

# Study on the Influence of Digital Economy on Urban and Rural Integrated Development in the Yangtze River Delta Region

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## Abstract

To realize the integrated development of urban and rural areas in the Yangtze River Delta region is the inherent requirement of Chinese modernization and the inevitable result of the high development of productive forces, and also an important way to solve the development problems in the new era. The development of the digital economy has become an important means to promote the orderly and free flow of factors of production and the rational allocation of resources. In order to discuss the influence of digital economy on urban-rural integration, this paper analyzes the direct effect of digital economy on urban-rural integration development and the intermediary role of the factor flow on the integration of urban-rural areas by using the intermediary effect model. The results show that the integration level of digital economy has been significantly improved, and the result effect is significant; digital economy promotes the optimal allocation of factors and promotes the integration of urban and rural areas; the two key ways that digital economy affects the integration of urban and rural areas are the loss of rural labor and capital allocation ability. Based on this, it is proposed to promote the improvement of the sustainable mechanism of urban-rural integrated development in the Yangtze River Delta region, and to develop digitalization to promote the basic construction of digital economy facilities.

## Keywords

Urban-rural Integration Development; Digital Economy; Factor Flow; Intermediary Effect Model.

## 1. Introduction

### 1.1. Research Background

Since the reform and opening up, a series of problems such as China's rapid urbanization, one-way flow of urban and rural factors, and weak rural development. Accelerate the connection between rural resources and elements in the Yangtze River Delta region and the global market, and make the whole urban-rural integrated development mechanism become an inevitable requirement for high-quality economic and social development. The development of the digital economy has clearly become an important driving force for China's economic and social development. At present, the problems of limited free flow of urban and rural resources and unequal basic public services still exist, which has become a major problem that must be solved as soon as possible. The issue of urban-rural integration has always been a hot spot in the academic circle. It is an inevitable requirement for the development of urban-rural relations to a certain stage. It is an institutional channel for the flow of factors between urban and rural

areas. Improving the distribution of resources in urban and rural areas and ensuring that the market plays a decisive role in resource allocation can promote interoperability and flow between urban and rural areas, and inject vitality into rural revitalization and integrated urban and rural development.

## 1.2. Study Significance

As the trend of the development of new economy, as an important factor and spatial carrier for the coordinated development of urban and rural areas, digital economy has gradually become the focus of solving new new drivers and transformation development [1]. However, the current empirical study of the impact of digital economy on urban-rural integration is still relatively limited. Digital economy can better promote the integrated development of urban and rural areas in the Yangtze River Delta region by promoting the optimal allocation of capital and labor factors in space. Digital economy promotes the resources in production and consumption in urban and rural areas in a larger spatial scope, and strengthens the linkage development of urban and rural industries; adjusting the industrial structure and creating new consumer markets, driving the growth of market economy and promoting the flow of labor force from the primary industry to the second and tertiary industries. The development of digital economy has continuously upgraded the Internet platform, applied digital technology to agricultural industries, combined modern agriculture, new industry and modern service industry, and cultivated various forms of industries. At the same time, it also promotes the flow of large capital elements to agricultural related industries, realizing multiple values and stimulating new impetus of economic development. Digital economy breaks through the limitation of geographical space, and the cross-space exchange of urban and rural elements is realized. Therefore, it is of great significance to actively innovate the road of urban-rural integrated development through digital development to promote the integration of urban-rural development.

## 2. Literature Review

At present, the academic research on the integrated development of urban and rural areas in China is divided into the following categories: first, the influencing factors of urban-rural integrated development in China; the level of urban-rural integrated development in each region; and the internal problems of urban-rural integrated development.[2] Guo Lingxia et al. (2023) said that the provincial urbanization index in China is generally on the rise, with the eastern region being the highest, followed by the central region, and the lowest urbanization index in the western region. The index of integrated urban and rural development in China shows a fluctuating trend, and the eastern region is higher than the central and western regions.[3] Wang wei, liu hui (2023) of 11 provinces, analyzes the provinces in the urbanization rate and urban and rural residents income ratio, analyzes the demonstration provinces of industrial integration coordinated development, points out the current rural population, the low rate of urbanization still exists, the income gap between urban and rural areas is larger, the 123 industry integration degree is relatively low, the industrial foundation is weak. Urban-rural integration is an important part of rural revitalization, and urban-rural integration promotes the development of rural revitalization.[4] Wen Jun and Chen Xue (2023) said that the integration of urban and rural development promotes the modernization of national governance. In recent years, the "certainty-uncertainty" tension of urban and rural integrated development has been intensifying, uncertain factors are growing, and various development opportunities and uncertain challenges of urban and rural integration coexist.

As a new economic model, digital economy promotes the high-quality economic development and plays a role in promoting China's economic growth. Economic growth promotes the development of urban-rural integration in China. Therefore, the digital economy helps to

narrow the income gap between urban and rural areas and promote urban-rural integration.[5] Money, Sun Fang (2023) through the intermediary effect model for empirical test, shows that the digital economy to promote the development of urban and rural integration, the allocation of rural resources and the flow of labor is the key path affecting the development of urban and rural integration, urban and rural integration is an important link to realize the rural revitalization, digital economy to promote the development of urban and rural integration progress.[6] Huaxing shun (2021), said the digital economy is not only the problem of economic and social sustainable development, but also a kind of promotion and development of human civilization, digital economy for the relationship between urban and rural areas and the relationship between workers and peasants has a very important role, to seize the digital economy layout, using digital economy and digital technology to promote the continuous development of urban and rural integration.[7] Yao Yuchun, Zhang Harvest (2023) by building "digital economy-rural integration development system" coupling coordination and obstacle model, coupling the development of different paths, shows that the overall development of digital economy is weaker than urban and rural integration development, but the growth of digital economy significantly faster, provide new development path for urban and rural integration development.

In general, the research direction of digital economy has a wide range of research directions and rich research results, but there are few research results on digital economy and urban and rural integration, and most of the studies on digital economy and urban and rural integration are theoretical, with few empirical studies. In addition, previous studies have not deeply explored the mechanisms of the digital economy in influencing urban-rural integration. Therefore, the research significance of this paper is to supplement the previous theories of digital economy and urban and rural integration; select the representative region of Yangtze River Delta as the research object to conduct empirical research to provide valuable reference for other regions; use data model to explore the relationship between digital economy and urban and rural integration, and provide scientific decision-making considerations for the further development of urban and rural integration.

### 3. Theoretical Analysis

#### 3.1. The Impact of Digital Economy on Urban-rural Integration

The impact of digital economy on urban-rural integration can be discussed from three aspects: data elements, data industry and data technology. From the perspective of data elements, the application of digital economy makes all data in production and life more open and shared. Digital elements are different from traditional elements, have strong spillover and involve multiple production links. With the role of data as a factor of production, the cost of urban and rural economic exchanges has been greatly reduced, bridging the digital divide between urban and rural areas, and improving production efficiency. From the perspective of the data industry, the development of the data industry has alleviated the dilemma of the lack of data in the past, and the characteristics of easy data sharing and transmission also provides a new way for urban-rural communication. The combination of data industry and urban and rural development, while promoting their respective economic development, boosts the coordination of urban and rural work and narrowed the gap between urban and rural areas.

Uncoordinated regional development and the large gap between urban and rural development are the inevitable and persistent problems in the development stage of all countries. Great achievements have been made in rural revitalization in China, but the gap between rural development and urban development has not been solved. As a powerful tool to seek development in the Internet era, data can be applied to solve the large gap between urban and rural development, and can narrow the regional development gap from many aspects.

According to the above analysis, the following assumptions are made:

Suppose H1: Digital economy promotes the integrated development of urban and rural areas.

### 3.2. Indirect Impact of Digital Economy on Urban-rural Integration

The integrated development of urban and rural areas is not only reflected in two aspects, and the application of digital economy is often not directly reflected. For example, one of the important links to promote rural development -- Improve rural infrastructure construction, the application of digital economy is not actually to install equipment or construction sites, but to use material tracking, follow-up data analysis and other work. Digital economy optimizes the industrial structure in various ways, and the development of digital industry promotes the training of a number of digital economy talents and the development of digital technology. The enrichment of digital talent team is beneficial to the transformation and optimization of China's talent structure and more adapted to the development of The Times. Talent is a powerful driving force for economic development, and a new transformation in the composition of talent team has given new drivers to economic development. The characteristics of digital economy make urban and rural interaction stronger and promote the integrated development of urban and rural areas.

According to the above analysis, the following assumptions are made:

H2: Digital economy indirectly promotes the integrated development of urban and rural areas.

## 4. Research Design

### 4.1. Selection of Variables

1) Interpreted variables: [8] [9] Level of urban-rural integrated development (y). In terms of index system construction, according to the relevant studies of Ma Zhifei (2022) and Chen Jingshuai (2022), the per capita GDP, urban-rural income ratio, urbanization rate and per capita road area are selected from the five aspects of economy, population, society, ecology and space. The specific index system is shown in Table 1.

**Table 1.** Urban-rural integration system

Level 1 indicators	Secondary indicators	Variable selection	Calculation instructions
Level of integrated urban and rural development	Urban-rural economic integration	per capita GDP	Regional GDP / regional permanent resident population at the end of the year
		Consumption ratio between urban and rural residents	Per capita consumption expenditure of urban residents / per capita consumption expenditure of rural residents
		Income ratio between urban and rural residents	Per capita disposable income of urban residents / per capita disposable income of rural residents
	Integration of urban and rural life	number of hospital beds	Ten thousand zhang
		Registered urban unemployment rate	%
		Urbanization rate	%
		road construction	Ten thousand kilometers
	Urban and rural spatial integration	Urban space expansion	Crop sown area / built-up area
		passenger capacity	thousands of people
		land area covered with trees	%
		Spending on environmental protection in GDP	Environmental protection expenditure / GDP
	Integration of urban and rural life	The ratio of urban construction land to agricultural land	Urban construction land area / crop sown area
		Urban green space area per capita	Urban green space area / the number of permanent resident population at the end of the year

2) Explanatory variables: Development level of digital economy (x). In terms of index system construction, reference China academy "China's digital economy development white paper

(2022)" in the "strong technology, strong industry, strong application, strong elements, strong market, and stronger do best do our digital economy" key measures, and based on the digital digital economy more than 80%, digital digital industry become the reality of the digital economy development.[10] [11] Referring to the relevant studies of Wu Jingfei (2022) and Chen Xinxin (2022), the index system is selected from three aspects of digital infrastructure, digital industry application and digital drive capability: Internet penetration rate, mobile phone penetration rate and number of Internet domain names. See Table 2 for details.

**Table 2.** Digital economic index system

Level 1 indicators	Secondary indicators	Indicator meaning	unit
The development level of the digital economy	Digital infrastructure	Long-distance optical cable line length	kilometre
		Internet penetration rate	%
		Mobile phone penetration rate	%
		Number of Internet access ports	Ten thousand
		Domain name number	Ten thousand
		The proportion of broadband Internet users	%
	Digital industry applications	The proportion of enterprises with e-commerce transaction activities	%
		The number of websites per 100 enterprises	%
		The proportion of employees in the information transmission software industry	%
		The proportion of mobile Internet users	%
	Digital drive capability	E-commerce purchase volume	100 million
		Software business revenue	100 million
		E-commerce sales volume	100 million
2. Value-added value of the three industries		100 million	

3) Control variables: The level of urban-rural integration development is not only affected by the development level of digital economy, but also by the following control variables

Impact: Industrial structure (x1), measured by the added value of secondary and tertiary industries / GDP; the urban-rural income gap (x2), measured by the difference between the per capita disposable income of urban residents and the per capita disposable income of rural residents; the traffic level (x3), measured by the natural log of highway passenger volume; and the opening level (x4), measured by the total import and export / GDP.

4) Intermediary variables: According to the research of Zhang Juntao (2021) on the impact of labor transfer on the transformation of urban-rural dual economic structure and Wang Juan (2019) on the allocation of driving factors of digital economy, the two intermediary variables set in this paper are rural labor mobility (trans) and capital allocation capacity (zb).

(two).

Referring to the analysis of [12] Taidejin (2022), the development of digital economy will enable the integration of urban and rural economy. In the analysis of Chen Xinxin (2022), there is a correlation between digital economy and urban-rural integration. Establish a two-way fixed-effect model to estimate the impact of the development level of digital economy on urban and rural integrated development. The specific forms are as follows:

$$y_{it} = m_0 + m_1 x_{it} + \lambda X_{it} + v_i + e_t + \varepsilon_{it}$$

Where  $i$  represents the province and  $t$  represents the year. Where  $m_0$  is the constant term,  $m_1$  is the regression coefficient for  $x_{it}$  to  $y_{it}$ ,  $X_{it}$  is the collection of control variables affecting the level of urban-rural integration,  $e_t$  is the time fixed effect,  $v_i$  is the individual fixed effect, and  $\varepsilon_{it}$  is the random disturbance term.

Considering that the digital economy will affect the inflow of urban and rural factors, it promotes the flow of rural labor and capital between urban and rural areas.

To promote the integrated development of urban and rural areas, the intermediary effect model is selected for empirical testing, and the metrological model is constructed as follows:

$$y_{it} = a_0 + a_1 x_{it} + \lambda X_{it} + v_i + e_t + \varepsilon_{it} \quad (1)$$

$$MED_{it} = b_0 + b_1 x_{it} + \theta X_{it} + v_i + e_t + \varepsilon_{it} \quad (2)$$

$$y_{it} = c_0 + c_1 x_{it} + \varphi MED_{it} + \delta X_{it} + v_i + e_t + \varepsilon_{it} \quad (3)$$

MED represents the intermediary variable, that is, the amount of rural labor flow and the ability of capital allocation, while other variables are defined unchanged. The equation (1) is used to test whether the influence of digital economy development level on urban and rural integration level is significant; Equation (2) is used to test whether the influence of digital economy development level on the intermediary variable is significant after adding the intermediary variable; Equation (3) tests whether the influence of intermediary variable on urban and rural integration is significant after controlling the influence of digital economy.

## 5. Analysis of the Robustness Test

In order to make the research results more robust, this paper uses (1) excluding some samples: excluding the data of the four municipalities, continue to use the two-way fixed effect model for regression analysis; (2) replace the regression method: replace the explained variables to estimate the relationship between digital economy and the urban-rural integration, compared with the previous year, in this year, the value is 1; on the other hand, if the development level of urban-rural integration drops in this year, the value is 0, so use Probit and Logit regression models.

The specific results are shown in Table Table 5. As shown in table 5, the model (1) ~ (3) the sample data for the four municipalities, change the explained variables and regression method regression results, it can be seen that the digital economic coefficient is still positive, promoting digital economy for urban and rural integration, namely the faster the digital economy development, the higher the development level of urban and rural integration.

**Table 3.** Results of the robustness analysis

variable	Part of the sample was removed	logit regression	Probit regression
	model (1)	model (2)	model (3)
X	0.138*	4.224***	2.360***
	(1.85)	(3.810)	(3.950)
X1	0.026	6.141***	3.314***
	(0.58)	(2.720)	(2.730)
X2	-0.204	-0.073	-0.043
	(-0.98)	(-0.590)	(-0.590)
X3	-0.016	0.268	0.166
	(-0.13)	(0.950)	(1.000)
X4	0.163***	-0.265***	-0.149***
	(2.82)	(-3.160)	(-3.120)
Individual effect	control	Uncontrolled	Uncontrolled
time effect	control	Uncontrolled	Uncontrolled
The intercept term	-0.678**	-1.499	-0.754
	(-2.08)	(-0.820)	(-0.720)
sample capacity	450	522	522
R	0.687	0.049	0.048

## 6. Mechanism Analysis

The above theoretical research shows that the promotion effect of the development level of digital economy on the level of urban and rural integrated development comes from the ability of rural labor flow and capital allocation, so the intermediary effect model is selected to test the above mechanism. Table 4 and Table 5 are the regression results of rural labor flow and capital capacity successively.

As shown in Table 4, Model (1) indicates that no mediation variables are added, Including control variables, The return results of the digital economy to urban-rural integration, The coefficient is significantly positive; Model (2) represents the level of digital economy as the explained variable, Rural labour mobility, as an explanatory variable, The coefficient is significantly positive; Model (3) represents the level of urban-rural integrated development as the explained variable, The regression results, including all variables such as the development level of digital economy and rural labor mobility, The regression coefficient was significantly positive, It shows that the rural labor mobility acts as a partial intermediary role in this mechanism, The digital economy promotes the integrated development of urban and rural areas by promoting rural labor mobility, This conclusion supports the hypothesis that 2.

**Table 4.** Analysis of the intermediary effect of regional labor mobility

Variables and the statistical parameters	model 1	model 2	model 3
	y	trans	y
X	0.213***	0.025**	0.173***
	(2.97)	(2.40)	(3.07)
trans			0.003
			(0.23)
controlled variable	control	control	control
The intercept term	-0.639***	2.137***	0.913***
	(-3.83)	(33.97)	(6.39)
sample capacity	522	522	522
R	0.728	0.405	0.692

As shown in Table 5, Model (1) indicates that no mediation variables are added, The regression results of the development level of digital economy for the level of urban-rural integrated development, The regression coefficient is significantly positive; Model (2) represents the level of digital economy as the explained variable, Capital allocation capacity, as an explanatory variable, The regression coefficient is significantly positive; Model (3) represents the level of urban-rural integrated development as the explained variable, The regression results, including all variables such as the development level of the digital economy and the capital allocation ability, The regression coefficient was significantly positive, Suggesting that capital allocation capacity plays a partial intermediary role in this mechanism, The development of the digital economy promotes the integrated development of urban and rural areas by improving the capital allocation capacity, This conclusion supports the hypothesis that 3.

**Table 5.** Analysis of the mediation effect of capital allocation

Variables and the statistical parameters	model (1)	model (2)	model (3)
	y	zb	y
X	0.213*** (2.97)	0.064** (2.33)	0.232** (2.39)
Z b			0.009 (0.37)
controlled variable	control	control	control
The intercept term	-0.639*** (-3.83)	2.179*** (33.11)	0.890*** (3.89)
sample capacity	522	522	522
R	0.728	0.387	0.667

## 7. Study Conclusion and Suggestions

This paper is based on the panel data of Yangtze river delta region, practical demonstration and test the different level of digital economy of the future development of urban and rural integration and its mechanism of action, the following is the main research of three conclusion: conclusion one, the digital economy influence the development of urban and rural integration, which is the largest influence rural mobile labor force and the allocation of resources. From the perspective of floating labor force in rural areas, the establishment of modern infrastructure such as high-speed rail and trains can promote the flow of labor between villages and cities, make it more convenient for farmers to move between cities and villages, and significantly increase farmers' income, thus having a positive impact on the integrated development of urban and rural areas. At the same time, the rapid development of digital economy has created new demand for jobs in the market, created new employment opportunities for farmers, promoted the flow of labor from rural to city, and further contributed to the integrated development of urban and rural areas. From the perspective of resource allocation, digital economy provides a new way of resource allocation, improves its efficiency, provides new energy and new power for the integrated development of urban and rural areas, improves the level of resource allocation, promotes rural development, reduces the gap between urban and rural areas, and further contributes to the integrated development of urban and rural areas. Second, the digital economy has a positive impact on the integrated development of urban and rural areas. This paper compares the different levels of digital economy and urban-rural integration, and lists regression equations through data analysis, which proves that digital economy can indeed promote the positive development of urban-rural integration. Conclusion three, digital economy of the development of urban and rural integration has regional differentiation,

compared to the development is relatively backward in the northern region, the digital economy of southern urban and rural integration development has a significant positive influence, the analysis found that two areas of digital economy developed degree, the allocation of resources, the region of the market size is more grand, and the acceptance of rural mobile labor force will be better.

Based on the above three conclusions, the following suggestions are put forward for accelerating the integrated development of the digital economy in the Yangtze River Delta region:

First, the digital industry drives it. We will encourage the transfer of digital industries to rural areas, and promote the deep integration of digital technology with traditional agriculture, manufacturing, and service industries. We will support the development of digital industries such as the Internet, mobile payment and distance education, and promote the interactive and coordinated development of urban and rural economies.

Second, the innovative application of digital technology. We will strengthen the application of digital technology in enterprises, education, medical care and other fields to promote digital transformation. Enterprises are encouraged to cooperate with universities and research institutions to jointly develop and innovate, and improve the level and efficiency of technology application. At the same time, policies and measures for the application of digital technology should be formulated to promote the promotion and application of technology to rural areas.

Third, the flow of digital factors of production. We will strengthen information flow and promote the optimal allocation of capital, talent, technology and other factors of production between urban and rural areas. Establish a digital platform for the flow of production factors, provide policy, finance, talent and other services, help enterprises and farmers solve problems in capital, technology, talent and other aspects, and promote the interaction and optimal allocation of production factors between urban and rural areas.

Fourth, improve digital public services. Digital technology will be used to improve urban and rural public services, including transportation, water conservancy, education, medical care and other fields. Establish digital traffic information platform to provide real-time traffic information to facilitate travel; promote digital water management system and improve the efficiency of water resources; strengthen digital education resource sharing and improve the quality of education; and establish digital medical system to facilitate remote medical treatment.

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