Digital Financial Inclusion and Multidimensional Poverty-Evidence from China

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Abstract. There are high hopes for the power of digital financial inclusion. However, there is restricted evidence on the relation between digital financial inclusion and poverty. Based on panel data for 31 provinces in China from 2013 to 2020, this paper attempts to uncover the affect of digital financial inclusion on multidimensional poverty. The multidimensional Poverty Index is measured by principal component analysis. The results of the study indicate that digital financial inclusion alleviates multidimensional poverty by equalizing income distribution. In addition, digital financial inclusion has a more significant effect on multidimensional poverty in the western region than in the eastern and central regions.

Keywords: Digital financial inclusion; Multidimensional poverty; Income distribution; Principal component analysis;

1. Introduction

The concept of digital financial inclusion began to take off in 2005. Research on digital inclusion has focused on the target audience. Shofawati (2018) [1] studied from the perspective of SMEs through a qualitative approach. Analysis reveals the importance of digital inclusion in the delivery of SMEs finance in Indonesia. Mushtaq and Bruneau (2016)[2] examine the development of information and communication technologies (ICT). The role that digital inclusion plays in poverty reduction is examined accordingly. Since then, scholars have gradually applied digital inclusion to poverty alleviation(Liu & Guo, 2023)[3]. Most scholars use per capita income to express the level of poverty(Alam&Alam,2021)[4](He, Li, Li, & Yu, 2022)[5]. Due to the multifaceted nature of poverty in China, it would be rather one-sided to measure poverty only at the income level. The current study of poverty reduction from a single perspective does not provide an accurate measure of multifaceted poverty. The emergence of multidimensional poverty theory has enabled scholars to push the study of poverty to multiple dimensions. (Mohanty & Vasishtha, 2021)[6](Chen,Leu,&Wang,2019)[7].

The MPI method is the most typical of the methods used to measure multidimensional poverty(Alkire,Apablaza,Chakravarty,&Yalonetzky,2017)[8]. So as to measure poverty and reflect the true state of poverty in China. This article sorts out the factors that influence poverty in China. Seven indicators in three dimensions were selected through the MPI model to construct a multidimensional poverty index. A poverty index is used for express poverty

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levels in China, which is targeted to measure the poverty situation in China. (Qi, Ye, Xu, & Chen, 2022)[9](Shen & Li, 2022)[10].

2. Methodology

2.1 Measurement of multidimensional poverty index

The measurement results are shown in Table 1.

Table 1 Evaluation indicator system

First-order index	Secondary index	Variable	Index	Attribute
Income-poverty	Per capita income of rural residents	inc	X1	Negative
	Consumer price index	cpi	X2	Negative
	Engel coefficient	eng	X3	positive
Medical-poverty	Number of medical personnel per 1,000 rural population	med	X4	Negative
	Number of rural medical institutions	org	X5	Negative
	Endowment insurance rate	end	X6	Negative
Educational-poverty	Average years of schooling above 6 years old	edu	X7	Negative

First, KMO and Bartlett tests were performed. The value of KMO was calculated to be 0.69, which meets the correlation requirement of principal component analysis. p-value is less than 0.001, which means that the correlation of each variable is at a relatively high level and meets the requirement of principal component analysis. Secondly, factor analysis was then carried out on the processed data.

Table 2 Principal components analysis

Principal components	Eigenvalue	Contribution rate%	Cumulative contribution rate%
F1	3.099	30.99%	44.27%
F2	1.489	14.89%	65.54%
F3	1.244	12.44%	83.31%
F4	0.622	6.22%	92.19%
F5	0.233	2.33%	95.52%
F6	0.168	1.68%	97.92%
F7	0.146	1.46%	100.00%

In table 2, there are three main components with eigenvalues above 1. After determining the three principal components, the eigenvectors of the three principal components F1, F2 and F3 were calculated as follows.

Table 3 Principal component feature vectors

Index	Principal component1	Principal component2	Principal component3
X1	-0.842	0.163	-0.108
X2	0.724	-0.129	0.136
X3	-0.860	0.237	0.323
X4	0.279	-0.806	0.422
X5	0.496	0.781	0.205
X6	0.866	0.342	0.097
X7	0.228	-0.113	-0.938

From Table 3, it can be observed that the eigenvector values of the three principal components are at a relatively high level. This also shows that the principal component analysis can represent the poverty status of each province as a multidimensional poverty index. The eigenvectors corresponding to each eigenvalue are then calculated, as shown in Table 4.

Table 4 Eigenvectors corresponding to eigenvalues

Index	Principal component1	Principal component2	Principal component3
X1	-0.478	0.134	-0.097
X2	0.411	-0.106	0.122
X3	-0.489	0.194	0.290
X4	0.158	-0.661	0.378
X5	0.282	0.640	0.184
X6	0.492	0.280	0.184
X7	0.130	-0.093	-0.841

After finding the eigenvectors corresponding to the three eigenvalues. The calculation formula for the primary component. The multidimensional poverty index of each province can be obtained.

3.Research Design

3.1 Variable Definition and Measurement

Table 5 lists the variable descriptions.

Table 5 Analyses of variables

	Variable	Index
Dependent variable	Multidimensional poverty (pov)	Multidimensional poverty index
Independent variable	Digital Financial Inclusion Index (difi)	Logarithm of the digital Financial Inclusion index
	Coverage span (cov)	Logarithm of the coverage span index
	Service depth (dep)	Use the logarithm of the depth exponent
	Degree of digitization (dig)	Logarithm of the digitization degree index
Control variable	Degree of government intervention (gov)	Government expenditure/gross regional product
	Urbanization rate (urban)	Urban population/total population

	Degree of openness (open)	Exports/provincial GDP
	Industrial structure (is)	Tertiary industry/provincial GDP
	Level of economic development (rgdp)	We take logarithm of GDP per capita
Mediating variable	Income distribution (ins)	Urban income/rural income

3.2 Experimental design

The model adopted in this paper is as follows:

$$pov_{i,t} = \alpha_0 + \alpha_1 difi_{i,t} + \alpha_2 x_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

In the above model (1)，$pov_{i,t}$ is multidimensional Poverty Index，$difi_{i,t}$ is Digital Financial Index，$x_{i,t}$is control variant，μ_i is a fixed effect，$\lambda_t$is time change，$\varepsilon_{i,t}$ is an error.

The mediation model adopted in this paper is shown in (2):

$$pov_{i,t} = \alpha_0 + \alpha_1 difi_{i,t} + \alpha_2 ins_{i,t} + \alpha_{32} x_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (2)$$

4. Empirical findings

4.1 Variable analysis

In Table 6, the peak and lowest values of pov are 0.507 and -3.660. The gap between the highest values is oldest, It also shows a disparity in poverty between different provinces. The averages of difi is 2.386, the highest value is 2.635 and the lowest value is 2.061. It shows that digital financial inclusion has achieved rapid development in China in recent years. About gov, The largest is 1.354 , the smallest is 0.120. The averages, largest and smallest of urban were 0.594, 0.240 and 0.896, respectively. This means that China's urbanization level is not high on the whole. The highest of open is 0.686 but the lowest is only 0.00389. This means that there are huge differences in the degree of openness of each region. The average value of is is 0.508. The peak and lowest values of rgdp are 5.046 and 2.918.

Table 6 Variable analysis

Variable	N	Average	SD	Min	Max
pov	248	-1.401	0.922	-3.660	0.507
difi	248	2.386	0.125	2.061	2.635
gov	248	0.299	0.209	0.120	1.354
urban	248	0.594	0.125	0.240	0.896
open	248	0.135	0.131	0.00398	0.686
is	248	0.508	0.0841	0.347	0.837
rgdp	248	4.247	0.428	2.918	5.046

4.2 Financial inclusion effect of digital on multidimensional poverty

In Table 7. 1 Refers to the overall impact under the fixed effects model. 2, 3 and 4 show the affect of the three sub-indices on multidimensional poverty. The affect of difi on multidimensional poverty is -13.165, -13.899,3.277,-1.665 ,both the total and sub-indices of difi have a major influence on multidimensional poverty. The result for the control variable was 3.255,8.193,0.328,14.188, also significant at different levels.

Table 7 Financial inclusion effect of digital on multidimensional poverty

	1	2	3	4
difi	-13.165***	-13.899***	3.277***	-1.665**
gov	0.650	1.571	-1.231	-1.008
urban	11.335	18.503**	-4.098	-0.526
open	3.255*	4.590**	4.511**	3.667*
is	8.193*	8.253*	-4.470	-0.677
rgdp	14.188***	16.362***	2.904	5.817**
ins	-26.549***	-21.358**	-12.057	-17.717*
Fin	0.328**	0.449***	-0.077	0.025
_cons	-29.549***	-45.239***	-10.581	-12.459

4.3 Robustness Checks

In Table 8, in regressions 1 and 2, the Engel coefficient and the income per capita were used for replace multidimensional poverty index, respectively. The regression result is -0.284, 0.353. Both regression results are significant at the 5% level. Regression 3 uses a mixed-effects model, and Regression 4 uses a random-effects maximum likelihood estimate. The regression result is 2.164, 2.164. Both regression results were significant at the 1% level. Therefore, the robustness of the paper's findings is good.

Table 8 Robustness test result

	1 eng	2 rural	3 pov	4 pov
difi	-0.284**	0.353***	2.164***	2.164***
gov	-0.049	0.007	1.768**	1.768**
urban	0.240	0.147	-1.172	-1.172
open	-0.074	-0.055	-0.538	-0.538
is	0.163	0.125	-2.394*	-2.394*
rgdp	-0.074	0.436***	0.467	0.467

4.4 Intermediary analysis

In Table 9, bootstrap is [-0.0749,-0.0044] at the 95% confidence interval. This indicates the presence of a mediating effect. Digital inclusive finance can play a role in multidimensional poverty alleviation through the intermediary channel of equilibrium income distribution.

Table 9 Results of mediating effects

Effect	Effect size coefficient	Standard error	95%Confidence interval	
			Lower limit	Upper limit
Total	0.1003	0.0643	-0.0246	0.2253
Direct	0.1308	0.0626	0.0075	0.2541
Mediating	0.0305	0.0172	-0.0749	-0.0044

4.5 Heterogeneity analysis

In Table 10.In the eastern region, the regression result was -4.11,which is not significant. In the center and west, the results are -18.14 and -16.13, the results are significant. The effect is more pronounced in the west for three stars than in the center. The growth of digital financial

inclusion has a higher marginal contribution to poverty alleviation in the relatively underdeveloped center and west. Compared with the east and center, the impact on alleviating the multidimensional poverty effect is more obvious in western China.

Table 10 Analysis of heterogeneity in the East, Center and West China

	1	2	3
Variable	East	Center	West
difi	-4.11	-18.14*	-16.13***
	(-0.95)	(-3.23)	(-7.34)
_cons	-45.73***	-30.38	-36.68**
	(-4.69)	(-0.99)	(-3.76)

5.Conclusion

In this paper, Construct multidimensional poverty index from three dimensions. Combined with the fixed effect model, the paper analyzes the poverty reduction effect of the growth of digital inclusive finance. The study found that digital financial inclusion effectively alleviates multidimensional poverty by providing financial services to poor areas. The poverty reduction effects of digital financial inclusion differ remarkable across regions. Poverty reduction is most evident in the west less developed areas, followed by the central and eastern regions. Moreover, income distribution plays a partial mediating role between digital inclusion and poverty reduction.

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