

Research on the Distribution of Venture Capital

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Abstract: *In order to provide a theoretical support for venture investment institutions to make reasonable investment decisions, and further understand the location choice behavior of venture capital in China, The spatial distribution characteristics of venture capital institutions in China from 2005 to 2014 were study by using the index of nearest neighbor, Gini coefficient, Lorenz curve and location entropy. The findings show that the spatial distribution of venture capital institutions in China is characterized by agglomeration, and the degree of agglomeration is increasing, especially in East China. The spatial distribution is imbalanced and the disequilibrium degree is decreasing, but the Gini coefficient is still greater than 0.7. The regional distribution of industry is obviously different, and the degree of industry difference is increasing. The regional entropy of more than 48% is more than 1.*

Keywords: Innovation; Venture Capital; Spatial distribution

1. Introduction

In recent years, the number of venture capital institutions and the scale of investment have substantially increased in China. While paying attention to the contribution of venture capital to science and technology, the spatial characteristics it has and the important role it plays in the development of regional economies have also received attention.[1]. The existing research on the spatial distribution characteristics of venture capital focuses on the local preferences of risk investment and geographical proximity [2]. From the perspective of the development of global venture capital investment, venture capital is affected by local preferences and shows the characteristics of clustering. As a result, risk investments across the globe, including China, show a clear regional imbalance in the geographical space. This has caused adverse effect for balanced development of the economy[3]. However, with the advent of the Internet economy, the widespread use of joint investment, the increasing popularity of information and communication technologies, the ever-changing competition in the venture capital market, and the gradual emergence of the characteristics of venture capital networking, more and more venture capital institutions will choose long distances (eg, Cross-regional, cross-border investment projects invest in investments, and the original spatial distribution of venture capital has changed [4]. Therefore, in order to grasp the changes in the existing spatial distribution of venture capital investment, and further understand the location selection behavior of venture capital in China, this paper provides theoretical support for rational investment decision-making for venture capital enterprises. This paper discusses the characteristics and changes of the spatial distribution of venture capital investment in China. and analyse.

2. Analysis of the Spatial Distribution Characteristics of Venture Capital

1) Conceptual definition of spatial distribution of venture capital

To study the spatial distribution characteristics of venture capital needs to define the concept of spatial distribution of

venture capital. Most of the related researches have used the concept of industrial spatial distribution in geography to study the spatial distribution characteristics of economic activities. Nordhaus thinks that the industrial spatial distribution is the geographical distribution of economic activity on the surface of the earth [5]. Yin Tao believes that the industrial spatial distribution is the pattern or pattern of spatial distribution of industrial economic activities, including the number, location, and scope of industrial clusters and the spatial relationship of different industrial clusters [6]. Liu Xiuyan and He Yumei think that the industrial spatial distribution is the ideal configuration of the industry in terms of geography. That is to say, for a single enterprise, the spatial orientation of the industry is actually the overall result of spatial-geographical site-specific addition of a single enterprise based on the goal of maximizing profits[7]. Wu Sanchuan and Li Shantong conducted a study on the spatial distribution of China's manufacturing industry, and considered that the spatial distribution of manufacturing industry is agglomeration, equilibrium, and center of gravity in manufacturing industries [8]. An Husen and Zhu Xi think that the industrial spatial distribution is mainly the cluster effect of industrial location, including cluster formation mechanism, cluster characteristics, cluster and innovation, and regional economic self-reliance development model [9].

The concept of existing spatial distribution mainly focuses on geographical distribution, industrial spatial distribution patterns, and cluster effects. Venture capital institutions make geographic locations based on investment decisions. The entire industry is agglomerative. Combined with the definition of spatial distribution of related industries, this paper defines the spatial distribution of risk investment in China as follows: Risk investment industry distribution refers to the economic activities of venture capital industry. The spatial distribution features include the degree of industrial aggregation, the degree of equilibrium, the differences in the distribution of industries, and their dynamic changes.

2) Analysis of characteristics of spatial distribution of venture capital

Volume 7 Issue 4, April 2018

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Combining the knowledge of geoeconomics, the description and analysis methods of spatial distribution features mainly include three types of methods [10]: (1) description of geographical distribution of points; (2) description of linear distribution of geographical things; (3) surface shape. Distribute the description of geographical things. China's risk investment institutions are distributed in a point-like manner, and investment decisions will take into account factors such as the geographical location, industry, and investment phase of the investment project. Because the spatial distribution of venture capital industry mainly refers to the overall result of spatial-geographic location-related additions of several venture capital institutions, this paper selects the description method of point-like distribution geographic objects to depict the space geographical location of venture capital institutions, and thus the risk in China. The spatial distribution characteristics of investment are studied. According to the characteristics of point-like things, the characteristics of describing their spatial distribution can be started from several aspects such as the orientation of points, distribution density, and dynamic changes [10]. Therefore, the spatial distribution characteristics of venture capital can be explored from the following aspects.

a) The clustering characteristics of venture capital. From the perspective of the development of global venture capital investment, the positive interaction between risk investment and economic development level will lead to rapid economic growth in regions with high levels of economic development, and slower economic growth in regions with low levels of economic development. This has brought about an increase in economic disparities [11]. Venture capital is often concentrated in areas with rapid economic development. Agglomeration is the most prominent distribution feature of economic activity. The clustering characteristics of venture capital mainly refer to the density of the spatial distribution of venture capital institutions, that is, the number of venture capital institutions within a unit area, which can be explored in terms of proximity and intensiveness.

b) Balanced characteristics of venture capital. Due to the differences in the level of economic development in our country, the level of economic development in the eastern and coastal areas is significantly better than in other regions. Therefore, the spatial distribution of risk investment in China also shows an imbalance, and it also aggravates the degree of imbalance in China's economic development. Studying the imbalance in the spatial distribution of venture capital investment is of great significance to the government in formulating a correct economic development strategy and narrowing the development gap between the eastern and western regions. The equilibrium characteristics of venture capital mainly refer to the degree of equilibrium of spatial distribution of venture capital institutions, that is, whether the number of risk investment institutions in the southern and northern regions of China, the eastern region, and the western region is balanced, and it is the result of the clustering analysis that further studies venture capital investment. The characteristics of spatial distribution and its

development trend.

c) Risk Investment Industry Distribution Characteristics. Venture capital is mainly invested in high-tech industries with huge development space, featuring high risks and high returns. The industry is an important consideration. The development of venture capital in China is still immature, and the industry of venture investment is quite different. A large amount of investment is flocking to communications equipment, traditional manufacturing, software industry, and network industries. For some emerging industries, the investment in the seed period is relatively small, and many. Mainly government investment. Such as: biotechnology, IT services, finance and insurance. This imbalance in the industry restricts the overall development of our economy. The distribution characteristics of venture capital industry mainly refer to the industry distribution of venture capital institutions, ie the number of industries and inflows of venture capital inflows. The main consideration is the selective investment of venture capital in the region, including the comparison of investment in different industries in the same region and the comparison of investment in the same industry in different regions.

3. Research Design

Sample Data Selection

Based on the data of venture capital institutions in the China Venture Capital Investment Development Report 2005-2014, this article has collected data on the number, geographical location and investment projects of venture capital institutions in 23 provinces and municipalities, 5 autonomous regions and 4 municipalities directly under the Central Government in 2010-2014. , Analysis of the spatial distribution characteristics of China's venture capital.

4. Research Methods

a) Research on Agglomeration

For the clustering characteristics of spatial distribution of venture capital, this paper describes the distribution density and spatial distribution map.

The distribution density indicates the ratio of the number of venture capital institutions in the region to the area of the region, ie $\text{distribution density} = \frac{\text{number of institutions in each region/area of each region}}{\text{area of each region}}$. The distribution density is a display of the intensive distribution of risk investment institutions in each region, and is also a manifestation of the degree of distribution of risk investment institutions in China.

The spatial distribution map is based on the number of venture capital institutions in various provinces and cities and the latitude and longitude of each province and city. It is mapped out on the ARCGIS 10.0 platform and can visually show the accumulation of risk investment in China and the agglomeration areas.

b) Research on imbalance

For the disequilibrium characteristics of the spatial

distribution of venture capital, this paper uses Gini coefficient and Lorentz curve to describe.

Gini coefficient is an important method used to describe the distribution of spatial elements in economic geography. It is mainly used to study the contrast of spatial distribution differences of objects, and then summarizes the spatial distribution of research objects. The degree of disequilibrium of the research object is proportional to its Gini coefficient. The Gini coefficient formula is as follows [12]:

$$H = -\sum_{i=1}^n P_i \ln p_i \quad (1)$$

$$H_m = \ln N \quad (2)$$

$$Gini = H / H_m \quad (3)$$

In the formula, P_i : the ratio of i venture capital institutions in the first region to the total number of venture capital institutions, N : the number of regions, and $Gini$ the value of the Gini coefficient. The value of $Gini$ is between 0 and 1. The larger the value, the greater the disequilibrium of risk investment institutions and the higher the degree of concentration. According to the division of international standards of Gini coefficient, this paper defines the criteria for the spatial distribution of Gini coefficient of risk investment [13]:

$$Gini < 0.5$$

Uneven spatial distribution

The Lorenz curve was proposed by the American statistician M.O. Lorenz. The entire Lorenz curve is a square. The bottom edge of the square is the horizontal axis, which represents the percentage of income earners in the total population. The left side of the square is the vertical axis and shows the percentage of income obtained by each percentage of the population. Later it was promoted to study the problems of unbalanced conditions. This paper also uses it to study the imbalanced distribution of risk investment institutions in China. The degree of depression of the Lorenz curve shows the degree of uneven distribution [14].

c) Industry Difference Study

For the industry characteristics of the spatial distribution of venture capital, this article uses location entropy to describe. Regional industry differences in the distribution of different industries in the same region as a result of investment differences and investment differences in different regions of the same industry. The distribution of the investment industry and the regional distribution are closely linked, and the location entropy index can reflect the regional industry distribution differences. Location entropy, also known as the specialization rate, was first proposed by P. Haggett and applied to location analysis. Location entropy measures the spatial distribution of elements in a certain region, and

reflects the degree of specialization of an industrial sector, and the important role of a region in the status and role of high-level regions. This article selects the location entropy index to quantitatively analyze the distribution of risk investment industry in China. The formula is as follows [15]:

$$LQ_{ij} = \frac{d_{ij} / d_j}{D_i / D}$$

Equation (4) LQ_{ij} is the location entropy of j the regional industry i , d_{ij} the relevant indicator of the regional industry, d_j the relevant indicator of all industries in the region, LQ_{ij} the related indicators of j the industry within the entire range, and the relevant indicators of all industries within the entire range.

The related indicator is the number of venture capital projects. The larger the value, the higher the degree of specialization of the industry in the region being surveyed; if it is, ie the location entropy is greater than 1, it means that the degree of regional specialization of the survey industry is higher than the average level of the entire region.

d) Research on the Spatial Distribution of Venture Capital in China

1 Research on Agglomeration of Risk Investment in China
 Based on the information of 1389 venture capital institutions included in the “China Venture Capital Investment Development Report 2006” and “China Venture Capital Investment Development Report 2015”, this paper uses the information of China’s basic geographic information database to divide the country’s provinces and municipalities into For the Northeast, North China, East China, South China, Southwest, and Northwest China, the number of risk investment institutions in each region in 2005 and 2014 was calculated, and the spatial distribution density of risk investment in the six regions was calculated. The spatial distribution density of venture investment in various regions in 2005 and 2014 is shown in Table 1.

Table 1: Distribution of Venture Capital by Region by 2005、2014

	Regional area (10,000/km ²)	Number of institutions		Distribution density (10,000/km ²)	
		2005	2014	2005	2014
Huadong Region	62.57	84	794	1.34	12.69
Central South Region	118.17	48	126	0.41	1.066
Southwest Region	112.3	12	68	0.11	0.606
North-east area	78.81	19	27	0.24	0.343
North-west region	310.87	38	43	0.12	0.138
North China	155.51	38	92	0.24	0.592

From Table 1, we find that in 2005, the number of venture capital institutions in East China accounted for 39% of the country, while in East China in 2014, 69% of the country's venture capital institutions were brought together. In addition, the number and density of venture capital

institutions in all six regions of the country are on the rise. In the comparison between 2005 and 2014, it was found that the number of venture capital institutions in East China grew faster than that in other regions. In the 14 years, the density in East China increased by 9.47 times compared with 2005, which is much higher than in other regions. The concentration of risk investment in China is increasing. The distribution density of the six regions in 2005 and 2014 were relatively different. The distribution density in the East China region was far greater than that in the other five regions, indicating that there are clustering characteristics in China's venture capital investment. As time goes on, China's risk investment is increasingly concentrated. In economically developed areas.

According to the collected data, a spatial distribution map of China's venture capital investment in 2014 was produced with the help of the ARCGIS 10.0 platform, as shown in Figure 3-1. The spatial distribution map can intuitively show the degree of agglomeration of risk investment in China and the main agglomeration areas.

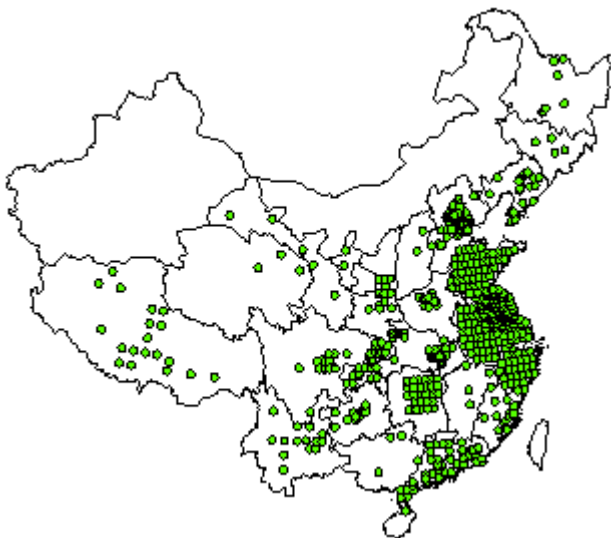


Figure 1: China's venture capital 2014 the regional distribution

From the map of risk investment in China, it can be seen intuitively that China's venture capital is agglomeration and distribution, and the main agglomeration is located in East China, which is consistent with the spatial distribution density analysis results.

In summary, the venture capital investment in the six regions of North China, East China, South China, Southwest China, Northwest China, and Northeast China has obvious development, and it has the characteristics of agglomeration and distribution, and the degree of agglomeration is increasing. Venture capital is mainly distributed in East China, and its distribution density has rapidly grown from 1.34 in 2005 to 12.69 in 2014, an increase of 9.47 times, much higher than in other regions, and higher than that of Central South, which is second only to its development. 11.9 times.

Research on the Unbalanced Distribution of Venture Capital in China

This article selects 11 regions in Jiangsu, Zhejiang, Guangdong, Hubei, Hunan, Beijing, Shanghai, Tianjin, Anhui, Sichuan, and Fujian with relatively active venture investment activities in the "China Venture Capital Investment Development Report". The number of institutions in the venture capital industry in the above regions In terms of representativeness, the number of venture capital institutions accounts for a relatively large proportion of the country. For example, the number of venture capital institutions in each region accounted for 77.6% of the country in 2014 and 2014. The calculation of the Gini coefficient needs the number of institutions as indicators. Therefore, the statistics of the number of 11 regional venture capital institutions are used in this paper. The Gini coefficient of the 11 regions from 2005 to 2014 is calculated using the formulas (1), (2) and (3) Gini coefficient calculation method. The Gini coefficient calculation results for 2005-2014 are shown in Table 3.

Table 3: 2005 to 2014 Gini coefficient calculation results

years	Gini Coefficient
2005 年	0.84
2006 年	0.85
2007 年	0.86
2008 年	0.87
2009 年	0.85
2010 年	0.82
2011 年	0.83
2012 年	0.82
2013 年	0.74
2014 年	0.74

From Table 3, we can see that the Gini coefficient of the spatial distribution of risk investment in China is above 0.7, with a high level of disequilibrium. In addition, the Gini coefficient of the spatial distribution of risk investment in China is relatively stable from 2005 to 2008, and it has been declining year by year since 2009. With the proliferation of venture capital in different regions, the keen eyes of venture capitalists will discover excellent seed projects in various regions, and these are the important areas for economic development and technological innovation. With the advancement of economic development and technological innovation, the disparity in the distribution of regional imbalances has also narrowed.

According to the number of risk investment institutions in 11 provinces, the Lorenz curve can be further plotted. The main method steps of the Lorenz curve drawing are: the proportion of the selected sample of regional venture capital investment data to the entire sample data, and then sorting from the smallest to the largest, and calculating the cumulative proportions one by one after the sorting. Taking the region where the venture capital is located as the x-axis of the abscissa and the cumulative proportion as the Y-axis of the y-axis, the Lorenz curve of the spatial distribution of venture capital in each region of China is plotted. The

Lorenz curve from 2010 to 2014 is shown in Figure 2.



Figure 2: China's venture capital in 2010-2014 Lorenz curve

As can be seen from Figure 2, the Lorenz curves of the 11 regions we have selected are significantly concave compared with the uniform distribution, and the degree of depression of the Lorenz curve reflects the unbalanced degree of the spatial distribution of venture capital, indicating that China's venture capital investment The spatial distribution is not balanced, but the concavity has a tendency of slowing year by year. This shows that the imbalance of the development of the relatively active areas of risk investment in China has weakened, which is consistent with the results of the analysis using the Gini coefficient.

To sum up, China's 11 areas of Jiangsu, Zhejiang, Guangdong, Hubei, Hunan, Beijing, Shanghai, Tianjin, Anhui, Sichuan, and Fujian have more active risk investment activities. The Gini coefficient of spatial distribution in the period from 2005 to 2014 is above 0.7. The spatial distribution of venture capital presents an imbalanced state, but as time changes, the uneven distribution of regional distribution has been reduced. The reduction in the degree of inequality here is not inconsistent with the increase in the degree of agglomeration we obtained above. First, the degree of disequilibrium has been reduced, but the Gini coefficient is still above 0.7, and the characteristics of uneven distribution are still very prominent; The clustering conclusion is that there are many venture capital investments in a unit area; and the balance we have is whether there are the same number of risk investment institutions in the south and the north, east, and

west, both of which are essentially different. The reduction in the degree of inequality can be caused by the accumulation of more and more venture capital institutions in economically underdeveloped regions. Specific reasons still need further study.

Distribution of Risk Investment Industry Distribution

This paper selects six representative areas such as Jiangsu, Zhejiang, Guangdong, Hubei, Beijing and Shanghai, which have relatively concentrated and active risk investment, to carry out location entropy analysis. These six regions are relatively mature areas for venture capital investment in China. They have 65% of the country's venture capital institutions and 70% of the country's venture capital projects. The industry distribution characteristics of the region can represent the industry distribution characteristics of venture capital in the country. The analysis of location entropy is calculated according to the industry. We select the top ten industries in the national venture capital investment projects to analyze the differences in industry distribution. According to the industry classification statistics in the "China Venture Capital Investment Development Report", we select the industry investment ranking before The ten industries count the number of projects that each sector accepts risk investment in each region, and use the formula of (4) location entropy to calculate the location entropy of each industry in each region in 2010 and 2014. The results of the location entropy distribution in 2010 and 2014 are shown in Table 4.

Table 4: Results of regional entropy in 2010、2014

	Zhejiang		Beijing		Shanghai		Guangdong		Jiangsu		Hubei	
	2010	2014	2010	2014	2010	2014	2010	2014	2010	2014	2010	2014
other industry	1.137	0.802	1.299	0	3.291	1.432	0.726	1.358	0.761	1.333	1.402	1.086
Traditional manufacturing	1.151	0.3	0.616	1.22	0.356	0	1.274	0.84	0.74	0.82	1.027	1.76
New material industry	0.832	0.644	0.604	0.17	0.505	1.203	0.891	0.78	1.119	1.491	1.178	0.746
New energy / energy efficient	0.974	1.172	0.782	0.172	0	1.241	1.295	0.862	1.115	1.586	0.577	2.552
Financial service	0.878	2.483	0.732	0.448	1.878	0.31	0.635	0.276	0.561	1.207	1.463	7.103
Consumer Products and Services	1.293	3.563	2.22	0.813	0	2.25	2.463	3.438	0.439	1.188	0.366	0.938
HealthCare	0.69	0.717	2.621	0.094	0.879	1.34	0.914	1.283	0.965	1.302	0.776	1.943
Optoelectronics in Mechatronics	0.883	0.789	0.5	0.158	0.433	0.947	0.8	1.789	1	1.842	2.983	5.421
agriculture	1.125	0.95	0.938	0.15	0	0.45	1.25	0.4	0.656	1.4	0.938	0.75
Biological Technology	0.714	1.027	0.804	0.216	0.911	0.73	0.339	0.728	1.429	1.622	1.857	0.784

Table 4 shows the location entropy calculation results for the 10 industries in 2010, 2014 in Jiangsu, Zhejiang, Guangdong, Hubei, Beijing, and Shanghai. From the results of the two-year location entropy calculations, 35% of the industry locations in 6 regions in 2010 have greater than 1 entropy and a high degree of specialization. In 2014, 48% of the industry's location entropy was greater than 1, and the degree of specialization increased. No reduction. For example, the location entropy of the financial services industry in Hubei Province is 7.103, which shows that venture capital investment in Hubei Province has a high degree of specialization in the financial services industry, and its capital investment is much higher than other industries. In 2010, the location entropy of consumer products and services industry in Zhejiang, Beijing, and Guangdong exceeded one, indicating that the consumer products and services in these three regions attracted more investment than other industries. In 2014, the location entropy of the Internet industry was higher in the three regions of Zhejiang, Guangdong, and Shanghai, indicating that the network industries in these three regions absorb more risk capital and develop better than other industries. In addition, from the perspective of the two-year development trend, the industry differences in risk investment in China have not been alleviated. In the data collected in 2010, 21 indicators were greater than 1, and in 2014, 29 indicators were greater than 1, and were greater than 1 There has been an increase of 7.103 and 5.421 extreme values.

We can draw the following conclusion: The distribution of investment industry in China's venture capital investment is not balanced, and it is embodied in two aspects. The first aspect is the uneven investment intensity of the same industry in different regions; for example, in 2014, the location entropy of the financial services industry was 7.103 in Hubei and the degree of specialization was relatively high, but it was only 0.276 in Guangdong. On the other hand, the

intensity of investment in different industries within the same region is uneven. For example, in 2014, the regional entropy of consumer products and services in Zhejiang was 3.563, and the degree of specialization was relatively high, but the degree of specialization in traditional manufacturing was relatively low, and the entropy of location was only 0.3. In addition, the distribution of China's venture capital industry in 2010-2014 has increased unabated. In 2010, the proportion of industry location entropy greater than 1 in 3 regions was 35%, and in 2014 it increased to 48%.

5. Conclusions and Inadequacies

5.1 Conclusion

This article uses the ARCGIS10.0 software, Gini coefficient, Lorentz curve and location entropy to analyze and analyze the spatial distribution characteristics of China's venture capital from the three aspects of agglomeration, imbalance and investment industry differences. Through the research and analysis of the spatial distribution of China's venture capital investment, the spatial distribution characteristics of China's venture capital are drawn.

First of all, China's venture capital is agglomerated and its degree of agglomeration is increasing. This paper calculates that the distribution density in East China is 12.69, which is much higher than that in other regions, and the increase in density in East China is faster than in other regions. For example, in 2005, the risk investment institutions in East China accounted for 39% of the country, while in East China in 2014. The region is home to 69% of the country's venture capital institutions. From the distribution map of China's venture capital, we can also see the clustering characteristics of China's venture capital, and the main agglomeration area is East China, which illustrates the reliability of the study from another perspective. In addition,

the spatial distribution of risk investment in China is uneven and the degree of imbalance shows a downward trend. With the development of network technology, more and more venture capital investment has been promoted over long distances, and the degree of imbalance has gradually decreased. The Gini coefficient of risk investment in China from 2005 to 2014 was all above 0.7, and the degree of disequilibrium was significant, but the Gini coefficient showed a declining trend, indicating that the degree of imbalance in the spatial distribution of risk investment in China was reduced [13].

At the same time, the Lorenz curve is concave and the degree of depression is decreasing year by year, which also proves the consistency of the conclusions of this paper. Finally, we calculated that in 2010 and 2014, Zhejiang, Beijing, Shanghai, Guangdong, Jiangsu, and Hubei accounted for 35% and 48% of the industry's location entropy was greater than 1, indicating that the regional distribution of investment industries in 2010 and 2014 was significantly different. Specifically in two aspects. The first aspect is the uneven investment intensity of the same industry in different regions; the second is the uneven investment intensity of different industries within the same region. In addition, compared with 2010, the value of bit entropy greater than 1 in 2014 increased from 21 to 29, and the degree greater than 1 also greatly increased, with 7.103 and 5.421 extreme values. This shows that there is an increasing trend in the risk industry in China.

5.2 Lack

In this paper, the data in the "China Venture Capital Investment Development Report" is used as a sample, and the data sources are relatively simple. Although the processed data, the lack of data cannot be ignored. This article does not fully demonstrate the data quality and data reliability, so the research conclusions may also be affected by the data quality of the database. In addition, this paper only studies the characteristics of the spatial distribution of venture capital. The formation reasons of the spatial distribution characteristics of the venture capital machine and its impact on the investment performance mechanism need to be further studied to get the answer. Finally, with the development of venture capital networks, investment institutions are embedded in the network and form a certain spatial distribution of the network. Therefore, the research on the spatial distribution of venture capital should be comprehensive (network size, network density) and individual (network location) level. Scientifically characterize the spatial distribution characteristics of venture capital, and this article only studies it from the overall level, and the individual characteristics of distribution still need further study.

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