

On the Impact of Financial Development and Technological Innovation on Industrial Agglomeration

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Abstract

This paper empirically analyzes the impact of financial development and technological innovation on Industrial Agglomeration by using spatial Dobbin model based on the data of Beijing -Tianjin -Hebei Economic Circle in China. This study draws the following conclusions: Financial development has a positive impact on industrial agglomeration, but the weight effect of geographical distance matrix is significantly different from that of economic distance matrix. In the spatial Doberman model with two matrix weights, technological innovation has a significant positive impact on industrial agglomeration. In the spatial Durbin model with two matrix weights, the cross effect of financial development and technological innovation has a significant negative effect on industrial agglomeration. Finally, the following policies are proposed to promote industrial agglomeration: further implement the coordinated development strategy, promote regional technological innovation for a long time, and realize the integration with financial development.

Keywords

Financial Development; Technological Innovation; Industrial Agglomeration.

1. Introduction

In recent years, the Communist Party of China and the government have attached great importance to the collaborative innovation of market subjects. Through various policy tools, the Chinese government has built a high-quality development economic circle to promote common economic development and technological progress. Therefore, the research on the effect of financial agglomeration and technological spillover is an important topic for the development of financial industry. As a national key strategic development area, the continuous progress of Beijing -Tianjin -Hebei region can effectively promote China's industry to move towards the middle and high-end of the global value chain. Vigorously develop industrial clusters and promote product technology innovation [1]. The industrial agglomeration in this region depends on the coordinated development of Finance and science and technology. Therefore, it is imperative to optimize the urban structure and industrial layout. The impact mechanism of financial development and technological innovation on industrial agglomeration is that the financial system improves regional industrial competitiveness by mobilizing funds. The financial system also promotes the development of emerging industries by providing diversified financial services. Technology R&D and introduction can improve the intensity of technological innovation and is conducive to regional technological integration and cooperation. The research of industrial agglomeration began at the end of last century. Marshall put forward two important concepts of industrial agglomeration in 1890: internal economy and external economy. Since then, the academic community has conducted an in-depth discussion on this issue.

Many scholars at home and abroad have made empirical analysis on this problem based on the threshold effect. However, some studies only involve two aspects of industrial agglomeration, namely financial development and technological innovation. Few studies consider the interaction between them and industrial agglomeration. Due to China's economic transformation and the transformation of economic development objectives, more scholars pay attention to the economic circles such as the Yangtze River economic belt and Guangdong, Hong Kong and Macao, while there is relatively little research on the economic circle.

In this context, based on two matrix weights, this topic takes Beijing -Tianjin -Hebei economic circle as the survey object, and creates a spatial measurement model that combines the interaction of Finance and technology. This paper will use the data of economic circle from 2011 to 2020 to empirically analyze the impact of financial development and its interaction on industrial agglomeration.

2. Research Design

2.1. Variable Selection

(1) Explained variables. Select industrial agglomeration (Y) as the explained variable. In previous empirical studies, the main factors related to industrial agglomeration are industrial concentration and location entropy. At present, Beijing -Tianjin -Hebei region is in a critical period of industrial structure upgrading and adjustment. Therefore, this paper uses the density quotient [2] of industrial enterprises to understand the level of industrial agglomeration. It reflects the increase of industrial scale and operating value to a certain extent. Therefore, this paper selects the contribution of industrial added value to GDP as the explained variable.

(2) Explanatory variables. The explanatory variables are financial development (X1) and technological innovation (X2). When determining the level of scientific and technological innovation, researchers all over the world choose two indicators as the evaluation reference standards, namely, the number of patent applications and the technology market turnover rate. This is mainly because design patents and utility model patents have no impact on economic development. Only invention and creation can really promote industrial development and then affect economic development. Therefore, referring to the empirical research, when measuring the financial development (X1), the subjects chose an indicator of the added value of the financial industry [3], while a group of indicators of scientific and technological innovation (X2) is the number of patent applications [4]. This paper also constructs a spatial measurement model combined with empirical cases. In this process, two natural logarithms, X1 and X2, are set.

(3) Control variables. Industrial agglomeration and financial development are inseparable from technological innovation. In addition, it also depends on the influence of many factors, such as policy, investment capital and so on, but these effects are not the main problem of this paper. In order to control independent factors, this paper selects government behavior, human capital and capital investment level as control variables. Due to the great impact of government public expenditure on industrial agglomeration, in the process of evaluating government behavior (Z1), this topic selects an index as the contribution value of public expenditure to local GDP. With the continuous advancement of industrialization and intellectualization, human capital is more reflected in the corresponding knowledge and skills. Therefore, when evaluating the human capital (Z2) of the discipline, an indicator is set as the proportion of college students in the local resident population. The level of capital investment (Z3) consists of fixed capital investment and working capital investment. However, due to the more obvious regional liquidity of working capital, it can't truly reflect the actual situation of capital investment in the region. Therefore, in the process of determining the level of capital investment, the selected index is the contribution value of fixed capital investment to GDP.

2.2. Spatial Autocorrelation Test

Spatial autocorrelation refers to the potential interdependence between different variables in the same distribution area. First, we verify the autocorrelation of variables [5]. Therefore, Moran's I index and Geary's C index are selected in this paper. However, Geary's C index has no advantage in using spatial weight, and its reliability is lower than Moran's I index. Therefore, when determining the spatial autocorrelation of the main variables, the subjects selected Moran's I index, industrial agglomeration (Y), financial development (X1) and technological innovation (X2), and then judged the significance of Moran's I index through Z statistics.

If it can significantly describe Moran's I index, it can vividly show that there is a certain spatial correlation between variables, then we can further set the weight matrix, construct the econometric model under different matrix weights, and analyze the direction and size of spatial correlation between variables. Formula for calculating Moran index:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^n (y_i - \bar{y})^2} \quad (1)$$

Where, w_{ij} represents the space weight matrix, which is generated between elements i and j , n is the total number of unit elements in the space, and S_0 is the sum of all spatial weights.

2.3. Spatial Weight Matrix Building

Because Beijing and Tianjin are geographically adjacent, and many cities are adjacent to Hebei Province, the weight matrix of geographical distance and economic distance is very important. The geographical distance weight matrix takes the distance between different cities as the weight of spatial correlation analysis.

$$W_{ij}^1 = \begin{cases} 1/d, i \neq j \\ 0, i = j \end{cases} \quad (2)$$

In expression (2), d as an important component, represents the Euclidean distance of each city. The economic distance weight matrix is the representative of the provincial spatial weight matrix, and its production premise is economic distance, which can use the output value of different industries in different cities as the weight of spatial correlation analysis.

$$W_{ij}^2 = \begin{cases} \frac{1}{|\bar{Y}_i - \bar{Y}_j|}, i \neq j \\ 0, i = j \end{cases} \quad (3)$$

Where, $\bar{y}$ is the average value obtained after comparing the total output value of the secondary and tertiary industries in each region for a continuous ten period of time since 2010, and i or j is the i or j cities.

2.4. Spatial Durbin Model Setting

The spatial Durbin model takes the space lag interpretation variable into account, and can use panel data to obtain the spatial spillover effect. Therefore, this paper introduces the lag value Y_{t-1} of the explained variable as the explained variable to study whether financial development

can affect industrial agglomeration. The spatial dynamic Durbin model constructed in this paper is as follows:

$$Y_{it} = \tau Y_{i,t-1} + \delta W_{ij} Y_{i,t} + \mu W_{ij} Y_{i,t-1} + \beta X_{it} + \alpha_1 Control_{it} + \theta W_{ij} X_{it} + \alpha_2 W_{ij} Control_{it} + u_i + v_t + \varepsilon_{it} \quad (4)$$

Where, W_{ij} is linked to the spatial weight matrix W_{ij}^1 and W_{ij}^2 , and X represents the level of financial development, technological innovation and the interaction between financial development and technological innovation, $Control$ represents the control variables of government behavior, human capital and capital input level. u_i represents the fixed effect of space, v_t and ε_{it} are separately fixed effect of time as well as the error term.

2.5. Spatial Effect Decomposition

The direct effect is to measure the influence of the change unit of each variable on the local dependent variable, and the indirect effect is to measure the influence of the change unit of each variable on the adjacent dependent variable. Because the spatial econometric model studies the complex spatial correlation between variables, the parameters of the model cannot reflect the direct and indirect influence of the function. Therefore, this paper uses the partial differential method to calculate the impact of financial development and technological innovation on industrial agglomeration. We established the following Durbin model:

$$Y = (I - \delta W)^{-1} (\beta X + WX\theta) + R \quad (5)$$

Where, W and X represent financial development and technological innovation respectively, R represents the residual term, which is composed of two parts, namely the intercept term and the error term.

For the k -th independent variable X , the partial derivative matrix of the expected value of its corresponding Y can be written as:

$$\begin{bmatrix} \frac{\partial E(Y)}{\partial x_{1k}} & \dots & \frac{\partial E(Y)}{\partial x_{nk}} \end{bmatrix} = \begin{bmatrix} \frac{\partial E(y_1)}{\partial x_{1k}} & \dots & \frac{\partial E(y_1)}{\partial x_{nk}} \\ \vdots & \ddots & \vdots \\ \frac{\partial E(y_n)}{\partial x_{1k}} & \dots & \frac{\partial E(y_n)}{\partial x_{nk}} \end{bmatrix} = (I - \delta W)^{-1} \begin{bmatrix} \beta_k & \omega_{12}\theta_k & \dots & \omega_{1n}\theta_k \\ \omega_{21}\theta_k & \beta_k & \dots & \omega_{2n}\theta_k \\ \vdots & \vdots & \ddots & \vdots \\ \omega_{n1}\theta_k & \omega_{n2}\theta_k & \dots & \beta_k \end{bmatrix} \quad (6)$$

The average value of the elements on the diagonal of the right partial derivative matrix represents the direct effect. See formula (6) for details. The evaluation of indirect effect comes from the average value of the row sum or column sum of non-formula elements, so as to get the diagonal of the right partial derivative matrix in formula (6).

3. Empirical Test and Analysis

This paper uses stata15.0 to analyze the panel data of 12 provinces in Beijing -Tianjin -Hebei economic circle, get the results of autocorrelation test and model regression, and make specific analysis.

3.1. Spatial Autocorrelation Test

Using the panel data of 12 provinces in the region, the Moran's I index of industrial agglomeration, financial development and technological innovation of the economic circle is calculated.

The results show that the Moran I index of dependent variable y is significant at the level of 5% from 2011 to 2020, and its value fluctuates between 0.11 and 0.18. The Moran I index of independent variable X_1 in 2015 and 2017 is significant. If it can meet the level requirement of 10%, after comparison, the significance of Moran I index in other years needs to meet more than 5%, and its value fluctuates between 0.16 and 0.36. In 2016, if the independent variable significance of Moran I index can meet the level requirement of 10%, after comparison, the significance of Moran I index fluctuates between 0.14 and 0.34 in other years, which can vividly show that there is a significant spatial positive correlation between industrial agglomeration, financial development and technological innovation in the economic circle.

3.2. Analysis of Empirical Results

According to the general idea of studying regional economic problems, this paper constructs a dynamic spatial Dobbin model, which mainly realizes this goal through different matrix weights, and comprehensively refines its influence through partial differentiation.

3.2.1. An Empirical Analysis of the Impact of Financial Development and Technological Innovation on Industrial Agglomeration

Using the dynamic spatial Dobbin model under the weight of geographical distance, this paper deeply studies the impact of financial development and technological innovation on industrial agglomeration from two aspects of direction and scale. Based on the empirical results and preconditions, the following series of studies have been carried out on this topic:

The spillover effect of industrial agglomeration in the economic circle is significant. In the Durbin model with two spatial matrix weights, the industrial agglomeration coefficient of the economic circle shows that the coordinated development of integration plays an important role. In the Durbin model under the weight of geographical distance matrix, the industrial agglomeration of economic circle shows a positive effect, which shows that with the construction and improvement of transportation networks such as expressway and high-speed railway, regional transportation integration has been formed. In the Durbin model under the weight of economic distance matrix, the industrial agglomeration of economic circle also shows that the industrial and economic development are moving towards deep integration.

Industrial agglomeration in economic circle has self-promoting effect. In the spatial Durbin model with two matrices as the basic weight, it is concluded that the regression coefficient of the lag value of industrial agglomeration is greater than 5% at the level, and there is a significant positive correlation. The initial industrial agglomeration of the economic circle can directly affect the current industrial agglomeration. The survey shows that the coordinated development strategy of Beijing, Tianjin and Hebei has paved the way for the continuous improvement of the industrial chain. The reason for industrial agglomeration is the change of industrial chain, which can form a good self-improvement closed loop.

Financial development and technological innovation have a positive impact on industrial agglomeration. In the Durbin model, the positive value of the financial development coefficient can be obtained under the weight of two spatial matrices. The financial development of the economic circle has a positive impact on industrial agglomeration, but it is only significant in the model under the weight of geographical distance matrix. This is mainly because the virtual economy such as real estate and sports economy in the region is more active, and finance serves the virtual economy more under the function of profit. However, there is a strong correlation between the development level of virtual economy represented by real estate and geographical

factors. Therefore, under the weight of geographical distance matrix, the positive impact of virtual economy on industrial agglomeration is more significant. The regression coefficient of scientific and technological innovation is positive. Under the weight of two spatial matrices, the Dobbins model is significant at the level of 5%, which fully shows that there is a positive impact between technological innovation and industrial agglomeration, and this relationship is significant. This is mainly due to the unified development of industry and technology in the region, which ensures the realization of the goal of industrial chain extension. It can also strive to reach the same level as the level of technological innovation. Technological innovation promotes industrial growth and industrial agglomeration.

Government behavior has no significant impact on industrial agglomeration. In the Durbin model with two spatial matrix weights, the regression coefficient of government behavior is negative. The reason for this phenomenon may be that the increase of public financial expenditure will not only improve public welfare such as transportation and education, but also produce siphon effect, which makes high-quality industrial development resources flow from surrounding cities to better central cities, that is, from Hebei to Beijing and Tianjin, which confirms that there is a negative impact between it and industrial agglomeration. In this region, the siphon effect of Beijing and Tianjin is significant, so there is a negative impact between state behavior and industrial agglomeration.

There is a positive impact between human capital and industrial agglomeration. Under the weights of the two spatial matrices, the regression coefficients of human capital are positive, which can be considered that human capital has a significant positive impact on industrial agglomeration, which makes the characteristics of talent agglomeration in the region obvious. Most college graduates in the region will choose to work in the city where the school is located or nearby provinces and cities, which make the talent reserve in the region continuously improve and can provide talent and technical support for industrial development and industrial agglomeration.

The level of capital investment has a positive impact on industrial agglomeration. In the Durbin model, the regression coefficient of capital investment level is positive. There is a significant positive correlation between the level of capital investment and the ability to serve industrial development. The reason for this phenomenon may be that the level of capital investment can reflect the level of urban infrastructure. The higher the ratio, the more foreign investment will be attracted.

The interaction between financial development and technological innovation has a negative impact on industrial agglomeration. Under the weight of geographical distance matrix, the coefficient in the model is negative. According to the weight of the economic distance matrix, the model is negative and has a significant impact, but it needs more than 5%.

3.2.2. Decompose the Impact of Financial Development and Technological Innovation on Industrial Agglomeration

In order to analyze the relationship between regional financial development and technological innovation, we need to decompose the impact effect. Because the model under the weight of geographical distance matrix has large goodness of fit R^2 and maximum likelihood log likelihood, the model under the weight of geographical distance matrix is selected.

Based on the spatial effect decomposition data, this paper makes the following analysis: it analyzes the impact of financial development and technological innovation on industrial agglomeration. In the direct and indirect effects, there is a significant positive correlation between financial development and industrial agglomeration. The index results must reach more than 10% and 5% respectively, which fully shows that financial development has a significant impact on industrial agglomeration and promotes it to varying degrees. The development can directly affect the local and surrounding industrial clusters, and finally

promote the sustainable development of the latter. The impact of technological innovation on industrial agglomeration is that the industrial development of the economic circle enters the era of industrial chain by adjusting the structure and optimizing the layout.

The interaction between financial development and technological innovation will produce corresponding changes to industrial agglomeration, which is negative at the level of 5% and 10%. Overall, if the overall benefit is negative, it needs to meet more than 10% of the index value, which fully shows that financial development and technological innovation have a significant negative impact on local and surrounding industrial clusters. The economic circle of financial development and technological innovation not only promotes the development of virtual economic circle, but also lays the foundation for the siphon effect, which in turn leads to the interaction between financial development and industrial agglomeration. This principle also applies to technological innovation.

The direct effect of government behavior is not significant, while the indirect effect is significant and negative. The overall effect is negative. This fully proves that there is a direct and indirect negative correlation between government behavior and industrial agglomeration. The impact of human capital is positive, but not significant. From the perspective of indirect effect and total effect, the result is positive and significant, and one condition needs to be met, that is, the final level exceeds 10%, which fully shows that human capital can promote industrial agglomeration. The reason may be that college students are only potential productivity and are not easy to have a direct impact on the degree of industrial agglomeration in the economic circle. However, most college students in this area will choose this area for employment after graduation, which will indirectly affect industrial agglomeration and is positive. Although the level of capital investment has a direct impact, it cannot be said to be significant. The generation of direct, indirect and overall effects needs to meet the conditions of more than 10%, which fully shows that there is a positive effect between capital investment and industrial agglomeration. The bottom line of this phenomenon is that there is a significant positive correlation between the level of capital investment and the level of industrial infrastructure construction, which can promote industrial agglomeration. However, with the continuous development of Finance and the improvement of the level of technological innovation, the level of fixed capital investment will increase accordingly, which will help to enrich the industrial structure. Therefore, at present, it has little impact and is not suitable for industrial agglomeration.

4. Conclusions and Suggestions

The empirical study on the impact of financial development and technological innovation on industrial agglomeration draws three conclusions. As an important part of Beijing -Tianjin -Hebei economic circle, financial development and technological innovation have a significant positive impact on industrial agglomeration. Government behavior and human capital have a certain impact on industrial agglomeration. The spillover effect of industrial agglomeration in Beijing -Tianjin -Hebei economic circle is significant, and the self promotion effect of industrial agglomeration has been formed.

In order to promote the role of financial development and technological innovation in industrial agglomeration, the following suggestions are put forward:

(1) Facing the current development situation of Beijing -Tianjin -Hebei region, it is necessary to formulate a scientific and coordinated development plan and give full play to the spillover effect of regional cooperation. The government should play a role of cross regional coordination, promote the development of regional financial service industry, further expand cooperation fields and improve cooperation mechanism while following the objective laws of the economic circle.

(2) Fully stimulate scientific and technological innovation in the economic circle. The state should fully understand the important practical significance of scientific and technological innovation, increase support for industrial technology R&D and talent training, promote technological reform, and realize the cross regional flow of scientific and technological innovation elements. In addition, the government needs to play a leading role and strengthen cross regional cooperation.

(3) With the development of service industry as the goal, we should correctly guide financial development and scientific and technological innovation. It is easy to see the relationship between financial development and scientific and technological innovation. Therefore, the government should promote the combination of financial development and scientific and technological innovation, and guide financial enterprises to provide centralized support.

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