

Comparison of Sub-Provincial Cities Competitiveness in China

Based On PCA Method

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Abstract: Based on PCA method, this paper sets an evaluation indicator system which is used to evaluate the sub-provincial cities' competitiveness. By ranking the overall competitiveness and integrating with the analysis of growth index calculation for competitiveness, the paper studies on science, technology and economic competitiveness and development of the 15 vice-provincial cities from 2006 to 2010. This paper provides references for decision-makers to promote a city's competitiveness and to strengthen the role of science and technology in support of economic transformation and upgrading, and to further push on the construction of innovative city.

Keywords: Sub-Provincial cities, competitiveness, PCA method

1. Introduction

By the end of 2005, China had 661 cities, 42.99% of the total population of the city. Only 287 prefecture-level or above cities, which accounted for 59.9 percent of the national GDP, of which 15 sub-provincial cities, the total population and GDP accounts for 27.1% and 33.8% of the total urban population and GDP, respectively, and these cities have become the region's growth pole of a strategic anchor and economic development.

The study on city competitive ability has become a hot subject, as it is important to the development of cities and the local area. 15 sub-provincial cities such as Guangzhou are under levels of four large municipalities, the urban management system is similar

and the cities are regional innovation center with the level of economic and technological development, its technological competitiveness has been widespread concern. However, the research on perspective of competitiveness developments and changes and technological economic coordination are rare. By constructing an evaluation system for competitiveness, using 2006-2010 data for analysis of scientific and technological competitiveness in 15 sub-provincial cities, and comprehensive competitiveness is also analyzed. By introducing technological competitiveness growth index, the technological competitiveness improvement degree in 15 cities is studied. Through the coordination analysis of scientific and technological and economic competitiveness of 15 cities, we make a cluster analysis.

2. Indicator system setting

To introduce the comprehensive competitiveness of sub-provincial cities, we first introduce the indicator system setting of science and technology competitiveness, because science and technology competitiveness is one of the most significant indicator of the comprehensive competitiveness, so the part is very important.

According to related evaluation system, from four aspects as science and technology investment levels, technological output level, technology and economic and social development degree as well as scientific and technological potential to build a more complete technology competition force comprehensive evaluation system (see Table 1).

Table 1 Sub-provincial city technology competitiveness evaluation index system

First level index	Weights	Second index	Weights	Third level index	Weights	Total weights
Science and technology investment	0.3	Financial investment in science and technology	0.5	R&D total expenditure	0.3	0.045
				R&D expenditure share of GDP	0.3	0.045
		Science and technology manpower	0.5	Local Financial Expenditure	0.2	0.03
				The proportion of local fiscal expenditure	0.2	0.03
	0.4	Patent output	0.5	Total professional and technical personnel	0.3	0.045
				The number personnel per million people	0.3	0.045
				R&D activities staff	0.2	0.03
				Proportion of employees for R&D personnel	0.2	0.03
Scientific output	0.4	Technology industry output	0.5	Patents granted	0.2	0.04
				Patents granted per 100,000 people	0.2	0.04
				Invention patents granted	0.3	0.06
				Per 100,000 patents granted	0.3	0.06
	0.15	Economic growth	0.4	High-tech industry output	0.25	0.05
				High-tech industries proportion	0.25	0.05
		Environmental resources	0.6	High-tech product exports	0.25	0.05
				High-tech products exports proportion	0.25	0.05
Coordination degree of technology, economic and social development	0.15	Higher base	0.6	Per capita GDP	0.5	0.03
				Gross Domestic Product (GDP)	0.5	0.03
		Information level	0.4	Wastewater discharge compliance rate	0.5	0.0405
				Ten thousand GDP comprehensive energy	0.5	0.0495
	0.15	Higher base	0.6	Number of students in colleges	0.3	0.027
				Local fiscal expenditure on education	0.35	0.0315
		Information level	0.4	Local fiscal expenditure proportion	0.35	0.0315
				Internet users	0.5	0.03
				Million Internet users	0.5	0.03

3. Index system evaluation of science and technology competitiveness

Using principal component analysis, the available five basic factors reflect most of the information of 25variables(three targets). Five factor sare: the total amount of techno-economic factors, the degree of

technology investment factor, scientific and technological potential factors, educational factors and harmonious development factor. We can obtain the technological competitiveness estimates from 2006-2010of15cities, see Table 2.

Table 2 Sub-provincial cities technological competitiveness ranking from 2006-2010

Rank	Year 2006	Year 2007	Year 2008	Year 2009	Year 2010
1	Shenzhen	Shenzhen	Shenzhen	Shenzhen	Shenzhen
2	Guangzhou	Guangzhou	Guangzhou	Guangzhou	Guangzhou
3	Wuhan	Hangzhou	Hangzhou	Hangzhou	Hangzhou
4	Nanjing	Nanjing	Ningbo	Nanjing	Nanjing
5	Hangzhou	Dalian	Nanjing	Ningbo	Ningbo
6	Shenyang	Wuhan	Qingdao	Wuhan	Chengdu
7	Xi'an	Ningbo	Chengdu	Chengdu	Wuhan
8	Qingdao	Qingdao	Shenyang	Xi'an	Qingdao
9	Chengdu	Shenyang	Wuhan	Shenyang	Dalian
10	Xiamen	Chengdu	Dalian	Qingdao	Xi'an
11	Ningbo	Xi'an	Ji'nan	Dalian	Shenyang
12	Ji'nan	Harbin	Xiamen	Harbin	Harbin
13	Harbin	Ji'nan	Xi'an	Ji'nan	Xiamen
14	Dalian	Xiamen	Changchun	Xiamen	Ji'nan
15	Changchun	Changchun	Harbin	Changchun	Changchun

(1) Guangzhou, Shenzhen have obviously competitive advantages in science and technology. From 2006-2010, Shenzhen and Guangzhou ranked the first and second place in sub-provincial cities.

(2) The level of innovation and technology incremental capacity is the most significant in Hangzhou, rising from No. 5 in 2006 to the third in four years of 2007, 2008, 2009, 2010, above Wuhan, Nanjing and had a good development trend.

(3) From year 2006-2010, Nanjing was ranking the top four in 15 cities, which displays a strong scientific and technological innovation capacity.

(4) Ningbo momentum is among the strongest in 15 cities. Although in 2006, it lived in the 11th of 15 cities, in 2007 that rose to No. 7, 2008 the first fourth rank, living behind Shenzhen, Guangzhou, Hangzhou and over Nanjing and held in the fifth in 2009 and 2010.

(5) Chengdu increased rapidly. Although once from nine in 2006 fell to 10 in 2007, but 2008, 2009, it was up to the position 7, 7, 6, respectively.

(6) In recent years, the competitiveness of Wuhan

continued to decline. Wuhan has many universities, so it has good industrial base and scientific and technological potential, but the human and financial investment in science and technology is inadequate, institutional mechanisms innovation is weak, science and technology advantage did not translate into competitive advantage.

(7) Qingdao and Dalian have similar resource endowments, they both have excellent harbor and good industrial base, technological competitiveness was generally favorable during 2006-2010, which moved up slightly.

(8) Shenyang and Xi'an was down from the sixth and seventh place all the way, respectively, to the position 9, 11, and 8, 13 place in 2008 and so on. Although there are many colleges and universities, which has good heavy industry base, but institutional innovation and technological innovation has short comings.

(9) Changchun's technological innovation was ranking behind, the situation has not been improved continuously. The competitiveness in Jinan, Xiamen,

Harbin, and several other cities are also relatively weak.

4. Index system evaluation of comprehensive competitiveness

According to the city's comprehensive competitiveness, follow the indicators selected

principles of scientific, purpose, operability and comparability, we select the comprehensive economic strength, the strength of the exchange, scientific and technological innovation strength and social environment overall strength to build cities comprehensive competitiveness index system.

Table 3 Comprehensive competitiveness comparison of 15 sub-provincial cities

City	Comprehensive economic strength	Exchange strength	Scientific and technological strength	Comprehensive social environment strength	Comprehensive competitiveness	City	Comprehensive economic strength	Exchange strength	Scientific and technological strength	Comprehensive social environment strength	Comprehensive competitiveness
Dalian	1.847(9)	0.708(5)	0.6431(3)	2.806(7)	1.558(9)	Qingdao	1.824(10)	0.560(7)	0.317(14)	2.754(8)	1.427(12)
Changchun	1.858(8)	0.204(14)	1.167(9)	2.461(12)	1.505(10)	Wuhan	2.262(4)	0.543(9)	1.246(7)	1.417(14)	1.453(11)
Harbin	1.621(14)	0.189(15)	1.036(11)	2.188(13)	1.330(14)	Guangzhou	4.372(2)	1.355(2)	1.626(4)	3.416(2)	2.843(2)
Nanjing	1.949(6)	0.569(6)	2.478(1)	3.239(3)	2.128(4)	Shenzhen	7.678(1)	2.121(1)	1.966(2)	8.884(1)	5.440(1)
Hangzhou	1.803(12)	0.527(11)	1.553(5)	3.096(4)	1.809(6)	Chengdu	1.819(11)	1.035(3)	1.285(8)	2.988(5)	1.821(5)
Ningbo	1.117(15)	0.532(10)	0.209(15)	2.510(10)	1.121(15)	Xian	2.018(5)	0.333(12)	1.493(6)	1.195(15)	1.344(13)
Xiamen	3.703(3)	0.980(4)	0.904(12)	2.645(9)	2.194(3)	Standard deviation	1.653	0.507	0.634	1.738	1.055

Taking into account the comparability between different cities, all of these indicators adopt per capital or relative proportion. Then, the comprehensive competitiveness comparison of 15 sub-provincial cities can be seen in Table 3. The number in parentheses represents city's comprehensive competitiveness sort order for each component.

From the comparison of scores on the table and results of each city's comprehensive competitiveness and competitive breakdown, we can draw the following conclusions: First, from the city's comprehensive competitiveness score, the comprehensive competitiveness in 15 sub-provincial cities in China's is strong as a whole, its lowest score is above 1.0, while their score difference is not very significant, and the standard deviation of the city's comprehensive competitiveness is 1.055. Second, from the view of the city's comprehensive economic competitiveness, the over all economic competitiveness gap of 15 sub-provincial cities is more significant, the standard deviation has reached 1.655. Third, from the open exchange competitiveness, the score difference in 15 sub-provincial city is not great, the standard

deviation is only 0.507. Fourth, from the point view of technological innovation competitiveness, the technological innovation competitiveness gap of 15 cities is not very obvious, their standard deviation is only 0.634. From the overall competitiveness of the social environment, this score difference in 15 cities is very significant and their standard deviation is 1.738.

5. Conclusions

Considering the regional characteristics of different cities, the economic structure, technological level is quite different, but the comprehensive competitiveness in different cities is close linked to the science and technology development, social environmental factors and the industrial competitiveness. The more developed the general economy, its technological competitiveness is relatively high, the competitiveness is also high, and vice versa. The growth index higher, the urban and technological competitiveness stronger in sub-provincial cities. How to start and promote comprehensive development of a relatively weak competitiveness of the city still needs further study.

Many cities are rich in scientific and educational resources, have good science and technology strength

and a good industrial base. There is a need to strengthen the cultivation and development of market economy and strengthen combination to ensure the scientific and technological potential in to a technological competitive edge to strengthen the competitiveness in other cities. While focusing on export-oriented investment in coastal cities, we must also strengthen the independent innovation capability of local industries to promote competitiveness and promote sustainable development.

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