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Digital Economy and Urban and Rural Integration, Development Research

Zhongwei Wu, Weijun Qiu, Li Wang

School of Business Administration, Anhui University of Finance and Economics, Bengbu, China

Abstract

Digital economy plays an important role in the transformation of traditional industries. It not only provides new impetus for economic growth, but also helps traditional industries to accelerate the pace of transformation and promote the optimization and upgrading of industrial structure. This paper discusses the connotation of digital economy, that is, the mechanism of digital economy affects the integrated development of urban and rural areas, and constructs a seven-index system, which uses the entropy weight method, linear regression model, coupled coordination model and intermediate effect analysis to measure the development of national digital economy from 2016 to 2022. The following conclusions are drawn: In recent years, China's digital economy has been sustainable developed, and the coordination between digital economy and urban-rural integrated development has gradually reached a good level. The digital economy contributes to the integration of urban and rural areas. Every 1% increase in the digital economy, the growth level of urban-rural integration will increase by about 0.4694%. Taking the innovation index of science and technology as the intermediate variable, a model is constructed to detect the development degree of digital economy and urban and rural integration. The results show that scientific and technological innovation passes the intermediate effect test, indicating that digital economy can be promoted through scientific and technological innovation and the process of urban and rural integration development. On this basis, this paper puts forward relevant suggestions, which provides reference for the comprehensive development of urban and rural areas.

Keywords

Digital Economy; Urban-rural Integration Development; Coupled Coordination Model; Intermediary Effect.

1. Foreword

The proposal of digital economy stems from the rapid popularization and development of the Internet and information technology. In the digital economy, the data, partial automation and networking of traditional economic activities become possible. A large amount of data is generated, recorded and shared. People can communicate and trade in real time through the Internet, making the flow of information more rapid and convenient. In recent years, more and more countries have realized the huge potential of digital economy in promoting national economic development. Various countries have begun to formulate relevant laws and policies, and vigorously promote digital economy to promote national economic development. The digital economy has achieved effective development, and innovative digital technologies and products are constantly pouring out, and they have been widely used in traditional industries, becoming a new driving force of national development.

Digital countryside is an important part of the construction of digital China, and also one of the action policies for rural revitalization. General Secretary Xi Jinping has proposed to "accelerate the development of the digital economy and promote the deep integration of the digital

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economy and the real economy". This means that the digital economy is needed to break the institutional barriers of the unbalanced and insufficient flow of urban and rural factors, and realize the reasonable distribution of urban and rural factors. At the same time, China's urban-rural relations have gradually entered the "urban-rural integration" and "urban-rural integration" development stage. The party's 20th report stressed the need to promote the integration of urban and rural areas and coordinated regional development, and promote the effective quality and reasonable economic growth. Breaking the urban-rural boundary and promoting the exchange of urban-rural factors has become an important means to promote the coordinated development of urban and rural areas in China, and the digital economy is considered as a powerful tool to alleviate the gap between urban and rural areas and promote urban-rural integration with its high mobility and sharing characteristics.

Based on the above analysis, this paper established a scientific comprehensive evaluation system, measure the nationwide from 2016 to 2022 digital economy development and urban and rural integration development level, analyze the digital economy and urban and rural integration development related data, and explore how the digital economy to promote the development of urban and rural integration, in order to provide policies for government departments to policy.

2. The Research Plan

2.1. Construction of the Index System

The rapid development of digital economy is inseparable from the development and innovation of information technology. In terms of digital industrialization, digital industry promotes the development and innovation of digital technology, promotes the development of emerging industries and the construction of new models, strengthens the construction of digital infrastructure, and provides support for the vigorous development of digital economy; in terms of industrial digitalization, industrial digitalization promotes the development and upgrading of digital economy, improves production efficiency, promotes innovation and creates employment opportunities, and the emerging technology of industrial digitalization can also greatly improve production efficiency, which is an important driving force for the vigorous development of digital economy.

Digital industrialization, namely the information and communication industry, is a process of deeply integrating traditional industries with information technology, and promoting industrial transformation and upgrading and economic development by means of digitalization, networking and intelligence. It can bring technological innovation, efficiency improvement, product upgrading, business model change and many other benefits. The information and communication industry is of great significance to the development of the digital economy, and can provide a lot of digital technology support, mainly including the ICT industry, telecom operation industry, digital media industry, etc. The rapid development of ICT industry is particularly effective. ICT industry can create jobs, attract investment and promote innovation; promote the development and application of new technologies, and promote digital transformation and innovation in different fields; provide various digital technologies and solutions to change people's lifestyle and social organizations, and bring economic benefits to countries and regions. Based on this, the total amount of telecom business, software business income, and the number of Internet access can be used as factors to measure the development of digital industrialization.

Industrial digitalization refers to the seamless combination of traditional industries and digital technology to improve efficiency, innovation and competitiveness. It is mainly the improvement of production capacity and efficiency brought about by the integration and penetration of ICT industry, digital industry and other industries. It can be divided into five

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aspects: data-driven and intelligent, Internet of Things and industrial Internet, artificial intelligence and machine learning, virtual reality and augmented reality, e-commerce and digital marketing. Specifically, the number of websites per 100 enterprises, the number of computers used by 100 enterprises, and e-commerce sales can be used as factors to measure the digital development of the industry.

The development of digital industrialization and industrial digitalization needs the support of network technology. Whether it is Internet application, the development of ICT industry, 5G, artificial intelligence, blockchain and other Internet industries all rely on the construction of sound and fast infrastructure. Therefore, the completion of optical cable lines and the number of websites can be used as the basic factor affecting the development of digital economy.

Based on this, this paper first to digital infrastructure, digital industrialization, digital, digital innovation ability four dimensions building index to measure digital economy development level, and then to urban and rural elements integration, urban and rural public service integration, urban and rural economic integration, urban and rural space environment fusion four dimensions to measure the index of urban and rural integration development, finally the scientific and technological innovation as a intermediary variable, try to analyze the digital economy to promote the development of urban and rural integration.

2.2. Data Source

The data of this paper are derived from China Statistical Yearbook and other public data. The indicators of this paper are selected as follows:

Table 1. Comprehensive evaluation system of China's digital development and urban-rural integrated development

Level 1 indicators	Secondary indicators	Level 3 indicators	direction
Digital development	Infrastructure level	Long-distance optical cable line length	the first month of the lunar year
		penetration	the first month of the lunar year
		The Internet broadband access port	the first month of the lunar year
	Digital industrialization	Total telecom business	the first month of the lunar year
		Software business revenue	the first month of the lunar year
		Number of ICT practitioners	the first month of the lunar year
		The ICT industry revenue	the first month of the lunar year
	Industrial digitization	The number of websites per 100 enterprises	the first month of the lunar year
		The number of computers per 100 people used by the enterprise	the first month of the lunar year

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		E-commerce sales volume	the first month of the lunar year
	Digital innovation ability	The proportion of R & D expenditure of industrial enterprises above designated size in regional GDP	the first month of the lunar year
		Number of patent applications	the first month of the lunar year
		Technology market turnover	the first month of the lunar year
Integrated development of both urban and rural areas	Integration of urban and rural factors	Urbanization rate	the first month of the lunar year
		Freedom of labor transfer degree	the first month of the lunar year
		The proportion of science and technology expenditure	the first month of the lunar year
	Integration of urban and rural public services	The average number of students per teacher in basic education	the first month of the lunar year
		Old-age insurance coverage in both urban and rural areas	the first month of the lunar year
		The ratio of medical beds per every thousand people in urban and rural areas	contrary
	Urban and rural economic integration	Per capita income ratio of urban and rural residents	contrary
		Per capita wage-income ratio between urban and rural residents	contrary
		Per capita consumption ratio of urban and rural households	contrary
		Urban-rural Engel coefficient ratio	the first month of the lunar year
	Urban and rural spatial environment integration	Urban space expansion	the first month of the lunar year
		density of highway network	the first month of the lunar year
		Green coverage rate of the built-up area	the first month of the lunar year

Among them, the land yield rate is expressed by the ratio of GDP to the land area, and the scientific and technological innovation is expressed by the amount of patent granted. Because the data needs to be standardized, no unit is given in the table.

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2.3. Methods and Models

This paper first uses the entropy method to comprehensively evaluate the development of digital economy and urban-rural integration in China, and then uses the coupling coordination model to measure the coupling coordination of the two systems and analyze its dynamic evolution process. Then use 13 indicators of the digital economy, in turn, return to the development of urban and rural integration, observe the influence of the development of urban and rural integration, and then the digital economy and urban and rural integration system linear regression, from the overall measure digital economy to promote the development of urban and rural integration, finally using the intermediary effect model analysis of digital economy to promote the development of urban and rural integration.

2.3.1. Entropy Value Method

This paper uses the entropy method to measure the indicators selected by the national digital economy and urban-rural integrated development system. The steps are as follows:

(1) Standardize the original index data to eliminate the impact of different index units.

For positive indicators:

$$z_{ij} = \frac{x_{ij} - \min\{x_{1j}, x_{2j}, ..., x_{nj}\}}{\max\{x_{1j}, x_{2j}, ..., x_{nj}\} - \min\{x_{1j}, x_{2j}, ..., x_{nj}\}} \tag{1}$$

For reverse indicators:

$$z_{ij} = \frac{\max\{x_{1j}, x_{2j}, ..., x_{nj}\} - x_{ij}}{\max\{x_{1j}, x_{2j}, ..., x_{nj}\} - \min\{x_{1j}, x_{2j}, ..., x_{nj}\}} \tag{2}$$

(2) Calculate the weight of each index. The normalized values were used for the following operation.

$$p_{ij} = \frac{z_{ij}}{\sum_{i=1}^{n} z_{ij}} \tag{3}$$

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^{n} p_{ij} \ln p_{ij} \tag{4}$$

$$w_j = \frac{1 - e_j}{n - \sum_{j=1}^{m} e_j} \tag{5}$$

(3) Calculate the composite score

$$s_{ij} = \sum_{j=1}^{m} w_{ij} p_{ij} \tag{6}$$

2.3.2. The Coupled-In-one Coordination Model

The coupling coordination model is adopted to measure the dependence relationship between digital economy development and urban-rural integration development.U1, U2For the comprehensive evaluation score of digital economy development and urban-rural integrated

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development, the coupling degree of digital economy and urban-rural integrated development is calculated through formula (7) C:

$$C=\frac{2\sqrt{U_1\times U_2}}{U_1+U_2} \tag{7}$$

Through formula (8), the coupling and coordination degree of digitalization and urban-rural integration development D:

$$D=\sqrt{C\times T},\ T=\alpha U_1+\beta U_2 \tag{8}$$

(8) In this formula, T represents the comprehensive evaluation index of digitalization and urban and rural integrated development systems, and represents the evaluation weight coefficient of digitalization and urban and rural integrated development. According to previous research results, the value here is 0.α, β.5

2.3.3. Benchmark Regression

The 13 indicators of digital economy were used to analyze the regression of urban-rural integrated development, and the influence of each index on the integrated development of urban and rural areas was observed respectively, and then linear regression was made on the two systems of digital economy and urban-rural integrated development, so as to measure the promotion degree of digital economy on urban-rural integrated development on the whole. In order to eliminate the possible heteroscedasticity and autocorrelation in the model, the mathematical model of digital economy and urban-rural integration development is established as follows:

$\ln Y=\alpha+\beta\ln X+\varepsilon\ln X\ln Y$, Among them, it is the natural logarithm of the comprehensive score of the digital economy index system, and the natural logarithm of the comprehensive score of the index system of urban and rural integrated development, and ε represents the random error term.

3. Empirical Analysis

3.1. Coupled and Coordination Analysis

Based on the evaluation index system of digital economy development and urban-rural integration level, the entropy method is used to measure the weight of each index, and the results are as follows.

As can be seen from Table 2, the number of websites built and e-commerce sales account for a high proportion, indicating that the improvement of infrastructure plays an important role in the development of digital economy, and the e-commerce sales of enterprises play an important role in the digital economy.

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Table 2. Weight measures

metric	weight
Long-distance optical cable line length	0.0604
penetration	0.0713
The Internet broadband access port	0.0767
Total telecom business	0.1051
Software business revenue	0.0892
Number of ICT practitioners	0.0542
The ICT industry revenue	0.0649
The number of websites per 100 enterprises	0.0794
The number of computers per 100 people used by the enterprise	0.0806
E-commerce sales volume	0.1017
The proportion of R & D expenditure of industrial enterprises above designated size in regional GDP	0.0738
Number of patent applications	0.0697
Technology market turnover	0.0726
Urbanization rate	0.0854
Freedom of labor transfer degree	0.0819
The proportion of government support for agriculture	0.0730
The average number of students per teacher in basic education	0.0850
Old-age insurance coverage in both urban and rural areas	0.1018
The ratio of medical beds per every thousand people in urban and rural areas	0.0717
Per capita income ratio of urban and rural residents	0.0748
Per capita wage-income ratio between urban and rural residents	0.0485
Per capita consumption ratio of urban and rural households	0.1282
Urban-rural Engel coefficient ratio	0.0716
Urban space expansion	0.0608
density of highway network	0.0655
Green coverage rate of the built-up area	0.0517

All the calculations are kept in four decimal places.

The coupling dynamic evolution of the development of digital economy and urban-rural integrated development is shown in the following table (figure):

Table 3. The coupling degree evolution

a particular year	degree of coupling
In 2016,	0.8796
In 2017,	0.9772
In 2018,	0.9997
In 2019,	0.9962
In 2020,	0.9889
In 2021,	0.9971
In 2022,	0.9959

All the calculations are kept in four decimal places.

From Table 3, the coupling degree between the two systems has been at a high level nationwide, and the coordinated coupling has been basically achieved since 2016.

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Table 4. Coupled coordination degree evolution

a particular year	Coupling coordination degree
In 2016,	0.3819
In 2017,	0.4741
In 2018,	0.5895
In 2019,	0.6701
In 2020,	0.7468
In 2021,	0.8536
In 2022,	0.9173

All the calculations are kept in four decimal places.

Table 4 shows that in 2016, the digital economy and urban and rural integration development of coupling coordination degree is only 0.3819, in the following years, the two systems of coupling coordination degree increased, in 2022, the two systems of coupling coordination degree reached 0.9173, during this period experienced a moderate disorder, basic coordination, from coordination to high coordination stage, shows that two system in 2016, the digital economy development and urban and rural integration development at a low level, in 2022 digital economy development and urban and rural integration development at a high level.

3.2. Regression Analysis

3.2.1. Regression Analysis of the Individual Indicators

In order to directly show the impact of digital economy on the integrated development of urban and rural areas, the 13 indicators of digital economy are used for the regression analysis of the integrated development of urban and rural areas, and the calculation results are shown in Table 2.

Table 5. Results of the individual index regression

	model 1	model 2	model 3	model 4
The number of computers per 100 people used by the enterprise	0.570			
	(0).000			
Software business revenue		0.549		
		(0).000		
E-commerce sales volume			0.558	
			(0).000	
ICT industry GDP				0.529
				(0).000

"()" Is the significance level P-value. All indicators were obtained using the standardized data.

Due to the space limitations, only the regression results of the four indicators are listed. From the regression results, it can be seen that each index (except for "the number of websites owned by each 100 enterprises") has a positive relationship with the integrated development of urban and rural areas, indicating that digitalization has a promoting role in the integrated development of urban and rural areas. Including enterprise per hundred people use the computer number, software business income, e-commerce sales and ICT industry GDP have larger partial regression coefficient, that the computer as the core of the digital equipment, is also the key to production, storage, and processing information, plays an important role in the integration of urban and rural development, the result is realistic. In addition, there is a

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significant positive correlation between the GDP of ICT industry and high-quality economic growth, indicating that the scale of ICT industry plays an important role in high-quality economic development.

This paper uses the Eviews software, and the results are as follows:

Table 6. Results of the ADF unit root test for variables

variable	The ADF test values	P price	bear fruit
l nY	-14.5539	0.0001	steady
l nX	-3.8385	0.003	steady

The test results showed that the sequence after taking the logarithm was stable and allowing for regression analysis. Using Eviews software, the OLS method is used to estimate the equation of digital economy on urban and rural integration development as follows:

$$lnY = 0.4694lnX - 0.4173$$
R2=0.8673F=32.6892DW=0.8729

At the 1% significance level, the estimated equation can pass a significance test. By Engle-Granger two tests, the calculated residual sequence passes the unit root test. As can be seen from the estimation equation, the digital economy plays a significant role in promoting the integrated development of urban and rural areas. When other conditions remain unchanged, for every 1% increase of the digital economy level, the level of urban-rural integration will increase by 0%..4694.

4. Conclusion and Suggestion

4.1. Conclusion

This paper discusses the logical relationship between digital economy, scientific and technological innovation and urban-rural integrated development, and constructs the theoretical framework from digital economy to the realization of urban-rural integration. According to the inherent significance of the digital economy and the integrated development of urban and rural areas, The measures were designed, For selected data from 2016 to 2022, A linear regression model was used to measure the promotion of digital economy to the overall development of urban-rural integration, Using a coupled coordination model, we analyzed the dynamic evolution of the digital economy and the integrated development of urban and rural areas, last, An intermediate effect model is used to verify the path of the conclusion of digital economy: digital economy provides an important impetus for the development of urban-rural integration in China, For every 1% increase in the digital economy level, The comprehensive level of urban and rural development will increase by about 0.4694%; The digital economy, by increasing input in high-end elements and improving the efficiency and synergy of resource allocation, Improved the resource allocation structure; Digital economy, as an intermediate variable to promote integrated urban and rural development, It is an important driving force for promoting urban-rural integration. Technological innovation has a revolutionary impact, which can not only replace traditional production methods, but also introduce new technologies and related products and services. This innovation can significantly improve production efficiency and production relations, while also promoting integrated development between urban and rural areas.

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4.2. Suggestions

Based on the above data and analysis, the following enlightening suggestions are proposed:

1) Build new digital economy infrastructure for the integrated development of urban and rural areas: First, the use of new information infrastructure such as new 5G infrastructure has accelerated the economic operation of the digital industry economic cycle of national information and communication, Internet and electronic manufacturing. Give full play to the role of computing power clusters, seize the opportunity of the operation of the National Blockchain Innovation Center, invest in improving the backbone node network of provinces and cities, enrich the industrial application node network, and make it a powerful digital infrastructure. Secondly, let data become "new agricultural currency", make mobile phone become "new agricultural tool", let live broadcast become "new agricultural work", and explore the construction of digital countryside. Through live broadcasting, we can help to sell featured agricultural products, find a network platform, carry out in-depth cooperation with industrial farmers, help increase the attention and influence of traffic, and promote the development of small enterprises together with the e-commerce platform. Finally, we should solve the problem of unbalanced urban-rural integrated development, encourage developed digital economy to give full play to their exemplary leadership role, pay attention to the basic research and development of digital technologies and core technologies, accelerate the integration of advanced technologies into urban and rural digital systems, and pave the way for the integrated development of digital economy and urban and rural areas. Regional urban centers and cities with perfect digital economy infrastructure in the eastern region should pay attention to the leading role of demonstration, actively explore a new model of digital integration of urban and rural development, accelerate regional development, and comprehensively promote the construction of digital urban and rural areas. In the development of digital economy, regions should take the lead in seizing the forefront of digital economy development and focus on narrowing the gap between the short board and the developed regions.

2) Promote the deep integration of digital economy and real economy: First, talents are the support of digital economy. Only by focusing on the training and reasonable allocation of talents can the progress of urban-rural integration be more effective. We will focus on popularizing and improving the digital literacy of urban and rural residents, focus on cultivating digital talents, build a new virtuous cycle model, and create new jobs and a wide range of employment opportunities. The focus is on improving the ability of rural residents to apply digital "new farm tools", adopting incentives to encourage more farmers to become highly skilled workers in the agricultural sector, and expanding farmers' participation in digital applications. We will improve the policy protection system, build a rural digital labor force that attracts the inflow and outflow of talents, enhance rural human capital, and effectively increase farmers' incomes in the era of digital economy. Secondly, the correct use of digital technology can respond to the national call for energy conservation and emission reduction, reduce carbon emissions, and make more rational and effective use of resources.

3) Promote enterprise digital transformation: digital transformation can improve the unbalanced allocation of resources between urban and rural areas, through the application of digital technology, can break the time and space limit, improve the efficiency of information flow, make the advantages of agricultural products and rural resources get better use and development, meet the urban residents demand for health food, leisure tourism, etc. At the same time, digital transformation can guide enterprises to carry out technological innovation, and promote the transformation and upgrading of traditional industries to high value-added and high-tech fields. By introducing advanced information technology and Internet of things technology, rural areas can develop emerging industries such as intelligent agricultural products and agricultural products e-commerce, and improve the level of rural economic development. Digital transformation can also promote exchanges and cooperation between

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urban and rural areas, and narrow the gap between urban and rural areas. With the support of digital technology, urban enterprises can provide technology, management and market support to help rural enterprises grow and grow, rural areas can also bring their agricultural products and characteristic services to the means of digital platforms and e-commerce.

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