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Research on Digital Inclusion, Rural Revitalization and Spatial Spillover Effect Based on Entropy Method and Index System

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Abstract: *As an important strategic goal of "agriculture, rural areas and farmers" in the new development stage of socialism with Chinese characteristics, rural revitalization also provides important basic support for the current reform and development tasks. As the main force in poverty alleviation, finance should comprehensively promote the revitalization of rural areas on the basis of the achievements of tools in poverty alleviation. Under this background, this paper comprehensively evaluates the rural revitalization index of various provinces in China based on the entropy weight TOPSIS method, and then uses the spatial Durbin model to measure the impact of digital inclusive finance on rural revitalization and development, and analyzes the regional heterogeneity and spatial spillover effects of digital inclusive finance on rural revitalization.*

Keywords: *Rural revitalization, Digital inclusive, TOPSIS entropy method*

1. Introduction

The Rural Revitalization strategy proposed at the 19th National Congress of the Communist Party of China is the general focus of China's "agriculture, rural areas and farmers" work in the new era. It is also a concrete embodiment of China's comprehensive construction of a socialist modern country and the realization of the second Centennial goal in the field of agriculture and rural areas. As an important strategic goal of the "three rural" work in the new development stage of socialism with Chinese characteristics, Rural Revitalization also provides important basic support for the current reform and development tasks. As the main force of poverty alleviation, finance should comprehensively promote rural revitalization on the basis of the achievements of poverty alleviation. In 2016, the concept of "digital Inclusive Finance" was first put forward at the G20 summit, breaking the barriers of traditional Inclusive Finance. Through the digital industrial service platform, digital Inclusive Finance enables financial institutions to provide effective support for the financing of rural small and micro enterprises and farmers, better meet the needs of decentralized and small funds, and realize the sinking and diversification of service objects. In the context of supply side reform, the government's investment in digital infrastructure in the field of agriculture, rural areas and farmers has created a good environment for the development of rural digital economy. Through the digital industrial chain, we can give play to the long tail effect of digital economy, reduce costs, break and promote information sharing, drive the value-added of all links [1] of the industrial chain, increase the vitality of the industrial chain and help rural revitalization.

2. Journals review

2.1. Digital Inclusive Finance alleviates rural poverty

Digital Inclusive Finance has a significant positive effect on the improvement of farmers' income (Chen Dan et al.; He Yiqing et al., 2020) [2]. By increasing the supply of inclusive financial services, vulnerable groups can have more opportunities to participate in financial services, increase wealth income (Claessens et al., 2006) [3], and finally achieve inclusive growth (MA Yufei and Du Chaoyun, 2017) [4]. However, this positive effect is not sustainable. (Huang Zongping et al., 2017) confirmed that the effect of digital Inclusive Finance on poverty alleviation presents a nonlinear relationship [5]. With the development of digital Inclusive Finance, the inhibitory effect on poverty is gradually weakened (Gong qinyi et al., 2018) [6]. However, when the development degree of digital Inclusive Finance crosses the threshold, it can further stimulate the income increasing effect (he Yiqing et al; 2020) [7].

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2.2. Digital inclusive finance promotes rural industrial upgrading

Mainly through factor allocation effect and demand effect. In terms of factor allocation effect, the continuous upgrading of digital financial services has brought significant improvements in the efficiency of credit resource allocation and industrial financing. Financial institutions can use information advantages to strengthen the accurate allocation of financial factors, so as to promote industrial transformation and upgrading. In terms of demand effect, digital inclusive finance creates a low-cost, convenient and wide coverage financial credit system based on the needs of agricultural operators, providing effective credit support for the development of rural industries. At the same time, Liu Xiangyun et al. (2018) found that digital inclusive finance promotes regional industrial upgrading by promoting the consumption diversification of rural residents.

2.3. Digital inclusive finance promotes rural innovation and Entrepreneurship

On the one hand, digital inclusive finance requires residents to have equal access to financial services and emphasizes financial Guanghua, which helps to promote the entrepreneurial behavior of families with low material capital and low social capital (Zhang Xun, 2019) and improve the overall social welfare. On the other hand, digital Inclusive Finance makes up for the shortcomings of traditional Inclusive Finance and has the characteristics of "wide coverage, low cost and fast speed".

Based on the above, at present, there is a more in-depth study on the impact of digital Inclusive Finance on rural development, especially on income increase and poverty reduction. However, there is little academic research on the direct relationship between digital Inclusive Finance and the overall development of Rural Revitalization.

3. Measurement of Rural Revitalization level

3.1. Construction of index system

Based on the national strategic plan for Rural Revitalization (2018-2020) and the principles of comprehensiveness, systematicness, comparability and representativeness of index selection, and referring to the evaluation indexes, this paper constructs an evaluation index system for Rural Revitalization in Western China, including 5 primary indexes and 13 secondary indexes. The specific evaluation index system is shown in Table 1.

Table 1: Evaluation index system of Rural Revitalization

Primary index	Secondary index	Index Interpretation
Industrial prosperity	Rural production benefit	Per capita gross value of agriculture, forestry, animal husbandry and fishery.
	Mechanization level	Agricultural machinery labor / agricultural land area.
	Rural electricity consumption level	Rural electricity consumption / total rural population
Ecologically livable	Natural ecological situation	Sulfur dioxide concentration in waste gas
	Medical condition	Village clinic staff per thousand people
	Disaster situation	Affected area of crops / agricultural land
	Traffic conditions	Highway mileage / total population
Rural civilization	Education level	Illiterate people over the age of 15
	Cultural and entertainment consumption level	Proportion of expenditure on education, culture and entertainment
Effective governance	Social security level	Number of rural minimum living security / total rural population
	Gap between urban and rural areas	Income of rural residents / income of urban residents
Affluent life	Income level	Rural per capita disposable income.
		Wage income / disposable income.
		Net property income / disposable income.
	Income structure	Wage income / net property income

3.2. Research method

In this paper, the combination of entropy and tosis is used as the main method to evaluate the level of Rural Revitalization in the western region. Entropy weight TOPSIS method is an improvement of the traditional TOPSIS evaluation method. The weight of evaluation indexes is determined by entropy

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method, and then the ranking of evaluation objects is determined by TOPSIS method using the technology of approaching the ideal solution.

3.3. Result analysis

Based on the Entropy TOPSIS method, the change trend of Rural Revitalization level in 12 western provinces from 2011 to 2020 is shown in the figure below.

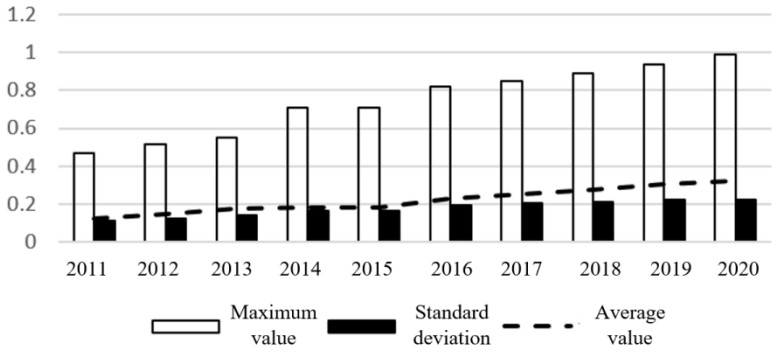

Figure 1: Changing trend

Overall, China's Rural Revitalization water has been continuously improved. From 2011 to 2015, the level of Rural Revitalization in China increased step by step in a two-year cycle; After 2015, it will become a linear growth, the largest rural revitalization index reached 0.99 in 2020. The standard deviation of the Rural Revitalization index of each province has also increased year by year, indicating that there are differences in the development level of Rural Revitalization in each region, and the regional heterogeneity is increasing.

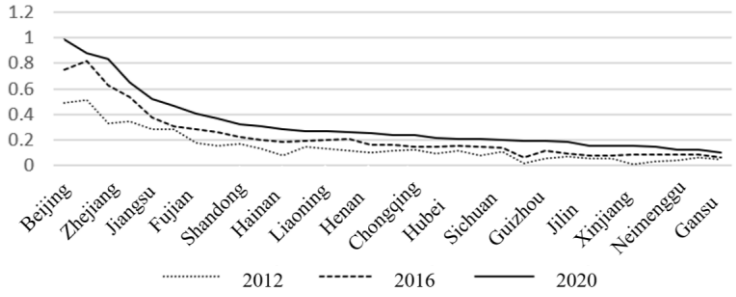

Figure 2: Changes of Rural Revitalization index in 31 provinces (autonomous regions) in China

As can be seen from Figure 2, the promotion speed of Rural Revitalization in some areas of China is relatively slow, and there is a large gap with other areas. According to the speed and level of Rural Revitalization and development in each province, 31 provinces can be divided into three echelons. The first echelon consists of nine provinces from Beijing to Shandong, and the Rural Revitalization level in 2012 was 0.5% Above 15. The first echelon is mostly the eastern coastal areas and Beijing Tianjin Hebei region. Beijing and Shanghai lead other provinces at a high level, and Tianjin will reach 0.5% in 2020 837, narrowing the gap with Beijing and Shanghai. The second tier consists of 12 provinces from Jiangxi to Sichuan, mainly the more developed provinces in the central and western regions. The third echelon is 10 provinces from Tibet to Gansu, and the level of Rural Revitalization in 2020 is 0.5% Below 20. The western provinces are the main force of the third echelon and are in the backward stage of Rural Revitalization and development

4. The impact of digital Inclusive Finance on Rural Revitalization

4.1. Model building

Inter econometric models can be divided into three types: spatial Doberman model (SDM), spatial lag model (SLM) and spatial error model (SEM). In practice, the situation of spatial lag and spatial error may exist at the same time. Therefore, the empirical analysis is carried out by constructing spatial Doberman model.

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$$y_{it} = \alpha \sum_{j=1}^{N} w_{ij} y_{jt} + X_{it}^{'} \beta + \sum_{j=1}^{N} w_{ij} X_{jt}^{'} \theta + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

LR test and Wald test reject the original hypothesis at the level of 1% and 10% respectively, and the spatial Dobbin model cannot be degenerated into spatial lag model and spatial error model. Combined with the existing research variables, this paper constructs the spatial Dobbin model as follows:

$$\begin{aligned} lnRural_{it} = \alpha \quad & \sum_{j=1}^{N} w_{ij} lnRural_{jt} + \beta lnDigFin_{it} + \gamma \sum_{j=1}^{N} w_{ij} lnDigFin_{jt} + \sigma_1 lnGDP_{it} \\ & + \sigma_2 lnInter_{it} + \sigma_3 \ln RD_{it} + \sigma_4 \ln Gov_{it} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \quad (2)$$

$Rural_{it}$ is the explained variable, indicating the rural revitalization index of the *t* year of the I province, while $DigFin_{it}$ is the core explanatory variable, indicating the digital inclusive financial index of the t year of the I province. The control variables GDP_{it}, $Inter_{it}$, RD_{it} and Gov_{it} are introduced to capture the impact of inter-provincial economic development level, Internet penetration rate, technological innovation capability and government support on the development level of rural revitalization. α, β, γ and σ are the parameters to be estimated, μ_I is the random disturbance term, and ε_{it} is the error term.

4.2. Empirical analysis

Firstly, this paper uses Moran index to study the spatial autocorrelation between Rural Revitalization level and digital inclusive finance index. The spatial first-order adjacency matrix is defined as: if the provinces are adjacent to each other, the matrix is assigned "1"; if there is no adjacent relationship, the matrix is assigned "0".

4.2.1 Fixed effect model selection

After the Hausman test, the spatial Doberman fixed effect model is used to calculate the results. Table 2 shows the fixed effect regression of the impact of digital Inclusive Finance on Rural Revitalization from 2011 to 2020. In the time fixed effect model and individual fixed effect model, the impact of digital Inclusive Finance on Rural Revitalization is positive at the significance level of 1%. Under the three fixed effects, the spatial lag of Rural Revitalization has a significant impact on the development level of Rural Revitalization in adjacent areas, while the spatial lag of digital Inclusive Finance has no significant impact. At the same time, the time fixed effect R^2 is the highest, which proves that the model is more stable. Therefore, this paper selects the time fixed effect to further analyze the direct, indirect and total effects of digital inclusive financial index and spatial lag variables on the level of Rural Revitalization.

Table 2: Fixed effect regression

	Time fixed effect		Individual fixation effect		Mixed fixed effect	
	Model (1)	Model (2)	Model (1)	Model (2)	Model (1)	Model (2)
$DigFin$	0.853***	0.707***	0.462***	0.292***	0.496***	0.080
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.322)
GDP	0.219**	0.196**	0.302**	0.413***	0.245*	0.293***
	(0.017)	(0.018)	(0.026)	(0.000)	(0.067)	(0.005)
$Inter$	0.257**	0.110	0.183***	0.228***	0.101	0.059
	(0.013)	(0.239)	(0.007)	(0.000)	(0.180)	(0.322)
RD	0.098***	0.100***	-0.180***	-0.163***	-0.201***	-0.142***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Gov	-0.195*	-0.103	-0.403***	-0.179*	-0.340***	0.000
	(0.052)	(0.262)	(0.001)	(0.075)	(0.006)	(0.996)
$WRural$		0.036***		0.118***		0.129***
		(0.000)		(0.000)		(0.000)
$WDigFin$		-0.136*		-0.230***		-0.116
		(0.095)		(0.001)		(0.197)
R^2	0.398	0.351	0.010	0.236	0.001	0.067
σ^2	0.088	0.068	0.022	0.014	0.020	0.012
rho	0.486	0.355	0.106	0.587	0.229	0.229

4.2.2 Time fixed effect of spatial Dobbin model

Regression models (3) and (4) represent the direct impact of digital Inclusive Finance on Rural Revitalization and development, and the regression coefficients of the two groups are 0.5 respectively

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902 and 0 766, with strong significance. Regression models (5) and (6) show that the indirect impact of digital Inclusive Finance on Rural Revitalization and development is relatively weak. This shows that the level of local digital inclusive finance directly promotes the revitalization and development of local villages. Regression model (4) introduces the spatial lag variable of Rural Revitalization index, and the coefficient is significantly positive, indicating that rural revitalization has a certain spatial spillover. In model (3), the level of regional economic development, Internet penetration and science and technology investment all play a significant role in promoting rural revitalization. Economic development promotes local industrial development and labor employment, and drives the development of rural areas; Investment in scientific and technological research and development and Internet development contribute to the modernization of rural agriculture, promote the development of rural e-commerce, and improve production capacity and sales of agricultural products. Government subsidies are not significant for Rural Revitalization and development, and continuous government support will lead to a lack of awareness of independent development.

Table 3: Results of the impact of digital Inclusive Finance on Rural Revitalization

	Direct effect		Indirect effect		Total effect	
	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
$DigFin$	0.902***	0.766***	0.512*	0.616*	1.414***	1.383***
	(0.000)	(0.000)	(0.059)	(0.081)	(0.000)	(0.002)
GDP	0.297***	0.218**	1.028**	0.302	1.325**	0.521
	(0.006)	(0.038)	(0.022)	(0.532)	(0.012)	(0.356)
$Inter$	0.247**	0.110	-0.237	-0.091	0.010	0.019
	(0.029)	(0.306)	(0.407)	(0.790)	(0.978)	(0.965)
RD	0.106***	0.122***	0.119	0.258**	0.225**	0.380***
	(0.000)	(0.000)	(0.199)	(0.018)	(0.038)	(0.003)
Gov	-0.180	-0.145	0.188	-0.484	0.008	-0.630
	(0.134)	(0.217)	(0.644)	(0.333)	(0.987)	(0.287)
$WRural$		0.036***		-0.002		0.034
		(0.000)		(0.916)		(0.202)
$time$	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
R^2	0.398	0.351	0.398	0.351	0.398	0.351

5. Conclusions

Based on the provincial panel data of 31 provinces in China from 2011 to 2020, this paper uses the entropy weight TOPSIS method to comprehensively evaluate the rural revitalization index of all provinces in China, and then uses the spatial Durbin model to measure the impact of digital inclusive finance on rural revitalization and development, and analyzes the regional heterogeneity and spatial spillover effects of digital inclusive finance on rural revitalization and development. The conclusions are as follows: (1) On the whole, the level of rural revitalization in China is growing, but the growth rate of some western regions in the third echelon is slow, and there is a big gap between China and other regions. (2) Digital inclusive finance can help the revitalization and development of rural areas in various provinces, which is affected by the development level of neighboring rural revitalization and digital inclusive finance. (3) The effect of digital inclusive finance directly promoting rural revitalization and development in the eastern region is more obvious, while the spillover effect of digital inclusive finance in the central and western regions is stronger.

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