Research on the Impact of Digital Economy on Rural Revitalization

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Abstract. In this study,we explores the theoretical relationship between the digital economy and rural revitalization. Based on the panel data of 31 provinces and cities in China from 2011 to 2021, our study empirically analyzes the impact and mechanism of the digital economy on rural revitalization. The results showed as following. First, the digital economy has a positive impact on rural revitalization. Second, promising government and effective market are important mechanisms for the digital economy to stimulate rural revitalization. Third, from a regional perspective, China's digital economy in the eastern and central regions has a more significant role in promoting rural revitalization than western region.

Keywords: Digital economy; Rural revitalization; Promising government; Effective market

1 Introduction

If the nation is to be revived, the countryside will be revitalized. Rural Revitalization Strategy (RRS) is the mainstay of the work of the "three rural areas" in the new period. It's also an momentous path for China to improve the production and living standards of farmers and realize common prosperity. China has vigorously promoted the revitalization and progress of the countryside. Today, digital economy is a key driver of China's economic rise and core driving force the transformation of agriculture into a modernized economy. At this stage, relevant researches on the digital economy are also emerging in an endless stream, mainly involving its conceptual connotation[1], measurement evaluation[2]and related empirical studies. Most of the studies aim at the digital economy, income gap[3], green innovation[4], high-quality development[5]. However, the existing literature on rural revitalization major focuses on its qualitative analysis[6], evaluation index system construction[7]and development path[8]. At present, the extensive extension and penetration of digital technology to agriculture and rural areas provides one desirable chance to promote the convergence development of digital economy and revitalization of villages. But existing research mainly pay attention to the theoretical analysis of the implication of digital economy on revitalization of villages[9]. So

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does China's rural revitalization affected by the digital economy? Further empirical research is needed to determine whether there are differences in the enabling effect between different regions.

In summary, scholars have conducted numerous fruitful research on the digital economy and rural revitalization. However, there is little literature on how the digital economy affects rural revitalization through promising government and effective market. Therefore, In this paper, we select panel data from 31 provinces, autonomous regions and cities in China. From the perspectives of promising government and effective market, this study empirically analyzes the internal link between digital economy and rural revitalization. Which broadens the study perspective. At the same time, our goal is to organically combine effective markets and promising governments as a way to jointly help high-quality agricultural development and provide new empirical evidence for the modernization of agriculture and rural areas.

2 Theoretical Mechanism and Research Hypothesis

2.1 Analysis of the direct impact of digital economy on rural revitalization

Firstly, digital economy drives industrial revitalization. Rural areas promotes the sale of agricultural products through digital technology and e-commerce platforms. It also spawns the formation of new forms and modes of rural industry, and enhances the added value and competitiveness of agricultural products. Secondly, digital economy contributes to the revitalization of talent. The digital economy provides technical training and employment opportunities in villages, attracting more young people to return to their hometowns to start their own businesses. It also improves the digital literacy of residents and enhances the stock of human capital through smart education and digital training. Thirdly, the digital economy drives cultural revitalization. Through digital media and network platforms, rural cultural resources can be better displayed and disseminated, thus attracting more tourists, enhancing the connotation and influence of rural culture. Fourth, the digital economy drives ecological revitalization. Through digital technologies, rural areas can realize precision agricultural management. At the same time, it will build a green consumption platform for facilitating sustainable development of agricultural ecological environment protection and agricultural economy. Fifth, digital economy boosts organizational revitalization. Through the rural e-commerce platform and digital technology to break the information block, enhance the degree of farmer organization, and widely mobilize villagers to participate in village governance and supervision. Therefore, we propose the following hypothesis:

H1: The digital economy has a positive contribution to rural revitalization.

2.2 Digital economy, promising government and rural revitalization

Firstly, digital economy provides local governments with the tools to manage and operate rural revitalization strategies more effectively. Through digital data collection and analysis, the government can more accurately understand the needs and problems of rural development, so as to optimize resource allocation and formulate more targeted policy measures. Secondly, the digital economy has also promoted the interaction and communication between local governments and the public. The government can communicate policy information and

publicity activities to rural residents through social media, mobile applications and other platforms, which strengthens rural residents' understanding of and participation in the rural revitalization strategy. Finally, digital economy helps to promote the governance capacity and transparency of local governments. Through digital supervision and data disclosure, government behavior is more standardized, the government's decision-making process is more transparent, and it is easier for the public to supervise and evaluate the work of the government. Accordingly, we make the following hypothesis:

H2: The promising government plays an intermediary role in the process of digital economy empowering rural revitalization.

2.3 Digital economy, effective market and rural revitalization

With advances in information technology, rural areas are gradually integrating into the global digital network, forming a more open and free market environment. The improvement of the marketization level in rural areas has made the rural economy, which was bound by traditional concepts in the past, gradually realize an important change from closed self-sufficiency to integration with the global market. Under the "blessing" role of digital technology, rural areas can obtain market demand information in time, adjust the production structure, effectively alleviate the information asymmetry caused by market development. Quality and market competitiveness of agricultural products will be improved. Meanwhile, the digital economy also contribute toward accelerating the marketization process of labor factors and technical elements, reducing the mismatch of labor resources and expanding the supply scale of the technology market, further contributing to rational sustainable development of rural economy:

H3: Effective market plays an intermediary role in the process of rural revitalization enabled by digital economy.

3 Research Methods

3.1 Model Setting

To explore the factor of digital economy on rural revitalization. We constructs the following econometric model:

$$Rural_{i,t} = \alpha_0 + \alpha_1 Dige_{i,t} + \alpha_2 Control_{i,t} + \mu_i + \delta_i + \xi \quad (1)$$

The i and t denotes region and time, $Rural$ denotes rural revitalization, $Dige$ represents digital economy, $Control$ denotes all control variables, μ_i denotes individual fixed effect, δ_i denotes time fixed effect, ξ is a random error term.

3.2 Variable selection and description

3.2.1 Explanatory variant: Rural revitalization(rural)

In view of the fact that there is no unified and clear measurement system for rural revitalization in the academic world, this paper takes the "five revitalizations" as a guideline and systematically constructs an evaluation indicator system for rural revitalization(Table 1).

The index of rural revitalization is obtained by weight analysis of each index with entropy value method.

Table 1. Rural revitalization indicator system construction.

Primary indicators	Secondary indicators	tertiary indicators	Unit
Industrial revitalization	Output level	Land productivity	Billions/thousand hectares
		Rural food production per capita	kg
	Industrial structure	Gross power of agricultural machinery per capita	kilowatt
		Share of non-farm output in total output	%
		Share of non-agricultural employees in total labor force	%
	Income level	Rural per capita output value of agriculture, forestry, animal husbandry and fishery	yuan
		Per capita disposable income of rural residents	yuan
Ecological revitalization	Ecological infrastructure conditions	Village greening coverage rate	%
		Harmless treatment ratio for house refuse	%
		Rural health toilet penetration rate	%
	Ecological cultivation capacity	Agricultural fertilizer applications	tons
		Proportion of communes that treat domestic sewage	%
Talent revitalization	Level of human capital development in the countryside	Average years of schooling of rural residents	year
		Proportion of illiterate people in rural areas to people aged 15 and above	%
	Agricultural Talent Development	Number of Agricultural Science and Technology Personnel	per
		Number of rural doctors and hygienists	per
Cultural Revitalization	Development level of rural public cultural service system	Number of cultural station organizations in townships	pcs
		Number of employees in township cultural stations	per
	Level of construction of rural culture and family customs	Rural cable radio and television subscribers	10 thousand
		Rural residents ' education, culture and entertainment expenditure	yuan per
Organizational revitalization	Level of comprehensive village governance	Percentage of administrative villages that have carried out village improvement	%
		Number of villages with village construction management organizations	pcs

	Level of agricultural organization	Number of village committees	pcs
		Number of communes with master plans	pcs

3.2.2 Explanatory variable: digital economy(dige)

This paper in view of the reference of Statistical Classification of Digital Economy and Its Core Industries (2021) and related studies[10]. We constructs an evaluation indicator system for the development level of digital economy from three point: digital infrastructure, digital economy environment and digital industry development(Table 2). In the present research, the entropy method is used to analyze the weight of each index, and digital economy development index is obtained.

Table 2. Digital economy indicator system construction.

Firstly indexes	Secondary indicators	Tertiary indicators	Unit
Digital Infrastructure	Hardware	Long-distance optical cable line length	kilo
		Number of Internet broadband access ports	ten thousand
		Number of mobile phone base stations	ten thousand
	Software Facilities	Number of domain names on the Internet	ten thousand
		IPv4 address count	ten thousand
		Number of web pages	ten thousand
Digital Economy Environment	Application Environment	Internet penetration rate	%
		Mobile Phone Penetration Rate	per 100 dep
	Talent Environment	The proportion of employees in the information service industry	%
		Number of graduates from general higher education institutions	10 thousand
	Innovation Environment	Full-time equivalent of R&D personnel in industrial enterprises above large scale	man-years
		Intensity of R&D investment	%
		Number of patents granted	pcs
Digital Industrialization Development	Digital Industrialization	Revenue from software operations	billions
		Total amount of the telecommunication service	billions
		E-commerce sales	billions
	Industrial	Websites per 100 businesses	pcs

Digitisation	Digital Inclusive Finance Index	—
	Percentage of enterprises with e-commerce trading activities	%

3.2.3 Intermediate variables

1.Promising government(gove). Considering the macro-control objectives of the government for local development, this paper starts from four dimensions of promoting economic growth, achieving full employment, stabilizing prices and maintaining the balance of international payments, and combines the government input with entropy method to synthesize the index. Among them, government inputs are expressed as a ratio of total government fiscal expenditures to the current year's GDP; economic growth is quantified by the total GDP, employment level is reflected by the unemployment rate; The price level is measured using the consumer price index; balance of payments is assessed by the ratio of net exports of goods and services to total imports and exports.

2.Effective mark(mark). The market plays a decisive role in the allocation of resources, and the development level of the effective market is related to the quality of rural revitalization. This paper uses Wang Xiaolu and Fan Gang's "China's Provincial Marketization Index Report" to characterize the degree of "market efficiency".

3.2.4 Control variables

To decrease bias due to omitted variables, our study choose as below control variables:(1) urbanization level (urban), measured using the proportion of the urban population in each province to the total population in each province; (2) Level of technological development (tech), measured using logarithmic value of R&D expenditures; (3) Level of human capital (human), it is measured by the proportion of the number of students in colleges and universities and the total population of the region. (4) Industrial structure (stru) is measured by the ratio of the second output to the total output value; (5) the degree of openness to trade (trade), measured using total import and export trade as a share of GDP.

3.3 Data source.

This paper selects the relevant data of 31 provinces (municipalities and autonomous regions, except Hong Kong, Macao and Taiwan) in China from 2011 to 2021 as the research sample. The relevant original data comes from the National Bureau of Statistics, the relevant data published by the Digital Inclusive Financial Research Center of Peking University, China Statistical Yearbook, China Rural Statistical Yearbook, China Science and Technology Statistical Yearbook, China Environmental Statistical Yearbook, etc. Linear interpolation method is used to fill the missing data in some areas.

4 Empirical Analysis

4.1 Basic regression results

Table 3 reports the results of the baseline regression on the impact of the digital economy on rural revitalization. The results shown that the digital economy (dige) coefficients are all

positive and its significant at the 1% level regardless of the inclusion of control variables and two-way fixed effects. It indicate that the digital economy has significantly facilitated the development of rural revitalization. Hypothesis 1 proposed in this paper is confirmed. In addition, from the regression results of control variables, it can be seen that the development of rural revitalization in China is also positively affected by human capital. The effect of other control variables on rural revitalization is not significant. Demonstrating the importance of highly qualified personnel for rural revitalization.

Table 3. Basic regression results.

variable	(1)	(2)	(3)	(4)
	rural	rural	rural	rural
dige	0.322*** (4.18)	0.170*** (3.09)	0.187*** (10.46)	0.167*** (3.06)
urban			0.004*** (11.66)	0.000 (0.56)
tech			0.001 (0.94)	-0.001* (-1.87)
human			-0.000 (-0.13)	0.001* (1.66)
stru			-0.000 (-0.77)	0.001 (1.55)
trade			-0.084*** (-7.43)	-0.036** (-2.05)
Constant	0.234*** (23.03)	0.255*** (33.46)	0.058** (2.32)	0.232*** (6.13)
Year	NO	YES	NO	YES
Province	YES	YES	YES	YES
Observations	341	341	341	341
R^2	0.934	0.978	0.975	0.979

Note: Robust t-statistics are in parentheses and ***, **, and * denote 1%, 5%, and 10% significance levels, respectively. Same below.

4.2 Intermediary effects

In this study, according to the mediation analysis procedure proposed by Zhao et al[11], Bootstrap mechanism analysis is carried out with the help of Process plug-in in SPSS27.0, and if the bias-corrected confidence interval of the test results not including 0. It demonstrate that the mediation effect is outstanding. Results are shown in Table 4. Firstly, The finding of promising government test indicate a confidence interval of [0.0642, 0.1413] at the 95% significance level, which does not contain 0, suggests that digital economy will empower revitalization of villages by playing a role of a promising government, and hypothesis H2 is verified. Secondly, the confidence interval of the effective market is [-0.0237, -0.0011],which

also does not contain 0, suggests that digital economy will empower rural revitalization by playing a role of effective market. This fact proves hypothesis 3 of our paper. Among them, it can be seen by comparing the value of the mediating effect that the mediating effect played by promising government is larger than the mediating effect of the effective market, the interaction between the meaningful government and the effective market, demonstrate the digital economy contributes significantly to rural revitalization, mainly through active government.

Table 4. Bootstrap method test results.

	Bootstrap Std . Err	z	p	95% confidence interval
gove (16.03%)	0.0196	5.22	0.000	[0.0642，0.1413]
mark (1.87%)	0.0058	-2.16	0.031	[-0.0237，-0.0011]
gove × mark (4.01%)	0.0121	2.13	0.033	[0.0020，0.0494]

Note: The share of mediating effects for each variable is in parentheses.

4.3 Robustness test

To further test the reliability of the model's event, we adopted relevant strategies: Firstly, considering that the residual terms may have serial correlation in the time dimension, the basic regression in this paper clusters the standard errors to the province level. We can see the results in column (1) of Table 5. Secondly, we take into account that changes in sample study intervals may lead to changes in data regression results, to further argue for the robustness of the results, our research shortens the sample years to 2015-2021 to conduct the test again. The test results are shown in column (2) of Table 5. Thirdly, considering that the role of the digital economy in rural revitalization may be affected by data extremes. For the purpose of exclude the interference of outliers, this studies shrinks all the data at the 1% and 99% quantile. The test output is shown in column (3) of Table 5. The regression results in Table 5 demonstrate that the estimated coefficients of digital economy are still a positive number, verifying the robustness of the previous results. This test supports the previous empirical analysis and provides strong evidence for our research.

Table 5. Robustness test results.

variable	(1)	(2)	(3)
	Cluster at the provincial level	Narrow the sample interval	Winsor indentation processing
dige	0.167** (2.39)	0.278*** (7.49)	0.172*** (3.00)
Constant	0.232*** (3.65)	0.250*** (6.53)	0.230*** (6.15)
Control	YES	YES	YES

Year/Province	YES	YES	YES
Observations	341	341	341
R^2	0.979	0.990	0.979

4.4 Endogeneity test

The benchmark regression indicate that China 's rural revitalization is remarkable affected by digital economy. However, in order to avoid the possible two-way causal relationship between the baseline estimation results, our paper uses the instrumental variable to deal with the endogeneity. This paper constructs an interaction term based on post offices per million population by region in 1984 and the region's income from information technology services in preceding year, which is acted as instrumental variable for assessing the standards of development of the digital economy in the current period after taking the logarithm of it(lniv). This was followed by regression analysis using two-stage least squares. The first part of the regression test is shown in column (1) of Table 6. We can discover the instrumental variable lniv shows a clear correlation with the explanatory and the first stage F value is significantly greater than 10. This indicate that there is no weak instrumental variables problem, which confirms that the selected instrumental variables are reasonable and valid. The second-stage results are shown in column (2) of Table 6, at which point the impact of the digital economy on being revitalized by the countryside remains significantly positive at the 1% confidence level.The results did not change significantly compared with the previous ones. Unsurprisingly, the conclusion that digital economy has a facilitating effect on rural revitalization remains robust when endogeneity issues are taken into account. Thus, the core conclusions of this paper remain validated when considering endogeneity issues.

Table 6. Endogeneity test results.

variable	(1)	(2)
	dige	rural
dige		0.5892***
		(5.63)
lniv	-0.338***	
	(-3.65)	
Constant	0.4019***	0.1036***
	(3.43)	(4.80)
Control	YES	YES
Year/Province	YES	YES
First stage F-stat	13.304***	
Observations	341	341
R^2	0.161	0.813

4.5 Region heterogeneity

Due to the vastness of the country, significant differences in the characteristics of Chinese provinces, and the east, central and west will also differ, because the degree of economic development in different regions are different. The influence of digital economy on rural

revitalization will also be different. Based on this, our studies divides the general area into eastern, central and western regions. and the regression data are shown in Table 7. The results demonstrate that the coefficients of digital economy on rural revitalization in the eastern, central and western regions are all significantly positive at the 1% level. From the value of the impact coefficient, The effect of the digital economy on rural revitalization manifests differently in different regions, with a decreasing trend in the center, east and west. We are of the opinion that this may lie in the fact that the boosting effect of the digital economy on rural revitalization is somewhat related to the level of local economic development. The economic development level of the central and eastern regions of China are more developed than that of western regions, and the new infrastructure construction is more complete and the talent reserve is more abundant, which makes the effect of rural areas in accepting digital transformation relatively more significant.

Table 7. Region heterogeneity analysis results.

variable	(1)	(2)	(3)
	eastern	central	western
dige	0.180***	0.441***	0.150**
	(3.71)	(4.61)	(2.34)
Constant	0.123**	0.197**	0.634***
	(2.35)	(2.32)	(5.65)
Control	YES	YES	YES
Year/Province	YES	YES	YES
Observations	121	88	132
R^2	0.989	0.989	0.977

5 Conclusions

Applying a econometric model, We test the relationship between the digital economy and rural revitalization in China. Simultaneous, our study explores the effect and transmission mechanism of the digital economy on rural revitalization from the perspectives of the promising government and the effective market, mainly draws the following conclusions:

Firstly, *digital economy will dramatically drive rural revitalization, and the result is still somewhat robust after many inspections*. *Suggests that the impact effect of the digital economy on rural revitalization exists.*

Secondly, *In the process of digital economy empowering rural revitalization, the promising government and the effective market play a significant intermediary role. The intermediation effect of promising government is stronger than that of efficient markets*

Thirdly, *There are clear regional differences in the impact of the digital economy on rural revitalization. in the empowerment effect of digital economy on rural revitalization, the influences is stronger in the central and eastern regions of China than in the western region,*

This may be that the level of economic development in the eastern and central regions of China is higher than that in the west. Their new infrastructure construction is more complete and the talent reserve is more sufficient. It makes the effect of rural areas in accepting digital transformation relatively more significant.

Our study provides some references to promote the research on rural revitalization strategy from the relevant numerical level, and further enriches the related research. However, there are some shortcomings, such as for the choice of control variables, which may produce omissions. This will also have an impact on our empirical results. In addition, this study only focuses on the current situation in China, and whether the findings are also applicable to other countries needs to be further explored. These are topics that need to be emphasized in future research in this field.

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