Spatial Econometric Analysis of Influencing Factors of Beijing Information Service Industry Agglomeration

Qiaoqiao Du
School of Economics and Management, Beijing Jiaotong University, Beijing, 100044, China

*Corresponding author’s e-mail: 704452702@qq.com

Abstract. This paper takes the Beijing information service industry as the research object and conducts a spatial measurement analysis of the factors affecting the agglomeration of information service industry in Beijing. By calculating the Moran’I index of Beijing's information service industry, there is a positive spatial correlation in Beijing's information service industry agglomeration. Then, SEM, SLM and SDM models are established to test the spatial effects of various factors on the gathering of Beijing's information service industry. The results show that human resources, innovation capability, regional scale and government policies have played a role in boosting the gathering of information services in Beijing. The development of related industries has a depressing effect on the aggregation of information services. Finally, based on the results of empirical research, combined with the development of Beijing's information service industry, relevant countermeasures are proposed accordingly.

1. Introduction
The level of agglomeration in Beijing's information service industry is far ahead in the country, and other provinces and cities are far behind. But there are still the following problems:(1) Compared with the needs of international developed countries and regions, as well as the implementation of national informationization strategies, the quality and efficiency of the development of Beijing's information service industry still needs to be further improved[1]. In 2016, the added value of Beijing's information service industry was 280.58 billion yuan, 5/7, 3/7, and 1/3 of London, Tokyo, and New York. From the perspective of its production efficiency, the productivity of Beijing's information service industry in 2006 is 303,000 yuan/person, which is 3/8 of Tokyo's, 1/3 of London's, and 1/9 of New York's.(2) There is a problem of uneven spatial distribution in the development of the information service industry in Beijing. The information service industry in Haidian District is far ahead of the information service industry in other districts, and the information service industry in some remote suburbs is almost stagnant. This paper focuses on and researches the reasons of agglomeration of information service industry in Beijing, and quantitatively analyzes the factors affecting the information service industry to achieve a better concentration of the Beijing information service industry.

2. Proposal of research hypothesis
2.1. Feature dimension
2.1.1. Production factor. The development of the information service industry requires relatively high technology and knowledge[2]. This special industry characteristics determine that the development of the information service industry attaches importance to the production factors of labor and technology. Hypothesis 1: Human capital has a significant positive correlation with the agglomeration of information services.

2.1.2. Innovation capability. If many enterprises are concentrated in the same area, the mutual competition and cooperation between enterprises will form an innovative network connection, which will make enterprises rely more and more on information technology[3]. Hypothesis 2: The ability to innovate has a significant positive correlation with the agglomeration of the information services industry.

2.2. Industry dimension
The particularity of this industry in the information service industry determines that the information service industry is co-developed with other industries, and the industrial agglomeration regions are more attractive to the gathering of information services. Hypothesis 3: The development of related industries has a significant positive correlation with the agglomeration of the information service industry.

2.3. City dimension
The continuous expansion of the regional scale will not only increase the demand for the information service industry, but also expand the demand for other related industries, and the development of other industries will drive the development of the information service industry[4]. Hypothesis 4: Within a certain range, the size of the city has a significant positive correlation with the agglomeration of the information service industry.

2.4. Institutional dimension
We initially believe that a series of policies implemented by local governments will have a positive impact on the gathering of information services. Hypothesis 5: Government support has a significant positive correlation with the agglomeration of the information services industry.

2.5. International dimension
The inflow of foreign funds can promote the development of the information service industry to some extent. Hypothesis 6: The level of openness has a significant positive correlation with the gathering of information services.

3. Model and test analysis

3.1. Variable selection and data source
Considering the availability of data, the locational entropy of information service industry in various districts of Beijing studied from 2008 to 2017 was used as the dependent variable, and the data was represented by LQ. The data comes from the statistical yearbooks of various districts of Beijing in 2009-2018.

| Influencing Factors | Metrics | Data Sources |
|---------------------|---------|--------------|
| Feature dimension   |         |              |
| human resources (HR)|         |              |
|                     | The proportion of scientific research personnel in all districts and colleges in the total population of each district, and the proportion of scientific research personnel in Beijing higher education institutions to the | The data comes from the statistical yearbooks of |

Table 1. Independent variable.
3.2. Model test analysis

3.2.1. Spatial autocorrelation test. The method commonly used to measure spatial autocorrelation is the Moran's index, which is used to determine whether there is spatial autocorrelation for the object under study by calculating the Moran index. The results are shown in the following table[5].

Table 2. Moran'I index change trend.

| Year | Moran Index | p value |
|------|-------------|---------|
| 2008 | 0.068       | 0.000   |
| 2009 | 0.096       | 0.028   |
| 2010 | 0.235       | 0.056   |
| 2011 | 0.394       | 0.003   |
| 2012 | 0.424       | 0.038   |
| 2013 | 0.455       | 0.005   |
| 2014 | 0.478       | 0.002   |
| 2015 | 0.44        | 0.003   |
| 2016 | 0.397       | 0.015   |
| 2017 | 0.390       | 0.001   |

Table 2 shows the Moran'I index calculated using the level of information service industry aggregation in Beijing from 2008 to 2017. The results show that the information service industry has significant spatial dependence on geospatial agglomeration, and the Moran'I indices are all positive, indicating positive spatial correlation, which is manifested in the spatial similarity between the information service industry clusters in each district[6].
Table 3. Spatial pattern evolution of the level of information service industry agglomeration in Beijing from 2008 to 2017.

| Year  | Quadrant          | Districts                                      |
|-------|-------------------|-----------------------------------------------|
| 2008  | H-H (First quadrant) | Xicheng District, Fengtai District             |
|       | L-H (Second quadrant) | Changping District, Fengtai District           |
|       | L-L (Third quadrant) | Haidian District, Tongzhou District, Daxing District |
|       | H-L (Fourth quadrant) | Chaoyang District, Dongcheng District          |
| 2012  | Shijingshan District, Fengtai District, Xicheng District | Changping District, Chaoyang District, Tongzhou District, Daxing District |
| 2017  | Shijingshan District, Fengtai District, Xicheng District | Changping District, Chaoyang District, Tongzhou District, Daxing District |

Figure 1. Beijing information service industry concentration level Moran scatter plot.

3.2.2. Model selection. By comparing the $R^2$, $\sigma^2$ and Log-likelihood values of the above models, the spatial Dubin model has the best fit, and compared with the traditional panel regression results, the statistical significance of the variables is also improved. We will analyze the estimation results of this model.

Table 4. Measurement model estimation results.

| variable | OLS   | SEM   | SLM   | SDM   |
|----------|-------|-------|-------|-------|
| HR       | 0.416 | 0.373 | 0.381 | 0.284 |
|          | (0.005) | (0.180) | (0.317) | (0.013) |
| INNO     | 0.085 | 0.009 | 0.061 | 0.051 |
|          | (0.053) | (0.045) | (0.205) | (0.015) |
| CONN     | -0.505 | -0.343 | -0.357 | -0.353 |
|          | (0.274) | (0.040) | (0.129) | (0.007) |
| SCA      | 0.070 | 0.135 | 0.077 | 0.161 |
|          | (0.029) | (0.014) | (0.087) | (0.000) |
| GOV      | 0.467 | 0.726 | 0.539 | 0.670 |
3.2.3. Result analysis. Human capital and innovation ability have positively promoted the gathering of information service industry in Beijing, indicating that in terms of production factors, encouraging scientific research and innovation, improving the high-end talent training mechanism can promote the gathering of information service industry; the implementation of relevant government policies has played a driving role in the agglomeration of information services in various districts of Beijing; the regional scale has also promoted the information service industry in each district; the development of related industries in the region will inhibit the agglomeration and development of the information service industry. There is a spatial correlation in the gathering of information services in various districts of Beijing. This correlation is reflected in the accumulation of information services in neighboring regions, such as human capital, innovation capabilities, related industry development, regional scale, and government policies.

|                | (0.015) | (0.013) | (0.044) | (0.000) |
|----------------|---------|---------|---------|---------|
| OPEN           | 0.025   | 0.007   | 0.001   | 0.008   |
|                | (0.385) | (0.295) | (0.528) | (0.491) |
| W*HR           |         |         |         | 0.794   |
|                |         |         |         | (0.023) |
| W*INNO         |         |         |         | 0.040   |
|                |         |         |         | (0.009) |
| W*CONN         |         |         |         | -0.170  |
|                |         |         |         | (0.003) |
| W*SAC          |         |         |         | -0.248  |
|                |         |         |         | (0.001) |
| W*GOV          |         |         |         | 0.761   |
|                |         |         |         | (0.064) |
| W*OPEN         |         |         |         | 0.006   |
|                |         |         |         | (0.701) |
| $\rho/\lambda$ | 0.624   | 0.437   | 0.386   |         |
|                | 0.000   | 0.004   | 0.010   |         |
| $R^2$          | 0.972   | 0.980   | 0.979   | 0.991   |
| sigma\(^2\)   | 0.001   | 0.006   | 0.001   |         |
| Log-likelihood | 47.208  | 155.187 | 150.904 | 170.878 |

4. Suggestion
The government should speed up the improvement of infrastructure construction. While enhancing the capabilities of information services, it must also improve the quality of information service products and the innovative skills of information technology, and continue to explore ways to reduce the operating costs of information service enterprises, thereby narrowing the gap with developed countries[7]. Especially for some small and medium-sized enterprises, preferential measures can be taken in terms of the access mechanism, such as tax policy investment and financing, to increase capital investment. Effectively implement the relevant policies issued by the government, introduce special government funds, and maximize the investment benefits of government funds. The proportion of output will be invested in some industrial sectors with strong industrial correlation effects and good future development prospects. Relevant departments should increase the investment of high-level talents, learn the foreign training system for professional talents, discard their dross, take their essence,
and integrate them into the cultivation methods of talents in China. We should build a mechanism environment conducive to the mutual promotion of traditional industries and information services, reasonably plan the location layout of high value-added and knowledge-intensive industries such as information service industry, and promote the improvement of coordination between information service industry and traditional industries[8]. Enhance the industrial linkage effect of each district, and fully utilize the industrial agglomeration effect through the industrial correlation effect. In real life, the suppression effect due to industrial linkage should be effectively avoided.

References
[1] Abel, J.R., Deitz, R. (2015) Agglomeration and job matching among college graduates. Regional Science and Urban Economics, 51:14-24.
[2] Fan, C.C. (2003) Industrial Agglomeration and Development: A Survey of Spatial Economic Issues in East Asia and a Statistical Analysis of Chinese Regions. Economic Geography, 79(3):295-319.
[3] Fujita, M., Thisse, J.F. (2002) Does Geographical Agglomeration Foster Economic Growth? And Who Gains and Loses From It?. CEPR Discussion Papers, 54(2):121-145.
[4] Marius, B., Mathys, N.A. (2008) Sectoral agglomeration economies in a panel of European regions. Regional Science & Urban Economics, 38(4):348-362.
[5] Eswaran, M., Kotwal, A. (2002) The role of the service sector in the process of industrialization. Journal of Development Economics, 68(2):401-420.
[6] Heidi, W.A.A., Isaksen, A. (2007) Knowledge Intensive Business Services and Urban Industrial Development. The Service Industries Journal, 27(3):321-338.
[7] Keeble, D., Nachum, L. (2002) Why do business service firms cluster? Small consultancies, clustering and decentralization in London and southern England. Transactions of the Institute of British Geographers, 27(1):67-90.
[8] Zhang, P., He, C., Sun, Y. (2014) Agglomeration economies and firm R&D efforts: an analysis of China’s electronics and telecommunications industries. The Annals of Regional Science, 53(3):671-701.