Study on the Impact of Financial Development on the Quality of Regional Innovation in China

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Abstract. Based on panel data from 30 provinces in China from 2001 to 2018, this article empirically studies the impact of financial development on the quality of innovation in Chinese provinces from three aspects: scale, efficiency, and structure, using a fixed effects model. The scale of financial development plays a promoting role in improving the quality of innovation, while the efficiency of financial development has a restraining effect on the quality of innovation. The effect of financial structure on the quality of innovation is not significant. The conclusion of this article provides policy implications for leveraging the driving and promoting role of the financial system in technological innovation.

Keywords: innovation quality · financial development scale · financial efficiency · financial structure

1 Introduction

China's economy is currently transitioning from high-speed development to a more moderate pace, and the problem of uneven economic development among different regions is becoming increasingly apparent. Essentially, this is due to significant differences in the quality of innovation between regions. Therefore, improving the quality of innovation in all regions is crucial for narrowing regional disparities and effectively promoting high-quality development of the Chinese economy.

Saint-Paul (1992) pointed out that funding for specific innovation activities is more easily obtained through financial markets, which can effectively drive economic growth. King and Levine (1993) stated that the financial system can effectively screen out promising enterprises and valuable investment projects, and the credit departments of financial institutions can support their financing. Bai et al. (2013) used a spatial panel Durbin model to study the three dimensions of the financial system, and found that the size of the financial system plays a significant role in promoting regional innovation capabilities. Some scholars have supplemented this research. Zhang and Gao (2017) conducted empirical research at the industry level and found that the size of the financial system can increase the number of innovations in the Chinese manufacturing industry, while the impact of financial efficiency is not significant. On the contrary, market-oriented

allocation of bank credit funds has a significant negative impact on patent stock. Yao (2010) pointed out that the development of financial intermediaries, namely financial efficiency, has a promoting effect on regional innovation capabilities. Jiang et al. (2012) used a spatial Durbin error model to study the role of the financial support system in regional innovation, and found that regional innovation exhibits strong spatial autocorrelation. Increasing research and development funding can promote innovation, but there is competition among regions. Increasing the number of researchers can increase the output of innovation, and there are also knowledge spillover effects among regions. Gong et al. (2014) found that as the industrial structure changes, the financial structure should also be adjusted to promote better development of innovation. As China's manufacturing industry transforms into a creative industry, the demand and requirements for the financial market have increased. The traditional financial system is no longer suitable for economic transformation, and the development of China's financial market requires the construction of a multi-level market.

Existing literature has extensively discussed the relationship between financial development and innovation, which has effectively supplemented and expanded research on the relationship between financial development and economic growth. However, the existing literature still has some shortcomings: under the current situation of innovation bubbles in China's patents, discussions about the impact of financial development on innovation quality mainly focus on research and development investment or the number of patents, which cannot accurately estimate the impact of financial development on innovation. This is unfavorable for the coordinated development of regions and the improvement of regional innovation capabilities. Due to limited information on the quality of Chinese patents, there are relatively few studies that use empirical methods to investigate the impact of financial development on regional innovation quality. This paper measures the value of Chinese invention patents using an innovation index, and studies the relationship between financial development and regional innovation quality using data from 30 provinces in China from 2001 to 2018. This paper attempts to supplement existing literature by empirically examining the impact of financial development on regional innovation quality, and provides a reference for the high-quality development of China's economy in the new era.

2 The Mechanism of the Impact of Financial Development on the Quality of Innovation in Chinese Provinces

Under the influence of financial development, mainly led by banks, this article discusses the impact of financial development on regional innovation quality, mainly from the perspective of the role of financial institutions in technological innovation. Bank credit and other financial tools can directly provide funding support for research and development and technological innovation activities of technology-based enterprises, and it can be discovered that financial development can act on innovation quality. Combined with the literature analysis in the previous section, this article proposes the hypothesis to be tested: financial development is conducive to promoting the improvement of innovation quality.

3   Research Design

3.1   Construction of Econometric Model

In order to study the relationship between financial development and innovation quality, combined with relevant theories and literature, the financial development indicators are expanded, and the following econometric model is constructed:

$$\text{Inn}_{it} = a + sca_{it} + eff_{it} + stu_{it} + x'_{it}\beta + u_i + \varepsilon_{it} \qquad (1)$$

where the explained variable Inn_{it} is innovation quality, and the core explanatory variables sca, eff, stu respectively represent the scale, efficiency, and structure of financial development, and $\mathbf{x}_{it}$ are control variables (eco, gpv, rd respectively represent the level of regional economic development, the degree of government support for the economy, and the intensity of R&D funding investment).

3.2   Variable Selection and Description

The explained variable is regional innovation quality. This article uses an innovation index that includes the patent value of each region to represent innovation quality.

The explanatory variable is the data on the loan balance of financial institutions, which is used to represent private sector credit data. Therefore, the financial structure is represented by the stock trading market value/loan balance of financial institutions (Levine, 2004).

This article selects the economic development level (eco) as the controlled variable, which is measured by the regional gross domestic product. The degree of government support for the economy (gov) is represented by government financial expenditure. The R&D funding intensity indicator is the ratio of government R&D funding to GDP.

3.3   Data Source and Descriptive Statistics

The data used in this article is panel data from 30 provinces in China (excluding Hong Kong, Macao, Taiwan, and Tibet Autonomous Region) from 2001 to 2018. The innovation quality data from 2001 to 2016 comes from the "China City and Industry Innovation Report" published by the Industrial Development Research Center of Fudan University. The data for 2017 and 2018 are calculated based on the measurement method in the report. The regional innovation quality data in the sample comes from the Industrial Development Research Center of Fudan University. The stock market value comes from the Wind database. The data on the balance of various deposits and loans of financial institutions, except for the data in 2018, comes from the statistical yearbooks of various regions, and the rest comes from the "China Financial Statistical Yearbook". The R&D expenditure intensity data comes from the National Bureau of Statistics' National Science and Technology Funding Input Statistical Bulletin. The data for the other variable indicators comes from the "China Statistical Yearbook". In order to better explain the variables, this article has performed logarithmic calculations on the control variables of economic development level (eco) and government support for the economy (gov).

4   Empirical Results and Analysis

4.1   Results of Full Sample Estimation

Columns (1)–(2) of Table 1 show the estimated results of the baseline regression model (1), where column (1) does not include control variables and column (2) adds control variables to column (1). From the results in Table 2, it can be seen that there is a significant positive relationship between financial size and innovation quality in the entire sample, but it can be found that the impact of not including control variables in the model is greater than that of including control variables. Financial development efficiency is only significant at the 1% level in the estimation results of column (1), and in all results, the coefficient of financial efficiency is negative, indicating that the improvement of financial efficiency does not necessarily directly lead to the improvement of innovation quality, but it is likely to inhibit the improvement of innovation quality. The results for financial structure are all not significant, and the coefficient is negative, indicating that the overall development of China's financial structure cannot effectively improve innovation quality.

Table 1. The full sample estimation results.

Variables	(1)	(2)
	Inn	Inn
scai	377.401***	109.714**
	(34.102)	(46.587)
eff	−615.484***	−161.526
	(96.168)	(103.525)
stu	−1.327	−10.519
	(13.657)	(11.937)
lneco		141.687*
		(75.740)
lngov		−107.892*
		(61.232)
rd		222.015***
		(20.613)
Constant terms	100.789*	−706.872***
	(60.443)	(257.581)
Observations	540	540
R^2	0.196	0.394

Note: The values in parentheses represent the standard deviation, *** indicates significant at the 1% level, ** indicates significant at the 5% level, and * indicates significant at the 10% level. The same applies below

Table 2. Estimated results of regional sample

Variables	(1)	(2)	(3)
	Eastern	Central	Western
	Inn	Inn	Inn
sca	204.504*	121.638***	32.632
	(114.866)	(23.401)	(20.182)
eff	−642.771**	50.379	−6.125
	(279.011)	(40.904)	(50.607)
stu	−19.110	10.102	12.282
	(19.398)	(16.592)	(8.148)
Control variables	Yes	Yes	Yes
Constant terms	−1,011.496	−1,333.592***	−444.416***
	(795.633)	(180.812)	(81.109)
Observations	198	144	198
R^2	0.497	0.770	0.404

4.2 Regional Sample Estimation Results

The whole sample is divided into three regions: east, central, and west, and the impact of financial development on innovation quality in these three regions is studied separately. All results are shown in Table 2. The results for the eastern region are shown in column (1) of Table 2, indicating that the scale of financial development has a positive impact on innovation quality at a significant level of 10%, while the efficiency of financial development has a suppressive effect on regional innovation at a significant level of 5%. The impact of financial development structure on innovation quality is not significant, which is consistent with the estimation results of the entire sample. The results for the central region are shown in column (2) of Table 2, indicating that the scale of financial development has a positive impact on innovation quality at a significant level of 1%, while the efficiency and structure of financial development are not significant, indicating that the scale of financial development can improve the innovation quality of the central region. The results for the western region are shown in column (2) of Table 2, indicating that the scale, efficiency, and structure of financial development are not significant, indicating that financial development cannot improve the innovation quality of the western region.

Controlling variables means controlling all the control variables in model (1).

5 Conclusion and Enlightenment

Under the financial development scenario with the banking system as the main force, this paper explores the relationship between financial development and innovation quality. Firstly, through regression analysis of the full sample data of 30 provinces and cities in

China from 2002 to 2018, and in order to consider regional factors, the full sample is divided into three regions for further study. The study found that the role of financial development in promoting innovation quality varies. The scale of financial development has a promoting effect on the improvement of innovation quality, while the efficiency of finance has a inhibitory effect on the improvement of innovation quality, and the role of financial structure in promoting innovation quality is not obvious.

To play the role of the financial system in promoting technological innovation, it is necessary to encourage mutual cooperation and joint research and development among enterprises, strive to improve China's independent innovation ability and innovation quality, formulate innovation policies from a holistic perspective, and grasp the technical innovation capabilities and characteristics of different regions at different stages of development, so that their advantages can complement each other and efforts can be made to reduce the differences between the central and western regions and the eastern regions. For regions with high innovation quality, support for independent research and development should be provided, while for regions with relatively backward innovation quality, support for technology introduction should be provided.

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