ATLANTIS PRESS
Advances in Economics, Business and Management Research (AEBMR), volume 62
International Academic Conference on Frontiers in Social Sciences and Management Innovation (IAFSM 2018)

Research on the Innovation Ability of High-tech Industry in China

Nini FU
Xi'an University of Science and Technology
funiniyouxiang@foxmail

Abstract: From the perspective of high-tech industry innovation ability, this paper selects ten indicators related to it as the research basis, uses SPSS 21.0 to analyze the index of 30 provinces and municipalities and autonomous regions in China, and selects the most important factors, then compares the industrial innovation ability of the 30 provinces and municipalities and autonomous regions. The results show that overall, the innovation capability of high-tech industries in eastern, central and western regions is decreasing, but some western provinces have larger development space.Based on this, we put forward our own suggestions.
Key words: High-tech industry; Innovation capability; Factor analysis

1 Introduction

High tech industry is a strategic industry of China's national economy, and has become a new growth point for China's economic development now and in the future. Since the Ninth "Five Year Plan", China's high-tech industry has entered a period of rapid development. According to statistics, in 2015, the scale of the main business income of China's high-tech industry exceeded 13 trillion yuan, accounting for 14.1% of the manufacturing industry[1]. The proportion of output value of domestic enterprises continued to rise steadily, reaching 51%, an increase of 4.4 percentage points over the previous year.

In recent years, domestic and foreign scholars have gradually increased their research on high-tech industries. In 2013, foreign scholars I. E. FrolovN. A. Ganichev O. B. Koshovets forecast the production capacity of Russian Federation high tech industry for a long time[2]; Matilde Bini and Margherita Velucchi study found that there is a close relationship between the performance of the enterprise and the ability to develop new technologies and new products, the close meeting of economic performance and geographical location[3];Ma gorzata Runiewicz-Wardyn believes that innovative regional capabilities are closely related to the underlying technological infrastructure[4]. Most scholars in China tend to study the efficiency of innovation. Dang Guoying and Qin Kaiqiang prove that there are differences in the efficiency of technological innovation in different industries by establishing SFA model[5].Zhang Hong and Wang Yulei based on the two stage perspective, using the DEA model to calculate the efficiency of the transformation of high technology industry results in Shaanxi province slightly higher than the technological R & D Efficiency[6];Xiao Renqiao and Qian Li built the DEA model, and made an empirical analysis of the overall efficiency and the two stage efficiency of the high-tech industry innovation in 28 provinces of China[7]; Hu Zhenhua and Yang Qiong divide China into three major regions in East and west to study the efficiency of high-tech industry innovation[8]. In addition, some scholars have done other research. Sun Bing and Lin Tingting use regression analysis to make an empirical study on the relationship between technological innovation and industrial competition. The results show that there is a significant correlation between the two[9];Pang Xiaoting and Xie Liwei have analyzed the current situation and Countermeasures of the high-tech industry in China.,they think that the technology innovation of high technology industry in China can be found. The force is restricted by many factors, and measures must be taken to further improve the ability of high technology innovation in China[10]. Shi Junguo and Wu and others use the data of 15 manufacturing industries in our country to build a linear regression model. It is believed that product development innovation has a significant positive effect on the consolidation and holding of the industrial international competitive advantage[11]. From the above analysis, there are not many scholars studying the innovation ability of high-tech industry at present, and few scholars have systematically analyzed and compared the high technology innovation ability of various provinces in China. Based on this, this paper selects ten indexes related to the ability of high-tech industry innovation on the basis of reading a large number of documents. In addition, we selected the data of 30 provinces, cities and autonomous regions outside Tibet, Macao, Taiwan and other provinces to analyze the factors, extract the public factors and find out the key factors, and make a comprehensive evaluation and ranking of the high technology innovation ability of each province, and analyze the situation.

2 Construction of evaluation index system

Copyright © 2019, the Authors. Published by Atlantis Press.

This is an open access article under the CC BY-NC license (http://creativecommons.org/licenses/by-nc/4.0/).

2.1 Index selection

On the basis of reading a lot of literature, the following 10 indicators are selected as the basis for evaluating the innovation ability of China's high-tech industry.

Table 1 Evaluation index system of high technology industry innovation capability

variable	index	unit
X_1	R&D Personnel distribution	1,000 person-years
X_2	R&D Expenditure	One hundred million yaun
X_3	Number of patent applications	piece
X_4	Number of effective inventions	piece
X_5	Main business income of high tech industry	One hundred million yaun
X_6	Export of high tech products	Millions of dollars
X_7	Import of high - tech products	Millions of dollars
X_8	Local financial science and technology expenditure	One hundred million yaun
X_9	New product development funds	One hundred million yaun
X_{10}	Sales revenue of new products	One hundred million yaun

2.2 Model selection

In this paper, factor analysis method, factor analysis method can be used to reduce the dimensionality and use less index to describe the information that contains almost all the data. These indexes and their weights are also calculated by SPSS software, which can avoid the abuse of human weight and make the research result more. Accurate and more objective.

2.3 Data sources

Since the recent years of scientific and technological data have not been improved, the recent year of the more complete scientific and technical statistics yearbook is in 2014; and the high technical expenditure and output of high technical funds in Tibet area are relatively low, which are not the typical provinces, and have little influence on the results of the research and are eliminated. Therefore, this paper selects the relevant data of high technology industry in 30 provinces, cities and autonomous regions outside Tibet, Macao and Taiwan and other provinces and autonomous regions in 2013 as the research object. The data are derived from China Statistical Yearbook, China's science and technology statistics 2014 and China high tech Industrial statistical yearbook 2014.

3 Factor analysis

3.1 KMO and Bartlett test

The collected sample data were input into SPSS 21 for KMO and Bartlett test. The results show that the value of KMO is 0.812 and more than 0.6, which indicates that the data of the group is suitable for factor analysis, and the P value of the Bartlett sphericity test is 0, the significant level is far less than 0.01, and the original hypothesis is rejected, indicating that the data can be analyzed by factor.

Table 2 Test of KMO and Bartlett

Kaiser-Meyer-Olkin measure of sampling sufficient degree		.812
The sphericity test of Bartlett	Approximate chi square	698.626
	df	45
	Sig.	.000

3.2 Dimensionality reduction processing

After the normalization of the original data of 10 variables, factor load matrix transformation is carried out to get the eigenvalue and variance contribution rate of each factor, and then dimension reduction is performed.

According to the principle that the eigenvalue is greater than 1 and the cumulative variance contribution rate is greater than 85%, two principal factors C1 and C2 are extracted. The cumulative variance contribution rate of C1 and C2 reached 92.343%, indicating that these two common factors can reflect all the evaluation indicators in a more comprehensive way.

Table 3 Total variance of interpretation

Factor	Initial eigenvalue			Extracting square sum and loading			Rotated square sum loading		
	Total	variance(%)	accumulate(%)	Total	variance(%)	accumulate(%)	Total	Variance (%)	accumulate(%)
1	7.327	73.266	73.266	7.327	73.266	73.266	6.769	67.693	67.693
2	1.908	19.077	92.343	1.908	19.077	92.343	2.465	24.650	92.343
3	.588	5.879	98.222						
4	.086	.864	99.085						
5	.040	.399	99.484						
6	.021	.209	99.694						
7	.017	.173	99.866						
8	.007	.067	99.934						
9	.005	.048	99.982						
10	.002	.018	100.000						
Extraction method: principal component analysis.									

Because the contribution rate of the public factor C1 to the X5 index is the largest, it is defined as the income capacity, the contribution rate of C1 to the total variance is 67.693%, the contribution rate is higher than the C2 factor, which indicates that the income capacity has a great influence on the innovation ability of the high-tech industry; C2 has a great contribution to the X3 and X4 index, so it is defined as the output capacity.

Table 4 Rotational component matrix [a]

	Components	
	Factor 1	Factor 2
R&D Personnel distribution	.935	.277
R&D Expenditure	.855	.469
Number of patent applications	.168	.981
Number of effective inventions	.077	.992
Main business income of high tech industry	.973	.067
Export of high tech products	.916	.053
Import of high - tech products	.893	.103
Local financial science and technology expenditure	.869	.434
New product development funds	.958	.101
Sales revenue of new products	.935	.069

Extraction method: principal component.
Rotation method: orthogonal rotation method with Kaiser standardization.
a. Rotation converges after 3 iterations.

3.3 Calculation and ranking of scores

After the selection and naming of the factors, the factor score is calculated, the data is input into the SPSS21.0, and the weight of each index is calculated as shown in table 5.
According to the coefficient matrix of factor scores, we can calculate the scores of each main factor of technological innovation capability of 30 provinces and cities in China, and rank them.

Table 5 Component score coefficient matrix

	Components	
	Factor 1	Factor 2
R&D Personnel distribution	.132	.024
R&D Expenditure	.096	.126
Number of patent applications	-.086	.455
Number of effective inventions	-.103	.472
Main business income of high tech industry	.164	-.082
Export of high tech products	.155	-.082
Import of high - tech products	.145	-.055
Local financial science and technology expenditure	.102	.108

Table 5, cont.

New product development funds	.157	-.064
Sales revenue of new products	.157	-.077
Extraction method: principal component. Rotation method: orthogonal rotation method with Kaiser standardization. Make up a score.		

$F_1=0.132*X_1+0.096*X_2-0.086*X_3-0.103*X_4+0.164*X_5+0.155*X_6+0.145*X_7+0.102*X_8+0.157*X_9+0.157*X_{10}$

$F_2=0.024*X_1+0.126*X_2+0.455*X_3+0.472*X_4-0.082*X_5-0.082*X_6-0.055*X_7+0.108*X_8-0.064*X_9-0.077*X_{10}$

The overall score is calculated according to the main factor score.

$F=（67.693\%*F_1+24.650*F_2）/92.343\%$

Table 6 Scores and rankings of provinces and municipalities and autonomous regions

Region	Main factor score				Comprehensive score F	Ranking
	F_1	Ranking	F_2	Ranking		
Beijing	-0.45194	17	5.01452	1	1.00727444	3
Tianjin	0.09961	6	-0.25916	15	0.003840093	7
Hebei	-0.28204	15	-0.33581	18	-0.29639334	16
Shanxi	-0.46777	20	-0.22935	13	-0.40412627	18
Inner Mongolia	-0.53296	22	-0.43018	24	-0.505523952	22
Liaoning	-0.26597	14	0.43084	3	-0.079963844	11
Jilin	-0.57302	24	0.02396	9	-0.41366242	20
Heilongjiang	-0.50652	21	-0.25474	14	-0.439309957	23
Shanghai	0.82624	5	0.83699	2	0.8291096	4
Jiangsu	2.84448	2	0.06965	8	2.103768094	2
Zhejiang	0.90745	4	-0.09436	11	0.640027277	6
Anhui	-0.09815	9	-0.0908	10	-0.096187994	12
Fujian	-0.05685	8	-0.35784	20	-0.137196139	13
Jiangxi	-0.40269	16	-0.44169	26	-0.413100643	19
Shandong	1.06862	3	0.10125	7	0.810390676	5
Henan	0.04932	7	-0.20734	12	-0.019192708	8
Hubei	-0.1201	11	0.1462	6	-0.049013995	9
Hunan	-0.10766	10	-0.37713	22	-0.179592204	14
Guangdong	3.66948	1	-0.32124	17	2.60419895	1
Guangxi	-0.45221	18	-0.38388	23	-0.43397002	21
Hainan	-0.64485	29	-0.45286	28	-0.593600273	28
Chongqing	-0.25184	13	-0.45074	27	-0.304934279	17
Sichuan	-0.14396	12	0.18146	5	-0.057092528	10
Guizhou	-0.5773	25	-0.44072	25	-0.540841395	27
Yunnan	-0.55424	23	-0.3671	21	-0.50428493	24
Shaanxi	-0.45921	19	0.38515	4	-0.233816911	15
Gansu	-0.61513	27	-0.31297	16	-0.534471542	25
Qinghai	-0.65951	30	-0.50276	29	-0.617667224	30
Ningxia	-0.63577	28	-0.53167	30	-0.607981592	29
Xinjiang	-0.60555	26	-0.34772	19	-0.536724973	26

4 Conclusions and suggestions

4.1 Research conclusion

From the ranking results of table 6, we can find that the provinces in the top ten are Guangdong, Jiangsu, Beijing, Shanghai, Shandong, Zhejiang, Tianjin, Henan, Hubei, Sichuan, almost all of the eastern part of China, and the base of the rankings is located in the west of China. In general, China is East, middle, and China. The Western high-tech industry has a decreasing trend of innovation capability, which is basically consistent with Xu Yuan's research conclusions[14]. As the economic support of our country, the Yangtze River Delta and the Pearl River Delta provide economic security for the research and development of science and technology; Beijing is the political and cultural center of our country, gathering all the universities and colleges in China, with strong scientific research strength; Shandong is a big coastal province, relying on the technology industry of Bohai to inject vitality into technology innovation; Tianjin is from the shore. The construction of Hai new area has gathered a large amount of funds and talents. In a word, the eastern region has strong economic strength, its natural environment is superior, and the speed of development in all aspects has always been better than that of other areas. And for a long time, the policy of the state's tilt has kept the eastern part of the East a high degree of talent accumulation, which provides a guarantee for the innovation ability of the high-tech industry; on the other hand, the central and Western countries have long been compared to the economy. Less developed, less scientific research and lack of talent, leading to a low level of innovation capability in the central and western regions.However, such as Sichuan, Shaanxi and other western regions, the development of high-tech industries is also relatively rapid, so these areas should give full play to their advantages and promote the development of the surrounding provinces.

4.2 Suggestions

It is understood that in 2015, the R&D funds of high technology industry in eastern China accounted for 78.2% of the national high technology industry R&D funds, which was far higher than the central and western regions. Among them, Guangdong and Jiangsu accounted for the highest proportion of the country, 34.7% and 12.1% respectively, and the other provinces were not more than 10%. The highest R&D input intensity is in the eastern region, reaching 1.74%, 1.38% in the western region and 1.28% in the northeast and 1.07% in the central region respectively. From the point of view of these data, the regional distribution of high-tech industries in China will be more and more unbalanced, and the eastern region is better than the central and western regions. If the investment in the central and western regions is not high, the gap with the eastern region will become more and more large.Therefore, the western region should increase the investment in scientific and technological innovation and actively implement the policy of introducing talents. Secondly, the geographical position of the central and western regions is special. We can make full use of geographical advantages, introduce foreign capital, develop some special high-tech industries, and realize the leapfrog progress in the central and western regions.

Reference

[1]In 2015, the main business income of China's high-tech industry reached nearly 14 trillion yuan.http://www.chinanews.com/cj/2017/09-05/8322730.shtml.html.

[2]I. E. FrolovN. A. GanichevO. B. Koshovets.Long-term forecast of the production capacity of high-tech industries in the Russian Federation[J].Studies on Russian Economic Development,2013.05(3):229-236.

[3]Matilde Bini.Italian Firms’Geographical Location in High-tech Industries: A Robust Analysis[J].Classification and Multivariate Analysis for Complex Data Structures,2010.11:185-192.

[4]Małgorzata Runiewicz-Wardyn.The Efficiency of Regional Innovation Systems (RIS). The Role of High-Tech Industry and Knowledge-Intensive Services[J].Knowledge Flows, Technological Change and Regional Growth in the European Union,2013.05:81-102.

[5]Dang Guo Ying.Technological innovation efficiency and influencing factors of high technology industry-Efficiency analysis of five categories and 23 industries [J]. Production commentary.2015.03 (2):15-27.

[6]Zhang Hong,Wang Yulei. Technical innovation efficiency and influencing factors of high-tech industries in Shaanxi province [J]. Journal of Shaanxi Normal University, 2016.09 (5):118-126.

[7]Xiao Renqiao, Qian Li, Chen Zhongwei. Research on China's high-tech industry innovation efficiency and its influencing factors [J]. management science.2012.10 (5): 85-98.

[8]Hu Zhenhua, Yang Qiong. Research on the innovation efficiency of China's high and new technology industry [J]. scientific management research, 2015.04 (2):32-35.

[9]Sun Bing, Lin Tingting. The relationship between high-tech industry competitiveness and technological innovation in China [J]. China Science and Technology Forum, 2012.01:23-29.

[10]Pang Xiaoting, Xie Liwei. Discussion on the current situation and Countermeasures of technological innovation in China's high-tech industry [J]. Journal of Liaoning Administration College.2014 (11):42-46.

[11]Shi Junguo, Wu Fei, Hou Zemin. The influence of different types of technological innovation on the international competitive advantage of industry [J]. technology economy, 2014.03:33-39.

[12]Wang Min, Gu Sheng block. An empirical analysis of China's high-tech industry's technological innovation capability [J]. China Science and Technology Forum, 2015.03(3):67-73.

[13]Neslihan Aydogan. How High-Tech Industries Benefit from the Economiesof Agglomeration[J].Social Capital and Business Development in High-Technology Clusters,2008:1-14.
[14]Xu Yuan. Hi tech industry's technological innovation capability [J]. economic vision.2014.08:189-190.