The impact of digital financial development on the economic development of cities in Jiangsu Province——Empirical test based on the spatial lag model

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Abstract. In recent years, with the application of big data, cloud computing and other digitalization and informatization in various fields, digital finance is changing the operating system of the traditional financial industry at an extremely fast speed, breaking through the bottleneck of the original economic development, giving better play to the role of finance in supporting the real economy, and further promoting the economic development of provinces and cities in China. This paper first summarizes the current research results of digital inclusive finance, and discusses its relationship with the real economy; Secondly, it analyzes the channels that digital finance affects regional economic development; Furthermore, this paper starts from the multi-dimensional connotation of high-quality development, and uses the spatial economics analysis method to study the relationship between digital finance and economic development in Jiangsu Province; Finally, based on the overall research conclusions of this paper, the relevant policy recommendations are put forward.

Keywords: Digital finance; Regional economic development; Space lag model.

1. Introduction

As a key factor in economic development, finance determines the method and cost of capital investment, and is indispensable in high-quality development. Digital finance integrates payment, financing, investment and other businesses. Through the application of key Internet technology tools, it improves financial inclusion and accuracy. It is a new generation of financial services. According to statistics, the GDP of Jiangsu Province reached 10.28 trillion yuan. At the same time, promoting the construction of digital finance in the Yangtze River Delta region is a requirement for the implementation of the national strategy for the integration of the Yangtze River Delta in the new era. As an important part of the Yangtze River Delta, Jiangsu Province has important research significance on the relationship between its economic development and digital finance.

Through the review of previous literature, this paper finds that most scholars pay more attention to how the development of digital finance can improve the real economy, drive enterprise innovation, affect the income gap between urban and rural areas, and promote coordinated regional development. However, most of the previous studies examined the impact of digital finance on the economy from a single perspective, such as innovation and entrepreneurship, industrial structure, and income gap, and ignored geographical and spatial factors. Therefore, starting from the multi-dimensional connotation of high-quality development, this paper uses the spatial economics analysis method to study the relationship between digital finance and economic development in Jiangsu province.

2. Literature review

2.1 Literature review on digital financial inclusion

In recent years, with the deepening and rapid promotion of information technologies such as the Internet, big data, and cloud computing in the financial field, the digital financial service model has further expanded inclusive financial services. With the help of digital technology, the cost of inclusive financial services has dropped significantly, and the problem of financial exclusion has been more effectively resolved. Digital inclusive finance has increasingly become a new field and trend for the development of inclusive finance. Digital financial inclusion has also received high attention in the

practical and academic circles, and has become a practice and research hotspot. But at present, there is no unified definition of digital financial inclusion. The concept of digital financial inclusion was first formally proposed in the "G20 Advanced Principles of Digital Financial Inclusion" released at the G20 Hangzhou Summit in September 2016. According to the definition of G20, digital financial inclusion refers to all actions to promote financial inclusion through the use of digital financial services, and the scope of digital financial inclusion is summarized as: using digital technology to provide financial services for groups that cannot access or lack financial services. A range of formal financial services that meet their needs and are delivered in a manner that is responsible, affordable and sustainable for service providers.

There is a wealth of academic literature on the discussion of the connotation of digital financial inclusion. Lu Jiajin believes that digital inclusive finance is essentially an inclusive financial service provided digitally [1]. Peterson defines digital financial inclusion as an inclusive financial practice aimed at promoting inclusive growth in developing countries and emerging economies through digital financial means [2]. Song Xiaoling interpreted digital inclusive finance as the realization of inclusive finance driven by digital technology, and pointed out that China's global leading position in e-commerce and electronic payment technology is a unique advantage in the development of digital inclusive finance, which can be realized with digital technology. Inclusive finance leads development [3]. Niu Yubin believes that digital inclusive finance is the integration of digital technology and inclusive finance [4]. Dong Yufeng and Zhao Xiaoming pointed out that digital inclusive finance is the continuous deepening of inclusive finance, and it has both commercial and social goals [5]. Liang Shuanglu and others deeply analyzed the connotation of digital financial inclusion, and believed that the core feature of digital financial inclusion is to transform traditional finance with the help of digital technology, and pointed out that digital financial inclusion can play a significant role in building an inclusive financial development system [6]. Guo Feng et al. believe that digital financial inclusion is a multi-dimensional concept, and point out that with the help of digital financial technology, the innovation of financial products and services can be realized, thereby reducing the cost of financial services and expanding service coverage [7]. In summary, although the above-mentioned scholars have different interpretations of the connotation of digital financial inclusion, the core interpretations are inseparable from the two keywords of digital technology and financial inclusion.

2.2 The relationship between digital inclusive finance and the real economy

At present, the widespread application of digital financial inclusion is the general trend. This is because the biggest risk of inclusive finance is credit risk, and the biggest constraint faced by inclusive finance is information asymmetry, while digital inclusive finance can minimize information asymmetry and avoid credit risk. In recent years, some domestic scholars have explored the relationship between digital financial inclusion and the real economy. Ge Heping and Zhu Huiwen found through empirical research that China's digital financial inclusion index develops decreasingly from east to west as a whole, while the development of the real economy in the region has a U-shaped relationship with the digital financial inclusion index [8]. Based on the panel data of 31 provinces from 2011 to 2018, Qian Haizhang et al. used the panel data econometric model, mediation effect model, instrumental variable method, and double difference method to conduct empirical tests, and found that the development of China's digital finance has significantly promoted economic growth [9]. The research results of Cheng Xuezhen and Gong Qinyi show that digital financial inclusion has significantly promoted the development of the real economy [10]. Ma Shaogang et al. studied the effect of inclusive finance on the real economy by constructing a DSGE model including the financial sector and the real economy, and found that countries with a higher level of inclusive finance had higher rates of economic growth and improved long-term living standards and higher persistence. The support of the industry to the real economy is also greater; China is called on to vigorously develop digital inclusive finance to reduce the proportion of people who are not inclusive [11]. It can be seen that research on China's digital financial inclusion has begun in recent years, but these studies

have not yet involved the relationship between digital financial inclusion and the coordinated development of the real economy.

3. Path Analysis

In general, the development of digital finance can promote regional economic development in the following ways.

First, digital finance can stimulate innovation and improve the innovation performance of cities and enterprises. On the one hand, digital finance uses technological means to reduce information search costs and transaction costs in the process of corporate investment and financing, which is conducive to improving the probability of corporate financing success; on the other hand, with the strong geographical penetration of digital technology, the development of digital finance can Break through the barriers of time and space and improve the availability of financing for enterprises in poverty-stricken areas. In addition, the development of digital finance has led to the continuous emergence of various business models and service formats, which is also conducive to regional innovation and development.

In addition, the development of digital finance can also inject impetus into the adjustment of industrial structure. The development of digital finance can improve financial efficiency, ease the financing pressure of small, medium and micro companies, and promote enterprises to continuously improve product technology content and continue to develop new products. In addition, the business model can be continuously updated, so that new enterprises and new formats with huge market space and development potential continue to emerge, which is conducive to optimizing the regional industrial structure.

Furthermore, digital finance provides a broader open platform for economic development. The continuous integration of digital technology and international trade has led to the emergence of digital trade, which drives the flow of goods, services, technologies, and talents with data, reducing trade thresholds and transaction costs; in addition, the emergence of new digital technologies has increased consumer preferences and domestic The matching speed of foreign products improves transaction efficiency and transaction scale. Therefore, the development of digital finance can promote the development of opening up to a high level.

Finally, digital finance can prevent risks and stabilize the economy. Digital technology is conducive to enhancing the financial system's ability to resist risks, dispersing risks in the real economy, and stabilizing the economic environment. Since 2020, digital finance has played a huge role in epidemic prevention and control, promoting consumption, protecting employment, providing financial support for enterprises, etc., effectively coping with complex and profound changes in the internal and external environment, and effectively
Stabilized the economy and life order.

To sum up, this paper puts forward the following hypothesis: the development of digital finance will promote the economic development of the region.

4. Selection of relevant variables and data sources

4.1 Variable selection

4.1.1 Explained variable: GDP

For the core explained variable macroeconomic development level, the most direct and representative data used in current academic research is the gross domestic product (GDP). This paper also chooses GDP as an index to measure the economic development level of each city in Jiangsu Province.

4.1.2 Explanatory variable: digital financial development (INDEX)

The explanatory variable in this paper is the development of digital finance, and in terms of the selection of its measurement indicators, the specific value of digital financial development (DF) comes from the "Peking University Digital Inclusive Finance Index" released by the Digital Finance Research Center of Peking University. In view of the fact that the index evaluates the development of digital financial inclusion in multiple dimensions and has been widely recognized by scholars, this paper chooses it as the main indicator to measure digital finance.

4.1.3 Control variable (CON)

The control variables in this paper are obtained by merging the indicators of multiple dimensions according to the weight. Firstly, the first-level indicators are set from the three dimensions, and then nine second-level indicators are constructed from these three dimensions, as shown in Table 1. First, the three dimensions are the fundamentals of urban development, the social outcomes of urban development, and the ecological outcomes of urban development. Among them, for the fundamentals of urban development, this article selects six indicators to measure: urban population, average wages, payment index, insurance index, credit index, and degree of digitization. For the social achievements of urban development, this paper selects the number of college students per 10,000 people and the number of doctors per 10,000 people to measure. Finally, for the ecological achievements of urban development, this paper chooses the emission of industrial sulfur dioxide to measure. In this paper, these nine variables are combined into one control variable (CON) by weight.

Table 1. Index system settings.

Fundamentals of development	Urban population Average salary Payment index Insurance index Credit index Degree of digitization
Social outcomes of development	Number of college students per 10,000 people Number of doctors per 10,000 people
Ecological outcomes of development	Industrial Sulfur Dioxide Emissions

4.2 Descriptive statistics

The descriptive statistics of the main variables are shown in Table 2.

Table 2. Descriptive statistics.

Variable	Observations	Average value	Median	Minimum value	Maximum value	Standard deviation
GDP	104	86,310.23	77,186.00	27,839.00	199,017.00	39,010.33
INDEX	104	176.82	178.12	50.35	289.18	65.69
CON	104	12,929.82	10,338.85	4,953.55	62,968.85	8,402.04

4.3 Spatial correlation test

Global Spatial Correlation Analysis. First, the Moran's I index is used to test the spatial autocorrelation between digital finance and high-quality development in Jiangsu Province, as shown in Table 3. From 2011 to 2018, the Moran's I index of GDP was around -0.08, and the Moran's I index of the quality of economic development was around -0.1, indicating that there is a significant spatial correlation between digital finance and high-quality development in this region. Therefore, it is reasonable to analyze regional economic growth based on space.

When Moran's I is greater than 0, it means that the data presents a positive spatial correlation, and the larger the value, the more obvious the spatial correlation; when Moran's I is less than 0, it means that the data presents a negative spatial correlation, and the smaller the value, the greater the spatial difference; the space is random.

Table 3. Moran's, I index test results of GDP and digital finance in Jiangsu Province.

Years	GDP	INDEX
2011	-0.0899	-0.0992
2012	-0.0897	-0.1368
2013	-0.0407	-0.1488
2014	-0.0665	-0.1270
2015	-0.0684	-0.1190
2016	-0.0700	-0.1131
2017	-0.0802	-0.1206
2018	-0.1234	-0.1283

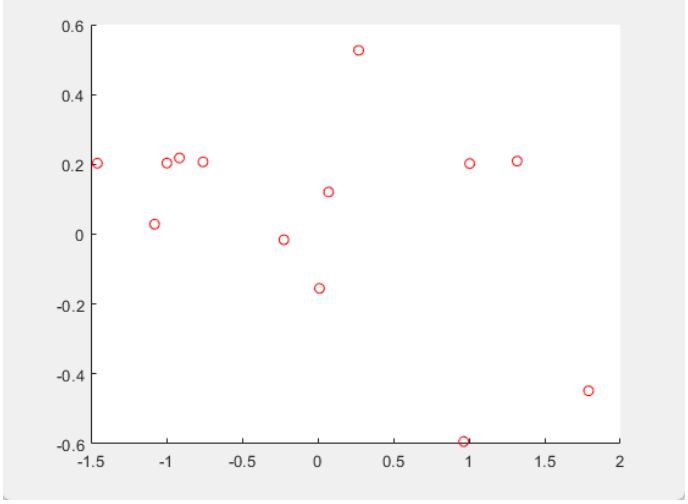

Fig 1. Moran, I scatter plot.

5. Model setting and empirical analysis

5.1 Model construction and testing

This paper chooses the spatial lag model to analyze the impact of digital finance on the quality of economic development in the Yangtze River Delta and its spatial effects. Its model form is:

$$GDP_{it} = \rho W_{ij} GDP_{it} + \alpha_1 INDEX_{it} + \alpha_2 CONTROL_{it} + \varepsilon_{it} \quad (1)$$

Among them, ρ represents the coefficient of the endogenous interaction effect, and its size reflects the degree of spatial spillover or diffusion effect between adjacent cities.

5.2 Demonstration results and analysis

Due to the small amount of relevant data in this paper, this paper decided to conduct model regression without fixed effects, fixed effects, and random effects, and then choose the best model form according to the regression results.

5.2.1 Panel spatial lag model without fixed effects

The regression results are shown in Table 4 according to the spatial lag model without fixed effects of the panel.

Table 4. Regression results of panel spatial lag model without fixed effects.

Variable	Coefficient	T-value	P-value
Intercept	49,977.1624	4.4342	0.0000
INDEX	431.1406	6.6690	0.0000
CON	-0.2582	-0.7217	0.4704
W*dep.var.	-0.4200	-2.6686	0.0076

Among them, the intercept item and explanatory variables are both greater than 0 at the 1% significance level, indicating that digital finance has a significant positive impact on the economic development of the region. In addition, the ^{R2} of this model is 0.3832.

5.2.2 Panel fixed effect space lag model

Table 5 shows the regression results according to the panel fixed effect spatial lag model.

Table 5. Regression results of the panel fixed effect spatial lag model.

Variable	Coefficient	T-value	P-value
INDEX	199.6362	5.3632	0.0000
CON	-0.1814	-1.4507	0.1469
W*dep.var.	0.2030	1.5088	0.1314

Among them, the explanatory variable is greater than 0 at the 1% significance level, which also shows that digital finance has a significant positive impact on the economic development of the region. In addition, the ^{R2} of this model is 0.9374.

5.2.3 Spatial lag model of panel random effects

Table 6 shows the regression results according to the spatial lag model of panel random effects.

Table 6. Regression results of spatial lag model of panel random effects.

variable	coefficient	t-value	p-value
Intercept	38342.715 2	3.4649	0.0005
Index	218.2030	5.638 7	0.0000
Con	-0.1763	-1.4507	0.1597
W*dep.var.	0.13 40	0.9560	0.3390
Teta	0.1161	3.6237	0.000 3

Among them, the intercept item and explanatory variables are both greater than 0 at the 1% significance level, indicating that digital finance has a significant positive impact on the economic development of the region. In addition, the ^{R2} of this model is 0.9280.

Combining the significance of the explanatory variables of the above three models and the size of R^2, this paper finds that the panel fixed effect spatial lag model is the most appropriate. In addition, the three models all prove that the development of digital finance will promote the economic development of the region, which is consistent with the previous assumptions.

6. Research conclusions and policy recommendations

6.1 Research conclusion

This paper uses the panel data of 13 cities in Jiangsu Province from 2011 to 2018 as a research sample to explore the impact of digital finance on the high-quality economic development of cities in Jiangsu Province. The main conclusions are: from the perspective of spatial effects, the quality of economic growth in Jiangsu Province has a significant positive spillover effect, and the high-quality

development of the local economy will drive the growth of the economic quality of surrounding areas. In addition, digital finance has a significant positive impact on the quality of economic development in the region, indicating that digital finance has become an important driving force for the high-quality development of the regional economy.

6.2 Policy suggestion

Based on the above conclusions, in order to better improve the level of coordinated development of my country's digital inclusive finance and the real economy, while reducing regional differences, accelerate the construction of a stronger spatial correlation network for the coordinated development of the two, and better exert the impact of the coordinated development of the two on the macro economy. The positive promotion effect of high-quality development, this paper puts forward the following suggestions:

First of all, it is necessary to strengthen the top-level design and deepen the reform of the inclusive financial system. The development of digital inclusive finance is a complex and systematic project involving financial and industrial policies, which is related to the national economy and people's livelihood as well as stable economic and social development. It is necessary to strengthen top-level design and overall planning and systematically promote it. On the one hand, the government should coordinate the overall situation and strengthen the top-level design of digital inclusive financial development goals, strategic planning, specific measures, and supporting policies. On the other hand, it is necessary to deepen the supply-side structural reform of digital inclusive finance, stimulate the enthusiasm, initiative, and creativity of supply entities related to digital inclusive financial services, establish and improve a multi-level digital inclusive financial market, and build a highly adaptable, competitive Powerful and inclusive modern digital inclusive financial system.

The second is to promote the deep integration of digital technology and finance, and improve the development level of digital inclusive finance. On the one hand, promote traditional financial institutions to follow the trend of technological development, accelerate the integration of traditional financial business and digital technology, and use modern digital technology to promote financial service innovation and transformation, improve service efficiency and enhance customer experience. On the other hand, steadily promote the innovation and development of new digital financial enterprises. Follow the laws of financial development, support new digital financial enterprises to take advantage of digital technology, carry out innovations in digital inclusive financial products, business processes, business models, etc., and promote digital inclusive financial services with precision, humanized service processes, and intelligent risk management. Increase the supply of multi-level digital inclusive financial services to the real economy.

Finally, it is necessary to accelerate the construction of financial infrastructure to facilitate the development of digital inclusive finance. The first is to continue to strengthen the construction of digital information infrastructure. In the era of digital economy, data elements have become one of the most important factors of production. The second is to continue to strengthen the construction of the basic database of credit information. Further promote the development of the central bank's financial credit information database, regional credit information database, comprehensive financial service platform, and market-oriented credit reporting agencies, and break through the "medium barriers" in connecting with major Internet lending platforms such as Ant Financial Services, and integrate financial credit information for customers Collect all credit transactions covering traditional banks and Internet platforms, and correlatively collect the basic information of enterprises and individuals involved in credit transactions, provident funds, litigation and other public information, expand the database information resources, and realize credit evaluation for inclusive groups from multiple dimensions, ease Information asymmetry in digital financial inclusion services. The third is to strengthen the construction of laws related to digital inclusive finance to provide legal protection for the sustainable and healthy development of digital inclusive finance.

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