The Impact of Financial Agglomeration on Technological Innovation

-- An Empirical Study based on 31 Provinces in China

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Abstract

Using panel data of 31 provinces in China from 2008 to 2019, the path of financial agglomeration on technological innovation was analyzed using the fixed-effects approach, and the following conclusions were drawn: the level of regional financial agglomeration in China has a catalytic effect on technological innovation; the financial agglomeration varies widely among provinces and cities, among which, Beijing, Shanghai, and Tianjin have higher financial agglomeration, and Henan, Inner Mongolia and Hunan The degree of financial agglomeration is low. The over-concentration of financial resources in the eastern region has a significantly lower effect on promoting technological innovation than other regions, and the central and western regions have not reached the level of financial agglomeration to meet the maximum level of technological innovation in the central and western regions due to their restricted financial development. The eastern region gives play to the radiation effect of financial agglomeration and strengthens cross-provincial financial cooperation and exchange. Increase the support for R&D investment in the central and western regions to utilize better the late-stage advantages of the west and central regions and improve the efficiency of technological innovation.

Keywords

Financial Agglomeration; Technological Innovation; Fixed Effect.

1. Introduction

Since the 19th Party Congress, China's economy has entered a stage of high-quality development. The root of high-quality development lies in the vitality and innovation of the economy. Financial agglomeration has the external economy of scale effect, innovation effect, network effect, and self-reinforcing mechanism, which can optimize the allocation of resources in the region.[1] The state strongly supports the development of financial industry agglomeration, which brings together many financial institutions in some areas in China, with Beijing, Shanghai, and Shenzhen as the representatives of financial agglomeration centers. Financial agglomeration has driven the rapid economic development of Shanghai and other regions and has played a positive role in enhancing the efficiency of economic operation, the diffusion of innovation achievements, and relieving employment pressure, and has become increasingly important in the high-quality economic development.

The role of innovation in driving national economic growth is also crucial. Innovation is the inexhaustible power of a country's prosperity, and the key to China's rapid economic development lies in technological innovation. To play the leading role of technological innovation in innovation, strong support from the financial sector is needed. Foreign scholars Buera and Shin's (2008) argue that economic development can promote technological innovation in the real economy through resource allocation and credit optimization effects. [2]

Can financial agglomeration have a catalytic impact on technological innovation while supporting high-quality economic development? Does the higher financial agglomeration in the eastern region have a more pronounced impact on technological innovation?

2. Literature Review

Numerous scholars have extensively studied the issue of the impact of financial agglomeration on technological innovation. In terms of financial agglomeration, financial industry agglomeration is the process of change, formation of a financial territorially intensive system generated in a certain geographical space by the mutual coordination, configuration, and combination of spatial and temporal dynamics of financial resources and geographical conditions of financial institutions, financial products, financial instruments, financial talents, and other resources as well as intermediary social services through the market and non-market linkages, which contribute to the growth and development of the financial industry Mutual cooperation, competition and geographically highly concentrated industrial agglomerations [3]. Liu Hong (2008) financial agglomeration is a dynamic process, i.e., the process of financial industry growth and development in a specific regional space through the integration, coordination, and allocation of financial resources with the spatial and temporal dynamics of regional conditions, and then the formation of a specific scale and concentration of financial markets [4].

In terms of the impact of financial agglomeration on technological innovation, Liu, Jun (2007) on the impact of financial agglomeration on technological innovation, financial agglomeration reduces information costs, improves resource allocation efficiency, and promotes technological innovation through the risk management function, information revealing function, and savings aggregation function of finance [5]. Gao, Xiaolong, and Yang (2017) empirically tested the effect of financial agglomeration on technological innovation using panel data of Chinese provinces and cities. Financial agglomeration has a significant promoting impact on technological innovation. Financial agglomeration will also impact technological innovation through the industrial agglomeration effect, service innovation effect, information diffusion, and human capital effect [6]. Lai, J. S., and Hu, Y. (2017) empirically demonstrated the differential effects of financial agglomeration on total economic growth and technological innovation, as well as the heterogeneity of the above impacts across regions and industries [7]. Wang, Renxiang, and Bai, Min (2017) found that financial agglomeration can promote the efficiency of science and technology innovation based on panel data of Chinese provinces and cities. The impact is most significant in the eastern and western regions, showing the phenomenon that areas with high financial agglomeration will enhance the efficiency of science and technology innovation. In contrast, regions with low financial agglomeration will be negatively affected [8].

In summary, most scholars believe that financial agglomeration has a promotional effect on technological innovation, but the impact of agglomeration level on technological innovation varies from region to region. Some scholars believe that areas with high financial agglomeration will enhance the efficiency of technological innovation. In contrast, some scholars believe that regions with high financial agglomeration will inhibit technological innovation and reverse the crowding-out effect.

3. Empirical Study

3.1. Research Design

The locational entropy index can be used to measure the degree of industrial agglomeration development of a region, and the larger the index, the higher the degree of agglomeration of the

region in that industry [9]. In this paper, location entropy is used to measure the level of regional financial agglomeration, and its calculation formula is.

$$Efinance_{it} = \frac{E_{it}/G_{it}}{E_t/G_t} \quad (1)$$

Where the numerator is defined as the ratio of the financial value-added of each region to the GDP of that region, and the denominator is the ratio of the national financial value added to the national GDP. The larger the value of financial location entropy, the higher the degree of financial agglomeration. The locational entropy index represents the ratio of a region's per capita financial holdings to the national per capita financial holdings.

In this paper, a fixed-effects model is used in the regression of panel data. To investigate whether the effect of the degree of financial agglomeration on technological innovation differs according to regional variability, the model is as follows.

$$\ln Inno_{i,t} = wEfinance_{i,t} + w_1 \ln FDI_{i,t} + w_2 \ln Trade_{i,t} + w_3 \ln RD_{i,t} + \mu_{i,t} \quad (2)$$

i denotes the province, t denotes time, $\ln Inno_{i,t}$ denotes the innovation output of a region at time t, and w represents the elasticity of the effect of financial agglomeration in an area on local technological innovation. Domestic R&D investment ($RD_{i,t}$), openness to the outside world ($Trade_{i,t}$), and foreign direct investment ($FDI_{i,t}$) all play a role in the technological innovation of the country, [7] therefore, the above variables are included in the model as control variables in this paper.

3.2. Variable Selection and Data Sources

The data in this paper are selected from the China Statistical Yearbook, China Financial Statistics from 2008 to 2019 where.

1. explanatory variable: the measure of innovation output. This paper uses the number of patents granted in region i at time year t to represent the number of patents granted as a measure of technological innovation includes the number of invention patents granted, the number of utility model patents granted, and the number of design patents granted.

2. Explanatory variable: entropy of financial agglomeration location.

3. Control variables.

(1) Foreign direct investment (FDI) generates technology spillover [7], and the amount of foreign investment is introduced as a control variable.

FDI=(Foreign-invested enterprises registered at the end of the year after the exchange rate translation of the investment)/(Gross Domestic Product)*100%

(2) R&D investment (R&D) is an essential support for technological innovation by enterprises and universities,[7] and creative human capital investment, with the full-time equivalent of research and experimental development personnel as an indicator.

(3) External openness (Trade). Endogenous growth theory emphasizes that the technology diffusion effect generated by international trade promotes technological innovation in developing countries. [10]

Trade=(Actual import and export trade after translation of exchange rate)/(Gross Domestic Product)*100%

Table 1. Descriptive statistics results of each main variable

Variable	Definition	Observation Point	Mean	Standard Error	Min.	Max.
Efinance	Financial holdings per capita	372	0.88	0.39	0.31	2.39
lnInno	Technological Innovation	372	9.56	1.70	4.20	13.18
lnFDI	Foreign Direct Investment	372	5.57	0.84	3.86	8.42
lnTrade	Total Import and Export to GDP Ratio	372	3.45	2.23	-5.26	6.95
lnRD	R&D investment	372	10.30	1.69	3.09	13.37
East Efinance	Financial Share in the East	132	1.11	0.52	0.49	2.39
Central Efinance	Central Financial Share	96	0.64	0.17	0.31	0.94
Western Efinance	Western Financial Share	144	0.84	0.19	0.43	1.34

3.3. Regression Results Analysis

3.3.1. Full-sample Regression: The Impact of Financial Agglomeration on Technological Innovation

Table 2. Full-sample regression

Explanatory variables	$\ln Inno_{i,t}$		
	OLS	Fixed-effects regression	Fixed-effects lagged by one period
$Efinance_{i,t}$	0.709*** (8.02)	2.142*** (6.13)	2.027*** (13.43)
$\ln RD_{i,t}$	1.031*** (40.45)	1.08*** (5.77)	0.919*** (15.64)
$\ln FDI_{i,t}$	0.322*** (5.54)	0.434*** (3.37)	0.517*** (8.07)
$\ln Trade_{i,t}$	-0.189*** (-7.54)	-0.119** (-2.42)	-0.159*** (-4.65)
$C_{i,t}$	-2.448*** (-7.51)	-5.496** (-2.67)	-3.114*** (-5.03)
N	372	372	372
R^2	0.907	0.738	0.794

Note: t-statistic values are in parentheses, ***, **, * denote significant at 1%, 5%, and 10% significance levels, respectively.

In the full-sample regression, this paper first uses the OLS method for the initial reversal of the model to examine the difference between the impact of the overall regional financial agglomeration level on technological innovation and economic growth. Considering significant differences among provinces, regression through fixed effects will make the results more accurate. The Hausman test obtained the Hausman statistic corresponding to the companion probability of 0.0000, which is less than 0.05. The random-effects model is rejected, and the fixed-effects model is chosen. This paper also adopts fixed-effects regression and performs

robustness tests on the model by adding one-period lag of the core explanatory variables, and the regression results are shown in Table 2.

The regression results of all three methods show that the coefficient of the effect of the degree of financial agglomeration on technological innovation is positive, and they all pass the 1% significance level test, which indicates that the level of financial agglomeration in China's regions has a catalytic effect on technological innovation. Nationally, the regression coefficient of domestic R&D investment is 0.919, indicating that a 1% increase in R&D investment is associated with an average increase of 0.919% in technological innovation, which is the leading cause of technological innovation.

The process of financial industry agglomeration to promote technological innovation activities is to enhance the efficiency of financial market financing through the economies of scale effect and service innovation effect generated by agglomeration. Economies of scale are reflected in the fact that when financial resources are clustered to a certain scale level, it leads to the reduction of transaction costs, savings in working capital, and acceleration of liquidity in the financial market. The service innovation effect is reflected in the fact that relative to areas with low concentration levels, financial agglomeration centers have richer financial resources and an open and fair social environment, which can better attract talents and thus have more prominent independent innovation capabilities. This is mainly reflected in the process of financial agglomeration to accelerate the financial industry's own technological innovation, promote the sharing of infrastructure and information, reduce social transaction costs, improve cross-regional liquidity and strengthen financial supervision. Technological innovation relies on the financial system to play the functions of resource allocation, risk management, information processing, payment, and clearing to provide financial support and risk management services for enterprises. The performance of these functions is closely related to the financial industry's operational efficiency. [11] Therefore, while promoting the operational efficiency of the financial market, financial agglomeration also strengthens the function of resource allocation, risk management, information processing, and payment clearing of the financial system, which promotes the efficiency of enterprises' technological innovation activities.

In addition, the estimated coefficients of R&D investment and foreign direct investment are both positive and significant, indicating that the pull of R&D investment and technology spillover are important influencing factors of technological innovation. The estimated coefficient of external openness is negative, meaning that external transparency has a significant positive effect on financial agglomeration at the beginning of the period but decreases marginal utility over time.

The two estimation results show high consistency and indicate that the model's regression results are more robust.

3.3.2. Regression by Region: The Impact of Financial Agglomeration on Technological Innovation

Considering the considerable variability of technology spillover effects among different regions in China, [12] and the differences in geographical characteristics and economic development levels of different regions, the impact of financial agglomeration on innovation inputs in 11 eastern provinces and cities, 8 central provinces, and cities, and 12 western provinces and cities are studied.

The eastern provinces include Beijing, Fujian, Guangdong, Hainan, Hebei, Jiangsu, Liaoning, Shandong, Shanghai, Tianjin, and Zhejiang. The central provinces include Anhui, Henan, Heilongjiang, Hubei, Hunan, Jilin, Jiangxi, and Shanxi. Western provinces have Gansu, Guangxi, Guizhou, Inner Mongolia, Ningxia, Qinghai, Shaanxi, Sichuan, Tibet, Xinjiang, Yunnan, and Chongqing.

Table 3. Regressions by region

Explanatory Variables	East	Central	West
$Efinance_{i,t}$	1.049*** (6.42)	2.967*** (7.61)	2.348*** (5.55)
$\ln RD_{i,t}$	0.617*** (4.59)	0.928*** (4.73)	0.773** (3.06)
$\ln FDI_{i,t}$	0.044 (0.21)	0.078 (0.29)	0.579*** (4.11)
$\ln Trade_{i,t}$	-0.931*** (-4.58)	0.052 (0.46)	-0.122** (-2.77)
$C_{i,t}$	5.227* (2.00)	-2.296 (-1.37)	-2.093 (-0.94)
N	372	372	372
R^2	0.599	0.643	0.797

Note: t-statistic values in parentheses, ***, **, * indicate significant at 1%, 5%, and 10% significance levels, respectively.

The difference in the level of financial agglomeration in different regions can have different effects on technological innovation. From the eastern, central, and western regions, financial agglomeration promotes technological innovation. Specifically, the central region has the most vital role of financial agglomeration in promoting regional technological innovation, followed by the western region and the eastern region is the weakest. The regression coefficients of financial agglomeration in the central and western regions are closer to the national financial agglomeration than those in the eastern region. The over-agglomeration of financial resources in the eastern region has a significantly lower effect on promoting technological innovation than the other regions. It can be concluded that the higher the degree of financial agglomeration, the lower the level of technological innovation, and the uneven development of financial agglomeration level in the region limits the stable development of regional technological innovation level. Central and western regions are defined in financial development due to their geographical characteristics, resulting in lower financial agglomeration compared with the eastern regions. They, therefore, do not reach the level of financial agglomeration that meets the maximum level of technological innovation in central and western regions. The higher the financial agglomeration, the weaker the role of financial agglomeration on technological innovation, and the "inverted U-shaped" relationship in the evolution process.

The coefficients of R&D investment all passed the significance test of 5%. The coefficient values were larger, which had a positive effect on technological innovation in all three regions, so R&D investment is an important factor influencing technological innovation in China. The regression coefficient value of R&D investment in the central region is larger than that of other regions, which means that technological innovation in the central region is more dependent on capital R&D investment. The regression coefficient of foreign direct investment in the western region is significantly positive, which indicates that the western region needs more financial support from foreign investment, and the slower economic development level restricts the level of technological innovation in the western region to some extent, so the technological innovation in the western region is more influenced by foreign direct investment. Foreign trade has a negative and significant impact on the east and west regions, and foreign exchange has a significant negative effect on technological innovation in the east. Technological innovation requires a large amount of R&D investment, and trade causes a reduction in R&D investment, which to a certain extent has a reverse crowding out of technological innovation.

4. Suggestions

(1) Gansu, Qinghai, and Xinjiang are in the front of the western region regarding location entropy. Still, the natural conditions are not superior; far from Beijing, Shanghai's financial resources are concentrated in the provinces. Therefore, the state should strengthen the financial information disclosure to effectively cover the central and western regions and let the central and western regions from the initial financial market scale as soon as possible. At the same time, the government should pay more attention to technological innovation, increase support for R&D investment in the central and western regions, and introduce professional financial talents to solve the phenomenon of regional innovation imbalance. So as to give full play to the latecomer advantages of the central and western regions, improve the efficiency of technological innovation, and thus achieve a leap in economic development.

(2) The degree of financial industry concentration in Hebei, Inner Mongolia, Anhui, and other provinces and cities is not high, indicating that the radiation-driven effect of Beijing, Tianjin, and Shanghai on the surrounding areas is not obvious, and the interactive development with areas with low financial concentration level needs to be improved. Economic zones such as Yangtze River Delta, Pearl River Delta, and Bohai Rim should play the radiation effect of financial agglomeration, strengthen financial cooperation and exchange across provinces, spread financial resources to neighboring regions, and drive the economic development of each region.

(3) Build multi-level financial agglomeration centers by region. Shanghai, Beijing, and Guangzhou are the main pillars of China's financial system, Chongqing, Sichuan, and Shaanxi as financial centers in the western region, and Hubei as a financial center in the central region, forming a clustering and radiating effect with the characteristics of the region and promoting a more balanced development of financial resources in each region.

5. Conclusion

The level of regional financial agglomeration in China has a catalytic effect on technological innovation. R&D investment and technology spillover are essential factors affecting technological innovation in China. According to the analysis of regional differences divided into eastern, central, and western regions, the excessive concentration of financial resources in the eastern region has a significantly lower effect on promoting technological innovation than other regions, and foreign trade has a significant negative impact on technological innovation in the eastern region. The central and western regions have not reached the level of financial agglomeration to meet the maximum level of technological innovation in the west and central regions due to their restricted financial development. Technological innovation in the central region is more dependent on financial investment in R&D, and technological innovation in the western region is more influenced by foreign direct investment. The higher the financial agglomeration, the weaker the role of financial agglomeration on technological innovation and the "inverted U-shaped" relationship in the evolution process.

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