Research on regional technical innovation capability

Muzilong

Beijing Jiaotong University, School of Economics and Management, Beijing, China

947101347@qq.com

Abstract. Regional technological innovation ability is the key to determine the level of regional industrial development and the strength of economic growth. This paper studies the classification characteristics of technological innovation capability in different regions. Factor analysis and cluster analysis are used to extract common factors, and then a systematic clustering is carried out according to the factor scores of each region to determine the categories of each region. Through the study of the main characteristics of various types, put forward targeted countermeasures, for the future to enhance the ability of regional technological innovation has important reference value.

1. Introduction

Regional technological innovation capability not only becomes an effective way to create regional competitive advantage and maintain it, but also becomes the main carrier for countries to participate in global industrial division of labor.

Scholars at home and abroad have studied this subject, and Shao Yunfei (2006) has made relevant literature review[1], previous studies have shown that the level of economic development in different regions of China are quite different. For this reason, scholars have evaluated regional technological innovation ability from different aspects[2-3]. On the basis of this, Shao Yunfei selected 20 indicators of regional technological innovation ability as the analysis variables according to China's actual situation, using principal component analysis and system clustering method to analyze the relevant indicators of regional technological innovation ability, and drew some useful conclusions.

This paper is to supplement and improve the index system design and analysis method of existing literature, expecting to use a more perfect method to get a more reasonable regional division. It also analyzes the characteristics of various regional technological innovation capabilities, and puts forward corresponding countermeasures accordingly.

2. Research design

The research process in this paper includes: (1) selecting variables and collecting data on the basis of existing research literature; (2) factor analysis of variables to extract the principal components; (3) clustering according to the scores of regional factor scores, identify category of each region; (4) making further study of the main characteristics of each category, analyzing the reasons and put forward targeted suggestions.

3. Variable selection and data collection

According to the framework of China's innovation index system, this paper selects variables from four aspects of technological innovation: technological innovation environment, technological innovation input, technological innovation output, technological innovation effectiveness. As shown in Table 1.

Table 1. Variables in the classification research design of regional technological innovation capability

	variables
X1	R&D full time equivalent (person year)
X2	Technical market turnover (100 million yuan)
X3	The total number of valid patents of three patents in China (piece)
X4	Number of 10000 R&D personnel (person year / million)
X5	Number of college graduates or above (person / 10000 person)
X6	Proportion of enterprises with R&D activity (%)
X7	R&D expenditure accounts for GDP share (%)
X8	Enterprise R&D expenditure accounts for the proportion of main business income (%).
X9	Number of scientific papers per million (article / million)
X10	Million patents for invention (piece / million)
X11	Labour productivity (10000 yuan per person)
X12	Per capita gross domestic product (yuan)

According to the variables in Table 1, the relevant data of 31 provinces and cities in China were collected by means of the "China Statistical Yearbook", "National Science and Technology Funds Input Statistical Bulletin", "National and Regional Science and Technology Progress Statistical Monitoring Results", "China Science and Technology Statistical Yearbook" and "China Regional Economic Statistics Yearbook".

4. Classification analysis of regional technological innovation capability

4.1 Factor analysis

Factor analysis is a generalization of principal component analysis. It is a multivariate statistical analysis method to find the basic structure of the observed data by studying the dependencies within the correlation matrix and to classify some variables with complex relationships into a few comprehensive variables.

Firstly, calculate the correlation coefficient matrix of the 12 variables. By calculating the correlation coefficient of the 12 variables, it is found that there is a significant positive correlation between the 12 variables. And the KMO value is 0.817, which is suitable for factor analysis. Therefore, it is necessary to extract principal components which can reflect sample information and relatively independent from 12 variables.

Table2. Interpretation table of total variance

Section	Initial eigenvalue			Extracting load sum of squares			Quadratic sum of rotational loads
	Total	Variance percentage	accumulation %	Total	Variance percentage	accumulation %	Total
1	8.313	69.275	69.275	8.313	69.275	69.275	5.112
2	1.773	14.775	84.050	1.773	14.775	84.050	3.061
3	.988	8.230	92.280	.988	8.230	92.280	2.900
4	.441	3.676	95.956				
5	.225	1.878	97.835				
6	.103	.856	98.691				
7	.064	.530	99.221				
8	.042	.352	99.572				
9	.027	.224	99.797				
10	.010	.084	99.880				
11	.008	.070	99.951				
12	.006	.049	100.000				

Table 2 is the common factor variance table of each component, from which we can see that the cumulative contribution rate of the first three principal components corresponding to the characteristic roots reached 92.28% (greater than 85%). So we finally extract 3 principal components to analyze China's regional technological innovation capability.

4.2 Sample clustering based on principal component analysis

Cluster analysis was adopted using SPSS, China's regional technological innovation capability can be divided into four categories:

First class: Beijing

Second class: Shanghai, Tianjin

Third class: Jiangsu, Zhejiang, Guangdong

Forth class: Fujian, Shandong, Liaoning, Sichuan, Shanxi, Anhui, Guangxi, Henan, Hunan, Guizhou, Yunnan, Gansu, Hainan, Jiangxi, Chongqing, Hubei, Shanxi, Heilongjiang, Jilin, Hebei, Neimenggu, Ningxia, Qinghai, Xinjiang, Xizang

5.   Results analysis and countermeasures

The purpose of classifying the regional technological innovation capability of 31 provinces and cities in China is to analyze various characteristics and make suggestions accordingly.

5.1 The first category of regional technological innovation capability

Only Beijing in this category. The biggest characteristic is the strong ability of independent innovation, the good combination of production, learning and research, and the rapid development of high-tech industries. Beijing should act as the supply node of technological innovation, improve the transformation ability from scientific research results to economic benefits through technological diffusion, and promote the technological innovation ability of the surrounding regions.

5.2 The second category of regional technological innovation capability

This category has Shanghai and Tianjin. The characteristics are strong ability of technology introduction and absorption, strong ability of human capital accumulation, independent innovation ability needs to be improved. In the future, these provinces and cities should strive to improve their independent innovation ability, increase investment in scientific research, promote the rapid development of high-tech industries, so that their economic strength to a higher level.

5.3 The second category of regional technological innovation capability

Jiangsu, Zhejiang and Guangdong are in the third category. Due to historical reasons or geographical constraints, the overall economic strength of the region is not strong enough, large enterprises are not enough, and lack of competitiveness in traditional industries. Therefore, while striving to cultivate high-tech industries, it is the best choice for the third type of regions to create a social environment in which talents can be retained and the potential of talents can be brought into play.

5.4 The second category of regional technological innovation capability

The remaining provinces fall into the forth category. These provinces have less awareness of technological innovation. Although government have strengthened their support for R&D, the development of high-tech industries, the total economic output are obviously not good enough. The first point ise to make full use of their geographical advantages, strengthen economic and technological exchanges with neighboring "rich provinces", vigorously introduce mature technology while strengthening their R&D capabilities, giving priority to promoting the development of high-tech industries.

References

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