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Research on the Impact of Digital Economy on Rural Economic Development——Analysis Based on Panel Data of Provinces and Cities in China from 2016 to 2020

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Abstract: At present, China's digital economy has entered a mature stage of development. This paper, relying on the real panel data of provinces and cities from 2016 to 2020, uses the fixed effect model and robust analysis to conduct empirical tests, enrich the statistical results and provide effective policy advice. The results show that digital economy plays a significant positive role in promoting rural economic development in China, and can effectively promote agricultural construction in digital infrastructure, digital technology and e-commerce development. The government has adopted digital governance to ensure coordinated development and revitalize rural development.

Keywords: Digital Economics; Rural Economic Development; Fixed Effect Model

1. Introduction

1.1 Research background and significance

In recent years, with the continuous upgrading of new infrastructure such as 5G network, data center and industrial Internet, which are the focus of China's construction, and the accelerated penetration of digitization in multiple directions, levels and chains at different industrial levels, digital economy has become an emerging economic concept. At the same time, the development of digital economy has also brought new opportunities to the rural economy. In 2019, the overall level of digital agriculture and rural development in counties and villages in China was 36%, an increase of 3% over the previous year, of which the digital level of agricultural production reached 23.8%.

This paper investigates the impact mechanism of digital economy and its components on China's rural economic development, makes a quantitative analysis, further investigates the role of various indicators measuring digital economy in affecting China's rural economic development, and provides data support for policy implementation in a certain sense, which is of great practical significance.

2. Variable selection and data description

2.1 Variable selection

Taking 29 provinces, municipalities and autonomous regions (excluding Tibet, Shanghai, Hong Kong, Macao and Taiwan) in China from 2016 to 2020 as the research objects, this paper studies the impact of digital economy on rural economic development. The data of this paper mainly comes from China Statistical Yearbook, Agricultural and Rural Information Center and Bloomberg. Due to the lack of relevant measurement indicators of digital industrialization in the digital economy of Tibet Autonomous Region and the lack of data on rural infrastructure construction in Shanghai, Hong Kong, Macao and Taiwan, the samples of these regions are excluded. Finally, we get 145 observations, which constitute the

panel data, and take logarithmic processing for some of the variables in the model processing to enhance the accuracy of the model.

(1) Dependent variable

This paper selects rural per capita income as the main indicator of rural economic development.

(2) Independent variable

This paper mainly studies the impact of digital economy on rural economic development, so we choose the index to measure the development of digital economy as our independent variable. Considering the availability of data at the provincial level and the current situation that the two main paths for the development of digital economy in China are digital industrialization and industrial digitization, we mainly refer to the measurement system of BEA, give three basic directions to measure digital economy, and select variables:

① Digital infrastructure level (DE^{inf}): Referring to the relevant digital economy development report, we selected two variables: the length of rural long-distance optical fiber line (*disfib*) and the number of rural broadband access users (*ruralacc*) in various provinces and cities to represent the level of digital infrastructure.

② Digital technology development level (DE^{tect}): The turnover of technology market and the income of relevant technology-based businesses reflect the transformation of scientific and technological achievements, which can further reflect the development level of digital science and technology in the region. Therefore, we choose the technology market turnover(*techturn*) and software revenue*(softinc*) as the measurement of the development level of digital technology.

③ E-commerce development level (DE^{elec}): In recent years, the concept of "Taobao village" has gradually prevailed, which has helped the rural economy achieve significant development. Therefore, we use the number of Taobao villages in each province as our indicator to measure the development level of e-commerce.

(3) Control variable

At the same time, this paper also selects some other variables that may have a potential impact on rural economic development as control variables, mainly including:

① Agriculture, forestry and water financial expenditure (*agrixpen*): It can reflect the state's investment and attention to rural economic development to a certain extent, so it also has an important impact on rural economic development.

② Rural power generation (*ruralpow*): There are many deficiencies in data such as rural hydropower construction investment and the scale of power stations under construction in various provinces and cities. Therefore, we select the data of rural power generation as the dimension to measure rural infrastructure construction.

Table 1 Evaluation System of digital economy development level

Target layer	Primary index	Secondary index
Development of digital economy	Digital infrastructure level （DEInf）	Length of rural long-distance optical fiber line （disfib）
		Number of rural broadband access users （ruralacc）
	Digital technology development level （DEtech）	Technology market turnover （techturn）
		Software business income （softinc）
	E-commerce development level （DEelec）	Number of Taobao villages （taobao）

3. Empirical test and result analysis

3.1 Model Setting

In order to test the impact of digital economy on rural economic development, this paper sets the following model and logarithmically processes some indicators:

$$ruralinc_{i,t} = \beta_0 + \beta_1 lruralacc_{i,t} + \beta_2 ldisfib_{i,t} + \beta_3 ltechturn_{i,t} + \beta_4 taobao_{i,t} + \beta_5 lsoftinc_{i,t} + \beta_6 lruralpow_{i,t} + \beta_7 lagriexpen_{i,t} + \varepsilon_{i,t}$$

Among them, $ruralinc_{i,t}$ refers to the rural disposable income in the province i in the year t. It is the similar with other variables. In order to facilitate observation, this paper makes logarithmic processing for some data. $lruralacc_{i,t}$, $ldisfib_{i,t}$, $ltechturn_{i,t}$, $lsoft_{i,t}$, $taobao_{i,t}$ are explanatory variables, $lrural\ pow_{i,t}$, $lagriexpen_{i,t}$ are control variables. β_0 means intercept item, β_1- β_5 is the regression coefficient of explanatory variable; β_6- β_7 is the regression coefficient of the control variable; $\varepsilon_{i,t}$ is random interference term. Moreover, in the regression model, the Hausman test results show that the p-value is 0.0000, rejecting the original hypothesis of random effect, so the fixed effect model is selected.

3.2 Analysis of regression results

3.2.1 Regression analysis of control variables

The regression results using Stata are shown in Table 4. Model (1) is the regression model of each control variable for rural economic development, and Model (2) represents the impact of core explanatory variables and control variables on rural economic development. Firstly, we analyze the influence of control variables on dependent variables through model (1) by judging the positive and negative of variable coefficients as well as significant level. Secondly, the digital economy variables are regressed with other independent variables to further verify the impact of digital economy on rural economic development.

After Hausman test, we choose the fixed effect model for regression. According to the regression results in Table 2, we can get:

In model (1), fiscal expenditure on agriculture, forestry and water has a very significant positive impact on rural economy (p-value is 0). This shows that the development of rural economy is inseparable from the government's investment in agriculture. The variable of rural power generation does not show statistical significance. The reason may be that the low-voltage distribution lines can not keep up with the high demand, and the quality of power also needs to be improved, thus the impact on rural economic development is not obvious.

The digital economy variables in model (2) have a significant positive impact on the rural economy except the length of rural long-distance optical fiber line. The reason may be that the rural power load mentioned just now is too large, but the equipment can not meet the requirements, resulting in less impact. The main reasons for other significant variables are: the number of users accessing broadband *ruralacc* can be expressed as the rural acceptance of the Internet. Through the Internet, agriculture develops faster and the per capita income rises sharply. Meanwhile technology market turnover *techturn* and software revenue *softinc* can better reflect how the development level of digital technology affects economic development. Finally, the number of Taobao villages *taobao* in each province can show that e-commerce has entered the rural market, broaden consumer consumption channels and lead the development of rural economy.

Table 2 Regression analysis of control variables

Model	(1)	（2）
ruralacc	-	0.09192***
		（0.034048）
disfib	-	0.014403
		（0.0338655）
softinc	-	0.035502*
		（0.033629）
Taobao	-	0.00012**
		（0.0000477）
techturn	-	0.050848***
		（0.0207659）
ruralpow	0.00734	0.00151
	（0.0166208）	（0.0117886）
agriexpen	0.84881***	0.47966***
	（0.0594088）	（0.0672719）
Code FE	Yes	Yes
Year FE	Yes	Yes
Include digital economic variables	No	Yes
N	145	145
R^2	0.6857	0.8259

Note: * * *, * * and * respectively represent 1%, 5% and 10% significant levels

3.2.2 Regression analysis of digital economic variables

In model (1), we can get that the regression coefficients of all indicators used to measure the development of digital economy (DE) are positive, and the results except the rural long distance optical fiber line length (*disfib*) are positive and significant. At the same time, a combined test of all measures of digital economy development (DE) yielded significant results at the 1% significance level. It can be seen that, in terms of the overall development of digital economy, the comprehensive effect of its various indicators on the development of rural economy is significantly promoting, which means that digital economy can drive the economic development of rural areas, but at the same time, it also needs various and

all-round technology penetration.

Next, we further explain the regression results of various components of digital economy development according to table 3 (2), (3) and (4) :

Digital infrastructure (DE^{inf}) plays a positive role in rural economic development. From the joint test, it can be concluded that, in general, digital infrastructure is positive and significant for the development of rural economy. In terms of specific indicators:

The number of rural broadband access users (*Ruralacc*) plays a positive role in promoting rural economic development, and the result is positive and significant. Possible reasons for an increase in the number of rural broadband users can break through the existing resources in the countryside and the rural information asymmetry and n delay, to a certain extent improve the employment problem, thus further improve the rural economic development.

The promotion effect of rural long distance optical fiber line length (*disfib*) is not obvious. Although its regression coefficient is positive, it is not significant. The reason may be that, long-distance optical transmission network quality stand or fall will directly related to the quality of communication and information transmission quality, and the quality of the optical cable network not only depends on the length of optical fiber links. It may also face the problem of high construction cost of optical fiber line length, so it does not promote the development of rural economy.

Level of development of digital technology (DE^{tech}) has a significant positive effect on rural economic development. No matter from the joint test, or from each index alone, the development level of digital science and technology has a strong driving effect. In terms of specific indicators:

The impact of Technology market turnover (*techturn*) on rural economic development is positive and significant. The possible reason is that the increase in the turnover of technology market means the further expansion of the scale of digital industry, thus will reduce the information barriers in rural areas, promote the realization of high-quality development in rural areas, thus driving the development of rural economy.

Software business income (*softinc*) plays a significant role in promoting the development of rural economy. This suggests that the number and the expansion of software business is conducive to good operation of the market, to a certain extent reduce the communication cost, improve profitability, and further enhance the development of rural economy.

The development level of e-commerce (*DEelec*) is positive and significant for the development of rural economy. Taobao is the main indicator used to measure the development level of e-commerce. From the regression results, it can be seen that the increase of the number of Taobao villages has a significant positive impact on rural economic development.

Table 3 Regression analysis of digital economic variables

	DE	DE^{inf}	DE^{tech}	DE^{elec}
model	(1)	(2)	(3)	(4)
ruralacc	0.0919185***	0.1254258***		
	（0.0199157）	(0.020727)		
disfib	0.0144031	0.0102904		
	（0.0386956）	(0.0437938)		
techturn	0.0508482***		0.0761374***	
	（0.0130031）		(0.0126969)	
softinc	0.0355024*		0.0723241***	
	（0.0190679）		(0.0193391)	
taobao	0.0001196**			0.0002406***
	（0.0000499）			(0.0000543)
agriexpen	0.4796599***	0.6160854***	0.5664571***	0.7936669***
	（0.0595526）	(0.0605167)	(0.0617762)	(0.0517013)
ruralpow	0.001508	0.0019669	0.0061994	0.0061908
	（0.0132067）	(0.0150643)	(0.0145844)	(0.0159809)
cons	4.527402***	4.793298***	3.651459***	4.367284***
	(0.5400261)	(0.5590664)	(0.3528319)	(0.3703006)
Code FE	control	control	control	control
Year FE	control	control	control	control
N	145	145	145	145
R^2	0.8259	0.7650	0.7802	0.7322
F1	17.56***			
F2		18.91***		
F3			24.09***	

Note: ***, ** and * represent the significance level of 1%, 5% and 10% respectively. Values in brackets are standard error; F1, F2 and F3 represent the F value of the combined test of DE, DEinf and DEtech indicators respectively.

4. Robust test

In order to reduce the influence of omitted variables on the regression results, robustness tests were conducted for the regression results. Referring to the research of Chen Wen and Wu Ying (2021), the education level in rural areas may also affect rural per capita disposable income to a certain extent. Therefore, we added the control variable of rural education level for further regression of the results. This paper quantifies the rural education level (*educ*) by taking the logarithm of the number of graduates from various schools in Rural China from 2016 to 2020. The data comes from The China Rural Education Development Report. The final regression results are shown in Table 6.

As shown in Model (2), even if the variables of rural education level are controlled, the significance of the results is the same as that of model (1), further verifying the accuracy of the model, so the research conclusion remains unchanged.

Table 4 Robust test

model	（1）	（2）
ruralacc	0.0919185***	0.047315***
disfib	0.0144031	-0.0084839
techturn	0.0508482**	0.0160646**
softinc	0.0355024	0.0131322
taobao	0.0001196**	0.0000156**
agriexpen	0.04796599***	0.172704***
ruralpow	0.001508	0.0030668
educ		1.934992***
Code FE	Yes	Yes
Year FE	Yes	Yes
N	145	145
R^2	0.8259	0.9512

Note: ***, ** and * represent the significance level of 1%, 5% and 10% respectively

5. Research conclusions

Digital economy plays a significant role in promoting China's rural economic development. At present, relevant researches mostly focus on the influence mechanism of digital economy on agricultural development, farmers' income, farmers' entrepreneurship and other dimensions that affect rural economic development. This paper constructs research equations from the factors of rural economic development to quantitatively study the overall driving influence of digital economy on rural economic development. The empirical results show that digital economy will have a positive effect on China's rural economy, and the specific mechanism is that digital economy will promote the process of agricultural modernization through the level of digital infrastructure, digital science and technology development water and e-commerce development level, and become an important force to promote the development of rural economy.

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