ij} + \theta_{21}GDP_{ij} + \rho_{21}FIN_{ij} + \varphi_{21}TOWN_{ij} + \mu_{21}INV_{ij} + \tau_{ij} \quad (2)$$

$$INCOME_{ij} = \alpha_{31} + \gamma_{31}INDEX_{ij} + \beta_{31}SALE_{ij} + \theta_{31}GDP_{ij} + \rho_{31}FIN_{ij} + \varphi_{31}TOWN_{ij} + \mu_{31}INV_{ij} + \omega_{ij} \quad (3)$$

where subscripts i, j represent region and time, respectively. $\alpha_{11}, \alpha_{21}, \alpha_{31}$ are model constant terms, $\gamma_{11}, \gamma_{21}, \gamma_{31}, \beta_{31}$ are correlation coefficients of the variables of interest, $\theta_{11}, \theta_{21}, \theta_{31}, \rho_{11}, \rho_{21}, \rho_{31}, \varphi_{11}, \varphi_{21}, \varphi_{31}, \mu_{11}, \mu_{21}, \mu_{31}$ are the correlation coefficients of the control variables, and $\varepsilon_{ij}, \tau_{ij}, \omega_{ij}$ are the random disturbance terms of the model.

Taking into account challenges such as data heteroskedasticity and autocorrelation, this paper uses a panel GLS technique to regress the benchmark model while adjusting for time and province effects. Table 2 displays the panel mediation model's benchmark regression results.

Table 2. Regression benchmark results.

	(1) INCOME	(2) SALE	(3) INCOME
INDEX	0 (68.0475)	0 (46.3156)	0 (50.431)
SALE			0 (0.3804)
GDP	0.3159 (-0.2767)	0.5141 (0.2789)	0.0874 (-0.3827)
FIN	0.2818 (-1.6442)	0.5089 (1.563)	0.0711 (-2.2387)
TOWN	0.0064 (-46.953)	0.4477 (20.1271)	0.0001 (-54.6085
INV	0 (64.8151)	0.0001 (93.4127)	0.018 (29.2847)
constant term	0.8695 (233.2551)	0 (-11052.553)	0.0003 (4437.1926)

time effect	YES	YES	YES
province effect	YES	YES	YES
N	248	248	248

Note: p<0.05 is significant.

Correlation coefficients for variables in parentheses.

According to model (1), the coefficient of digital financial inclusion is considerably positive at the 5% significance level, indicating that digital financial inclusion benefits farmers' income. The following are the basic steps for testing the panel mediation effect: First, determine whether the impact of digital financial inclusion on farmer income is considerable in model (1), and if so, proceed to the next step of the test. The final stage of the test will be performed if the coefficient of the influence of digital financial inclusion on the mediator variable e-commerce development level in model (2) is significant. Finally, in model (3), determine if the coefficients of the direct explanatory variable digital financial inclusion and the mediating variable e-commerce level on the explanatory variable farmers' income are significant. The empirical results reveal that both the explanatory and mediating factors' regression coefficients are considerably positive at the 5% significance level. As a result, the hypothesis that digital financial inclusion helps to farmer income increase via the mediating role of e-commerce expansion is confirmed.

4.2   Check for Robustness

This section evaluates the model's resilience. First, the Bootstrap method is used to test whether the baseline model's mediation effect exists, and second, the explanatory variable of farmers' disposable income per capita is replaced by farmers' consumption expenditure per capita (CONSUM), and the proxy variable of the level of e-commerce development is replaced by the volume of express delivery business (EX). First and foremost, there is a significant positive correlation between per capita consumption expenditure and per capita disposable income; if the level of digital financial inclusion and e-commerce development can significantly promote the growth of farmers' income, then theoretically and logically, it can stimulate farmers to spend to some extent; secondly, the volume of express delivery business and the level of e-commerce development also have a strong positive correlation.

The findings of the Bootstrap test in Table 3 reveal that there is no 0 in the 95% confidence interval, indicating that e-commerce development has an indirect mediation influence in digital financial inclusion to increase farmer income.

Table 3. Results of the Bootstrap test.

Indirect effect	SALE	
Observation coefficient	5.5636	
95%Conf.Interval	3.3326	9.0321

Models (4) through (6) in Table 4 show the regression results after variables in the benchmark model were replaced, and the regression results reveal that both the direct explanatory factors and the mediator variables are significantly positive at the 5% sig-

nificance level. All of the foregoing robustness tests show that digital inclusive financing will increase farmers' income indirectly through e-commerce development, confirming the robustness of the benchmark model setting. Table 4 displays the benchmark regression results of the panel mediation model with replacement variables.

Table 4. Tests for Replacement Variables' Robustness.

	(4)CONSUM	(5)EX	(6)CONSUM
INDEX	0	0	0
	(47.9786)	(2109.684)	(42.415)
EX			0
			(0.0026)
GDP	0.0277	0.0149	0.001
	(-0.3887)	(60.7422)	(-0.5488)
FIN	0.8143	0.9814	0.7934
	(0.2285)	(-3.2015)	(0.2369)
TOWN	0.0082	0.2144	0.019
	(-29.02)	(-1912.76)	(-23.9758)
INV	0	0.3244	0
	(39.4852)	(1304.789)	(36.0443)
constant term	0.4167	0.0007	0.0287
	(735.7402)	(-440024)	(1896.161)
time effect	YES	YES	YES
province effect	YES	YES	YES
N	248	248	248

Note: p<0.05 is significant.
Correlation coefficients for variables in parentheses.

5   Conclusions

The empirical results of this paper through the mediation effect study show that (1) digital financial inclusion has a positive impact on farmers' income. (2) Digital financial inclusion promotes farmers' income growth through the mediating effect of the level of e-commerce development. (3) There is a significant positive effect of farmers' fixed asset investment on farmers' income growth. (4) The direct effect of digital financial inclusion in promoting farmers' income growth is greater than the indirect effect based on e-commerce development.

Based on the above findings, this paper makes the following implications: (1) Strengthening financial and technological innovation and digital payments, and establishing cooperation mechanisms and diversified cooperation models. (2) Improving digital infrastructure in rural areas and providing training in digital technologies adapted to the needs of farmers. (3) Encouragement of fixed investments by farmers through fiscal support policies. Subsequent research can further explore the role of digital inclusive finance and e-commerce in farmers' entrepreneurship and innovation and promote the attention on rural revitalisation.

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