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China's Regional Innovation Environment Evaluation

SHI Ping[a],*; TANG Danni[b]; WANG Yong[b]

[a]Professor, Doctoral tutor. School of Economics and Management, Northwest University, Xi'an, China.
[b]School of Economics and Management, Northwest University, Xi'an, China.
*Corresponding author.

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Abstract

On the base of monitoring China's regional environmental quality and analyzing soft power of innovation environment, the authors make a comprehensive evaluation on China's 31 provinces' regional innovation environment in four levels: basic environment, organizational environment, cultural environment and information environment. The study shows that the innovation environment in East Coast is the best; the Central and Northeastern regions are moderate; while the innovation environment of the West is worse than the other three regions. Also, the policy recommendations to enhance innovation environment quality of the West have been proposed.

Key words: Regional innovation environment; Integrated utility value; Policy recommendations

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INTRODUCTION

With the development of knowledge economy and the deepening of globalization, the worldwide economic development has shown the characteristic of regionalization. Regional innovation capability is increasingly becoming a decisive factor for regional economy to get internationally competitive advantage. A region's favorable innovation environment is fundamental assurance for sustainable development of its economy, and technical innovation capability depends on the region's good regional innovation environment. Only if the region has a good innovation environment can its innovation become more effective and build its own regional competitive advantage.

China's regional innovation capacity report from Liu & Chen (2013) indicated that China has formed a stable pattern of regional innovation capability: the East region is the backbone and its unique situation is evolving to the balanced development of the three regions, but the development of a balanced pattern of regional innovation is still a long way to go. Improving Northeast old industrial base's innovation capability is not easy. Also, the West region has geopolitical differences. There are many difficulties need to be faced. The innovation capability is highly subjected to the quality of innovation environment. Therefore, the study of China's regional innovation environment becomes urgent and really necessary.

1. DOMESTIC AND INTERNATIONAL RESEARCH REVIEW

To the research on regional innovation environment, Saxenian (1994) compared regional culture and competitive advantage of the Silicon Valley and Route 128, pointing out the important influence of regional innovation environment. Kaufmann and Todtling (2000) made a conclusion that different innovation environment have important impact on different traditional industries through empirical comparison of innovative environmental systems of traditional industrial region Styria. Guo-yong (2010) analyzed how the characteristics

of regional innovation networks, regional node size and individual innovation impacted technological innovation based on network relationships and structure in sociological theory. He noted that networks of regional innovation environment were becoming the main model of regional innovation and development. Amir (2013) took the developing country Malaysia as an example and analyzed how regional innovation system affected the economically underdeveloped regions. He indicated that the regional innovation system should ensure that there were appropriate measures to improve the manufacturing industry's technology innovation at regional level.

Chinese scholar Xu (2007) used principal component analysis and cluster analysis to evaluate China's 31 provincial-level area's innovation environment after the analysis of regional innovation environment status. Yue and Zhang (2008) did empirical studies in relationship among R&D investment, innovation environment, and regional innovation capabilities. They pointed out that significant difference of China's 30 provinces (district) innovation capabilities came both from the regional R&D investment differences and from the key role of innovation environment. Huang, Li, and Li (2011) used factor analysis method to compare the provincial regional innovation environments and then revealed the disadvantages and advantages of eastern and mid-western regions' environment and rose up related policy recommendations to improve the regional innovation environment. Li and Chen (2009) did a systematic analysis of differences in regional innovation environment. Then they put regional innovation environment as a set of quantitative indicators, using principal component analysis method to rate and analyze on the East, Central and Western regions, and pointed out reasons for the formation of differences. Shi, Han, and Song (2011) used the non-parametric method of Malmquist Productivity Index to calculate the changes from 1999 to 2011 of China's regional research and innovation efficiency. Also, they used convergence theory to do in-depth analysis of the differences evolution and internal mechanism. The conclusion was that there were significant spatial differences between TFP growth of research and innovation, and the East, Central and West area existed obvious conditional convergence. Information level, the level of utilization of foreign capital, human capital and some other factors are the main factors that impact the spatial differences of China's research and innovation activities.

Based on extensive literature and the experience and achievements of previous studies, we divided regional innovation environment into four levels, and each level had a number of specific indicators to describe various regional innovation environment. Ultimately, it gave comprehensive scores on the quality of each regional innovation environment and policies and recommendations to enhance western area's innovation environmental quality according to the score results.

2. QUALITY MONITORING OF REGIONAL ENVIRONMENT

To analyze regional environmental quality and innovation environment, economic areas are divided into four regions: the East Coast area (the Pearl River Delta, Yangtze River Delta, Beijing, Tianjin and other places), Central area, West area and Northeast area. East Coast area includes a total of 10 provinces or municipalities: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan; Central area includes a total of 6 provinces: Shanxi, Anhui, Jiangxi, Henan, Hubei and Hunan; West area includes 12 provinces or municipalities: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang; While the Northeast area includes 3 provinces: Liaoning, Jilin and Heilongjiang. The land area, population, regional GDP and economic development characteristics of the four regions are as shown in Table 1.

Table 1
Four Regions' Environment and Characteristics

	Number of provinces or municipalities (a)	Land area (Ten thousand square kilometers)	Proportion of the total land area	Population (one hundred million)	Proportion of the total population	Regional GDP (one hundred million)	Characteristics of regional economic development
East coast	10	91.6	9.50%	4.8	36.70%	269084.75	Open up earlier, Prosperous economy
Central	6	102.8	10.70%	3.55	27.10%	104473.87	Large population, Economic hinterland, An important market
West	12	687.6	71.50%	3.65	27.90%	100234.96	Economically underdeveloped, Need to enhance the development
Northeast	3	78.8	8.20%	1.09	8.30%	45377.53	Rich in natural resources, Bountiful

Source: "China Statistical Yearbook (2012)" and the Chinese Government Network http://www.gov.cn

Table 1 shows that four regions are different, both in environmental quality and in infrastructure environment, institutional environment, social and cultural environment, resources environment and organization network environment, in which all have their own characteristics. Regional innovation environment in these areas largely affected the development and market competitiveness of each region's high-tech enterprises, resulting in large differences in high-tech industrial output value. As is shown in data of China's high-tech industry in 2010, Guangdong province's output value reached 2.105 trillion Yuan and Jiangsu province's output value reached 1.6278 trillion Yuan. They were ranked the first and second place respectively in the country; while Tibet, 0.6 billion Yuan, and Qinghai, 2.3 billion Yuan, were ranked as the lowest and the second lowest in output value. Their comparison is shown in Figure 1.

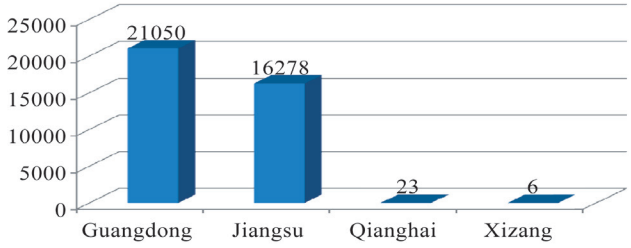

Figure 1
Guangdong and Other 3 Provinces' High-Tech Industry Output Value Comparison (One hundred million Yuan)
Source: "Chinese high-tech industry data (2012)."

After summing the four regions' provincial high-tech industry output value together, inter-regional comparison is as shown in Figure 2.

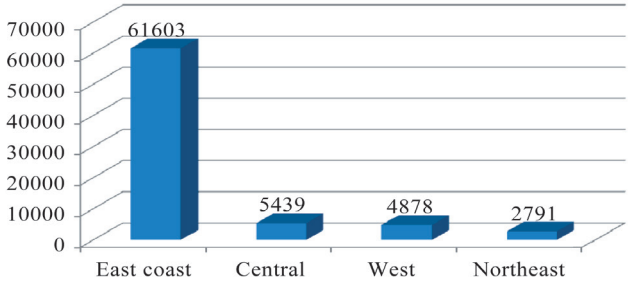

Figure 2
Comparison of Four Regional High-Tech Industry Output Value (One Hundred Million Yuan)
Source: "Chinese high-tech industry data (2012)."

Figure 2 shows that, among the total output value of 7.4709 trillion Yuan in the national high-tech industry, the East Coast area contributes up to 82.46%, and high-tech industry output value of the 10 east coast provinces or municipalities is around 12.36 times of the output value from western 12 provinces. The disparity is quite evident when comparing the provinces among different regions.

3. EMPIRICAL ANALYSIS OF REGIONAL INNOVATION ENVIRONMENT

3.1 Choosing the Indicators

This paper believes that regional innovation environment consists of four layers: basic environment, organizational environment, cultural environment and information environment. Basic environment mainly refers to the basic infrastructure, education and research institutions and high-quality personnel training, etc. These factors are the most basic material and personnel guarantee of regional innovation environment. Organizational environment can be viewed as a dynamic and open system, through strategic alliances, suppliers' vertical contact, joint ventures and other ways to promote communication and exchange in order to better promote the formation of innovation. Cultural environment is an area of values and norms of behavior, etc., which will cultivate an overall regional social groups and people in the same mode of cultural environment to enable them have the same way of thinking, values, social customs, etc. forming a centripetal force. Information environment is composed by the critical knowledge information and market information which plays a key role on innovation since the uncertainty is smaller when you have more information. Small uncertainty will help to optimize the risk to enable the industries in this region to obtain greater economic benefits.

China's four major regional innovation environments are different, making a comprehensive evaluation need to refine all levels into quantified indicators. *China's regional innovation capability report 2011* (2013) made decomposition and calculation on the various types of data in accordance to the index system. The composite indicator is decomposed into three specific indicators: strength, efficiency and potentiality. Respectively, each specific indicator is measured from its five aspects of innovation capacity: knowledge creation, knowledge acquisition, enterprise innovation, innovation environment, and innovation performance.

To the indicator "innovation environment" (Technical Innovation Environment and Management) of the innovation capacity estimation, this paper, from the relevant indicators of the innovation environment, selected the number of telephone subscribers per hundred average, growth in the number of Internet users, road ownership, passenger throughput of the three kinds of modes of transportation, government expenditure, gross domestic investment per capita in fixed assets, the level of consumption growth, education funding, the percentage of college education among the population aged 6 and older, funding received by the National Innovation Fund, loans obtained by above-scale industrial enterprises in R&D activities from financial institutions, proportion of high-tech enterprises in above-scale industrial enterprises,

and so on to measure the comprehensive utility value of innovation environment of each province and municipality.

3.2 Empirical Results and Analysis

According to related collation of data and estimation in *China' regional innovation capability report 2011*, the rankings, strength, efficiency and potentiality of the ultimate integrated municipal utility value innovation environment in each province and municipality are shown in Table 2.

Table 2
Innovation Environment Score and Ranking of Provinces in Each Region

Region	Province/ Municipality	Innovation environment					Innovation ability	
		Integrated utility value	Integrated ranking	Strength ranking	Efficiency ranking	Potentiality ranking	Integrated utility value	Integrated ranking
East Coast	Jiangsu	51.86	1	2	8	25	55.49	1
East Coast	Guangdong	50.32	2	1	7	28	54.88	2
East Coast	Beijing	45.95	3	9	1	29	50.31	3
East Coast	Shanghai	34.95	7	7	2	30	49.98	4
East Coast	Zhejiang	41.58	5	4	10	23	42.83	5
East Coast	Shandong	41.71	4	3	19	19	39.04	6
East Coast	Tianjin	34.14	9	22	3	3	38.29	7
Northeast	Liaoning	32.07	11	8	15	21	31.77	8
West	Sichuan	35.74	6	5	18	9	31.07	9
West	Chongqing	23.86	24	24	22	20	30.77	10
Central	Hunan	29.91	18	12	27	11	29.81	11
West	Shaanxi	34.76	8	15	5	15	29.8	12
Central	Hubei	31.16	14	11	21	14	29.35	13
East Coast	Fujian	30.13	17	14	16	12	28.62	14
Central	Anhui	31.52	13	13	26	1	27.81	15
Northeast	Jilin	29.31	19	20	11	8	27.14	16
Central	Henan	31.64	12	6	31	10	27.05	17
Central	Jiangxi	30.61	15	16	14	7	24.52	18
East Coast	Hebei	32.44	10	10	24	5	24.44	19
Northeast	Heilongjiang	26.13	21	18	23	13	24.05	20
West	Neimenggu	30.39	16	17	12	6	23.49	21
West	Guangxi	23.1	28	23	30	18	23.41	22
Central	Shanxi	23.44	27	21	20	27	23.16	23
West	Guizhou	23.62	26	26	25	16	22.62	24
West	Gansu	23.73	25	27	28	2	22.41	25
West	Yunnan	27.25	20	19	13	24	21.78	26
East Coast	Hainan	24.55	23	28	6	22	21.46	27
West	Xinjiang	25.35	22	25	9	26	20.81	28
West	Ningxia	20.41	31	30	29	4	19.72	29
West	Qinghai	21.34	29	29	17	17	18.41	30
West	Xizang	21.14	30	31	4	31	18.02	31

Source: *China's regional innovation capability report 2011* edited by X. L. Liu and A. Chen.

The total strength of innovation environment mainly refers to the resources that a region has; efficiency refers to benefits generated by the unit input in a region; and the potentiality mainly refers to the growth speed of a region comparing with the previous year. The data above was analyzed and classified according to four regions and the weighted average of each region is obtained. The results are shown in Figure 3.

As can be seen from Figure 3, the innovation environment score of China's East Coast is 38.76. Except Hainan province, it is higher than the average of other regions, especially in Jiangsu Province, Guangdong Province and Beijing, which are the top three; the Innovation environment score of the Central region is 29.71. All the provinces in this region, expect Shanxi province, are ranked between 10 and 20; the Innovation environment score of Northeast is 29.17 with Liaoning better than other provinces although these three provinces are quite balanced; the innovation environment score of the West region is 25.89, in which all the provinces, expect Sichuan and Shaanxi provinces who are ranked sixth and eighth, take the last few in the ranking. Overall, the innovation environment of each region in China various and is quite different from each other.

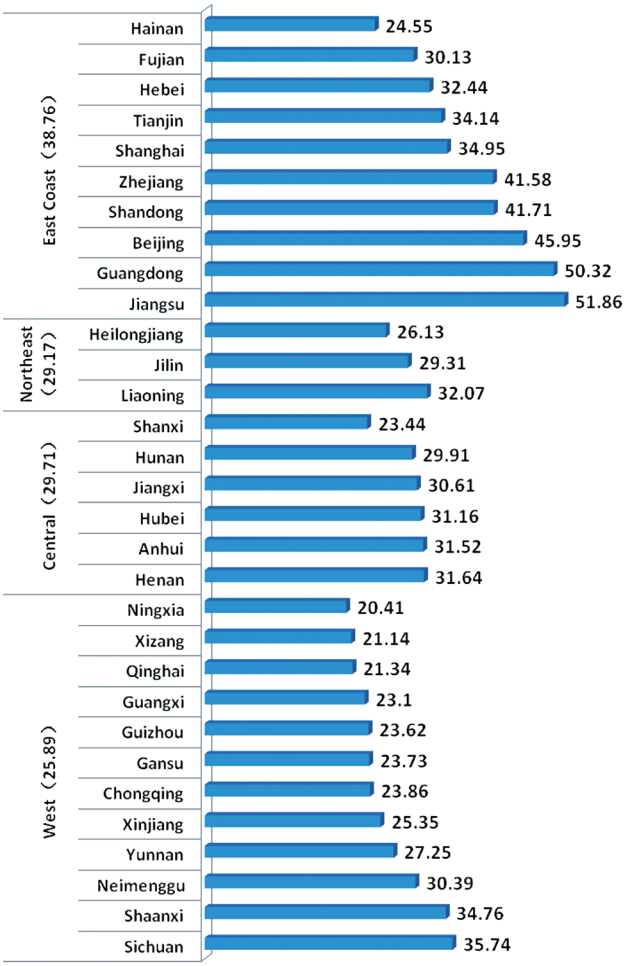

Figure 3
Innovation Environment Score in Each Region

CONCLUSIONS AND SUGGESTIONS

To the innovation environment in each region, East Coast is 40.34; Central region is 29.53, Northeast region is 29.17, and West region was 28.92. The innovation environment of East Cost is higher, but the potentiality of innovation environment is lower than the West region, that is, less space for improvement.

The innovation environment for East Coast is better, with better strength and efficiency. It is the backbone of innovation. The provinces that have higher innovation abilities, such as Tianjin, Jiangsu, Shandong, Guangdong, and so on, still have more spaces for improvement; the innovation environment in Central region and Northeast region are moderate; while the innovation environment of the West region is the worst when comparing with other three regions. Its strength and efficiency are lower, but it has large potentiality to be improved. Therefore, the West region's innovation environment needs to be further strengthened.

Based on the analysis above, this paper proposed the following recommendations for enhancing quality of regional innovation environment: (a) improve the regional GDP—the East Coast region plays a lead role in promoting the rapid growth of GDP in Central and West regions and simultaneously promoting the balanced regional development within the provinces and narrowing down the inter-provincial gap. (b) Introduce high-tech and innovative talents, increase capital investment, and promote regional economic development. (c) Industries should analyze themselves from a macro perspective and combine their advantages from five aspects, including infrastructure environment, institutional environment, social and cultural environment, resources environment and organizational network environment, to prevent their weaknesses, improve their regional Innovation environment warning system functions and increase their sensitivity, and then promote the development of two dimensions (macro-regional innovation environment quality and enterprise development) together.

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