

The Impact of the Digital Finance on the Agglomeration Development of China's Logistics Industry Based on Empirical Evidence at Provincial Level in China

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Abstract: In recent years, the integration of digital technology development and the traditional financial service industry has generated a new financial service model, that is, digital finance, which has exerted a certain impact on various industries. This paper selects the panel data of 30 provinces in China from 2011 to 2020 to explore how digital finance will affect the agglomeration development of the logistics industry. The two-way fixed model is used for empirical analysis and the results show that digital finance has a significant role in promoting the agglomeration development of the logistics industry. From different perspectives, the coverage breadth, depth of use, and digitalization finance greatly promote the logistics industry, while digitalization development has no such impact on the logistics industry. The positive impact of digital finance on logistics industry agglomeration has clear regional heterogeneity. Specifically speaking, the impact of digital finance in central and western regions is significant on logistics industry agglomeration, while that in the eastern region is not. Therefore, in order to further expand the role of digital finance in promoting the agglomeration development of the logistics industry, we should spare no efforts to develop digital finance, strengthen regional cooperation, and improve the coordinated development of digital finance and logistics industry agglomeration.

Keywords: Digital Finance, Logistics Industry, Industry Agglomeration, High-Quality Development

1. Introduction and Literature Review

As a key industry of the modern service industry, the logistics industry plays an important role in upgrading and developing industrial structures. With the continuous improvement of transportation and the development of electronic information technology in China, the logistics industry has attracted more and more attention. Especially in recent years, the rapid development of the Internet of Things, the Internet, and the supply chain has made new changes in the traditional logistics industry. At the same time, logistics industry agglomeration has turned a vital trend of high-quality development of the logistics industry. Logistics parks with a certain scale and comprehensive service functions have been formed in many areas of China, such as Shanghai Waigaoqiao Free Trade Logistics Park, Weilong Songjiang Logistics Park, and Beijing Southwest Liangxiang Logistics Base. Therefore, it is of great significance to further promote the agglomeration and high-quality development of the logistics industry. Meanwhile, the development of digital technology and the traditional financial service industry has been integrated in recent years. A new financial service model digital finance has been generated, which aims to break the time and space constraints and expand the boundaries of

traditional financial models by using digital technology. Obviously, digital financial models are affecting China's economic development today. However, there are few kinds of literature on the relationship between digital finance and logistics industry agglomeration, so this paper mainly discusses the practical importance of digital finance to the agglomeration development of China's logistics industry.

The main part related to this paper includes two aspects, namely, the influencing factors of logistics industry agglomeration and digital finance as well as its impact assessment. Firstly, in terms of influencing factors of the logistics industry agglomeration, Liu Qijing et al. (2022) studied the logistics cluster and its future development from three perspectives, that is, the concept and quantitative identification of the logistics cluster, the agglomeration externality of the logistics cluster, and the competitiveness and growth trend of the logistics cluster. Liu Xiaoyan et al. (2022) analyzed the interaction between technological upgrading, urbanization, and rationalization of the logistics industry structure. From different aspects, Zhu Wanchun et al. (2020) found that the impact of opening high-speed rail on the logistics industry agglomeration in cities along the route is critical. Guo Hubin et al. (2021) and Fu Qiufang et al. (2019)

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demonstrated the promotion of the logistics industry agglomeration to economic growth and its spatial differences. Wang Yu et al. (2021) discussed the influence mechanism of logistics industry agglomeration on regional economic growth. Xu Qiuyan et al. (2018) empirically tested the spillover effect and spatial heterogeneity of the logistics industry on regional economic growth. According to Shi Xinping (2019), there is a positive relationship between the efficiency of the agglomeration industry and the logistics industry. Cao Bingru (2019), Zhang Jianqi (2017), and Zhu Hui (2015), etc. explored how manufacturing affects the development of the logistics industry from different perspectives. Cui Yuanyuan et al. (2017) believed that the spillover effect of logistics agglomeration contributes greatly to its development in various provinces, while the impact of economies of scale on the logistics industry is limited in the central and western regions. Li Lin (2018) found that both financial agglomeration and financial development have significantly promoted the logistics industry, and the effect of financial development on the logistics industry is much greater than that of financial agglomeration. Li Li (2016) believed that the factors affecting the logistics industry mainly include industry, transportation, commerce, software and hardware infrastructure, government, and labor costs. Secondly, from the aspect of digital finance and its impact assessment, the overall development of inclusive finance in China is quite different and unbalanced in various regions (Zhang Heng et al., 2022). Digital finance is an important force in China's economic development, which can effectively promote the high-quality economic development of the region (Zeng Yanping et al., 2022). Besides, the development of digital finance in China has a long-term and significant promotion on the agglomeration of secondary and tertiary industries (Xia Guangrui, 2021). Digital finance improves the optimization and upgrading of industrial structure through the transmission mechanism of "digital finance — economic development — industrial structure upgrading" (Mu Xiaowei et al., 2022). Moreover, the impact of digital finance on industrial structure upgrading will have a different impact from various aspects (Zhao Rui et al., 2021). Digital finance in this region has a positive impact on economic growth, while that in surrounding areas has a negative one on economic growth (Li Linhan et al., 2021). Digital finance can better promote the service of enterprises, labor-intensive enterprises, high-tech industries, and private enterprises in the central and western regions (Chen Shengqi et al., 2021). The development of digital finance can significantly improve the quality of enterprises' export products (Zhang Mingxin et al., 2021), which positively affects the development of import and export trade. Digital finance not only accelerates the overall upgrading of industrial structures, but also promotes the advanced development of the industrial structure. With the improvement of regional economic openness, the role of digital finance in the overall upgrading of industrial structure has been continuously enhanced (Cheng Yu, 2022).

In past research on the development of the logistics industry, the role of digital finance was often ignored. Although some scholars have found that the digital economy leaves a crucial impact on the development of the logistics industry, there are few types of literature on how digital finance affects the agglomeration development of the logistics industry. This paper combines digital finance with the agglomeration development of the logistics industry in China to provide some reference for related research in the future. This paper also has important practical significance. It is found that digital finance plays a positive role in promoting the agglomeration development of China's logistics industry. Therefore, further promoting the coordinated development of the digital finance and logistics industry has important practical significance for enhancing the high-quality development of the Chinese industrial structure. At the same time, this paper selects the panel data of 30 provinces in China from 2011 to 2020. Referring to relevant research literature, this paper makes a multi-dimensional research and analysis on how the coverage breadth, depth of use, and digitalization of digital finance affect logistics industry agglomeration, which enriches the pertinent research on digital finance and logistics industry agglomeration.

2. Empirical Design

2.1 Setting of Econometric Model

This paper is devoted to exploring the influence of digital finance in the development of logistics industry agglomeration. In order to empirically test the relationship between digital finance and logistics industry agglomeration, this paper selects the panels of 30 provinces from 2011 to 2020 as the basis and constructs a two-way fixed effect model to empirically implement the test. The model constructed in this paper is as follows:

$$LOG_{it} = \beta_0 + \beta_1 AGG_{it} + \sum \varphi Control_{it} + u_i + v_t + \varepsilon_{it}$$

In this model, i represents the province and t represents the year. LOG represents the agglomeration level of the logistics industry in the t^{th} year of the i^{th} province, AGG indicates the total index of digital finance in the t^{th} year of the i^{th} province; β_0 and β_1 are constant terms and core variable coefficients respectively. $Control$ represents a group of control variables that affect LOG , including investment, trade, transportation, population, technology, urbanization, etc. Σ^∞ represents the set of control variables; U_i is the regional (provincial) fixed effect, v_t is the time (year) fixed effect, and ε_{it} is the random error term.

2.2 Variable Description

1. Core variables. The development of the logistics industry (LOG) is the core explanatory variable of this paper. The value-added of the logistics industry (i.e. transportation, warehousing, and postal services) in each province is measured by the proportion of GDP in that year. Besides, digital finance development (AGG) is also the core explanatory variable, considering the feasibility

and availability of data sources. The digital financial data used in this paper include results from the *Digital Inclusive Financial Index* released by the Digital Finance Research Center of Peking University. The digital financial data of 30 provinces from 2011 to 2020 are selected as the substitute index of the core explanatory variable. At the same time, this paper uses the data of three dimensions, including coverage breadth, depth of use, and digitalization of digital finance in the database to construct the index, so as to better depict the changing trend of digital finance in various provinces.

2. Control variables. In order to investigate the influence of digital finance on logistics industry agglomeration more comprehensively and eliminate the interference of other variables that may affect the logistics industry on the effect of digital finance, this paper combines theoretical knowledge and results of existing literature research, selecting the main control variables from five perspectives, that is, investment, trade, transportation, population, technology, and urbanization to control the influence of other variables on logistics industry agglomeration. (1) Investment (FA) which is measured by the ratio of fixed assets investment to GDP in each province of China every year. (2) Trade (IFE), which is measured by the ratio of the annual import and export value of goods to GDP in each province of China. (3) Traffic (DENSITY), which is measured by traffic DENSITY, namely, the ratio of the sum of railway and highway mileage to the area of each province every year. (4) Population (PD) which is measured by population density, namely, the ratio of the annual number of people in each province to the area of the province. (5) Technology (RD), which is measured by the annual investment intensity of research and experimental development (R&D) in each province. (6) Urbanization (TOWNS) which is measured by the annual urban population ratio of each province.

2.3 Data

This paper takes the panel data of 30 provinces (excluding Tibet, Hong Kong, Macao, and Taiwan) from 2011 to 2020 as research samples, all of which come from the *China Statistical Yearbook* and *Digital Inclusive Financial Index of Peking University*. Meanwhile, the data on population (PD) are processed logarithmically, with the details of variables shown in descriptive statistical table 1.

Table 1 Descriptive Statistics of Variables

Variable	Number of Observation	Mean Value	Standard Deviation	Minimum Value	Maximum Value
LOG	300	3.333	2.295	0.249	9.390
BRE	300	198.010	96.334	1.960	397.000
DEP	300	212.036	98.106	6.760	488.680

DIG	300	290.238	117.644	7.580	462.230
AGG	300	217.246	96.968	18.330	431.930
FA	300	79.301	25.782	20.999	147.955
IFE	300	26.648	29.629	0.757	154.816
DENSITY	300	0.165	0.5075	0.00001	2.174
PD	300	211.630	747.181	0.001	3923.981
RD	300	1.673	1.135	0.411	6.444
TOWNS	300	59.006	12.218	35.030	89.600

3. Empirical Results and Discussion

3.1 Full Sample Analysis

In order to explore the influence of digital finance on the benchmark regression of logistics industry agglomeration, this paper uses the model sample data for benchmark regression and chooses the two-way fixed effect model for the next empirical analysis. The regression results are shown in Table 2.

According to the benchmark regression results of the model, it can be seen that the coefficient of the digital financial aggregate index (AGG) is positive on the basis of adding control variables. The regression result of digital finance (AGG) to logistics industry agglomeration (LOG) is significantly positive, which shows that the value of LOG rises with the increasing AGG value when other control variables are unchanged. This fully manifests that digital finance can significantly promote the agglomeration of the logistics industry. It also can be seen that the development of digital finance can effectively alleviate the constraints of logistics industry agglomeration. The high development level of digital finance also means the advance of the digital economy. Digital finance provides a better digital platform for logistics industry agglomeration, which is convenient for logistics, e-commerce, and other enterprises to better conduct procurement and financing transactions, thus providing demand for the development of the logistics industry.

In this model, the regression coefficients of control variables FA, RD, and TOWNS are significantly positive, which proves that investment, science and technology, and urbanization are important driving forces for logistics industry agglomeration.

Table 2 Baseline Regression Results

	LOG (1)	LOG (2)	LOG (3)	LOG (4)
AGG	0.016*** (3.60)	0.019*** (3.80)	0.016*** (3.25)	0.021*** (4.01)
FA		0.005** (2.07)	0.005** (2.41)	0.005* (1.72)
IFE		0.010** (2.26)	0.012** (2.41)	0.005 (0.87)
DENSITY			-0.264 (-0.11)	2.784 (1.04)
PD			2.974** (2.26)	1.900 (1.31)
RD				-0.414* (-1.79)
TOWNS				0.075** (2.24)
Constant Term	2.667	1.874	10.450	3.573
Provincial Fixed Effect	Control	Control	Control	Control
Year Fixed Effect	Control	Control	Control	Control
R2	0.0485	0.094	0.112	0.139
Sample Size	300	300	300	300

Note: The values in brackets are robust standard deviations, with *, **, *** being significant at the levels of 10%, 5%, and 1% respectively. The followings are the same.

3.2 Dimensional Analysis

In order to investigate the overall impact of digital finance on logistics industry agglomeration, this paper also studies the impact of three dimensions of digital finance on logistics industry agglomeration, including coverage breadth, depth of use, and digitalization. The dimensional regression results are shown in Table 3.

The empirical study shows that the coefficient regression results of the impact of coverage breadth (BRE) and depth of use (DEP) of digital finance on the logistics industry are significantly positive, while the regression coefficient of digitalization (DIG) of digital finance on the logistics industry is not. This shows that the coverage breadth and depth of use of digital finance can greatly improve the logistics industry agglomeration. It can be seen that with the improvement of the coverage breadth and depth of use of digital finance, more residents enjoy the services of digital finance, so they choose more digital financial instruments for purchasing, trading, and other activities, thus further promoting the development of e-commerce and driving the agglomeration development of logistics industry. Therefore, we need to improve the depth and coverage of digital finance. However, the reason why the digitalization of digital finance has no significant impact on the logistics industry may be because the development of the logistics industry requires a higher digitalization of digital finance, while the current digitalization in China has not fully met such requirements.

Table 3 Dimensional Regression Results

	LOG (1)	LOG (2)	LOG (3)
BRE	0.041*** (5.45)		
DEP		0.008*** (2.69)	
DIG			0.003 (1.35)
FA	0.005** (2.18)	0.006** (2.10)	0.007** (2.49)
IFE	0.010* (1.78)	0.003 (0.53)	0.002 (0.35)
DENSITY	2.673 (1.03)	2.283 (0.84)	2.128 (0.78)
PD	0.769 (0.53)	2.745* (1.89)	3.243** (2.24)
RD	-0.059 (-0.26)	-0.390 (-1.63)	-0.311 (-1.29)
TOWNS	-0.015 (-0.44)	0.081** (2.24)	0.056 (1.60)
Constant Term	3.815	6.181	9.093
Provincial Fixed Effect	Control	Control	Control
Year Fixed Effect	Control	Control	Control
R2	0.180	0.110	0.091
Sample Size	300	300	300

3.3 Regional Analysis

Considering the differences in resources and industrial development in different regions, the impact of digital finance on logistics industry agglomeration may be different in various regions. Therefore, according to the division of provinces and cities by the National Bureau of Statistics, we divide the samples into three sub-samples, including eastern China, central China, and western China for sub-sample regression analysis. The regression results by the sample are shown in Table 4.

The regression results of sub-samples show that in the central and western regions, the regression results of digital finance on logistics industry agglomeration are significantly positive, while that of eastern regions is not. This result indicates that digital finance will have a more important impact on the agglomeration development of the logistics industry in the central and western regions. Besides, the influence of digital finance on logistics industry agglomeration in western China is higher than that in eastern China. The reason for this phenomenon may be that the level of economic development in the central and western regions is relatively lower than in the eastern regions, thus digital finance can have a greater driving effect on logistics industry agglomeration. Moreover, the overall resource conditions and development in the western region are higher than those in the western region, so the impact of digital finance on logistics industry agglomeration is more significant. However, the development of the logistics industry and service industry in the eastern region is relatively high, and the existing promotion effect of digital finance on the

logistics industry may have been realized ahead of schedule. Therefore, for the current eastern region, the promotion effect of digital finance on the logistics industry is not obvious. It can be seen that digital finance can promote logistics industry agglomeration, although this influence has significant regional heterogeneity.

Table 4 Regression Structure of Sub-samples

	East-LOG (1)	Central-LOG (2)	West-LOG (3)
AGG	0.003 (0.39)	0.049** (2.53)	0.023* (1.87)
FA	0.012*** (3.35)	0.012** (2.22)	0.001 (0.34)
IFE	0.014** (2.46)	-0.040 (-0.84)	-0.023 (-1.42)
DENSITY	-2.515 (-1.13)	2611.130 (0.27)	-1875.874 (-0.23)
PD	10.690*** (4.71)	11.491 (1.53)	4.336 (1.57)
RD	-0.827*** (-3.19)	-1.239** (-2.04)	0.221 (0.45)
TOWNS	-0.176*** (-4.32)	-0.045 (-0.31)	-0.061 (-0.93)
Constant Term	20.353	46.503	24.951
Provincial Fixed Effect	Control	Control	Control
Year Fixed Effect	Control	Control	Control
R2	0.535	0.6862	0.120
Sample Size	110	80	110

4. Conclusion and Enlightenment

This paper uses the panel data of 30 provinces in China from 2011 to 2020 based on the *Digital Inclusive Financial Index of Peking University* and *China Statistical Yearbook*, empirically testing the impact of digital finance on the logistics industry agglomeration by constructing a fixed effect model. It is found that digital finance can significantly promote logistics industry agglomeration, but different dimensions of digital finance have diverse impacts on logistics industry agglomeration, among which the coverage breadth and depth of use of digital finance can effectively promote the logistics industry agglomeration, while the digitalization has no significant effect. In addition, digital finance has significant regional heterogeneity in the logistics industry development. Digital finance can obviously promote logistics industry agglomeration in the central and western regions, while the promotion effect on logistics industry agglomeration in the eastern region is not significant.

The practical enlightenment of this study is shown as follows. First, vigorously develop digital finance. This paper empirically analyzes that digital finance has a significant role in promoting logistics industry

agglomeration, so it is of great significance to develop digital finance for logistics industry agglomeration. In order to develop the digital financial industry, we should deepen the integration of industry and explore the integration mode of innovation, technology, industry, and finance. At the same time, we should improve China's digital financial systems. The government, enterprises, and other agencies should do a good job in leading the correct development of digital finance. Meanwhile, the empirical results of this paper show that the coverage breadth and depth of use of digital finance can significantly promote the agglomeration of the logistics industry. Therefore, we should improve the coverage of digital inclusive finance. Banks can effectively expand the coverage of digital finance and lower the threshold for small and micro enterprises to obtain financing services. Broadening the depth of digital finance requires us to explore more diversity of digital financial services and products. Secondly, strengthen regional cooperation. Due to the different effects of digital finance on the agglomeration of the logistics industry in the eastern, central, and western regions, we should boost inter-regional logistics cooperation, build an efficient logistics cooperation network system, fully mobilize the enthusiasm of regional logistics enterprises, respect the law of market development, reduce improper government intervention in the logistics industry development, and promote smooth regional logistics and complementary advantages, so as to enhance the agglomeration and high-quality development of inter-regional logistics industry. Thirdly, improve the coordinated development of digital finance and logistics industry agglomeration. First of all, the government should establish and improve the coordinated development mechanism. Secondly, it integrates the management platform of the logistics supply chain, digital mall service platform, and digital financial service platform to realize the integration of business flow, logistics, capital, and information flow, with digital finance empowering the logistics industry to gather and develop. At the same time, in addition to creating full-cycle financial support services and realizing the vigorous development of digital finance in the trade and logistics industry, we will help enterprises transform and upgrade, promote the optimization of the logistics industry structure, and make the logistics industry cooperate with digital inclusive finance.

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