Evaluation and Analysis of Innovation Capability of High and New Technology Park

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Abstract

The emergence of high and new technology park is a new industrial development mode in the era of knowledge economy. It has played a leading role in the development of local economy, attracting more and more local governments to establish high-teach parks. However, the innovation of each park is uneven, and the driving force of the local economic development is also different. So how to evaluate the innovation ability of high-tech park is an important research problem. This article starts from the comparison of the innovation ability of the two industrial parks in Baoshan District, Shanghai, on the premise of constructing the evaluation index system of the innovation ability of the high and new technology park, based on the combination entropy weight method and weighting method, constructing a comparative model of innovation capability evaluation of high-tech park, and proves its feasibility by empirical analysis.

Keywords

Innovation Capability; Entropy Weight; Weighted; High-tech Park.

1. Introduction

With the development of science and technology and the progress of society, high-tech industry has gradually become a key factor to promote the development of productivity and economic growth. It is the product of the combination of the frontiers of science and technology and the needs of modern society (Xu W X, Fang L, 2015; Wang X, 2015).The high-tech industry integrates basic research, application research and development research, and integrates science and technology, economy and society. The benign development of high-tech industry should take high intelligence as support, build up the operation mechanism of transforming high-tech achievements into real productive forces, and form the economic, social and cultural environment that exerts the greatest utility of human capital (Zhang S R, Yang Y J, 2013). High-tech enterprises acquire advanced technology through independent innovation, and apply this technology to the production process of products, so as to improve the production efficiency and quality of products, or reduce the cost of products (Ji D S, Yang L X, etc., 2008; Zhang W C, 2013).

The emergence of high and new technology park is a new industrial development mode in the era of knowledge economy. It has played a leading role in the development of local economy, attracting more and more local governments to establish high-teach parks. However, the innovation of each park is uneven, and the driving force of the local economic development is also different. So how to evaluate the innovation ability of high-tech park is an important research problem. The evaluation index system of the innovation ability of high-tech industrial park covers a wide range and contains a large amount of information. Its key research content is to establish a scientific, standardized, systematic and normalize index system, which can comprehensively and objectively reflect the overall picture of technological innovation capability (Wang Y N, Han R C, etc. 2010).

This article evaluates and compares the innovation ability of two industrial parks in Shanghai, so that the park enterprises can grasp their technological strength and competitive level, and find out their own shortcoming and efforts, so as to achieve the goal of upgrading the core competitiveness of the park and promoting the long-term development of the park. There are many factors to consider in its evaluation. It is difficult to make accurate and reasonable judgement based on single index, qualitative method or general mathematical evaluation method. Therefore, this paper attempts to combine the entropy weight method with the weighted method to establish an objective and scientific evaluate model, and use this method to evaluate and compare the innovation ability of the two parks, in order to provide theoretical and practical support for the development of the park.

2. Construction of evaluation index system for innovation ability of high and new technology park

The establish of a scientific and reasonable evaluation index system is the basis and the key the correct and objective evaluation of the innovation ability of the park. In the process of constructing the evaluation index system, we should fully analyze the factors that affect the innovation ability of the enterprises in the park, according to the principles of systematisms, scientificity and rationality, on the basis of summarizing the research of the existing innovation system at home and abroad to build a comprehensive evaluation index system that reflects the innovation capacity of the park. The index system includes the five secondary indicators, they are science and technology activities input, science and technology projects, enterprise scientific and technological institutions, scientific and technological activities output and other related indicators. On the basis of the secondary indexes, the corresponding tertiary indexes are established. Based on the interrelated effects and affiliation of three levels indicators, an analytical structure model containing three levels is formed (such as table1).

Table 1. Evaluation index system of industrial park innovation capability

Target layer	*Two level instructions*	*Three level instructions*
Innovation capability of high and new technology park（A）	science and technology activities input(B1)	Scientific and technological personnel(C1)
		Expenditure on scientific and technological activities within an enterprise(C2)
		Outlay of the entrustment unit to carry out the scientific and technological activities(C3)
		Fixed assets used for scientific and technological activities in the year(C4) Use of funds from scientific and technological activities from government departments(C5)
	science and technology projects(B2)	
		All scientific and technological projects(C6)
		All funds internal expenditure science and technology projects(C7)
	enterprise scientific and technological institutions(B3)	Number of institutions(C8)
		Institutional stuff(C9)
		Institutional expenditure(C10)
		Original price of apparatus and equipment (C11)
	scientific and technological activities output(B4)	Number of patent applications(C12)
		Number of effective inventions(C13)
		New product output value(C14)
		Sales revenue of new products(C15) Publishing scientific papers(C16) Have registered trademark(C17) Form a national or industry standard(C18)
	other related indicators(B5)	Research and development expenses plus deductions and exemption(C19)
		Tax exemption for high and new technology enterprises(C20)
		Expenditure on technical transformation(C21)

3. Comparative Model of Innovation Ability Evaluation of High and New Technology Park

3.1 The principle of determining the weight of the index by entropy weight method

There are m samples, n evaluation indexes, and the original index data matrix X=(xij)m·n, for a certain index xj, the greater the gap between the index values, the greater the role of the index in the comprehensive evaluation. If the index value of an index is all equal, the index does not play a role in the comprehensive evaluation. In the information theory, information entropy represents the degree of order of the

$$H(x) = -\sum_{i=1}^{n} p(\mathrm{x}_i) \ln p(\mathrm{x}_j)$$

system, the higher the order of a system is, the greater the entropy, the smaller the utility value of the information; On the contrary, the higher the degree of disorder in a system, the smaller the entropy, and the greater the utility value of the information. Therefore, we can calculate the weight of each index based on the different of the utility value of each index and use information entropy to provide the basis for multi index comprehensive evaluation (Sun S N, Nie X T, 2010; Zhou W H, Wang R S, 2005).

3.2 The steps of determining the weight of the index by entropy weigh method

3.2.1 Standardize the data of each index

The original index xij can be divided into positive index and negative index, for the positive index, the ideal value of Mj is recorded, for the negative index, the ideal value of mj is recorded. The acquisition of ideal values can be used as an ideal value through the original data, let Mj=max(xij), mj=min(xij, define xij*as the proximity of xij to the ideal value, for the positive index xij*= xij/max(xij), for the negative index xij*= xij/min(xij), define its normalized value $y_{ij} = x_{ij}^{*} / \sum_{i=1}^{m} x_{ij}^{*}$

3.2.2 The information entropy and the information utility value of the calculation index

The information entropy of item j is $e_j = -k\sum_{i=1}^{m} y_{ij} \ln(\mathrm{y}_{ij})$, where k is constant, for a system with completely disordered information, its entropy is maximum, and at this time x_{ij} is all the same for a given j, then $y_{ij} = 1/m$, at this point, e takes the maximum value. If k=l/(ln m), then $0 \le e_j \le 1$. Information utility value of the indicator: d=$1-e_j$.

3.2.3 Calculation index weight and comprehensive evaluation value

The higher the information utility value of a certain index, the greater the importance of the evaluation, then the weight of item j is $w_j = d_j / \sum_{j=1}^{n} d_j$. The comprehensive evaluation value of j sample is $f_j = \sum_{j=1}^{n} w_j x_{ij}^{*}$

3.3 The process and result of comprehensive evaluation of high and new technology park

In order to evaluate the innovation ability of the Baoshan District Industrial Park in Shanghai, this study collected data on the Baoshan Industrial Park and the urban industrial park. The index system is divided into three grades of A, B, C, 5 two level instructions, 21 three level instructions, as is shown in Table 1.

Through the processing of the 21 index data of the two parks according to each step of the above entropy weight method (The target is two parks, the index is 21 three level instructions, that is m=2,

n=21). We get the weight of the 21 indicators. The comprehensive value of each park is obtained by multiplying and adding the weights corresponding to each index of each park and the values after the standardization of each index. The evaluation values of the two level instructions of the two parks are obtained by the standardized values of each index weight based on the two level instructions of the two parks.

Table 2. The evaluation value of the secondary index of two parks

	Baoshan Industrial Park	Urban Industrial Park
science and technology activities input（B1)	0.160185	0.217314
science and technology projects (B2)	0.028706	0.071054
enterprise scientific and technological institutions (B3)	0.052174	0.161129
scientific and technological activities output (B4)	0.204617	0.239166
other related indicators (B5)	0.079401	0.07581
Total	0.525083	0.764472

On the analysis of above table, we can see that for indicators of science and technology activities input, science and technology projects, enterprise scientific and technological institutions and scientific and technological activities output are significantly stronger than those of Baoshan Industrial Park. Because the expenditure on technological transformation of Baoshan Industrial Park is far more than that of Urban Industrial Park, the index of B5 in the two level instructions in Baoshan Industrial Park is better than that in Urban Industrial Park. On the whole, the score of Baoshan Industrial Park is 0.525, while the score of Urban Industrial Park is 0.764, that is, the technological innovation ability of Urban Industrial Park is higher than that of Baoshan Industrial park.

4. Concluding remarks

This article uses entropy method and weighting method to evaluate and compare the innovation ability of two industrial parks in Baoshan district, Shanghai, using the entropy weight method to determine the weight of each index, and then the two industrial parks are analyzed and compared with the weighted method. These evaluation results can objectively reflect the innovation ability of the evaluated park, and also has the guiding significance for the enterprise innovation activities.

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