Research on the Influence of Green Finance on Rural Revitalization and Development in Hunan Province- -An Empirical Analysis Based on Spatial Dubin Model

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Abstract. This paper selects the panel data of 13 prefecture-level cities in Hunan Province (except Xiangxi Autonomous Prefecture) from 2007 to 2021, uses the entropy right method to measure the rural revitalization and development index and green finance development index, and studies the spatial spillover effect by constructing the spatial dubin model. The results show that green finance and rural revitalization development in Hunan Province show a positive spatial correlation, and the effect is remarkable. The development of green finance directly drives the local rural revitalization and development, and also promotes the level of rural revitalization and development in surrounding areas.

Keywords: Green financ;rural revitalization;space Dubin model;space spillover effect

1 Introductions

1.1 Research Background and Significance

(1) Research background.

The current rural revitalization strategy has been raised to an unprecedented height. With the gradual maturity of the green finance market, more and more investors and enterprises begin to realize the importance of green finance, and take it as an important investment and financing choice.

At present, China's rural green potential has not been fully released, green finance has not been rolled out in the vast rural areas of China, only part of the green finance pilot has made good achievements, the development of different regions is unbalanced.

(2) Research significance.

Unbalance between urban and rural development and inadequate rural development are the concentrated reflection of the Chinese contradiction. In September 2020, Comrade Xi Jinping for the first time proposed the "two-carbon" goal for the world, stressing

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the importance of the ecological environment. As an important force of rural green development, green finance should actively give full play to the advantages of green financial resource allocation.

1.2 Literature Review and Analysis of The Research Status at Home and Abroad

(1) green finance related research.

In terms of financing improvement, for heavily polluting enterprises, the restrictions on financing constraints will force heavily polluting enterprises to improve the degree of environmental information disclosure in order to obtain more green credit (Zhanhua, 2021)[1]. At the same time, in order to ease the financing constraints brought about by the green credit policy, heavy polluting enterprises continue to carry out green technology innovation (Yu Bo, 2023)[2], Further improve the investment efficiency of enterprises (Wang Yanli et al., 2021)[3].

In terms of resource allocation and green technology innovation, Zhang Xuelan and He Desxu (2008) believe that green credit can realize green allocation of funds and guide funds to flow to environmental protection institutions[4]. Xiao Liming et al. (2020) believe that green securities can improve the energy structure of enterprises and enhance the efficiency of their green investment[5]. Green bonds can enhance corporate value (Ma yaming et al., 2020)[6], Continue to drive enterprises to continue to increase r & d investment to carry out green innovation (Wang Ying and Feng Jiahao, 2022)[7]. Green investment can promote enterprise technological innovation and then improve the environmental governance level of enterprises (Li Xiaomei and Li Manman, 2022)[8]. Carbon trading policies can promote strategic optimization and green innovation (He Yanni He, 2022)[9]. At the same time, carbon trading can promote green technology progress (Liu Zimin et al., 2022)[10], Promoting the upgrading of industrial structure (Long Yun'an, 2022)[11].

(2) Related research on green finance development and rural revitalization.

From the perspective of research methods, most of the existing studies focus on the theoretical level of green finance and rural revitalization and development, and the empirical studies rarely involve them. Yang Lin and Zou Jiang (2019) believe that a green supply chain system should be built, and finance should be green, inclusive and technology, to jointly promote rural revitalization from the perspective of industrial chain[12]. Scholtens(2006) believes that Green finance includes green bonds, green insurance and carbon finance. They are effective means to help rural revitalization and sustainable development, which is conducive to alleviating development and environmental problems[13].Lietal (2023) believes that the deepening of green finance can indirectly improve the green total factor productivity of agriculture by affecting the industrial structure[14].

2 Green Finance Affects the Level of Rural Revitalization

2.1 Sample Selection

In this paper, the relevant data of green finance and rural revitalization in various prefecture-level cities in Hunan province are selected from 2007 to 2020. Relevant data are from Hunan Statistical Yearbook, China Urban Statistical Yearbook, China Rural Statistical Yearbook, China Population and Employment Statistical Yearbook, China Tai'an, EPS database, etc.

2.2 Measurement of Rural Revitalization and Green Finance Development Level

(1) Selection of rural revitalization indicators and construction of index system.

This study etc (2023), Tan Yanzhi (2021), Tian Lin (2022) and xie tiancheng (2022), finally select industry, ecological livable, local custom civilization, effective governance and life rich five dimensions as a rural revitalization index, to reflect the rural revitalization level as far as possible, a total of 30 tertiary index, finally use panel entropy method to build rural revitalization index.

(2)The selection of green financial indicators and the construction of the index system.

As shown in Table 1,this study selects the seven dimensions of green credit, investment, insurance, bond, support, fund and equity as the second-level indicators, and uses the entropy right method to construct the green financial index.

Table 1. Evaluation index system of green finance

one-level metric	two stage metric	Index definition
green finance	green-credit policy	Total credit of environmental protection projects in the city / total credit of the province
	Green investment	Investment in environmental pollution control / GDP
	Green insurance	Environmental pollution liability insurance income / total premium
	Green bonds	Total Green bond issues / all bond issues
	Green support	Expenditure on fiscal and environment protection / general fiscal budget expenditure
	Green fund	Total market value of the Green Fund / Total market value of all funds
	Green rights and interests	Carbon trading, energy use right trading, emission right trading / equity market trading total amount

3 The Empirical Test of the Impact of Green Finance on Rural Revitalization

3.1 Variable Declaration

(1) The explained variables:.

Rural revitalization (Rur). The basic data are from Hunan Statistical Yearbook, China Rural Statistical Yearbook and EPS database.

(2) Core explanatory variables:

Green finance (green). Green credit, green investment, green insurance, green bonds, green support, green fund, green rights and interests.

(3) Control variables:.

At the end of the year, the deposit balance of financial institutions and the added value of the secondary industry.1. Economic development level (ln pgdp); 2. Green innovation level (ln patent);3. Logarithm of urban population density (ln density) of urban population density; 4. Number of industrial enterprises above designated size (ln firm)5. Balance of deposit balance of financial institutions at the end of the year (ln deposit); 6. Loan balance of financial institutions at the end of the year (lndeposit2); 7. added value of the secondary industry (ln chanye2).

3.2 Empirical Analysis

(1) Descriptive statistics and correlation analysis of the variables.

This paper, 330 samples are selected. Table 2 is the descriptive statistical results of all explained variables, core explanatory variables and control variables, as shown in the following table:

Table 2. Descriptive statistical results for the variables

VarName	Obs	Mean	SD	Min	Max
y	195	0.372	0.052	0.273	0.490
green	195	0.371	0.052	0.284	0.491
lnpgdp	195	10.397	0.631	8.864	11.849
lnchanye2	195	15.642	0.943	12.794	17.777
lndensity	195	-3.371	0.378	-4.353	-2.463
lnfirm	195	6.822	0.637	4.533	8.000
lndeposit	195	16.544	0.904	14.072	19.334
lndeposit2	195	15.994	1.034	13.838	19.413
lnpatent	195	4.050	1.340	0.000	7.895

Table 3. Benchmark regression

	（1）	（2）	（3）	（4）	（5）	（6）	（7）	（8）
	y	y	y	y	y	y	y	y
green	0.8609	0.789	0.7511	0.7514	0.7503	0.6730	0.6494	0.6298
	***	9***	***	***	***	***	***	***

	(0.0364)	(0.0499)	(0.0503)	(0.0504)	(0.0506)	(0.0532)	(0.0565)	0.0591
lnpgdp		0.0084**	0.0230***	0.0232***	0.0243***	0.0182	0.0265***	0.0309***
		(0.0041)	(0.0061)	(0.0062)	(0.0070)	0.0069***	0.0097	0.0104
lnchanye2			-0.0104***	-0.0107***	-0.1296*	-0.0205***	-0.0256***	-0.0261
			(0.0033)	(0.0037)	(0.0074)	(0.0074)	(0.0085)	(0.0085)
lndensity				0.0010	0.0008	0.0049	0.0054	0.0071
				(0.0056)	(0.0057)	(0.0056)	(0.0056)	(0.0058)
lnfirm					0.0028	0.0044	0.0035	0.0028
					(0.0080)	(0.0080)	(0.0080)	0.0080
lndeposit						0.0195***	0.0346***	0.0397***
						(0.0052)	0.0133	0.0141
lndeposit2							0.0136	0.0162
							(0.0110)	0.0112
lnpatent								0.0033
								0.0030
cons	0.0518***	0.0094	0.0161	0.0222	0.0264	0.0215	0.0583	0.1157
	(0.0137)	(0.0326)	(0.0329)	(0.0468)	0.0484	0.0486	0.0570	0.0767
obs	195	195	195	195	195	195	195	195
R2	0.7431	0.7487	0.7611	0.7611	0.7613	0.7776	0.7794	0.7809

Note: * * * and * * * indicate significant significance levels at 10% 5% and 1%.

Model 2 to model 6 gradually add control variables to explore the green finance on rural revitalization of nonlinear robustness,as shown in Table 3, it can be seen that the green finance in each model are significantly positive, and the overall model 6 goodness of fit is greater than other models, shows that the overall regression results robust, fitting effect is good.

In terms of control variables, the coefficient of lnpgdp and lndeposit is significantly positive in every models, indicating that the level of economic development and the improvement of the deposit balance of financial institutions at the end of the year can effectively improve the level of rural revitalization. However, the coefficient of lndensity in the model was positive but not significant, indicating that there was a positive effect of increasing urban population density on rural revitalization, but it was not significant in the regression model of studying green finance on rural revitalization.

(2) Inspection and identification of the spatial measurement model.

The basic idea of the Hausman test is to choose between the fixed-effects model and the random-effects models by testing whether the fixed-effects are correlated with the other explanatory variables. If the Hausman test can normally output the p-value, select fe if the result is significant (p is less than 0.1), and re if not significant. Test results are shown in Table 4:

Table 4. Hausman test

	Fe	Re	DiffeRence	Std.Err.
green	O.0501	0.0888	-0.0387	0.0360
lngdp	0.0327	-0.0230	0.0557	0.0385
lndensity	0.0068	-0.0015	0.0083	0.0130
lnchanye2	-0.0352	0.0009	-0.0362	0.0272
lnfirm	-0.0076	0.0001	-0.0077	0.0172
lndeposit	0.0080	-0.0369	0.0449	0.0231
lndeposit2	-0.0128	0.0394	-0.0522	0.0179
lnpatent	-0.0030	0.0026	-0.0055	0.0031
		Chi2(8)=31.41		
		P=0.0001		

From the above tests, it can be seen that the p-value is 0.0001, significantly rejecting the null hypothesis, indicating that fixed effects should be selected for analysis.

Before the spatial Dubin regression, a spatial model setting test should be conducted to determine the optimal spatial model for this problem. The LM, LR, and Wald tests were performed in this study (as shown in Table 5). Both the error and lag terms of the three tests significantly indicate that the SDM model should be selected. Random effects consider the error term as completely exogenous and inconsistent with reality, so the fixed effect model is used in this paper. This study used an SDM model with individual fixed effects to analyze the spatial effects of green finance and rural revitalization.

Table 5. Model setting test

method of calibration	Inspection quantity	statistics	p price
LM checkout	LM—spatial error	0.595	0.440
	Robust LM—spatial error	19.920	0.000
	LM—spatial lag	48.961	0.000
	Robust LM—spatial lag	68.286	0.000
LR checkout	LR—spatial lag	16.780	0.032
	LR—spatial error	18.030	0.021
Wald checkout	Wald—spatial lag	19.190	0.014
	Wald—spatial error	17.790	0.023

(3) Analysis of the regression results.

Table 6. shows the spatial regression analysis

	Main	Wx	Direct	Indirect	Total
green	0.1373**	0.4157*	0.1287*	0.2924	0.4212**
	(0.0635)	(0.2432)	(0.0657)	(0.1797)	(0.1874)
lnpgdp	0.0068	-0.0287	0.0069	-0.0228	-0.0159
	(0.0173)	(0.0542)	(0.0172)	(0.0429)	(0.0401)
lndensity	-0.0024	-0.0028	-0.0012	-0.0034	-0.0046
	(0.0121)	(0.0339)	(0.0117)	(0.0262)	(0.0271)
lnchanye2	0.0203*	-0.0107	0.0206*	-0.0123	0.0084
	(0.0122)	(0.0264)	(0.0124)	(0.0226)	(0.0186)
lnfirm	0.0092	0.0565*	0.0113	0.0455*	-0.0342
	(0.0137)	(0.0322)	(0.0134)	(0.0245)	(0.0225)
lndeposit	0.0549***	-0.0151	-0.054***	0.0023	0.0516**
	(0.0189)	(0.0366)	(0.0196)	(0.0301)	(0.0252)
lndeposit2	0.0351**	0.0923**	0.0326**	0.0580*	0.0906***
	(0.0140)	(0.0453)	(0.0143)	(0.0313)	(0.0287)
lnpatent	-0.0019	0.0133**	-0.0025	0.0107**	0.0082**
	(0.0038)	(0.0057)	(0.0037)	(0.0050)	(0.0033)

Note: * * * and * * * indicate significant significance levels at 10% 5% and 1%.

As shown in Table 6,the coefficient of the main effect of green finance is 0.1373, which is significantly positive at the 5% level, indicating that green finance can effectively support rural revitalization and development. Under the spatial effect, the coefficient of W xgreen was 0.4157, which was significantly positive at the 10% level, indicating a relatively significant spatial spillover effect of green finance on rural revitalization. Further decomposition of space effect, green finance of rural revitalization of direct and indirect effects are positive, shows that in Hunan province thirteen cities overall level, green finance can drive the development of the local rural revitalization, also can drive the progress of adjacent cities rural revitalization.

(4) Robustness test.

Endurance test.

To exclude endogenous effects, the lag one to the third periods of green finance were selected as instrumental variables for 2 SLS regression, and the results are shown in Table 7. It can be seen that green finance plays a significant role in promoting rural revitalization in the three equations, indicating that the selection of tool variables can better solve the endogenous problem.

Table 7. Results of the endogeneity test

	The lag-phase I was used as an instrumental variable	The lagging second phase was used as an instrumental variable	The lag triple phase was used as the instrumental variable
L.green	0.6201***		
	(0.0626)		

L2.green		0.5713***	
		(0.0664)	
L3.green			0.5529***
			(0.0714)
lnpgdp	0.0239**	0.0291**	0.0272**
	(0.0112)	(0.0119)	(0.0123)
lndensity	0.0105*	0.0085	0.0067
	(0.0060)	(0.0064)	(0.0066)
lnchanye2	-0.0254***	-0.0314***	-0.0387***
	(0.0090)	(0.0097)	(0.0101)
lnfirm	-0.0051	0.0008	0.0121
	(0.0085)	(0.0092)	(0.0101)
lndeposit	0.0367**	0.0402**	0.0308*
	(0.0152)	(0.0163)	(0.0172)
lnde-posit2	-0.0106	-0.0143	-0.0081
	(0.0122)	(0.0131)	(0.0139)
lnpatent	-0.0022	-0.0021	0.0002
	(0.0031)	(0.0032)	(0.0033)
_cons	-0.0623	-0.0430	0.0710
	(0.0835)	(0.0900)	(0.0991)
N	182	169	156
R2	0.7521	0.7093	0.6709

Note: * * * and * * * indicate significant significance levels at 10% 5% and 1%.

3.3 Change the Spatial Weight Matrix

After excluding endogenous effects, in this study the study replaced the spatial weight matrix for robustness testing, and different spatial weights were used to test the robustness of the regression results, and Table 8 shows that the regression results were basically consistent with the table. Moreover, the significance level and the direction of the regression coefficient did not change fundamentally, so the regression results were robust.

Table 8. Results of the spatial panel regression under the adjacency matrix

	Main	Wx	Direct	Indirect	Total
green	0.1893***	0.2973**	0.1868***	0.2797***	0.4665***
	(0.0638)	(0.1171)	(0.0660)	(0.1075)	(0.1141)
lnpgdp	0.0110	0.0149	0.0105	0.0142	-0.0037
	(0.0182)	(0.0355)	(0.0177)	(0.0344)	(0.0325)
lndensity	-0.0025	0.0070	-0.0013	0.0076	-0.0089
	(0.0126)	(0.0190)	(0.0121)	(0.0178)	(0.0211)
lnchanye2	0.0160	0.0081	0.0160	0.0078	0.0082
	(0.0123)	(0.0172)	(0.0122)	(0.0173)	(0.0144)
lnfirm	0.0111	0.0396*	0.0121	0.0397**	-0.0276
	(0.0139)	(0.0218)	(0.0133)	(0.0201)	(0.0196)

lndeposit	0.0437**	0.0021	0.0428**	0.0001	-0.0429
	(0.0189)	(0.0294)	(0.0192)	(0.0291)	(0.0295)
lndeposit2	0.0304**	0.0478*	0.0293**	0.0429*	0.0722***
	(0.0148)	(0.0265)	(0.0148)	(0.0235)	(0.0216)
lnpatent	-0.0011	0.0083*	-0.0014	0.0080	0.0066*
	(0.0038)	(0.0049)	(0.0037)	(0.0049)	(0.0038)

Note: * * * and * * * indicate significant significance levels at 10% 5% and 1%.

4 Conclusions and Suggestions

4.1 Conclusions

Green finance has a significant positive effect on the rural revitalization in Hunan Province. The geographical distance matrix was used to verify the spatial spillover effect of green finance and rural revitalization, and the results showed that the first item of green finance under the direct effect and indirect effect was significantly positive. It shows that green finance can effectively drive the development of rural revitalization in this city and neighboring prefecture-level cities.

4.2 Suggestions

The government should give full play to the spatial spillover effects of green finance and rural revitalization, and focus on coordinated development between cities and cities.It also should promote the rationalization of the industrial structure.The government should increase government spending on agriculture and rural area.Reasonably control the level of environmental regulation.

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