Evaluation of Innovation Efficiency in Shibaolang Comprehensive Innovation Reform Pilot Zone

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Abstract. Based on the background of hebei province, this paper calculates the innovation input-output efficiency of shibaolong city with DEA method, combine with the input and output base of shibaolang innovation and the average annual growth rate, this paper analyzes the comprehensive innovation situation in the three cities of shibaolang, and puts forward Suggestions on the development of innovation efficiency in shibaolang comprehensive innovation reform pilot area.

At present, the national level and local provinces and cities are vigorously promoting innovation and reform experiments. The national leading group for deepening reform, headed by general secretary xi jinping, has vigorously advanced the top-level design of innovation and reform, introduced a series of national innovation and reform policies, and vigorously implemented the innovation-driven development strategy. In July 2016, the national development and reform commission and the ministry of science and technology approved *The Comprehensive Innovation Reform Plan for the Beijing-Tianjin-Hebei Region System* and *The Comprehensive Innovation Reform Test Plan for Shibaolang Region*. For comprehensive innovation reform test work for further systematic research, is to deepen the reform of the science and technology system in our province and to strengthen the regional innovation a major step, is a big opportunity for regional development, to implement the development strategy of innovation drive, for innovation to promote structural reform and further optimizes the supply side structure play a crucial role. This paper will evaluate the innovation efficiency of shibaolang from the perspective of innovation efficiency, hoping to play a certain reference role in the construction of the three comprehensive innovation and reform experimental areas in shibaolang.

Jiang haitao (2017) studied the current development situation of deyang regional scientific and technological innovation mechanism under the background of full innovation zone, analyzed the existing problems and reasons in the development process, and put forward effective suggestions and countermeasures. Tu yun (2017) used DEA method to evaluate and analyze the innovation efficiency of 21 cities, states and four provincial comprehensive innovation reform pilot zones in Sichuan province. Shi Xiusong, Zhao Shudong and Wu Fuxiang (2009) measured the innovation efficiency of Chinese provincial regions and analyzed their spatial differences. The results showed that the overall level of regional innovation efficiency in China was not high and the regional differences were obvious. Ye Dan and Huang Qinghua (2017) used the DEA-Malmquis method to calculate the innovation efficiency of high-tech industries in 28 provinces and cities of China in 10 years, and analyzed the impact of innovation environment on the innovation efficiency of high-tech industries. Liu hongjiu, liu qingyang, Hu Yanrong, Dai Dan (2018) studied the innovation efficiency and spatial distribution characteristics of 11 cities in Zhejiang province. And put forward the relevant Suggestions and measures to improve the innovation efficiency. This paper comprehensively evaluates the regional innovation efficiency of jiangsu province from the static and dynamic perspectives and analyzes the reasons for the improvement of provincial regional innovation efficiency.

1. Establishment and Selection of Index System of Regional Innovation Efficiency Evaluation

In the selection of the index of innovation efficiency input, it can be found that scholars generally consider the two aspects of personnel input and funds input, considering the availability of data

(Hebei province 2013-2014 no R&D personnel full time equivalent statistics), When selecting the index of innovation efficiency input, this paper will focus on the aspect of expenditure input. The correlation analysis between internal expenditure of R&D expenditure and local financial science and technology expenditure shows that the correlation coefficient is 0.811, which is not highly correlated with each other. Therefore, internal expenditure of R&D expenditure and local financial science and technology expenditure are selected as the measurement indexes of innovation efficiency input.

The selection of the output index of innovation efficiency refers to the previous literature, and this paper chooses to consider the two aspects of knowledge output and economic output. Correlation analysis was conducted on the number of patent application acceptance and the number of patent authorization of the patent index. The correlation coefficient was 0.979, which was higher than 0.95. They are highly correlated, The number of patent authorization was selected as the measure index of knowledge output. Economic output is measured index chooses gross regional product.

first grade indexes	second index				
	Internal expenditure on				
input index	R&D (100 million yuan)				
	Fiscal expenditure on				
	science and technology				
	(100 million yuan)				
	patent authorization				
output index	quantity(pcs)				
	GDP (\$100 million)				

 Table 1
 Innovation efficiency evaluation index system

2. Analysis of Innovation Efficiency

2.1 Data Source and Sample Selection

The purpose of this paper is to evaluate the innovation efficiency of shibaolang comprehensive innovation reform experimental area. Although this paper analyzes the three pilot zones of comprehensive innovation and reform in shibaolong, in order to more comprehensively analyze the efficiency of these three cities, the three cities will be compared under the background of 11 cities in Hebei province. In order to show the change process of innovation efficiency, data from 11 cities in Hebei province from 2013 to 2016 were selected as measurement samples. Due to the time lag from input to output. According to the convention, the time delay from input to output is set as 2 years. That is, the input index data were selected from 2013 to 2014, and the corresponding output index data were selected from 2013 to 2016.

The data of the two input indexes of the 11 cities in Hebei province are from statistical bulletin of Hebei province's scientific and technological investment from 2013 to 2016 and Hebei economic yearbook from 2017. The data of output indexes are from Hebei economic yearbook from 2015 to 2017.

2.2 Evaluation and Result Analysis of Regional Innovation Efficiency

DEAP2.1 software has two algorithms to choose: Input and output. Considering that innovation Input occurs before innovation output in innovation activities and is easier to control and adjust than output, this paper chooses input-orientated algorithm, and DEA efficiency measurement results are shown in table 2.

City	Comprehensive technical efficiency		Pure technical efficiency		The scale	efficiency	Returns to scale	
	2016	2015	2016	2015	2016	2015 Voor	2016 Voor	2015 Year
	Year	Year	Year	Year	Year	2015 Teal	2010 Teal	
Shijiazhuan g	0.481	0.444	1	1	0.481	0.444	drs	drs
Langfang	0.961	1	1	1	0.961	1	drs	-
Baoding	1	0.907	1	1	1	0.907	-	drs
Hebei Province mean	0.807	0.781	0.968	0.964	0.830	0.813		

Table 2Changes of city efficiency and scale compensation in 2015-2016

NOTE: irs, -, drs Respectively represents scale increasing, constant and decreasing.

From the perspective of comprehensive technical efficiency, langfang city was the most effective city in Shibaolang 2015, Shijiazhuang city, Baoding city comprehensive technical efficiency was invalid. In 2016, Baoding's comprehensive technical efficiency in Shibaolang achieve effective, Langfang's comprehensive technical efficiency from effective became invalid in 2015, decreasing by 0.039, while Shijiazhuang's comprehensive technical efficiency has increased by 0.103.

From the perspective of pure technical efficiency, Shibaolang has maintained pure technical effectiveness in 2015 and 2016, It indicates that the management level of Shibaolang innovation reform pilot zone is high and the system is reasonable.

From the perspective of scale efficiency, In 2015, only Lang fang city achieved effective in the scale efficiency of shibaolang, Shijiazhuang and Baoding were in an invalid state. In 2016, Baoding city changed from invalid state in 2015 to effective state, The scale efficiency of Shijiazhuang city increased by 0.045, while that of Lang fang city decreased by 0.248, The scale efficiency of Shijiazhuang city and Baoding city is in invalid state.

From the perspective of the scale of compensation changes, In 2015, Lang fang city was in a state of constant return on scale, It indicates that the ratio between innovation input and output in Lang fang city is reasonable and innovation resources are fully utilized; Shijiazhuang and Baoding are in the state of diminishing returns, It indicates that the proportion of innovation output is less than that of innovation input, and there is redundancy in innovation input.

In general, In 2016, Baoding's comprehensive technical efficiency became effective, the scale reward changes from declining state to constant state, indicating that after one year's efforts, Baoding eliminated the waste of innovative resources and made full use of innovative resources. Although after one year Shijiazhuang city has improved its construction innovation efficiency, it is still in an invalid state, yet the pure technical efficiency of Shijiazhuang city is effective, which indicates that the invalid of scale efficiency is the direct cause of the ineffectiveness of its comprehensive technical efficiency. It can be found that there is no redundant innovation resource input in Shijiazhuang, indicating that its scale inefficiency is not caused by the waste of innovation resource input, but the output does not reach the ideal level, and the input-output scale is not reasonable. The comprehensive technical efficiency of Lang fang city has decreased by 0.039 compared with that of 2015, and the pure technical efficiency is effective. Therefore, the ineffective innovation efficiency is caused by the inefficiency of scale, which indicates that the ratio of innovation input and output in Lang fang city has not reached the ideal level, and the scale is not reasonable, so the input and output can be further increased.

Above is the static analysis. By measuring the data growth rate of Hebei province from 2013 to 2016, we can see the effect of regional innovation from the perspective of development. After

calculation, it can be found in table 3 that the average growth rate of input and output in Shijiazhuang is in the middle level of the whole province. The average growth rate of input and output in Lang fang city is relatively high in the whole province (except the number of patents granted), and the development speed is fast; The input growth rate of Baoding city is in the middle level, the average output growth rate is low, the development speed has room to rise. It should be pointed out that regions with fast growth rate have something to do with their small base.

	Average growth rate of input indicators					Average growth rate of output indicators				
City	R&D funds internal spending	Hebei provinc e ranking	financial technology expenditure	Hebei provin ce rankin g	Hebei province comprehe nsive ranking	GDP	Hebei province ranking	The number of patents granted	Hebei province ranking	Hebei province compreh ensive ranking
Shijiazh uang	0.52%	9	17.09%	7	7	6.47 %	4	22.70%	8	6
Lang fang	13.79%	4	39.48%	3	3	10.93 %	1	25.28%	7	2
Bao ding	4.71%	5	16.08%	8	6	6.17 %	5	13.92%	10	9

 Table 3
 The moving average growth rate of the input-output index of shibaolang

3.Conclusion and Suggestion

As all mentioned above, in terms of the balance of input and output and the development speed in Hebei province, shibaolang three cities have their own characteristics. From the perspective of innovation, shijiazhuang is a inbalanced city with medium-speed development, baoding is a balanced city with low-speed development, and langfang is a balanced city with high-speed development. From the above analysis, it can be seen that shijiazhuang should focus on improving the conversion efficiency of input and output to improve the level of innovation efficiency, that is, work hard on the scale of input and output; Baoding must speed up its development and move toward a high-end balance; Langfang city has a good development momentum, should maintain the trend of rapid development, and strive to reach the level of the province's upstream cities.

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