

# Digital Economy Empowers Rural Revitalization — An Empirical Study Based on the PVAR Model\*

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## ABSTRACT

With the development of digital economy and rural revitalization, the current research on the relationship between the two has become more and more in-depth. Whether the digital economy can promote comprehensive rural revitalization and whether it can effectively empower rural revitalization is the main content of this paper. Based on the theory of digital economy and rural revitalization, this paper collects and organizes panel data of 30 provinces in China from 2012 to 2019, uses the principal component analysis method and entropy method to calculate the index of digital economy and rural revitalization, and then uses the panel vector autoregressive model (PVAR model) to test the enabling effect of the digital economy on rural revitalization. The research shows that the digital economy has a significant role in promoting rural revitalization and can better boost the development of rural revitalization. Guiding the development of the digital economy is of great significance for the implementation of the rural revitalization strategy.

**Keywords:** Digital economy, Rural revitalization, Empirical evidence

## 1. INTRODUCTION

With the shift of the focus of agriculture, rural areas and farmers, the importance of rural revitalization has become more and more prominent at this stage, and the digital economy has also become a new driving force for rural economic development. The outline of the "14th Five-Year Plan" clearly proposes to comprehensively promote rural revitalization, strengthen the construction of digital China, and emphasize the promotion of smart cities and digital villages. At present, the development of the digital economy mainly relies on the Internet and big data technology to promote the high-quality development of China's economy. According to the "White Paper on the Development of China's Digital Economy (2020)", the added value of the national digital economy in 2019 was 35.8 trillion yuan, accounting for 36.2% of the country's GDP. Its growth trend is obvious. Current world situation is developing and changing rapidly, the overall development situation of the country

cannot be underestimated, the international system and international order are deeply adjusted, and many problems need to be solved to develop the national economy under uncertainty and instability. Among them, the people's livelihood is the most important issue. Although China's high-quality economic development has freed China from the problem of absolute poverty, relative poverty is still relatively common and influential in China's three rural issues. Therefore, in order to promote the development of China's rural areas, it is urgent to accelerate the rural revitalization strategy. In view of this, in the process of discussing the coordinated development of digital economy and rural revitalization, this paper explores the effect basis of digital economy empowering rural revitalization, proves the realistic logic of digital economy empowering rural revitalization through empirical analysis, and draws corresponding conclusions and inspirations.

## 2. LITERATURE REVIEW

Regarding the research on the empowerment of rural revitalization by the digital economy, scholars in China and foreign countries focus on the

\*Project: The phrased result of Tibet University Graduate High-level Talent Training Program: "Research on the Evaluation of Rural Governance Ability in Tibet's Border Areas Against the Background of Rural Revitalization — Taking Dammam Village as an Example", Project No.: 2020-GSP-S115.

connotation, mechanism and effect of development as a single factor. The current research results are mainly at the following levels: the first is the concept and connotation of digital economy and rural revitalization. The most basic step to carry out the research on the topic of this paper is to clearly define the concept of the research object. From the collection and arrangement of literature, the current concept of digital economy mainly introduces the digital economy as an important production factor of data and information, and through the development of digital information technology, integrates it with different economic forms, especially in the real economy. In order to promote high-quality employment, the digital economy needs to be integrated with new technologies such as the Internet and artificial intelligence, and the current development models and practical applications of new business forms and new organizations should be promoted.<sup>1</sup> [11] Rural revitalization was proposed by Xi Jinping in the report of the 19th National Congress of the Communist Party of China in October 2017.<sup>2</sup> The main purpose is to solve the problems of agriculture and rural areas, adhere to the priority development of agriculture and rural areas, and establish institutional mechanisms and policy systems suitable for agricultural and rural development through the five dimensions of industrial prosperity, rural civilization, ecological livability, effective governance and affluent life, coordinate the promotion of rural economic construction, political construction, social construction, cultural construction, ecological civilization construction and party construction, better promote the modernization of the governance capacity of the rural governance system, and realize the modernization of agriculture and rural areas, always adhere to the road of socialist rural revitalization with Chinese characteristics, and build the most suitable development system for agricultural and rural farmers.<sup>3</sup> The development of the digital economy has created more opportunities for rural revitalization, and created a supply model for the construction of new rural industries, new formats,

and new business models.<sup>4</sup> [12] Driven by the digital economy, the rural economy has achieved a lot of room for development, creating more vitality for rural economic development. The dual structural barriers between urban and rural areas have gradually weakened, better realizing the sustainable development of the rural economy, and injecting new momentum into the development of the rural economy against the background of rural revitalization.<sup>5</sup> [5] With the penetration of digital technologies such as the agricultural Internet of Things, mobile Internet, blockchain, and artificial intelligence into the countryside, agriculture, rural areas and farmers have carried out digital self-transformation subtly. It is necessary to rely on digital resources and reorganize them to realize the digitization and digital industrialization of rural industries, drive rural industries to improve efficiency and upgrade, cross-border integration, and reconstruct the organizational competition model, create more employment and entrepreneurial opportunities, and promote the revitalization of rural industries, reshape the production and economic value of the countryside, and provide the material foundation for the prosperity of the industry and the prosperity of farmers; there is also a need to realize low-carbon, convenient and equal rural production and life, promote urban and rural integrated planning and overall development, promote the integrated development of rural economy, society and nature, promote the harmonious coexistence of people and people, people and resources, and people and the environment, and promote rural ecological revitalization, enhance the ecological and living value of rural areas, and build an ideal space for ecological livability; it is very important to realize sensitive and efficient rural governance, prosperous and prosperous local culture, and homogeneous and balanced urban and rural education, build an integrated management service platform, rich and diverse cultural and educational network media, improve the degree of rural organization, cultivate high-quality new rural talent teams, and promote the revitalization of rural organizations, cultural revitalization, talent revitalization, enhance the cultural and educational value of rural areas, and provide important carriers and intellectual support

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1. Zhang Xun, Wan Guanghua, Zhang Jijia, He Zongyue, Digital Economy, Financial Inclusion, and Inclusive Growth [J]. Economic Research Journal, 2019, 54(08): 71-86.

2. Xi Jinping emphasized that the new development concept should be implemented and a modern economic system should be built. Xinhuanet [2017-10-18]

3. The Central Committee of the Communist Party of China and the State Council issued the "Strategic Plan for Rural Revitalization (2018-2022)"\_2018 State Council Communiqué No. 29\_China Government Network. China Government Network\_Central People's Government Portal

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4. Wang Xiaobing, Kang Chunpeng, Dong Chunyan, Rethinking of "Internet+" Modern Agriculture [J]. Issues in Agricultural Economy, 2018(10).

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for rural governance and rural civilization.<sup>6</sup> [4] Among them, the construction of digital countryside is mainly based on the "digital revolution", through the development laws of digitization, networking, platformization, etc., to form a virtual space of the rural "digital world". In this space, the use of data as an important element can release various effects, such as matching effect, diffusion effect, multiplier effect, etc., to provide data support for rural development, make up for the shortcomings of rural network, and empower rural development.<sup>7</sup> [9] Moreover, in the agricultural platform ecosystem, data, talents and technology systems are the most basic and important production factors to realize the connection between the supply side and the demand side. They are the "black land" of the platform ecosystem and the most basic elements to promote the optimization of the industrial structure, the promotion of the industrial chain, the reconstruction of the supply system, and the improvement of governance capabilities.<sup>8</sup> [2] The functional effects of digitalization go far beyond matching effects, diffusion effects, multiplier effects, spillover effects, fairness effects and enhancement effects. Various functional effects are not released in isolation. They are interconnected, triggered, and infiltrated, and converge into digital productivity, digital governance, and digital revitalization, and continue to empower rural infrastructure construction, governance model innovation, production mode upgrades, lifestyle improvements, and ecological environment optimization. On the basis of co-creation, sharing and value symbiosis within the village, they are supplemented by external public services and supporting links to form a sustainable digital ecological cycle system and promote the realization of the beautiful vision of "strong agriculture, beautiful rural areas, and rich farmers".<sup>9</sup> [4]

6. Zhao Deqi, Ding Yiwen, On Digitalization Promoting Rural Revitalization: Its Mechanism, Path and Countermeasures [J]. Journal of Hunan University of Science and Technology(Social Science Edition), 2021, 24(06): 112-120.

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To sum up, the research on the respective concepts, connotations, policies and paths of the digital economy and rural revitalization is relatively rich, but there is less research on the development of the two from an empirical perspective. Secondly, a small number of current empirical studies have only studied the local impact of a certain dimension, but have not analyzed the relationship between the two from a global perspective, let alone the impact mechanism between the two. Based on this, this paper constructs the index system that this paper needs to measure by combing and drawing on the research results of experts and scholars on the digital economy and rural revitalization. This paper uses quantitative research methods to weight the indicators, and uses the panel vector autoregressive model (PVAR model) to test the relationship between the two to prove whether the digital economy has played an enabling role in rural revitalization; in addition, by comprehensively measuring the digital economy and rural revitalization in 30 provinces in China, it is possible to find out the evolutionary characteristics of the two in the development process.

### 3. RESEARCH DESIGN

#### 3.1 Model Construction

The vector autoregressive model (VAR) was proposed by Sims in 1980 and has been widely used in macroeconomics. The model combines the advantages of the VAR model to carry out both dynamic analysis and static analysis in the multivariate system equation, so as to solve the problem of endogenous variables generated by incorporating endogenous variables and exogenous variables into the same endogenous system, which on the one hand solves the lag effect of variables, and on the other hand overcomes the problem of time span. In order to ensure the robustness of the research results, this study uses the PVAR model to analyze the dynamic relationship between border trade and border residents' income. The general form of the model is:

$$y_{i,t} = \alpha_0 + \sum_{j=1}^p A_j y_{i,t-1} + f_i + d_t + \mu_{i,t} \quad (1)$$

where:  $y_{i,t}$  is a vector containing 2 variables {dige,rural}, dige and rural represent the digital economy and rural revitalization, respectively;  $j$  is the lag order, and  $y_{i,t-1}$  is all endogenous variables of the  $j$ -order lag;  $\alpha_0$  is the intercept;  $A_j$  is the regression coefficient matrix;  $f_i$  is the fixed effect,

$d_t$  is the time effect;  $\mu_{it}$  is the random disturbance term.

Before the model is tested, the forward mean difference method (Helmert process) and the within group mean difference method (Mean-Differencing) are used to solve the individual effect and time effect of the data, solve the possible correlation between explanatory variables, and improve reliability and accuracy of the model.

### 3.2 Variable Description

Digital economy: As a complex economic form, the digital economy is rich in connotations and covers a wide range of areas. Multiple indicators need to be used to measure the digital economy when constructing indicators. Therefore, this paper draws on the measurement methods of Mu Juan et al. (2021)<sup>10</sup>[6], Li Zongxian and Yang Qianfan (2021)<sup>11</sup>[7], Liu Jun et al. (2020)<sup>12</sup>[10] to construct three element layers of digital infrastructure, agricultural digitalization and agricultural digitalization industry. The indicators are shown in "Table 1" below. In view of the different dimensions of each indicator, the above indicators are standardized, and the digital economy development index (dige) of each province and city is calculated by the entropy method.

Rural revitalization: The evaluation indicators of rural revitalization are mainly constructed in combination with the overall requirements of rural revitalization. Based on the party and government documents and the research results of Zhang Wang and Bai Yongxiu (2022)<sup>13</sup>[3], He Leihua et al. (2022)<sup>14</sup>[1], Zhang Ting et al. (2018)<sup>15</sup>[13] and Ge

Heping et al. (2021)<sup>16</sup>[8], from the five dimensions of industrial prosperity, ecological livability, rural civilization, effective governance and affluent life, this paper selects five indicators to construct a rural revitalization measurement index system, as shown in "Table 2". Principal component analysis is used to reduce the dimension of each index, extract the principal component, calculate the weight of each index, and then calculate the rural revitalization index (rural).

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Table 1. Digital economy evaluation index system

Variables	Element layer	Indicator layer
Digital economy	Digital infrastructure	Internet penetration in rural areas
	Agricultural digitalization	Investment in agricultural production
	Agricultural digital industry	Rural network payment level

Table 2. Evaluation index system of rural revitalization

Variables	Element layer	Indicator layer
Rural revitalization	Industry revitalization	Labor productivity
	Pleasant living environment	Number of rural health technicians per 1,000 population
	Rural civilization	Farmers per capita cultural entertainment consumption expenditure
	Effective governance	Number of village committees
	Living in plenty	Engel coefficient of rural residents

### 3.3 Data Sources

In view of the availability and accuracy of the data, the data in this article are mainly from the "China Statistical Yearbook", "China Rural Statistical Yearbook", the Digital Finance Research Center of Peking University and the official websites of the national and local statistical bureaus. The authors selected the panel data of 30 provinces in China from 2012 to 2019 except the Tibet Autonomous Region and Hong Kong, Macao and Taiwan, in order to examine the impact and mechanism of the digital economy on rural revitalization.

## 4. EMPIRICAL ANALYSIS

### 4.1 Panel Data Unit Root Test

Before performing the PVAR model test on the variables, the variables need to be tested for stationarity, so as to prevent the problems of "false regression" and "pseudo regression". If the variable is not stationary in the first test, it is necessary to perform a first-order difference on the data. LLC, ADF-F and PP-F are usually used in the stationarity test of variables. In order to ensure the accuracy and objectivity of the test results, this paper adopts the above three methods to test the stationarity of the data. The results are shown in "Table 3".

Table 3. Unit root test

Variables	LLC		ADF-F		PP-F	
	Statistical magnitude	P value	Statistical magnitude	P value	Statistical magnitude	P value
rural	-23.531	0.000	101.784	0.001	88.501	0.009
dige	-13.905	0.000	110.466	0.000	276.527	0.000

As can be seen from "Table 3", the three test results of the variables all show that the null hypothesis of rejection is satisfied, and the data is stable. Therefore, a cointegration analysis can be performed. In this paper, the Pedroni test and the KAO test are used to test the cointegration of the data of the two variables.

### 4.2 Cointegration Analysis

After each variable passes the stationarity test, it is necessary to further test whether there is a cointegration relationship between the variables. In this paper, two methods, the Pedroni test and the KAO test, are selected for the cointegration test. The test results are shown in "Table 4".

Table 4. Cointegration test results

Test statistics	Statistical value
Panel V statistics	0.669 ( 0.252 )
Panel $\rho$ statistics	-1.057 ( 0.145 )
Panel PP statistics	-5.067*** ( 0.000 )
Panel ADF statistics	-2.953*** ( 0.002 )
Group $\rho$ statistics	1.661 ( 0.952 )
Group PP statistics	-5.878*** ( 0.000 )
Group ADF statistics	-3.320*** ( 0.000 )
Kao-t statistics	-2.803*** ( 0.002 )

a Note: \*\*\* means  $p < 0.01$ ; \*\* means  $p < 0.05$ ; \* means  $p < 0.1$

In the Pedroni test results, panel V statistic ( $P=0.669$ ), panel  $\rho$  statistic ( $P=-1.057$ ) and group  $\rho$  statistic ( $p=1.661$ ), it can be seen that the p-values of these three statistics are all greater than 0.05, which failed the significance test. Panel PP statistic ( $P=-5.067$ ), panel ADF statistic ( $P=-2.953$ ), group PP statistic ( $P=-5.878$ ) and group ADF statistic ( $P=-3.320$ ) were all significant at the 1% level, and Kao-t statistic ( $P=-2.803$ ) is also significant at the 1% level. In summary, the observation results of the Pedroni test and the KAO test show that there is a long-term equilibrium relationship between the digital economy and rural revitalization, that is, there is a cointegration relationship between the two sets of variables.

### 4.3 Determination of the Optimal Lag Order

The panel vector autoregression (PVAR) model needs to determine the optimal lag order after the unit root test proves that the data is stable. In this paper, the optimal lag order is selected by using the AIC criterion, the BIC criterion and the HQIC criterion. Lian Yujun's stata software package was used to test the PVAR model. The results are shown in the following "Table 5". The lag order corresponding to the minimum value of the three is 2nd order. Therefore, this study determines that the optimal lag order is 2nd order.

Table 5. Test of optimal lag order

Lag	AIC	BIC	HQIC
1	-0.642	0.642	-0.121
2	-1.663*	-0.084*	-1.022*
3	-1.334	0.666	-0.528
4	-1.246	1.406	-0.209
5	-1.141	2.595	0.054

### 4.4 GMM Estimation

This paper mainly uses Generalized Moments Estimation (GMM) to estimate the PVAR model, examines the relationship between the digital economy and rural revitalization, and uses forward mean difference and cross-sectional mean difference to eliminate the impact of individual fixed effects and time effects on the model, so as to ensure that the data is reliable and accurate. "Table 6" presents the estimated results.

Table 6. GMM estimation results

	h_rural		h_dige	
	b GMM	t GMM	b GMM	t GMM
L.h_rural	0.522	3.220***	0.014	1.887**
L.h_dige	1.396	1.241	-0.084	-1.168
L2.h_rural	-0.039	-0.483	0.010	2.044**
L2.h_dige	-0.742	-1.078	0.496	12.122***

a Note: (1) b\_GMM and t\_GMM represent the estimated coefficient of system GMM and its T test value respectively;

b (2) "\*\*\*", "\*\*", and "\*" indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

It can be seen from "Table 6" that at the 5% significance level, the effect of the digital economy second lag on the current rural revitalization results is significant, and the influence coefficient is 2.044, which is a positive promotion effect, showing that the digital economy can promote the development of rural revitalization and has a driving effect.

However, the effect of rural revitalization in the second lag on the digital economy is not significant, indicating that the digital economy has a positive impact on rural revitalization, but rural revitalization does not have much impact on the digital economy.

### 4.5 Impulse Response Analysis

The impulse — response function reflects the influence trajectory of each variable by the standard deviation of the random disturbance term, records the dynamic interaction and influence between variables, and reflects the time-delay relationship between variables. This study uses impulse response to analyze the impact of digital economy

and rural revitalization on itself and other variables in future periods, and can show the dynamic shock response between variables after the shock changes. In this paper, the impulse response function is estimated according to the PVAR model, and the impulse response graph with 95% confidence interval is obtained by 200 times of Monte-Carlo simulation. (See "Figure 1")

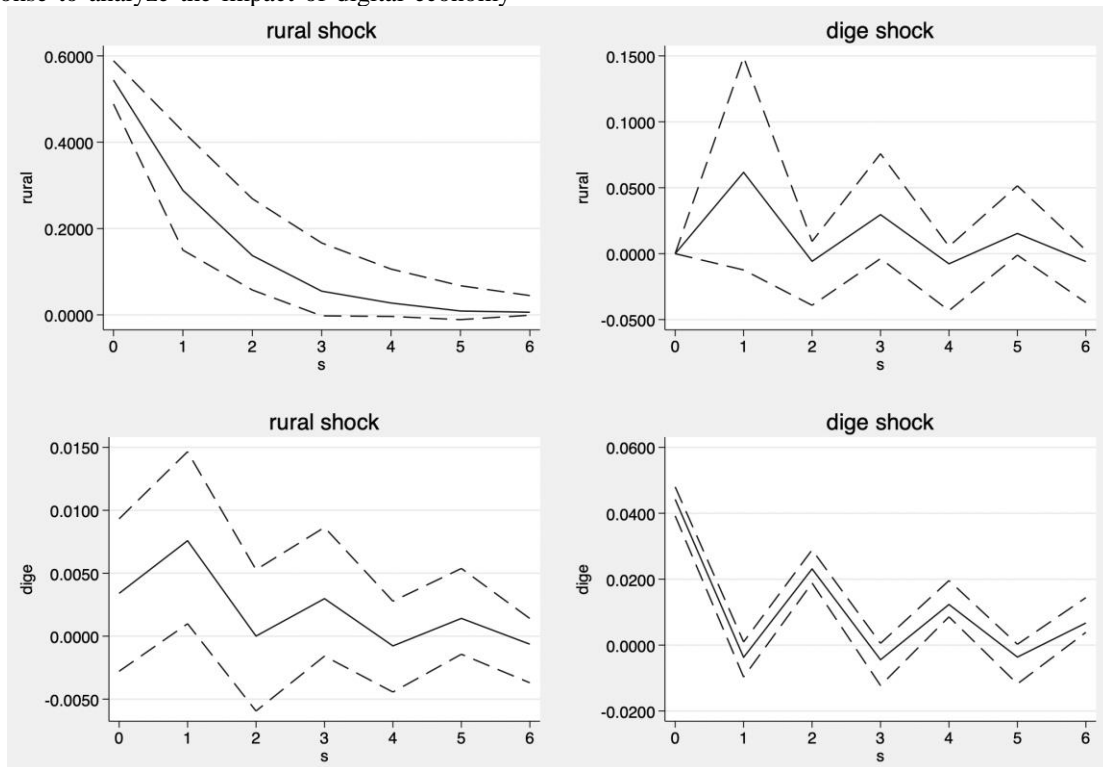


Figure 1 Impulse response diagram.

The short-term dynamic relationship between the variables is obtained by using the corresponding function diagram of the digital economy and rural revitalization pulse obtained by the Monte-Carlo simulation method. It can be seen from the results in "Figure 1" that the positive impact of one unit of the digital economy on rural revitalization reached the greatest impact in the first phase, and then the impact fluctuated, but it was never higher than the impact of the first phase. There is a gradual downward trend in the sixth period, indicating that the expansion of the digital economy has a promoting effect, but the promoting effect is gradually decreasing. At the same time, the results of the impulse response further confirmed that the digital economy has played a role in promoting the development of rural revitalization.

### 4.6 Variance Decomposition

In order to more accurately study the role of the digital economy in promoting rural revitalization, this study obtains variance decomposition through 200 Monte-Carlo simulations to evaluate the contribution rate of each variable to the fluctuation of endogenous variables. The expected error originates from the orthogonalization information of different variables. The details are shown in "Table 7":

Table 7. Variance decomposition

Indicators	s	rural	dige
rural	10	0.987	0.013
dige	10	0.029	0.971
rural	20	0.987	0.013
dige	20	0.029	0.971
rural	30	0.987	0.013
dige	30	0.029	0.971
rural	40	0.987	0.013
dige	40	0.029	0.971
rural	50	0.987	0.013
dige	50	0.029	0.971

Looking at the forecast of rural revitalization (rural) for the next 50 periods, from the perspective of the impact of the variance decomposition of the forecast errors from the 10th to the 50th period on the rural revitalization, the self-reinforcing contribution will remain stable in the next 50 periods, up to 98.7%. Looking at the forecast of the digital economy (dige) for the next 50 periods, from the perspective of the impact on the digital economy after the variance decomposition of the forecast errors from the 10th to the 50th period in the future, the self-strengthening contribution will remain stable in the next 50 years, up to 97.1%. The impact of the digital economy on rural revitalization will also remain stable in the next 50 years, with a contribution rate of 1.3%. It shows that starting from the 10th issue in the future, with the passage of time, the contribution rate of rural revitalization to itself is greater than that of the digital economy. From a long-term perspective, in the next 50 years, rural revitalization will remain stable under the influence of itself and the digital economy, maintaining 98.7% of its own strengthening and 1.3% of border trade. All in all, rural revitalization is mainly manifested in its own strengthening role, and the digital economy only plays a supporting role.

## 5. CONCLUSION AND IMPLICATION

### 5.1 Conclusion

Based on the actual situation that the digital economy affects rural revitalization and development, this study selects panel data from 30 provinces in China from 2012 to 2019, draws on the principles and variables of Chinese and foreign experts and scholars for the construction of digital economy and rural revitalization indicators,

calculates the digital economy and rural revitalization index, selects the panel vector autoregressive model (PVAR) to test the relationship between the selected two variables of digital economy and rural revitalization, and carries out empirical analysis of the dynamic relationship between the two with the help of software stata15.0. The results show that the digital economy can obviously promote the rural revitalization, but the effect of rural revitalization in promoting the development of the digital economy is not significant. Similarly, with the development of the digital economy and rural revitalization, the role of the two in promoting their own development is significantly higher than that of the other.

### 5.2 Implication

The following policy implications can be drawn from the conclusions of this paper: First, it is a basic fact that the digital economy can promote rural revitalization and development. By increasing investment in rural Internet, it can promote the construction of digital villages, improve farmers' ability to obtain information, and consolidate the digital economy's advantages in rural revitalization and dividends; Secondly, by stepping up the implementation of Digital China, it can break down the spatial barriers for rural areas and establish a broader area for farmers' agricultural and rural development, whether it is real development or online development, so as to effectively protect and legally use data, promote the high-quality digital economy to promote rural vitality, and create new economic growth points and economic development capabilities; Then, it is necessary to increase the construction of rural communication network infrastructure, develop new technologies and new infrastructure for rural areas, and enable rural netizens to popularize the network faster. At the same time, it is also necessary to establish a rural data center to more easily apply artificial intelligence in agricultural production, and realize the standardization, intelligence and precision of agricultural production; Finally, relying on the support of digital technology, there is a need to improve the efficiency of rural financial services. By improving the technical capabilities of big data applications, reducing the cost of rural digital financial outlets, and improving the ability of rural inclusive financial services, farmers can better enjoy digital financial services.



## AUTHORS' CONTRIBUTIONS

Yong Yu was responsible for thesis design and wrote the manuscript, and Zhu Ye analysed data and contributed to revising and editing.

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