Study on the Influence of Digital Finance on High-quality Economic Development：based on the Mediation Effect of Regional Innovation Efficiency

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Abstract. To examine the relationship between digital finance and quality economic developmen, and the mechanisms by which regional innovation efficiency is transmitted in. This paper use the data of 31 provincial in China from 2011 to 2018, as well as the Fixed effect model,intermediary effects model do test the impact and transmission mechanism of digital finance on high-quality economic development. The research found that digital finance can promote high-quality economic development. Digital finance can drive high-quality economic development by promoting regional innovation efficiency.

Keywords: Digital Finance; Regional innovation efficiency; High-quality Economic Development；

1 Introduction

The Fifth Plenary Session of the 19th CPC Central Committee mentioned that high-quality economic development should be the main theme of China's 14th Five-Year Plan period, and all work should be carried out around high-quality economic development. Digital finance has emerged in China in a relatively short period of time, and the forms and development focus of digital finance at different stages of development are different, and the connotation is also different.

There are differences in the form and focus of digital finance at different stages of development, and the connotation is constantly changing. The attributes of digital finance are in line with the requirements of high-quality economic development, and digital finance can combine scenarios, data and financial innovation products, with the characteristics of "low cost, high speed and wide coverage", profoundly shaping and changing the traditional financial system in China [1].

Therefore, this paper seeks to contribute to the following aspects: first, to examine the relationship between digital finance and economic quality development from an empirical perspective. Secondly, we use regional innovation efficiency of different regions as a mediating variable to test the mechanism of digital finance in high-quality economic development, and establish the main line of research of "digital finance-regional innovation efficiency-high-quality economic development". This

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paper expands the mechanism and path of digital finance's effect on high-quality economic development and reveals the important role of regional innovation efficiency in it.

2 Literature Review and Research Hypothesis

2.1 Digital finance and high-quality economic development

As a combination of Internet and finance, digital finance naturally carries the characteristics of finance and does not change its own financial logic. Digital finance is usually measured by the "Peking University Digital Inclusion Index". The source of this index is the transaction account data of Ant Financial Services, which has constructed a digital financial inclusion index system in three dimensions: breadth of coverage, depth of use, and degree of digitization [2]. With the help of the aforementioned index, relevant quantitative research can then be conducted.

To explore the path of high-quality economic development, it is most important to understand the definition of high-quality economic development and its measurement method. At present, there are several approaches to measuring high quality in academia: the first is to take a single indicator to measure economic high quality development, the most common is total factor productivity (TFP) The method is often one-sided and does not provide a good measure of the overall operation of the economy. The second is the use of indicator system to measure economic quality development, the method is usually to select representative indicators, and then with the help of principal component analysis, factor analysis, entropy method and other methods to combine the selected indicators with certain weights into a specific number, so as to measure economic quality development.

The impact of digital finance on high-quality economic development can be analyzed mainly from several perspectives of capital allocation, industrial structure and green development. In general: digital finance, as a product of combining traditional financial business with the Internet, has greatly expanded the breadth of financial business coverage as well as the total scale, improved economic efficiency, and established a solid foundation for high-quality economic development.

H1: Digital finance can contribute to high-quality economic development

2.2 Digital finance, high-quality economic development and regional innovation efficiency

The regional innovation efficiency reflects the quantitative relationship between innovation inputs and outputs of a region, and regions with high innovation efficiency can maximize innovation outputs with minimal innovation resource inputs [3].

The efficiency of digital finance for regional innovation is mainly reflected in two aspects: on the one hand. The regulatory system of China's financial system has developed slowly and is still in an imperfect stage overall, with a series of problems such as information asymmetry, which increases the cost of innovative agents in the process of seeking financing. Digital finance with its inclusive and wide coverage can

bring sufficient financial support to innovative subjects and make up for the shortcomings of traditional financial institutions such as high cost and low efficiency of credit supply, while digital finance can also mitigate credit risk and reduce the transaction costs of financial services, making the risks and benefits more compatible [4]. On the other hand, there is also an indirect incentive effect of the development of digital finance on regional innovation, and the efficiency of regional innovation is influenced by both innovation input and innovation environment, i.e., internal and external factors. From the perspective of innovation input, the development of digital finance can fully drive the spillover of technology elements and R&D personnel. From the perspective of innovation environment, the development of digital finance can enhance the efficiency of financial services, release business potential, and stimulate the demand for talents. Both paths indirectly contribute to the efficiency of regional innovation[5].

High-quality economic development cannot be achieved without innovation, and innovation efficiency, as a key link in the innovation system, will also have an impact on high-quality economic development. Ren Baoping (2021) proposed that the high-quality development of China's economy is closely related to innovation subjects and innovation incentive mechanisms [6]. Li Fuping (2021) used a spatial Durbin model test to conclude that the improvement of innovation efficiency of a region not only has an impact on the economic high-quality development of that region, but also has a positive spatial spillover effect on the economic high-quality development of the surrounding regions [7]. Wang Guimei (2021) concluded that intellectual property protection can promote regional innovation efficiency as a way to drive high-quality economic development [8]. Yang Weili (2021) verified that improving the innovation efficiency of cities can promote high-quality economic development under the total factor perspective [9]. Therefore, the following hypothesis is proposed in this paper.

H2: Digital finance can influence the high-quality development of the present economy through the path of regional innovation efficiency

3 Research Design

3.1 Description of variables

3.1.1 Explained variables.

The explanatory variable selected in this paper is the level of economic quality development (EQ). Referring to Mlachila, Jiang Song, Shi Bo and others, the economic quality development is measured in two dimensions: the fundamentals of the economy and the social outcomes and this paper discards the equal weight assignment method in the above literature and uses the entropy value method to determine the weights of the indicators [10,11].

3.1.2 Main explanatory variables.

The main explanatory variable of this paper is digital finance (index) [2]. The Digital Financial Inclusion Index of Peking University, jointly compiled by the Digital Finance

Research Center of Peking University, Ant Financial Group, using the massive data of Ant Financial, is used to measure the level of digital financial development in Chinese provinces and municipalities.

3.1.3 Mediating variables.

In terms of innovation inputs, from the perspectives of capital and labor, the R&D expenditure of industrial enterprises above the scale and the equivalent full-time equivalent of R&D personnel of industrial enterprises above the scale are selected as input indicators. For innovation output, the direct knowledge output and indirect economic output of regional innovation activities are measured using the number of domestic patent applications granted and new product sales revenue as output indicators [12].

3.1.4 Control variables.

According to the existing literature[13], regional infrastructure (Reg), local government intervention (Gov), trade openness (Tra), regional education level (Edu), and regional industrial structure (Structure), a total of five variables, were selected as control variables for the model.

3.2 Setting of the econometric model

Integrating the selection of the above variables, in testing the effect of digital finance on the promotion of high-quality economic development, since this paper uses panel data, it is necessary to test to decide the question of whether to choose a fixed-effect, or random-effect model. This paper rejects the original hypothesis at the 1% level by Hausman test, so the random effect model is rejected and the fixed effect model is chosen, and the robust standard error is used by default.

$$EQ_{it} = \alpha_0 + \alpha_1 index_{it} + \beta control_{it} + \varepsilon_{it} \quad (1)$$

where EQ_{it} denotes the indicator of the level of economic quality development of province i in period t, and $index_{it}$ denotes the level of digital finance of province i in period t. $control_{it}$ is the control variable.ε_{it} denotes the random disturbance term.

Equation (1) reflects a direct influence relationship with digital finance as the explanatory variable and high-quality economic development as the explanatory variable. To further test the impact mechanism involved, the mediating variable regional innovation efficiency is added and the mediating effect model is constructed as follows.

$$TE_{it} = \alpha_0 + \alpha_1 index_{it} + \beta control_{it} + \varepsilon_{it} \quad (2)$$

$$EQ_{it} = \alpha_0 + \alpha_2 TE_{it} + \beta control_{it} + \varepsilon_{it} \quad (3)$$

To test whether there is a nonlinear relationship between digital finance in regional innovation activities, a threshold regression model proposed by Hansen is used to analyze the heterogeneous impact of digital finance on regional innovation efficiency

under different development qualities, drawing on the threshold variable of high-quality development, as follows.

$$EQ_{it} = \alpha_0 + \alpha_1 index_{it} \times I(TE_{it} < \gamma_1) + \alpha_2 index_{it} \times I(TE_{it} > \gamma_2) + \beta control_{it} + \varepsilon_{it} \quad (4)$$

Among them, TE_{it}, $index_{it}$ and EQ_{it} have the same meaning as above and are regional innovation efficiency, digital finance and high-quality economic development, respectively, and λ is the threshold value to be estimated, through which λ is able to divide the sample of the study into two parts. I(-) is the indicative function, when the condition in the bracket is satisfied, the value is 1, indicating that the multiplication term is retained; conversely, if the condition in the bracket is not satisfied, the value is 0, indicating that the whole multiplication term is 0.

4 Empirical results and analysis

4.1 The impact of digital finance on the high-quality development of the economy

The regression results in the first column of the baseline regression shown in Table 1 indicate that digital finance can lead to high-quality economic development, i.e., for every unit increase in the digital finance index, high-quality economic development improves by 0.11 units, and the results are significant. After we control for the control variables such as regional infrastructure and local government intervention respectively, the coefficient of the impact of digital finance on high quality economic development decreases slightly from about 0.11 to about 0.0706, but it is still significant at the level of changing to kanji numbers, which means that there is a significant impact of digital finance on high quality economic development with or without adding control variables.

Table 1. Regression results of the basic model

	(1)	(2)	(3)	(4)	(5)	(6)
index	0.11002***	0.06962***	0.06500***	0.07701***	0.07690***	0.07069***
	(8.81176)	(4.88197)	(4.46953)	(5.53694)	(5.52109)	(5.21828)
Reg		0.12779***	0.12299***	0.12402***	0.12013***	0.10868***
		(5.07042)	(4.85604)	(5.19078)	(4.87331)	(4.53051)
Gov			0.06799	0.07752*	0.08477*	0.09578**
			(1.51482)	(1.82928)	(1.93298)	(2.25581)
Tra				0.13267***	0.13397***	0.13085***
				(5.24191)	(5.26992)	(5.32452)
Structure					-0.12774	-0.29930
					(-0.65491)	(-1.54873)
Edu						-0.48953***

						(-4.01111)
Constant	-1.33003***	-1.29617***	-1.29765***	-1.14116***	-1.14264***	-1.87484***
	(-20.85876)	(-21.32886)	(-21.41465)	(-17.69530)	(-17.68366)	(-9.71806)
Observations	248	248	248	248	248	248
R-squared	0.2642	0.3429	0.3496	0.4243	0.4250	0.4661
Number of PROVENCE	31	31	31	31	31	31

Note: t-statistics calculated based on robust standard errors are in parentheses:*** p<0.01, ** p<0.05, * p<0.1.

5 Further Research

The above results suggest that digital finance can effectively stimulate the high-quality development of the economy. Then, whether there is an impact path for digital finance to promote high-quality economic development by improving regional innovation efficiency. And whether the impact of digital finance on high-quality economic development differs in regions with differences in the level of innovation efficiency. In summary, this paper will further explore the role of regional innovation efficiency in it through the mediation model and threshold effect model as well as heterogeneity analysis.

5.1 Regression analysis of the mediating effect

In order to test whether there is a transmission path of digital finance-regional innovation efficiency-economic quality development, this paper uses regional innovation efficiency as the mediating variable and digital finance and economic quality development distribution as the explanatory and explanatory variables of the mediating effect model, respectively. The regression results of the mediating effect model are shown in Table 2.

Table 2. Regression results of the mediating effect model

	(1)	(2)	(3)
VARIABLES	EQ	TE	EQ
TE			0.20343***
			(3.16372)
Index	0.07069***	0.05964***	0.05856***
	(5.21828)	(4.19862)	(4.24047)
Reg	0.10868***	0.06275**	0.09592***
	(4.53051)	(2.49468)	(4.02396)
Gov	0.09578**	0.02557	0.09058**
	(2.25581)	(0.57427)	(2.17669)

Tra	0.13085***	-0.03615	0.13820***
	(5.32452)	(-1.40318)	(5.71601)
Structure	-0.29930	-0.38342*	-0.22131
	(-1.54873)	(-1.89219)	(-1.15953)
Edu	-0.48953***	-0.13364	-0.46234***
	(-4.01111)	(-1.04437)	(-3.85843)
Constant	-1.87484***	0.00159	-1.87517***
	(-9.71806)	(0.00787)	(-9.92507)
Observations	248	248	248
R-squared	0.46611	0.31074	0.48901
Number of PROVENCE	31	31	31

Regression (2) is the regression result of Equation (2), and the result of regression (2) shows that digital finance significantly contributes to regional innovation efficiency, and the coefficient of regression is 0.0596, indicating that a one-unit increase in the level of digital finance in a region increases the innovation efficiency of that region by 0.0596 units. Regression (3) is the regression result of equation (3), and the result of regression (3) shows that both digital finance and regional innovation efficiency can significantly promote high-quality economic development, and the coefficients are 0.2034 and 0.058, respectively. Combining the results of regression (1) and regression (2), we can get the conclusion that digital finance can promote high-quality economic development by enhancing regional innovation efficiency. In order to test whether this mediating variable is valid, Sobel test should be used for further testing, and the result obtained z-statistic is 4.42 and the p-value is less than 0.01. Thus, it can be seen that regional innovation efficiency is a valid mediating variable and plays a significant partial mediating role in this model.

6 Conclusion

6.1 Conclusion

In this paper, we examined the impact of digital finance on high-quality economic development and the transmission mechanism of regional innovation efficiency in it using the provincial panel data of China from 2011 to 2018. The following conclusions are drawn.

First, digital finance can effectively promote high-quality economic development. And the three descending indicators of digital finance have different impacts on the economic high-quality development, and the impacts vary from digital finance to the depth of use, the breadth of coverage, and the degree of digitalization in decreasing order.

Secondly, regional innovation efficiency plays a positive part in mediating the process of digital finance's influence on high-quality economic development. From the mechanism of action, digital finance can promote regional innovation efficiency and use it to drive economic quality development.

6.2 Research Implications

First, improve the infrastructure construction of digital finance and sound the development system of digital finance. Accelerate the combination of digital information technology and the traditional financial industry, enrich the types of digital financial products and the coverage of financial services, so that digital finance can more actively and effectively promote high-quality economic development.

Second, while vigorously promoting the development of digital finance, attention should be paid to the improvement of regional innovation efficiency. For enterprises, they should formulate innovation development strategies, improve their service and innovation efficiency, and maximize innovation output with minimal innovation resource input under the established conditions.

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