Frontiers in Business, Economics and Management
ISSN: 2766-824X | Vol. 4, No. 2, 2022

Research on the Spatio-temporal Evolution and Influencing Factors of the Innovation Capability of the New Generation of Information Technology Industry

Qianying Wang, Ling Jiang*

School of Economics, Anhui University of Finance and Economics, Bengbu, Anhui, China
*Corresponding author email: tiaowudejiangling@163.com

Abstract: In the critical period of China's economic transformation, the new generation of information technology plays an important role, and the key to the development of the new generation of information technology industry lies in innovation. This paper takes 31 Chinese provinces and cities as the research objects, and based on the data related to the innovation capability of the new generation of information technology industry from 2010 to 2019.Firstly this paper analyzes the spatial and temporal evolution of the innovation capability of the new generation of information technology industry in 31 Chinese provinces and cities using the entropy method. Secondly, principal component regression analysis is applied to analyze the main influencing factors of the innovation capability of the new generation of information technology industry and its degree of influence. Then it was concluded that the innovation capability of China's the new generation of information technology industry showed an overall upward trend, but the growth rate slowed down in 2018; there were obvious differences between the innovation capability of coastal regions and inland regions, and the regional development was unbalanced; the factors that had a greater impact on the innovation capability were focused on the capital investment in innovation (41.839%) and talent investment (26.975%).Finally, it proposes to strengthen the core technology research and development to accelerate the development of independent innovation, strengthen the leading role of coastal areas to promote balanced and coordinated development of the industry, broaden financing channels to increase capital investment, pay attention to personnel training while strengthening the government's guiding role, and improve the industrial development environment.

Keywords: New generation of information technology industry, Innovation ability, Entropy method, Principal component regression analysis.

1. Introduction

According to the *Statistical Bulletin of the Software and Information Technology Service Industry in 2020* published by the Ministry of Industry and Information Technology of the People's Republic of China, the number of enterprises in this industry in China exceeded 40,000 in 2020, generating cumulative revenue of more than 816.16 billion yuan, an increase of 13.3% year-on-year, and the increase in the digital economy in a broad sense reached 36.2% of GDP. In a period of deep transformation of China's economy, China's digital economy is showing a trend of rapid growth through the continuous promotion of the digital revolution [1]. Especially under the impact of the new crown pneumonia epidemic, it still maintains a good momentum of development and has become the new engine of China's economic development [2]. The key to achieving the goal of accelerating the construction of the digital economy and strengthening the new engine of economic development is to strengthen the research on key core technologies [3]. As an important part of the key core technology, the new generation of information technology industry plays a pivotal role in gathering technological innovation resources, optimizing industrial structure, and improving the overall innovation capability and economic strength of the country. The Fifth Plenary Session of the 19th CPC Central Committee adopted the *Proposal of the CPC Central Committee on Formulating the 14th Five-Year Plan for National Economic and Social Development and the 2035 Visionary Goals* (hereinafter referred to as *the Plan*), in which it is clearly stated that: accelerating the realization of the promotion and application of key technologies, while emphasizing the need to accelerate key core technology innovation [4], the role of innovation for key core technologies is evident. Although China's the new generation of information technology industry is growing steadily, there are still many unknowns and challenges in the ever-changing competition of information industry. To realize the development of the new generation of information technology industry into the main driving force of economic development mode transformation and industrial structure optimization, the key to change this situation lies in innovation.

2. Literature Review

As the application area of the new generation of information technology industry becomes more and more extensive and influential, scholars also pay more attention to the new generation of information technology industry.

In terms of research objects, Yongping Fu et al. (2016) used data of listed companies in strategic emerging industries to conduct innovation capability research [5]; Weiwei Dong et al. (2018) took China's key autonomous demonstration zones as an example to analyze the innovation capability of strategic emerging the new industries in autonomous demonstration zones [6]; Xiaomei Hu et al. (2019) took the Yangtze River Economic Belt as a research object and analyzed the 11 provinces in the Yangtze River Economic Belt's technological innovation capability of strategic emerging industries [7]; Hongqi Wang et al. (2020) used Heilongjiang province as an example to quantitatively analyze the innovation capability of regional strategic emerging industries [8].

In terms of research perspectives, XingCao et al. (2017) studied the technological innovation capability of strategic emerging industries using the pharmaceutical manufacturing industry in Hunan Province as an example [9]; WeizhuZhuet al. (2107) studied the regional innovation of the new generation of information technology industry using data related to the new generation of information technology industry in eight economic zones [10].YunfeiShao et al. (2019) conducted a study on the innovation capability of strategic emerging industries based on the data of strategic emerging industries in 31 provinces in China [11]; XiangjuLi et al. (2019) collected data of A-share listed companies in strategic emerging industries in China and analyzed the impact of tax preferential policies on the independent innovation capability of companies in strategic emerging industries [12]; Xing Li et al. (2019) used 2015 data related to strategic emerging industries from four municipalities and 27 provinces in China as a research sample to analyze the differences in ecological innovation capability of strategic emerging industries in China's provinces [13]; Chen Zhang et al. (2021) analyzed the innovation performance of strategic emerging industry companies listed on A-shares in Shanghai and Shenzhen from 2014 to 2017 [14].

In terms of research methods, Jing Mao (2016) used cluster analysis to analyze the independent innovation capability of strategic emerging industries in Sichuan Province [15]; Yanglin Chen et al. (2018) used propensity score matching method (PSM) to study the incentive effect of tax incentives on innovation investment in strategic emerging industries [16]; Junzhou Yan et al. (2019) used BCC model, super efficiency model and regression model to evaluate the supply-side innovation efficiency of China's strategic emerging industries from 2013 to 2015 [17]; Zejiong Zhou et al. (2019) used a dynamic panel econometric model to analyze the internal and external drivers of independent innovation capability of China's strategic emerging industries [18]; Yu Xue et al. (2020) used a grey fuzzy comprehensive evaluation model to evaluate the strategic emerging industries' innovation capability of 30 Chinese provinces [19].

Through the above analysis, it can be seen that: in terms of research objects, the evaluation objects are mainly divided into two categories, one is to evaluate the innovation capability of the new generation of information technology industry (or strategic emerging industries) in China or a certain region, and the other is to analyze the innovation capability by combining enterprise data; in terms of research perspectives, there are mainly two major directions of evaluation perspectives, one is to make a comprehensive evaluation of industrial innovation capability, and the other is to evaluate a certain aspect of innovation capability like industrial regional innovation capability, technological innovation capability or independent innovation capability. In terms of research methods, scholars use cluster analysis method, PSM, DEA model, panel econometric model and gray fuzzy comprehensive evaluation to study the innovation capability. Through the analysis, we found that there are fewer studies on the new generation of information technology, mainly on strategic emerging industries, and the studies on innovation capability of the new generation of information technology focus on a certain dimension of time or space, and even fewer studies on the analysis of its influence factors.

Therefore, this paper collects data related to the new generation of information technology industry in 31 provinces and cities in China from 2010-2019. Firstly, the innovation capability evaluation index system of the new generation of information technology industry is constructed from two dimensions of knowledge output and product output. Secondly, the entropy method was applied to analyze the spatial and temporal evolution pattern of the innovation capability of the new generation of information technology in 31 provinces and cities in China from 2010 to 2019. Then, the principal component regression analysis is applied to categorize the nine indexes into three aspects, namely, capital investment, talent investment and industrial environment, and analyze the influencing factors of the new generation of information technology industry and the degree of influence of each factor. The research on the spatio-temporal evolution of innovation capability of the new generation of information technology industry and the analysis of influencing factors have high practical significance and research value for guiding the government to correctly understand the innovation capability of local the new generation of information technology industry, guiding the government to implement the innovation-driven development strategy, and helping the development of the new generation of information technology.

3. Construction of Innovation Capability and Influence Factors Indexes of the New Generation of Information Technology Industry

3.1. Construction of Innovation Capability Index System of the New Generation of Information Technology Industry

The new generation of information technology industry mainly includes the next-generation communication network industry, Internet of Things, tri-network convergence, high-performance integrated circuits, the new flat-panel displays and high-end software industry represented by cloud computing [28]. The innovation capability reflects the industrial efficiency and competitiveness brought by the innovation of the new generation of information technology industry. The innovation of the new generation of information technology industry mainly stays at the stage of theoretical research at the initial stage, and commercialization of theoretical research results is realized at a later stage, while the new generation of information technology as a general-purpose technology not only generates benefits, but also reacts and penetrates the industry and promotes its development [10]. Therefore, the innovation capability of the new generation of information technology industry can be evaluated in three aspects: the knowledge output capability, the product output capability, and the innovation penetration capability. Knowledge output capability reflects the effectiveness of theoretical innovation obtained by the research of the new generation of information technology industry talents, which is the basis for transformation into innovative products, mainly reflected by the number of industrial invention patents/number of industrial patent applications (A_1), the number of industrial invention patents/number of R&D personnel (A_2), and the number of industrial published scientific and technical papers/number of R&D personnel (A_3).Product output capability is the ability to commercialize theoretical innovation research results, reflecting the innovation benefits of the new generation of information technology industry, mainly analyzed from 2

aspects: the number of the new product development projects (A_4) and technology market turnover (A_5). In addition, the n-the new generation of information technology innovation not only can obtain output, but also will reflect the field, penetrate the industry, enhance the competitiveness of the industry to obtain higher profits, mainly analyzed from 2 aspects: the number of information transmission, computer services and software industry employees per 10,000 people (A_6) and the total profit of the industry (A_7) . The specific indexes are shown in Table 1.

Table 1. Evaluation Indexes System for the Innovation Capability of the New Generation of Information Technology Industry

Guideline level	Primary Indexes	Secondary Indexes	Weighting	Unit
Knowledge Output	Knowledge Output Capability	number of industrial invention patents/number of industrial patent applications (A_1)	0.1735	%
		number of industrial invention patents/number of R&D personnel (A_2)	0.2409	pieces/person
		number of industrial published scientific and technical papers/number of R&D personnel (A_3)	0.0410	articles/person
Product Output	Product Output Capability	number of the new product development projects (A_4)	0.1677	item
		technology market turnover (A_5)	0.1169	billion yuan
	Innovation Penetration Capability	number of information transmission, computer services and software industry employees per 10,000 people (A_6)	0.1068	million
		total profit of the industry (A_7)	0.1532	billion yuan

3.2. Selection of Variables Influencing the Innovation Capability of the New Generation of Information Technology Industry

It is clearly stated in *the Plan* that the overall innovation level of China's the new generation of information technology industry is not high enough, and the core technology in some fields is restricted by others. During the "14th Five-Year" Plan period, it is necessary to create the environment required for innovation drive, optimize talent, technology and capital, and accelerate the development and growth of a number of the new industries such as the new generation of information technology industry to promote economic and social development [21]. Therefore, the factors influencing the new generation of information technology industry should be analyzed in terms of innovation capital investment, talent investment and industrial environment.

Capital investment is a strong driving force for the development of the new generation of information technology industry and reflects the degree of government support, specifically analyzed from four variables: the number of enterprises (X_1), industrial investment amount/local fiscal expenditure (X_2), industrial the new product development expenditure (X_3) and technical transformation expenditure (X_4). Talent investment reflects a certain extent the innovation potential of the new generation of information technology industry and plays a supporting role for the future innovation capability of the new generation of information technology industry. Talent investment is mainly reflected from the talent reserve and the current situation of talents, specifically analyzed by three variables of R&D institution density (X_5), the density of higher education institutions (X_6), and R&D funding intensity (X_7). Meanwhile, the new generation of information technology innovation needs a industrial environment, and an industrial environment refers to the general environment of the new generation of information technology industry development, specifically analyzed by 2 variables of the number of enterprises with R&D activities/total number of enterprises(X_8) and Internet penetration rate (X_9). The specific variables are shown in Table 2.

Table 2. Summary of Factors Influencing the Innovation Capability of the New Generation of Information Technology Industry

Factor	Index	Unit
Capital Investment(F_1)	number of enterprises (X_1)	units
	industrial investment amount/local fiscal expenditure (X_2)	%
	industrial the new product development expenditure (X_3)	billion yuan
	technical transformation expenditure (X_4)	billion yuan
Talent Investment(F_2)	R&D institution density (X_5)	units / million hectares
	density of higher education institutions (X_6)	units / million hectares
	R&D funding intensity (X_7)	%
Industrial Environment(F_3)	number of enterprises with R&D activities/total number of enterprises (X_8)	%
	Internet penetration rate (X_9)	%

4. Measure of Innovation Capability and Influencing Factors of the New Generation of Information Technology Industry

4.1. Entropy Method

In order to avoid the influence of subjective factors on index weights and ensure the scientific and effective weighting of indexes, this paper uses the information entropy of each index to determine its weight. For a certain index, the lower the value of its information entropy means the higher the degree of variation of the corresponding index, the more information the index contains, the greater the importance of the index. Then the entropy method is used to derive the comprehensive score of innovation capability of the new generation of information technology industry for each sample. The specific steps for calculating the weights and comprehensive scores using the entropy method are as follows.

Firstly, the percentage of the jth index of the ith sample in the index b(i,j) is calculated using the formula (1).

$$b(i,j) = \frac{s(i,j)}{\sum_{i=1}^{m} s(i,j)} (i = 1,2,3 \ldots m; j = 1,2,3 \ldots n) \quad (1)$$

Secondly, using the formula (2) to analyze the index entropy value h_j for the jth term.

$$h_j = -\frac{1}{\ln(n)} \sum_{i=1}^{m} b(i,j) * \ln\big(b(i,j)\big) (i = 1,2,3 \ldots m) \quad (2)$$

Then the weights w_j of each index are calculated using the formula (3).

$$w_j = \frac{1-h_j}{\sum_{j=1}^{n}(1-h_j)} (j = 1,2,3, \ldots n) \quad (3)$$

Finally, the final comprehensive score value Z for each sample was calculated using the formula (4).

$$Z = \sum_{j=1}^{n} w_j * s(i,j) (i = 1,2,3 \ldots m; j = 1,2,3 \ldots n) \quad (4)$$

4.2. Principal Component Regression Analysis

In the case of more explanatory variables, the regression equation is prone to the problems of multicollinearity and failure to test the significance levels of multiple indexes, which cannot accurately reflect the influence of each index on the innovation capability of the new generation of information technology industry. In order to avoid the above situation, this paper reduces the dimensionality of the above indexes based on the principal component analysis to obtain the corresponding principal component factors, and then uses the ordinary least squares (OLS) method to obtain the regression equation [22], and the specific operation steps are as follows.

Firstly, the *k* eigenvalues of the correlation coefficient $R - \lambda_1 > \lambda_2 > \cdots > \lambda_k$ were obtained by calculating the standardized data, while the standardized eigenvalue vectors $u_1, u_2, \ldots, u_k$were obtained correspondingly. Secondly, the obtained eigenvalues were analyzed and tested for multicollinearity. If there is multicollinearity in the model, one or more eigenvalues are approximately zero, assuming that the value of $\lambda_{m+1}, \lambda_{m+2}, \ldots, \lambda_k$ is equal to zero, that is, there are *k-m* linear correlations between the *k* explanatory variables. The relationship between the *k* explanatory variables and the *k* principal components is then obtained, as shown in the formula (5).

$$\begin{cases} F_1 = u_{11}x_1 + u_{12}x_2 + \ldots + u_{1k}x_k \\ F_2 = u_{21}x_1 + u_{22}x_2 + \ldots + u_{2k}x_k \\ \cdots \\ F_k = u_{k1}x_1 + u_{k2}x_2 + \ldots\ldots + u_{kk}x_k \end{cases} \quad (5)$$

where, the *m* principal component factors $F_1, F_2, \ldots, F_m$ are uncorrelated with each other, while the values of $F_{m+1}, F_{m+2}, \ldots, F_k$ are approximated to be zero. Then, the *m* principal components $F_1, F_2, \ldots, F_m$ of the *k* explanatory variables are used to regress the explanatory variables to obtain the formula (6).

$$\hat{y} = \hat{a}_1 F_1 + \hat{a}_2 F_2 + \hat{a}_3 F_3 + \ldots + \hat{a}_m F_m \quad (6)$$

Finally, the original model (7) is obtained by substituting the regression equation (6) based on the relationship between the *k* explanatory variables and the *m* principal components.

$$\hat{y} = \hat{b}_0 + \hat{b}_1 x_1 + \hat{b}_2 x_2 + \hat{b}_3 x_3 + \ldots + + \hat{b}_k x_k \quad (7)$$

5. Empirical Analysis of Innovation Capability and Influencing Factors of the new Generation of Information Technology Industry

5.1. Data Sources and Processing

In 2010, the State Council issued the Decision of the State Council on Accelerating the Cultivation and Development of Strategic Emerging Industries, which clearly proposed to accelerate the development of strategic emerging industries and elevated them to a national strategic level [35]. As one of the seven key strategic emerging industries for development in China, the impact of the new generation of information technology industry cannot be ignored. Since the concept of the new generation of information technology was formally defined in 2010 and there is no special index for statistics, while the new generation of information technology is an important part of high technology. Therefore, in this paper, the data statistics are specified between 2010 and 2019, and some index data are replaced by the data related to high-tech industry instead of the index data of the new generation of information technology industry. The data on R&D institutions, the number of enterprises and industrial development are extracted from the *2011-2020 China High-Tech Industry Statistical Yearbook* and the *China Information Industry Yearbook*, and the population, land area and finance are obtained from the *2011-2020 China Statistical Yearbook*, in which some indexes are obtained by processing the original data. The number of enterprises in 2017, the number of high-tech enterprises with R&D activities, the number of information transmission, computer services and software industry employees per 10,000 people, profits and investment amounts in 2018 and 2019 are missing, and this paper uses the proximal point linear trend estimation method to fill in the missing values.

Based on the innovation capability index system of the new generation of information technology industry, relevant data were found and calculated to obtain data related to the evaluation of innovation capability of the new generation of information technology industry in each province and city from 2010 to 2019. Since there are different data orders of magnitude and units among the indexes, the calculation of the comprehensive score of innovation capability cannot be carried out directly. Therefore, this paper performs dimensionless processing of the data. Because the selected indexes are all benefit-type indexes, that is, for a certain index, the larger the value of the index represents the better the benefit of this index, so this paper uses the formula (8) to dimensionlessly process the data of the indexes related to the new generation of information technology industry, so as to obtain standardized data.

$$s(i,j) = \frac{S(i,j) - m(S(i,j))}{M(S(i,j)) - m(S(i,j))} \quad (8)$$

where, $s(i,j)$ represents the data corresponding to the jth index of the ith sample region, $M(S(i,j))$ represents the maximum value of the data corresponding to the jth index,

and $m(S(i,j))$ represents the minimum value of the data corresponding to the jth index.

5.2. Spatial and Temporal Evolution of Innovation Capability of the new Generation of Information Technology Industry

The weights of the indexes of the innovation capability of the new generation of information technology industry in 31 provinces and cities from 2010 to 2019 were calculated using the entropy method, and the specific data are shown in Table 1. The top three indexes in terms of weight are number of industrial invention patents/number of R&D personnel (0.2409), number of industrial invention patents/number of industrial patent applications (0.1735), and number of the new product development projects (0.1677).The indexes with the top three weights focus on the knowledge output capability, indicating that the knowledge output capability has a greater influence on the development of innovation capability of the new generation of information technology industry, and the influence of industrial invention patents is particularly obvious. The greater weight of the number of the newly developed projects reflects that the innovation capability of the new generation of information technology industry is more related to the product output capability.

According to the *Regional Planning Method* proposed during the 11th Five-Year Plan, 31 provinces and cities in China were divided into eight economic zones based on spatial, economic and natural resource factors [27], and the classification results are shown in Table 3.

Table 3. Chinese 31 Provinces and Cities Classification Table

Region	Provinces
Northeast Region	Liaoning, Jilin, Heilongjiang
Northern Coastal Region	Shandong, Tianjin, Hebei, Beijing
Eastern Coastal Region	Shanghai, Jiangsu, Zhejiang
Southern Coastal Region	Fujian, Guangdong, Hainan
Middle Yellow River Region	Inner Mongolia, Shanxi, Henan, Shaanxi
Middle Yangtze River Region	Hubei, Hunan, Jiangxi, Anhui
Great Southwest Region	Sichuan, Guangxi, Chongqing, Guizhou, Yunnan
Great Northwest Region	Xinjiang, Qinghai, Ningxia, Gansu, Tibet

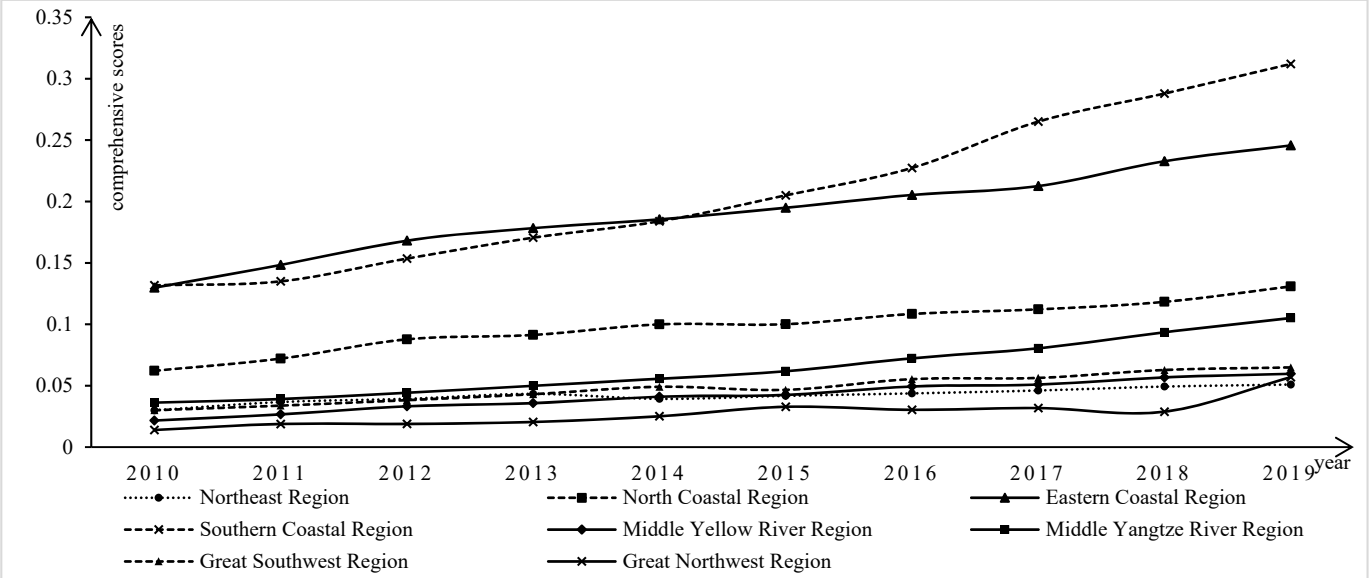

Figure 1. Trend of comprehensive scores of the eight economic regions from 2010-2019

Then, according to the classification results of 31 provinces and cities and the comprehensive score data of innovation capability of the new generation of information technology industry from 2010 to 2019, the trend figure of comprehensive score of the new generation of information technology industry in eight economic zones from 2010 to 2019 was drawn, as shown in Figure 1.

It can be seen through Figure 1 that the comprehensive score of the innovation capability of the new generation of information technology industry in the eight economic zones developed well from 2010 to 2019, with an overall upward trend, but the growth rate decreased in 75% of the regions in 2018-2019. Specifically: the Southern Coastal Region, although comprehensive score of the innovation capability of the new generation of information technology industry decreased by 0.0032 in 2010-2011 but the overall development momentum is great. The comprehensive score of the innovation capability of the new generation of information technology industry continued to rise from 0.1350 in 2011 to 0.3120 in 2019, with an average annual increase of about 10.1%. The comprehensive score of the innovation capability of the new generation of information technology industry in the Eastern Coastal Region and the Northern Coastal Region from 2010 to 2019 maintained a steady growth, and the comprehensive score of the innovation capability of the new generation of information technology industry in the eastern region increased from 0.1299 in 2010 to 0.2457 in 2019, with an average annual growth rate of about 7.4%, and the comprehensive score of innovation nearly doubled. The comprehensive score of the innovation

capability of the new generation of information technology industry in the northern region continued to rise from 0.0621 in 2010 to 0.1309 in 2019, with an average annual growth rate of about 8.8%. TheMiddle Yangtze River Region has the strongest development momentum, and comprehensive score of the innovation capability of the new generation of information technology industry has continued to grow from 0.0362 in 2010 to 0.1051 in 2019, with an average annual growth rate of about 12.6%. Although comprehensive score of the innovation capability of the new generation of information technology industry in the Great Southwest Region decreased by 0.0500 in 2014-2015, it still maintained a good development trend overall, with an average annual growth rate of 9.2%. The innovation capability of the new generation of information technology industry in Middle Yellow River Regionincreased from 0.0216 in 2010 to 0.0597 in 2019, with an average annual growth of about 12.2%. The comprehensive score of the innovation capability of the new generation of information technology industry in the Northeast Region grew at an average annual rate of 6.4%, and the comprehensive score of the innovation capability of the new generation of information technology industry in the Great Northwest Region, although its average annual growth reached 20.3%, was more volatile, with negative growth in several years, including 2015-2016 and 2017-2018.

Based on comprehensive score of the innovation capability of the new generation of information technology industry of 31 provinces and cities from 2010 to 2019 obtained by entropy method, the comprehensive score and ranking table of the new generation of information technology industry innovation capability of each province and city from 2010-2019 are drawn, as shown in Table 4.

Table 4. Comprehensive Score and Ranking of Innovation Capability of The New Generation of Information Technology Industryin 31 Provinces and Cities in 2010-2019

Region	2010	Rank	2011	Rank	2012	Rank	2013	Rank	2014	Rank	2015	Rank	2016	Rank	2017	Rank	2018	Rank	2019	Rank
Beijing	0.073	6	0.093	5	0.111	5	0.119	5	0.124	6	0.116	6	0.141	5	0.153	4	0.169	4	0.212	4
Tianjin	0.08	5	0.087	6	0.109	6	0.104	7	0.111	7	0.109	7	0.101	8	0.097	8	0.093	10	0.093	13
Hebei	0.032	16	0.032	19	0.035	20	0.035	21	0.039	21	0.041	21	0.045	22	0.051	19	0.056	19	0.062	19
Shanxi	0.017	24	0.02	24	0.028	23	0.022	26	0.033	25	0.031	26	0.043	23	0.043	23	0.046	21	0.053	22
Inner Mongolia	0.013	27	0.015	27	0.021	26	0.02	28	0.022	27	0.024	28	0.025	28	0.026	28	0.027	28	0.022	29
Liaoning	0.038	11	0.05	10	0.053	10	0.049	15	0.05	16	0.048	18	0.047	20	0.056	18	0.06	18	0.062	18
Jilin	0.026	23	0.031	20	0.035	19	0.051	13	0.038	22	0.045	19	0.05	18	0.047	21	0.051	20	0.053	21
Heilongjiang	0.026	22	0.029	23	0.03	22	0.03	22	0.03	26	0.032	25	0.035	25	0.035	25	0.037	25	0.038	26
Shanghai	0.11	3	0.121	3	0.123	4	0.126	4	0.13	4	0.13	5	0.125	6	0.14	6	0.144	6	0.149	8
Jiangsu	0.183	2	0.211	2	0.251	2	0.273	2	0.289	2	0.308	2	0.325	2	0.312	2	0.343	2	0.339	2
Zhejiang	0.097	4	0.113	4	0.13	3	0.136	3	0.137	3	0.146	3	0.166	3	0.186	3	0.212	3	0.249	3
Anhui	0.031	18	0.032	18	0.042	16	0.047	18	0.053	15	0.057	14	0.067	14	0.076	13	0.083	14	0.092	14
Fujian	0.06	8	0.069	8	0.078	8	0.086	8	0.089	8	0.093	8	0.106	7	0.113	7	0.133	7	0.15	7
Jiangxi	0.034	15	0.038	15	0.042	15	0.049	16	0.053	14	0.059	13	0.073	11	0.082	11	0.095	9	0.106	10
Shandong	0.064	7	0.077	7	0.096	7	0.107	6	0.125	5	0.135	4	0.146	4	0.149	5	0.155	5	0.157	6
Henan	0.028	21	0.037	16	0.045	13	0.053	11	0.061	12	0.066	12	0.072	12	0.069	15	0.079	15	0.084	15
Hubei	0.046	9	0.045	12	0.051	11	0.054	10	0.064	11	0.075	10	0.089	9	0.092	9	0.107	8	0.12	9
Hunan	0.034	14	0.041	13	0.043	14	0.05	14	0.053	13	0.056	15	0.061	15	0.072	14	0.089	13	0.103	11
Guangdong	0.319	1	0.317	1	0.356	1	0.397	1	0.42	1	0.484	1	0.55	1	0.649	1	0.698	1	0.747	1
Guangxi	0.032	17	0.031	21	0.032	21	0.037	19	0.037	23	0.038	24	0.045	21	0.041	24	0.038	24	0.047	23
Hainan	0.016	25	0.019	25	0.026	25	0.029	23	0.043	18	0.038	22	0.026	26	0.033	26	0.032	27	0.039	25
Chongqing	0.038	12	0.039	14	0.05	12	0.052	12	0.074	10	0.069	11	0.087	10	0.08	12	0.089	12	0.081	16
Sichuan	0.036	13	0.056	9	0.066	9	0.077	9	0.078	9	0.054	16	0.07	13	0.083	10	0.09	11	0.103	12
Guizhou	0.029	19	0.029	22	0.027	24	0.028	25	0.036	24	0.044	20	0.05	19	0.049	20	0.061	17	0.058	20
Yunnan	0.015	26	0.014	28	0.016	29	0.021	27	0.02	28	0.027	27	0.025	27	0.029	27	0.036	26	0.035	27
Tibet	0.002	31	0.016	26	0.019	27	0.028	24	0.043	19	0.08	9	0.058	16	0.06	17	0.042	23	0.183	5
Shaanxi	0.028	20	0.034	17	0.039	17	0.048	17	0.049	17	0.048	17	0.057	17	0.065	16	0.075	16	0.08	17
Gansu	0.011	28	0.012	30	0.012	30	0.015	29	0.016	29	0.019	29	0.021	29	0.02	29	0.02	30	0.025	28
Qinghai	0.008	30	0.009	31	0.011	31	0.009	31	0.01	31	0.012	31	0.017	30	0.013	31	0.017	31	0.019	30
Ningxia	0.039	10	0.046	11	0.036	18	0.037	20	0.041	20	0.038	23	0.04	24	0.047	22	0.043	22	0.04	24
Xinjiang	0.01	29	0.012	29	0.017	28	0.013	30	0.016	30	0.015	30	0.016	31	0.019	30	0.022	29	0.018	31

Analyzing the comprehensive score and ranking table of the innovation capability of the new generation of information technology industry in 31 provinces and cities from 2010-2019, it is easy to see that from 2010-2019, the top 10 provinces and cities in terms of innovation capability of the new generation of information technology industry in major years are Guangdong, Jiangsu, Zhejiang, Beijing, Shanghai, Shandong, Tianjin, Fujian, Hubei and Sichuan, concentrated in the coastal region, where all provinces and cities in the Eastern Coastal Region are firmly in the top 5 in terms of innovation capability of the new generation of information technology industry from 2010-2019.

The four provinces of Liaoning, Chongqing, Tibet and Ningxia were among the top 10 in some years, but their comprehensive scores of the new generation of information technology industry fluctuate greatly. Dividing China's 31 provinces and cities into eight economic zones for analysis, it can be obtained that the development level of innovation capability of the new generation of information technology industry in China's eight economic zones is roughly as follows: Southern Coastal Region>Eastern Coastal Region>Northern Coastal Region>Middle Yangtze River Region>Great Southwest Region>Middle Yellow River Region>Northeast Region>Great Northwest Region, if the eight economic zones are divided into three categories, the first category is the southern and Eastern Coastal Region .The second category is the Northern Coastal Regionwith the second strongest innovation capability, and the third category is the inland regions with weaker innovation capability, and the innovation capability of each region differs significantly.Both the Eastern Coastal Region and Northern Coastal Region belong to early modernization development areas, which, together with their unique geographical advantages and national policy support, attract more talents and capital investment, thus promoting the development of the new generation of information technology industry in the Eastern Coastal Region and Northern Coastal Region; although the Southern Coastal Region has a late start compared with the Eastern Coastal Region and Northern Coastal Region in the development of the new generation of information technology industry the Southern Coastal Region is rich in overseas social resources, and coupled with its superior geographical location [10], the new generation of information technology industry is developing rapidly; although the inland regions are developing more slowly, the Middle Yangtze River Region have seen a steady growth in the innovation capability of the new generation of information technology industry in recent years.

5.3. Analysis of Factors Influencing the Innovation Capability of the New Generation of Information Technology Industry

In this paper, with a cumulative contribution of variance of 81.028%, the nine indexes selected as explanatory variables were subjected to principal component regression analysis, and firstly, three principal components were extracted from the nine variables as follows.

$$\begin{cases} F_1 = 0.336X_1 + 0.217X_2 + 0.303X_3 + 0.311X_4 - 0.081X_5 - 0.042X_6 + 0.046X_7 - 0.095X_8 - 0.012X_9 \\ F_2 = 0.011X_1 - 0.064X_2 + 0.009X_3 - 0.034X_4 + 0.368X_5 + 0.358X_6 + 0.305X_7 - 0.156X_8 + 0.07X_9 \\ F_3 = -0.098X_1 - 0.015X_2 - 0.034X_3 - 0.035X_4 - 0.092X_5 - 0.114X_6 - 0.033X_7 + 0.773X_8 + 0.443X_9 \end{cases} \quad (9)$$

According to the results of the rotated component matrix, the nine explanatory variables are divided into three principal components, and the specific classification is shown in Table 2. The variance contribution rate of the first principal component is 41.839%, the variance contribution rate of the second principal component is 26.975%, and the variance contribution rate of the third principal component is 12.213%, which shows that the first principal component has the greatest influence on the innovation capability of the new generation of information technology industry, and the index variables of the first principal component focus on the capital investment, reflecting that the capital investment has the has the most significant influence.

The innovation capability of the new generation of information technology industry calculated by entropy method is used as the explanated variable, and the extracted principal component is used as the explanatory variable, and then OLS is used to establish the regression equation, and the following estimation equation is obtained.

$$Y = 0.081 + 0.087F_1 + 0.026F_2 + 0.018F_3 \quad (10)$$

Based on the regression results, it is easy to see that: the estimated equations pass the statistical significance test and the econometric test at the 5% significance level.The principal component equations extracted from the nine explanatory variables are then substituted, and the regression equations of the composite innovation capability scores for the nine index variables are obtained.

$$Y=0.081+0.001X_1+0.028X_2+0.002X_3+0.004X_4+0.009X_5+0.017X_6+0.0260X_7+0.011X_8+0.0256X_9 \quad (11)$$

In the regression equation, the larger the absolute value of the coefficient corresponding to the explanatory variable, the greater the influence of this index on the innovation capability of the new generation of information technology industry; the coefficient of the explanatory variable is greater than 0, which means that the variable has a positive influence on the innovation capability, and the coefficient of the explanatory variable is less than 0, which has a negative influence. Observing the results of the regression equation, the influence of the above nine variables on the innovation capability of the new generation of information technology industry is positive. The most influential factor is industrial investment amount/local fiscal expenditure which belongs to the field of capital investment, and the five factors with the greatest influence are industrial investment amount/local fiscal expenditure (0.028) > R&D funding intensity (0.0260) > Internet penetration rate (0.0256) >density of higher education institutions (0.017) >the number of enterprises with R&D activities/total number of enterprises (0.011), the top 5 influencing factors are mainly in the areas of talent investment and industrial environment, which means that capital investment has a significant role in the innovation capability of the new generation of information technology industry, but the influence of talent investment and industrial environment should not be underestimated.

6. Countermeasures to Improve the Innovation Capabilityof the New Generation of Information Technology Industry

Today, China is in a critical period of economic transformation, and the new generation of information technologyplays an important role, while innovation is one of the main driving forces for the development ofthe new generation of information technology. Facing the problems of innovation capability of the new generation of information technology industry, this paper proposes the following countermeasures.

6.1. Strengthen Core Technology Research and Developmentto Accelerate the Independent Innovation Development

Analyzing the composite score of the innovation capability of the new generation of information technology industry in each region from 2010-2019, it can be found that in 2018 the growth rate of the innovation capability of the new generation of information technology industryslowed down in 75% of the regions. This may be correlated with these measures: the adoption of an additional 25% tariff on Chinese products, the ban on the sale of integrated circuits, software and other products to ZTE Corporation and the ban on the sale of Huawei cell phones in 2018 in the United States [23] [24]. It also shows that mastering core technologies is the key to truly enhancing the innovation capability of the new generation of information technology industry. The government should implement relevant policies to protect intellectual property rights and create a favorable innovation environment for enterprises. When pursuing technological innovation, enterprises are prone to the problem of considering the increase in the number of products and industries and momentary benefits, while neglecting the research and development of core technologies. Enterprises should have the business concept of technological innovation, actively guide employees to technological innovation, take the initiative to cooperate and exchange with scientific research institutions, and accelerate the productization of knowledge achievements. In the context of big data and cloud computing, China should combine its own advantages to develop a series of "disruptive technologies" to expand the influence of the new generation of information technology industry.

6.2. Strengthen the Coastal Region's Leading Role to Promote Balanced and Coordinated Industrial Development

Analyzing the spatial difference of innovation capability of the new generation of information technology industry from 2010 to 2019, it is not difficult to find that there is an obvious gap between the innovation capability of the new generation

of information technology industry in coastal areas and inland areas, and the regional development is unbalanced. Therefore, the government should enhance the leading role of innovation in coastal areas while ensuring the stable development of the new generation of information technology industryin coastal areas to achieve balanced and coordinated development of the new generation of information technology industry. Coastal regions attract more foreign enterprises and overseas talents with their unique geographical advantages and excellent foundation of the new generation of information technology, so as to further improve their own innovation capability. Inland areas selectively undertake the new generation of information technology industryin coastal areas, while strengthening technical interaction with enterprises and research institutions in coastal areas to learn about the latest technologies and develop the new generation of information technology industry suitable for the local area by combining advantages, so as to narrow the differences between regions [25].

6.3. Increase Financing Channels to Increase Capital Investment

According to the results of principal component regression analysis, it can be seen that: the variance contribution of capital investment to the innovation capability of the new generation of information technology industry reaches 41.839%, and the factor that has the greatest influence on the innovation capability of the new generation of information technology industry- the industrial investment amount/local fiscal expenditure also belongs to the field of capital investment. As the saying goes, "a clever woman cannot cook without rice", without capital support, it is difficult to carry out relevant scientific research activities and the innovation capability cannot be improved [26]. At present, the main capital investment comes from government financial funds, but it is unreasonable to rely solely on government financial support; the government should actively play the role of propaganda and guidance, and carry out financing through multiple channels. Through the promotion of local the new generation of information technology industry, foreign enterprises are attracted to invest. Most of the new generation of information technology products are intangible products, but it contains invention patents, the government should actively guide the financial sector to set up credit projects related to intangible assets, which can not only solve the problem of enterprise capital, but also stimulate enterprises to research and development of the new generation of information technology products.

6.4. Pay Attention to Talent Cultivation and Enhance Market Competitiveness

Through the results of principal component regression analysis, it can be seen that: the variance contribution of talent investment to the innovation capability of the new generation of information technology industry reaches 26.975%. And in the ranking of the degree of influence of 9 factors, 2 of the top 5 factors in the degree of influence - the intensity of R&D funding intensity and the density of higher education institutions, which focus on talent investment, it is easy to see that the influence of talent investment is very important for the innovation capability of the new generation of information technology industry. Students in higher education institutions play an important role as a reserve force for the development of the new generation of information technology industry. The government should increase investment in education to cultivate more high-quality talents to promote better and faster development of the new generation of information technology. At the same time, universities and enterprises should put the cultivation of scientific and technological talents on the first place and set up majors related to the new generation of information technology or carry out technical training related to the new generation of information technology. In addition, they should implement the corresponding incentive mechanism. Localities should also increase investment in critical the new generation of information technology projects and absorb scientific and technological talents from around the world to join them to create scientific and technological innovation teams. By cultivating students' or staff's capability to apply the new generation of information technology, we will promote the development of the new generation of information technology industry.

6.5. Strengthen Government Guidance and Provide a Better Environment for Industrial Development

According to the results of principal component regression analysis, it can be seen that: although the principal component variance contribution rate of industrial development environment is only 12.213%, among the 5 factors that have the greatest impact on the new generation of information technology , Internet penetration rate and the number of enterprises with R&D activities/total number of enterprises, which means that all indexes of industrial development environment have a greater impact on the innovation capability of the new generation of information technology industry. Therefore, local governments should strengthen the construction and improvement of infrastructure, such as: Internet and other infrastructure, so as to provide an better environment for the development of the new generation of information technology industry and fully support the development of the new generation of information technology industry. At the same time, the government should improve the development system of the new generation of information technology industry based on two levels of industrial intellectual property protection as well as industrial security management to create a good industrial development environment.

References

[1] Hao Shouyi. On information capitalization and high-quality development of China's economy[J]. Nankai Economic Research, 2020(06):23-33+49.

[2] Li Xiaohua. "Development trends, problems and policy suggestions of digital economy in the 14th Five-Year Plan period [J]. People's Forum, 2021(01):12-15.

[3] Meng Q. S., Yu J., Chen F., Lu Chao. Research on the role mechanism of digital technology innovation on the upgrading of the new generation of information technology industry [J]. Research and Development Management,2021,33(01):90-100.

[4] Zhang J, Wu Shufeng. "Analysis of obstacles and breakthrough paths of key core technology innovation in China during the 14th Five-Year Plan period [J]. Journal of Humanities, 2021(01): 9-19.

[5] Fu YP, Rui MJ, Ma Y. R & D investment, foreign direct investment and corporate innovation--a study based on listed

companies in strategic emerging industries [J]. Exploration on Economic Issues,2016(06):28-33.

[6] DongWeiwei,Cai Yusheng. Evaluation of innovation capability of China's national independent innovation demonstration zones[J]. Industrial Technology Economy, 2018, 37(08): 78-85.

[7] Hu Xiaomei, Song Dandan. Research on the evaluation of technological innovation capability of strategic emerging industries in Yangtze River Economic Belt[J]. Journal of Qiqihar University (Philosophy and Social Science Edition), 2019(12): 80-84.

[8] Wang Hongqi, Liu Meng,Wu Chuan,Wu Jianlong. Evaluation study on the stability level of regional strategic emerging industry innovation ecosystem [J]. Science and Technology Progress and Countermeasures, 2020, 37(12):118-125.

[9] Cao X, Zhang W, Zhang Y. Measurement and evaluation of independent technological innovation capability of strategic emerging industries [J]. Journal of Central South University (Social Science Edition), 2017, 23(01):101-109.

[10] Zhu Weizhu, Li Chunfa. A study on the dynamic evolution of coordinated development of regional technological innovation and the new generation of information technology industry in China [J]. Modern intelligence, 2017,37(05):137-144.

[11] Shao Yunfei, Mu Rongping, LiGanglei. Evaluation and policy research on innovation capability of strategic emerging industries in China[J]. Science and Technology Progress and Countermeasures, 2020,37(02):66-73.

[12] Li Xiangju, Yang Huan. Industrial heterogeneity, tax incentives and independent innovation: an empirical study of A-share listed companies in China's strategic emerging industries[J]. Science and Technology Progress and Countermeasures, 2019, 36(09): 60-68.

[13] Li X., Cai Q. Statistical measurement and comparison of ecological innovation capability of strategic emerging industries in China [J]. Statistics and Decision Making, 2019, 35(18):84-88.

[14] Zhang Chen, LiuRuojin. Government subsidies, equity structure and corporate innovation performance--an empirical study based on listed companies in strategic emerging industries[J]. Science and Technology for Development, 2021, 17(02): 310-316.

[15] Mao Jing. Evaluation of independent innovation capability of strategic emerging industries in Sichuan Province[D]. Chengdu University of Technology,2016.

[16] Chen Yanglin,SongGenmiao,ZhangChangquan. Evaluation of the incentive effect of tax incentives on innovation investment in strategic emerging industries--an empirical analysis based on propensity score matching method[J]. Taxation Research, 2018 (08): 80-86.

[17] Yan Junzhou, Yang Yi. Research on the innovation efficiency of supply side of strategic emerging industries in China [J]. Scientific research management,2019,40(04):34-43.

[18] Zhou Zejiong, Lu Miaomiao. Research on the driving factors of independent innovation capability of strategic emerging industries[J]. Journal of Jishou University (Social Science Edition),2019,40(01):30-38.

[19] Xue Y, Zhang WY, Lei J. Cheng. Evaluation of regional strategic emerging industries' innovation capability based on complex network analysis[J]. Scientific Decision Making,2020(04):49-66.

[20] Ministry of Industry and Information Technology of the People's Republic of China. Statistical Bulletin of Software and Information Technology Service Industry in 2020 [EB/OL] https://www.miit.gov.cn/gxsj/tjfx/rjy/art/2021/art_f6e61b9ffc494c099ea89faecb47acd2.html,2021-01-26/ 2021-05-19

[21] Wang Xiaohui. Research on high-quality development of China's economy [D]. Jilin University,2019.

[22] Ma Chengwen, Xu Nana. Econometric analysis of haze influence factors based on principal component regression[J]. Journal of Shenyang University (Social Science Edition), 2017, 19(01):21-24.

[23] Zhu Jianmin, Zhu Jingjiao. Exploring the path of China's innovation-driven strategy--thinking based on the ZTE incident[J]. Finance and Accounting Monthly,2018(23):34-39.

[24] Su Jingqin, Cui Miao. Adaptation evolution of core technology innovation and management innovation[J]. Management Science, 2010,23(01):27-37.

[25] Hu Xuhua, Xu Junjie. Comparative analysis of regional technological innovation network evolution in China's electronic information industry at different life cycle stages[J]. Science and Technology Progress and Countermeasures, 2017, 34(22): 25-34.

[26] Yang Y. Research on the evaluation of independent innovation capability of high-tech industry in Anhui Province[D]. Anhui University,2014.

[27] Li ZW. Research on the impact of innovation input and ICT capability on total factor productivity of China's inter-provincial environment [D]. Nanjing University of Posts and Telecommunications,2020.

[28] Hu JX, Zhong SH. Review of domestic research on "evaluation of the new generation of information technology industry development"[J]. Science Management Research, 2019, 37(04): 57-62.