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Research on the Effects and Countermeasures of Digitalization Empowering High Quality Development of Rural Ecological Industry

--Field Survey Based on Anhui Province

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Abstract

With the continuous development of information technology, digital technology plays an immeasurable role in rural production, and has a profound impact on adhering to rural revitalization and high-quality development of rural ecological industries. This article is based on first-hand data collected through field surveys to empirically study the impact mechanism and effects of digital empowerment on the development of rural ecological industries. The research conclusion of this article has practical reference value in revealing the effect of digital empowerment on the high-quality development of rural ecological industries, clarifying the bottleneck of rural ecological industry development, and accelerating the construction of specific mechanisms and measures for digital empowerment of rural ecological industry development.

Keywords

Digitization; Rural ecological industry; Entropy weight method; Regression analysis; Threshold effect

1. Introduction

In recent years, China has attached great importance to the rural revitalization strategy, explicitly proposing to implement it, accelerate the coverage of communication technology networks in rural areas, and bridge the digital divide between urban and rural areas. In May 2023, the Ministry of Finance issued a work notice to innovate the development mechanism of digital rural areas and promote the integration and development of digital rural construction and rural real economy. At the same time, China is deeply practicing the concept of "green waters and green mountains are golden mountains and silver mountains", transforming rural ecological advantages into industrial advantages, and developing rural ecological industries to promote rural revitalization strategies. What is the position of digital technology in the development of rural ecological industries, and what are the conditions that affect the mechanism and path of digital technology for high-quality development of rural ecological industries? There is a significant gap in the level of cultural and educational resources in rural areas compared to urban areas, and regional differences in rural educational resources cannot be ignored. Does this also have some interference with the impact effect? For the above issues, this article establishes an econometric model for empirical analysis based on the relevant indicator data of 16 cities in Anhui Province in 2020.

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2. Literature Review

Digital technology has broken the time and space limitations of traditional technology, and digitalization has infiltrated every corner of society, empowering the development of various industries in China, and promoting the construction of digital China and digital countryside. In current existing research, most scholars' research conclusions have shown the positive impact of digital technology. Hou Mingli and Hao Xinzhe[1] studied the impact path of digital technology on the high-quality development of rural agriculture based on the mediating effect of factor flow and industrial structure transformation. The empirical research conclusion indicates that digital technology can effectively promote the high-quality development of agriculture, and the driving effect of digital technology should be affirmed. The application of digital technology in agricultural production should be further strengthened. In addition, based on the perspective of rural revitalization, Guo Lu et al.[2] empirically tested the impact of the digital economy on farmers' employment. Digital technology optimizes the industrial structure of rural areas, achieves farmers' prosperity, and thus achieves high-quality employment for farmers.

China attaches great importance to the construction of rural ecological civilization, emphasizing the implementation of green circular economy and the harmonious development of human and nature. From the perspective of research on the high-quality development of ecological industries, Cui Wenjing et al. (2022)[3] constructed an indicator system for rural industrial ecosystems from the perspective of dissipative structure, exploring the evolution characteristics of China's rural industrial ecosystems. Through research, suggestions are proposed to accelerate industrial integration, optimize rural ecological environment, and strengthen technological innovation to promote the balance of rural ecosystems and promote high-quality development of rural ecological industries.

Through literature review and comprehensive academic research, scholars have focused on the related research between digital technology empowerment and rural ecological industries. There is still relatively little research on promoting high-quality development of rural ecological industries through digitization. This article is based on a field survey in Anhui Province, collecting relevant data, and constructing an econometric model for empirical analysis.

3. Empirical research

3.1. Variable Selection

3.1.1. The Dependent Variable

High quality development of rural ecological industry (Y): The development of rural ecological industry covers industries such as agriculture, forestry, animal husbandry, and fishing. Agriculture, forestry, animal husbandry, and fishing are important parts of ecological agriculture. This article selects the total output value of agriculture, forestry, animal husbandry, and fishing to replace the high quality development level of rural ecological industry, and uses it as the dependent variable in the benchmark econometric model for regression analysis.

3.1.2. Core Explanatory Variables

Rural digitization (X): This article draws inspiration from the ideas of Hu Zhihui and Sun Yaowu[4] in studying the development of digital economy and the consumption structure of farmers. It constructs an indicator system based on rural delivery lines, internet broadband access and the number of rural mobile phone users at the end of the year, and the digital inclusive finance index. The digitalization index is calculated using the entropy method. The specific steps are as follows:

Table 1 Comprehensive Evaluation index System for Rural Digitization

Core Explanatory Variable	Primary Indicator	Direction
Rural digitization	Rural delivery routes/km	+
	Number of rural mobile phone users at the end of the year/ 10000 households	+
	Number of rural fixed internet broadband access users/ 10000 households	+
	Digital Inclusive Finance Index	+

3.1.3. Control variables:

The development of rural ecological industries and digital economy cannot be separated from the support and utilization of rural hydropower, and is also closely related to agricultural development. Referring to the selection of control variables in existing research, the control variables are selected as follows:

(1) Agricultural mechanization level (Z1): Reflected by the total power of agricultural machinery.

(2) Rural residents' electricity consumption (Z2): Select the electricity consumption of rural residents to represent.

Table 2 Control Variable Evaluation Indicator System

Control Variable	Primary Indicator	Direction
Agricultural mechanization level	Total power of agricultural machinery (10000 kilowatts)	+
Rural residents' electricity consumption	Rural residents' electricity consumption (100 million kWh)	+

3.1.4. Threshold variable

This article takes the level of rural cultural and educational resources (EDU) as the threshold variable, and calculates the cultural and educational resource level index using the number of regional higher education institutions and regional education expenditure.

Table 3 Evaluation Index System for Rural Cultural and Educational Resource Level

Threshold variable	Primary Indicator	Direction
Rural cultural and educational resource level	Number of regional higher education institutions	+
	Regional education expenditure	+

3.2. Model Settings

3.2.1. Benchmark measurement model

To verify hypothesis one, establish a data econometric model for 16 cities in Anhui Province to test whether digitization effectively empowers the high-quality development of rural ecological industries, and construct the following model:

$$Y_i=\alpha+\beta X_i+\mu_1 Z1_i+\mu_2 Z2_i+\varepsilon_i. \quad (1)$$

Among them, Y represents the high-quality development of rural ecological industries, X represents rural digitization, Z represents other control variables, Å represents a random disturbance term, α is a constant term, β, μ_1, μ_2 are the coefficients of the explanatory variables, and the corresponding subscripts i for each explanatory variable represent the region.

3.2.2. An econometric model combining the influencing factors of differences in rural cultural and educational resources

To verify hypothesis two and further examine the relationship between rural cultural and educational resources (EDU) and digital technology and the development of rural ecological industries, this article refers to Hansen's research and continues to construct the following econometric model:

$$Y_i=\alpha+\beta_1 X_i I(EDU_i\leq\gamma_1)+\beta_2 X_i I(\gamma_1<EDU_i\leq\gamma_2)+\ldots+\beta_n X_i I(\gamma_{n-1}<EDU_i\leq\gamma_n)+\beta_{n+1} X_i I(\gamma_n<EDU_i)+\mu_i Z1_i+\varepsilon_i. \quad (2)$$

Among them, EDU is the threshold variable for rural cultural and educational resources, γ is the threshold value, and I is the indicator function.

3.3. Data Source

This article selects sample data from 16 cities in Anhui Province in 2020, and the relevant raw data mainly comes from China Statistical Yearbook and Peking University Digital Inclusive Finance Index. All data in this article are shown in the table below:

Table 4 Benchmark Econometric Model Variable Data

City	Total output value of agriculture, forestry, animal husbandry and fishery/10000 yuan	Rural Digital Comprehensive Index	Total power of agricultural machinery/10000 kilowatts	Rural residents' electricity consumption/100 million kilowatt hours	Rural cultural and educational resource level index
Hefei City	5242558	0.201007	503.7813	18.6987	42.3863569
Huaibei City	1338407	0.020511	278.1327	7.254	1.909715934
Bozhou City	4724260	0.079377	813.1443	21.0755	3.094280507
Suzhou City	6070058	0.088739	802.8001	19.5509	4.141912919
Bengbu City	4270283	0.047868	584.111	11.4006	4.967957355
Fuyang City	7854740	0.110477	730.3552	39.8276	6.943739699
Huainan City	2473293	0.035047	456.8916	10.6095	4.516814673
Chuzhou City	4843535	0.069265	732.8341	16.2447	4.383954791
Lu'an City	4537506	0.080622	616.4004	19.6186	4.925568954
Ma'anshan City	1731254	0.032887	156.3986	7.7356	4.10677686
Wuhu City	2966291	0.068642	223.9862	14.5056	7.959098125
Xuancheng City	2848151	0.049722	244.5822	11.1497	0.847393468
Tongling City	910090	0.011175	84.9685	4.2396	1.495975729
Chizhou City	1547983	0.014424	141.8026	5.5884	1.489348864
Anqing City	4288674	0.066825	345.4358	18.1941	5.450290521
Huangshan City	1157441	0.023411	83.88	5.0001	1.380814704

4. Empirical Result Analysis

4.1. Benchmark Regression Analysis

This article selects EVIEWS 9.0 software and uses OLS to estimate the parameters of the benchmark regression model. The regression model calculation results show that the overall fit of the model is good, and the coefficient of impact of rural digitization on the high-quality development level of rural ecological industries is positive. The core explanatory variable, rural digitization level, passes the significance test at the 5% level, indicating that rural digitization is conducive to the high-quality development of rural ecological industries, confirming hypothesis one. The specific results are shown in the table below.

Table 5 OLS Regression Results of Benchmark Econometric Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	142463.5	251049.5	0.567472	0.5809
X	7891695.	3616088.	2.182385	0.0497
Z1	2764.379	714.1833	3.870685	0.0022
Z2	120666.8	23617.37	5.109240	0.0003
R-squared	0.952769	Mean dependent var		3550283.
Adjusted R-squared	0.940961	S.D. dependent var		1995513.
S.E. of regression	484866.8	Akaike info criterion		29.23345
Sum squared resid	2.82E+12	Schwarz criterion		29.42660
Log likelihood	-229.8676	Hannan-Quinn criter.		29.24334
F-statistic	80.69043	Durbin-Watson stat		1.660392
Prob(F-statistic)	0.000000			

In fact, the level of digitalization in rural areas and the level of development of rural ecological industries have improved to some extent over time, and digital technology can indeed affect the high-quality development of rural ecological industries to a certain extent. In China, the eastern regions with high levels of digitization, such as Shanghai and Shenzhen, have relatively advanced digital technology and correspondingly high levels of development in rural ecological industries; However, for western regions with low degree of digitalization, such as Xinjiang and Xizang, digital technology is underdeveloped and the development level of rural ecological industry is low.

In addition, the total power of agricultural machinery and the electricity consumption of rural residents show a positive direction at a significance level of 5%. The P-value of the T-test is significantly less than 0.05, which has a significant impact on the dependent variable and has a positive effect on promoting the high-quality development of rural ecological industries. The regression equation at this point is:

$$Y=142463.4971+7891695.2433X+2764.3787Z1+120666.7863Z2. \quad (1)$$

4.2. Benchmark Econometric Model Verification

4.2.1. Testing for Multicollinearity

In the testing of multicollinearity in benchmark econometric models, this article adopts the variance inflation factor method to test the multicollinearity problem of the model. When the variance inflation factor (VIF) is greater than 10, it is generally believed that the model has serious multicollinearity problems. The test results in this case show that the VIF values of each explanatory variable are significantly less than 10, indicating that there is no multicollinearity problem in the model.

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Table 6 Test Results of Variance Expansion Factor Method

	Coefficient	Uncentered	Centered
Variable	Variance	VIF	VIF
C	6.30E+10	4.289374	NA
X	1.31E+13	5.319210	1.842943
Z1	510057.8	8.516306	2.247149
Z2	5.58E+08	10.69084	2.799194

4.2.2. Heteroscedasticity Test

In the classical assumption of OLS regression models, the random error term is required to have homoscedasticity. Therefore, when the variance of the random error term is no longer a constant and is regarded as a functional form of the explanatory variable, the model has heteroscedasticity, which may lead to prediction failure. This article selects the White test method to test the heteroscedasticity of the model, and the test results are shown in the table below. The results showed that under the condition of significance level of 5%, nR2=9.7496, p-value=0.3711, greater than 5%, so the model does not have heteroscedasticity.

Table 7 White Test Results

Heteroskedasticity Test: White			
F-statistic	1.039903	Prob. F(9,6)	0.4999
Obs*R-squared	9.749643	Prob. Chi-Square(9)	0.3711
Scaled explained SS	4.216492	Prob. Chi-Square(9)	0.8966

4.2.3. Autocorrelation test

When there is autocorrelation in the model, it can have a certain impact on parameter estimation, model validation, and model prediction. Through the B-G test method, nR2=3.607414, and the critical probability p=0.1647, therefore the auxiliary regression model is not significant and there is no autocorrelation.

Table 8 Inspection Results of B-G Inspection Method

F-statistic	1.455473	Prob.F(2,10)		0.2787
Obs*R-squared	3.607414	Prob.Chi-Square(2)		0.1647
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8744.718	243978.1	0.035842	0.9721
X	-686191.5	3583383.	-0.191493	0.8520
Z1	-275.1578	886.6121	-0.310347	0.7627
Z2	9443.542	28674.79	0.329333	0.7487
RESID(-1)	0.181163	0.335255	0.540375	0.6008
RESID(-2)	-0.512927	0.331261	-1.548404	0.1526

4.3. Testing the Threshold Effect of Resource Endowment

Considering the correlation between the level of cultural and educational resources in rural areas and the process of digital impact on the development of rural ecological industries, this article constructs a threshold effect model to explore the relationship between the impact of different cultural and educational levels on the development of rural ecological industries. The Bootstrap P-Value value of this variable is 0.0466, and there is a threshold effect through threshold testing at the 0.05 level.

Table 9 Threshold Variable Threshold Test

Number of Bootstrap Replications:	5000
Trimming Percentage:	.15
Threshold Estimate:	4.92556895
LM-test for no threshold:	7.34893689
Bootstrap P-Value:	.0466

The analysis of the model calculation results shows that the threshold value γ is 4.9256. When the threshold variable is greater than this value, the degree of influence will be significantly higher than when the threshold variable is less than this value. Regardless of the differences in cultural and educational resources in different regions, the circulation of rural digital technology is beneficial for the development of rural ecological industries. However, when the level of rural cultural and educational resources does not exceed a fixed low threshold, that is, the impact coefficient of rural digitization on the high-quality development of rural ecological industries will be significantly lower than that when the level of rural cultural and educational resources exceeds a high threshold. Its economic significance can be significantly manifested as that for regions with good economic conditions and abundant educational resources in the eastern part of China, the development speed of their ecological industries will be significantly higher than that of the western region with insufficient educational resources. Therefore, the improvement of rural cultural and educational resources will indirectly catalyze the process of digitalization in promoting the development of rural ecological industries.

5. Conclusion

Based on the above analysis, digitalization has a positive promoting effect on the high-quality development of rural ecological industries. In daily life, with the progress of science and technology and the popularization of digital information technology, rural industries in various regions have achieved certain development. In addition, there are differences in the level of cultural and educational resources in different regions, which also leads to industrial development gaps between regions due to resource endowments. The educational resources of first tier cities are significantly better than those of underdeveloped areas, with higher per capita cultural quality and education level, which has an accelerating effect on the popularization of digital technology in rural areas. Therefore, rural ecological industries have the prerequisite and solid foundation for high-quality development.

5.1. Strengthen the promotion of digital technology in rural areas

Digital technology is widely used in various fields such as the Internet and artificial intelligence, playing a positive role in enhancing people's happiness, social progress, and economic development. Rural areas are relatively underdeveloped compared to urban areas, and the popularization of urban digital technology is more widespread. Strengthening the promotion of rural digital technology can help promote the popularization of digital technology in rural areas, thereby affecting the high-quality development of rural ecological industries.

5.2. Conducting digital technology training in rural areas

The training of rural digital technology has a positive effect on the development of rural industries. Farmers have a certain level of mastery of digital technology, understand the convenience and efficiency of digital technology for production and life, and have a positive effect on the promotion of digital technology in rural areas. It helps farmers build digital villages, achieve rural industrial advantages, further comprehensively promote rural revitalization strategies, and achieve rural economic development and social common prosperity.

5.3. Realizing a balanced allocation of educational resources between urban and rural areas

Due to limited resources and a lack of cultural and educational resources in rural areas, it is difficult to cultivate talents and there is a serious brain drain. The imbalanced distribution of educational resources between urban and rural areas has led to a lag in rural economic development compared to cities. The balanced allocation of educational resources helps to improve the per capita education level and cultural literacy of rural residents, and there is also a certain relationship between the acceptance and learning level of digital technology among rural residents. It can promote the effective promotion and promotion of digital technology in rural areas, and promote the integration of industries in rural areas with current technology to enhance rural residents' income. It also has a positive effect on the development of rural ecological industries.

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