

Research on the impact of digital finance on regional innovation

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Abstract. Innovation is indispensable for the high-quality self-reliance and development of an economy and society in a country. At present, China's existing innovation capacity is still unable to meet the needs of economic development. This paper focuses on how digital finance affects regional innovation in China. The findings show that digital finance has a significant positive promotion effect on regional innovation, and this promotion effect has been gradually strengthening over time.

Keywords: Digital finance, Regional innovation, Difference-in-difference method.

1. Introduction

Innovation activities are a complex process characterized by high risk, long cycle, and uncertainty. Therefore, traditional finance usually carefully considers their safety and liquidity factors, making it difficult to provide long-term stable credit support for innovation activities. As an important subject of innovation activities, enterprises have a large demand for capital investment in innovation activities, which cannot be met solely by endogenous financing. Digital finance, as an organic integration of digital technology and financial functions, has the characteristics of strong risk identification and control capabilities, wide service scope and coverage, and low transaction costs. It can accelerate the free flow and effective allocation of funds, information, digital and other elements, stimulate new driving forces for regional innovation level improvement.

Enterprises are the main micro subjects of innovation activities, and their innovation activities are constrained by the input of innovation factors. The development of the financial system can greatly affect the allocation of innovation factors in enterprises, thereby realizing the role of innovation activities. The theory of financial development points out that a developed financial system has more effective allocation of financial resources, provides more efficient financial services, and innovation entities will have more opportunities to engage in innovation activities^{[1][2]}. When financial resources are insufficient, due to their own survival needs, the funds for enterprise innovation activities are forced to be squeezed, leading to a decrease in the level of enterprise innovation. This inhibitory effect is more significant in small and medium-sized enterprises. Przychodz et al (2015) found that innovation requires stable financial and capital support after conducting research on the level of innovation in enterprises^[3]. The financial system in China, dominated by commercial banks, is constrained by the high risk of innovative activities and prudent financial regulatory policies, making it difficult to provide sufficient financial support for corporate innovation activities. The development of digital finance has to some extent broken through the limitations of traditional financial systems. Through methods such as blockchain, big data models, and mobile payments, it has improved the efficiency of financial services while reducing the cost of enterprise financing and information asymmetry between financing parties, providing new channels for alleviating the financing difficulties of enterprises.

Based on the above analysis, this article proposes the following research hypothesis: Digital finance affects regional innovation by alleviating financing constraints.

2. Empirical testing

This article uses the difference in differences method to examine how the level of digital finance development affects regional innovation at the provincial level in China. Specifically, this article sets the time variable 'after'. According to the G20 Advanced Principles for Inclusive Digital Finance,

when the sample observations occur before 2016, this variable is set to 0, and thereafter it is set to 1. At the same time, this article sets a grouping variable *top*. Due to the impact of the G20 Advanced Principles for Digital Financial Inclusion, which cover almost all regions of China, it is not possible to directly divide the experimental group and the control group based on whether they have been directly impacted. Considering that the purpose of this study is to examine the impact of the level of digital financial development on provincial regional innovation, this article focuses on the relative size of the Digital Inclusive Finance Index as an indicator. The province with the highest index value in the current year is taken as the benchmark value, and the provinces ranked within 80% of the benchmark value are listed as the first tier. Therefore, the regions in the first tier are set as the experimental group, and other regions are set as the control group. The grouping variable *top* is taken as 1 in the experimental group sample and 0 in the control group. Therefore, this article sets the benchmark model as follows:

$$pat_{it} = \beta_0 + \beta_1 top_{it} \times after_t + \beta_2 top_{it} + \beta_3 after_t + \beta_4 Control_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

In the model, index *i* represents region and index *t* represents time; pat_{it} It is the regional weighted number of patent authorizations; top_{it} For grouping variables, $after_t$ for time variables; $Control_{it}$ To control variables at the regional level with the aim of reducing potential endogeneity issues; $\lambda_t \mu_i$ For regional effects, for temporal effects. This article mainly observes the $after_t$ coefficient of the interaction term β_1 , which measures the causal effect of the development level of digital finance on regional innovation.

In order to intuitively reflect the causal effect of the level of digital finance development on regional innovation, this paper introduces regional characteristic control variables such as economic development level (*pgdp*), industrial structure (*ins*), and financial scale (*fsc*), and further analyzes them using a two-way fixed effects model including region (*prov*) and time (*year*). The results are shown in Table 1.

The results in column (1) of Table 1 show that without introducing any control variables, the coefficient of *Top* × *after* is 13.2629, which is significantly positive at the 1% level; The results in column (2) show that after adding regional feature control variables, the coefficient of *Top* × *after* is 8.3917, which is still significantly positive. This indicates that as the level of digital finance development increases, the level of regional innovation also improves. Furthermore, in order to examine the dynamic effects of digital finance development on regional innovation, this paper also introduced variables *year2017*, *year2018*, *year2019*, and *year2020*, with values of 1 in 2017, 2018, 2019, and 2020, and 0 in other years. These variables were then used as interaction terms with the grouping variable *Top*, as shown in columns (3) and (4) of Table 1. The results in column (3) show that, without introducing control variables, the *Top* × *year* variables are significantly positive at the 1% level, and the coefficients increase year by year; The results in column (4) show that after adding regional feature control variables, the *Top* × *year* variable is also significantly positive at the 1% level, and the coefficient increases year by year. This indicates that the promotion effect of digital finance development on regional innovation continues to strengthen over time.

Based on the above results, it can be concluded that after the G20 advanced principles for inclusive digital finance were proposed, the experimental group showed a significant increase in the number of regional weighted patent authorizations compared to the control group. Moreover, dynamically, the promotion effect of digital finance development on regional innovation showed a trend of increasing over time.

Table 1. Double difference test

Dependent variable	Weighted number of patents granted by region (pat)			
	(1)	(2)	(3)	(4)
<i>Top</i> × <i>after</i>	13.2629*** (0.0000)	8.3917*** (0.0000)		
<i>Top</i> × <i>year2017</i>			5.6468** (0.0183)	3.0972* (0.0927)
<i>Top</i> × <i>year2018</i>			10.9423*** (0.0000)	7.1823*** (0.0003)
<i>Top</i> × <i>year2019</i>			12.6060*** (0.0000)	8.9808*** (0.0000)
<i>Top</i> × <i>year2020</i>			24.5824*** (0.0000)	17.5866*** (0.0000)
<i>Pgdp</i>		0.0914*** (0.0008)		0.0685*** (0.0084)
<i>Inds</i>		-0.0873 (0.5019)		-0.1739 (0.1585)
<i>Fsc</i>		0.2821*** (0.0006)		0.2236*** (0.0040)
<i>Edu</i>		0.1432*** (0.0000)		0.1399*** (0.0000)
<i>Fdi</i>		0.0069*** (0.0000)		0.0066*** (0.0000)
<i>Rdc</i>		0.0758*** (0.0004)		0.0671*** (0.0010)
<i>Cons</i>	6.0071*** (0.0000)	-37.6905*** (0.0000)	6.0071*** (0.0000)	-29.2145*** (0.0001)
<i>Year</i>	YES	YES	YES	YES
<i>Prov</i>	YES	YES	YES	YES
<i>R</i> ² (<i>Within</i>)	zero point four seven seven two	zero point seven one eight five	zero point five four zero two	zero point seven five three five
<i>N</i>	three hundred and ten	three hundred and ten	three hundred and ten	three hundred and ten

Note: Year represents a fixed time effect, while Prov represents a fixed regional effect. The values in parentheses are p-values, and the asterisks (*, **, ***) represent significance levels of 10%, 5%, and 1%, respectively.

For this study, the double difference method requires that the region weighted patent grants of the experimental and control groups maintain a basic parallel time trend before external shocks. This article selects the period before the proposal of the G20 Advanced Principles for Inclusive Digital Finance as the research interval (2011-2016), and based on this, resets the time dummy variable after 14 for a difference in differences test.

3. Conclusions

The main research conclusions of this article are as follows:

Digital finance has a significant positive promoting effect on regional innovation. The empirical results show that compared with the control group, the impact coefficient of regional digital finance on regional innovation in the experimental group is significantly positive. Further dynamic examination from the time trend shows that this positive promotion effect continues to strengthen over time, and the promotion effect of digital finance on regional innovation has passed the robustness test.

Based on the above research conclusions, in order to promote the development of digital finance and improve regional innovation level, combined with relevant theories, this article proposes the following policy recommendations:

Firstly, accelerate the construction of a digital financial infrastructure system and improve the level of digital financial services. Firstly, promote the construction of digital financial information infrastructure. Taking financial technology as the core and based on the new generation of information technology, we will create a new type of financial data center, combine communication network technology with artificial intelligence, cloud computing, blockchain and other technologies to innovate financial service usage scenarios, and build a digital financial information infrastructure. Secondly, promote the construction of digital financial security infrastructure.

Secondly, strengthen policy guidance, improve the depth and coverage of digital finance usage, and implement differentiated development strategies. Firstly, formulate differentiated regional development strategies. Based on the reality of regional heterogeneity, allowing digital finance to develop freely and adopting the principle of consistent development not only fails to eliminate regional and urban-rural differences, but also exacerbates the imbalance of digital finance development between regions through the siphon effect. Therefore, policy guidance should be tailored to the development characteristics of different regions.

References

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