Research on Dynamic Evaluation of University Collaborative Education System Based on Global Entropy Method Under Big Data

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Abstract. Based on the analysis of the essence of global entropy in collaborative education under big data, this paper constructs the evaluation model of university collaborative education from the overall perspective. Through the analysis of the regional innovation system from the perspective of "structure function", it is found that the dynamic evaluation of university collaborative education system. Cooperative education in Colleges and universities has a certain direction. Through this study. It expands the breadth and depth of the application of collaborative education in Colleges and universities.

Keywords: Global entropy · Cooperation · Education system

1 Introduction

With the increasingly fierce competition in the international market, innovation has become an effective way and means for all countries and regions to establish competitive advantages, enhance their comprehensive strength and enhance their international status. China has also promoted innovation drive to the height of national strategy [1]. In the report of the 19th National Congress of the Communist Party of China, the great decision of "improving the ability of independent innovation and accelerating the construction of an innovative country" was put forward. As an important part of the national innovation system, regional innovation system is an effective tool to enhance regional innovation ability and promote the sustainable growth of regional economy. It is also the foundation and foothold of building an innovative country. Comprehensive and scientific evaluation of regional innovation system and understanding of the operation of regional innovation system have important practical significance for clarifying regional development advantages, formulating scientific and effective regional science and technology innovation policies, and promoting the improvement of regional innovation ability.

2 The Formation of the Concept of Collaborative Innovation

In his speech on the 100th anniversary of the founding of Tsinghua University, General Secretary Hu Jintao (2011) stressed that colleges and universities, especially research-oriented universities, are not only an important base for training high-level innovative

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talents, but also an important source of innovative achievements in basic research and high-tech fields [2–4]. They should actively promote collaborative innovation through institutional innovation and policy project guidance, We should encourage colleges and universities to carry out in-depth cooperation with scientific research institutions and enterprises, establish strategic alliances for collaborative innovation, promote resource sharing, jointly carry out major scientific research projects, achieve substantive results in key areas, and strive to make positive contributions to the construction of an innovative country. Collaborative innovation is the first concept put forward by Peter gloor, a researcher of Sloan Center of Massachusetts Institute of technology in the United States. He believes that collaborative innovation is a network group composed of self-motivated personnel to form a collective vision and achieve a common goal through network communication and cooperation. Domestic scholars have also elaborated on the concept of collaborative innovation. Yan Xiong (2007) proposed that when collaborative innovation is enlarged to the macro level, the main operation form is industry university research collaborative innovation. Lin Tao (2013) analyzed from the perspective of synergetics that the university collaborative innovation system is composed of subsystems (universities, scientific research institutions, enterprises, etc.) and elements (talents, knowledge, technology, information, etc.) in the system, as well as the relationship flow between them. Different innovation subjects achieve synergy through resource sharing. The essence of collaborative innovation system in Colleges and universities is a grand innovation organization mode for the realization of major knowledge innovation and scientific and technological innovation. It is a multi collaborative network innovation mode with universities, enterprises and scientific research institutes as the main body and supplemented by government, intermediary organizations and service platforms (Li zuchao, 2012) [5]. The Collaborative Innovation led by colleges and universities clearly focuses on the major national needs, industry common key technologies and regional strategic industry development. Through resource integration, under the cooperation of the government, service institutions, finance and other relevant departments, it has made great progress and breakthroughs in theoretical innovation and technological research.

3 The Manifestation of Collaborative Innovation Dilemma

3.1 The Policy Environment of Collaborative Innovation is not Perfect

Collaborative innovation is a new scientific research management mode in China in recent years, and it takes colleges and universities to take the lead in applying for the "2011 plan" as the specific implementation mode. As it is an exploration process and requires colleges and universities to occupy a dominant position in collaborative innovation, it is difficult to carry out substantive collaborative innovation under the current situation of imperfect domestic policy environment. For this reason, Li zuchao (2012) pointed out that the policy environment suitable for collaborative innovation needs to be improved, which is embodied in the following aspects: at present, the domestic laws and regulations on collaborative innovation have not been issued or detailed, so it is difficult to have rules to follow; the intellectual property system is not clear enough, so it is difficult to quantify and implement the definition and distribution of achievements and interests; the intellectual property system is not clear enough; The government's policy

guidance in personnel employment and assessment, tax loans and other aspects is still difficult to mobilize the enthusiasm of all parties involved; the construction of common service platform and resource sharing system needs to be strengthened [6]. He Haiyan (2012) believes that the current traditional mode of scientific research organizations in Colleges and universities in China is limited to cooperation within the University, and there is a lack of scientific research platforms, channels and means for resource sharing among colleges and universities and between colleges and research institutes; there is a lack of strategic cooperation between colleges and enterprises, and it is difficult to clearly agree and implement responsibilities and rights.

3.2 It is Difficult to Cooperate in the Process of Collaborative Innovation

The members of collaborative innovation come from universities, scientific research institutes, government (industry) departments and local (industry) enterprises. There is a lot of room for improvement in the aspects of subject confirmation, leadership role positioning and task division. Li zhongyun (2011) believes that the crux of the difficulty lies in the differences in the purposes of various units. Colleges and universities attach importance to scientific research achievements, enterprises emphasize technological breakthrough, local governments need economic benefits, and participants also have great differences in innovative ideas and values. Ma Zhiqiang (2012) proposed that school enterprise collaborative innovation is a sincere cooperation process in which both sides complement each other to achieve greater innovation benefits. However, due to the influence of moral hazard factors such as asymmetric information and opportunistic behavior, school enterprise collaborative innovation has the typical characteristics of dynamic game [7, 8]. Considering the evolutionary game analysis of school enterprise collaborative innovation, this paper explores the conditions for realizing the optimal game state of both sides, Construction of university service value model based on the background of University Enterprise Collaborative Innovation.

4 Path Selection of Collaborative Innovation

4.1 Define the Orientation of All Parties and Establish a New Flexible Organizational Structure

In the collaborative innovation system, we should first make clear the positioning of all parties: colleges and universities are the subject of collaborative innovation responsibility for basic research oriented to the frontier of science and technology; industry departments (enterprises) are the subject of collaborative innovation responsibility for application research oriented to industry common key technologies; local governments are the subject of collaborative innovation responsibility for achievement transformation oriented to regional industrial transformation and upgrading. In order to carry out the above three types of collaborative innovation, universities need to establish flexible boundaryless organizations: first, break the barriers of cooperation within the University, realize the cooperation within the University, build interdisciplinary research platform, and realize data sharing; second, communicate with scientific research institutes, build

laboratories and R & D bases, share software and hardware resources and information network, and jointly declare major scientific research projects; The third is to build industry university research alliance and scientific and technological achievements Incubation Park with off campus units (Li zhongyun, 2011) [9–12]. In the flexible organization, involving personnel from different units and systems, the information superhighway can be used as the connection way and hub to strengthen the communication between the personnel of all parties and break through the differences.

4.2 Pay Equal Attention to Basic Application and Promote the Connection Between Disciplines and Industrial Clusters

Discipline specialty industry chain is an effective carrier of collaborative innovation in Colleges and universities. Colleges and universities should plan and allocate professional talents and educational resources around the needs of industrial clusters, and develop and expand the disciplines and subject clusters urgently needed by industrial clusters. In this regard, Luo Weidong (2012) proposed that it is an inevitable trend for colleges and universities to promote the new mode of combination of industry, University and research, which is mainly characterized by collaborative innovation of discipline groups and industrial clusters. In the cooperation of industry, University and Research Institute, the subject cluster and industrial cluster form an alliance in mutual cooperation, so that the production factors such as labor force, capital, information and technology can flow reasonably among enterprises, universities, scientific research institutions and other organizations, cross coordination and complementary advantages, so as to form an organization with expansion power: emphasizing the combination of disciplines, majors and social needs for expansion; Take the platform management as the specific governance mode, play the intermediary role of the platform, and enhance the expansion ability through the integration of disciplines, majors, funds, production factors and other resources (Hu CHIDI, 2012). Tang Anbao (2012) analyzed the current situation and existing problems of subject clusters in Jiangsu Province, and proposed to make full use of the advantages of existing subject clusters in southern Jiangsu and Nanjing, connect with industrial clusters, build a collaborative development platform of subject industry with universities as the main body, and consolidate the manufacturing subject cluster, which is the strongest and largest subject cluster in Jiangsu Province, At the same time, we should increase the cultivation and investment of relatively weak subject clusters in agriculture, forestry, animal husbandry and service industry.

5 Entropy and Performance of Regional Innovation System

Entropy is the first concept in physics, and then it is gradually applied to the field of social science through the continuous research and development of scholars. Therefore, to clarify the meaning of entropy in the performance evaluation of regional innovation system, it is necessary to sort out and analyze the development process of entropy theory.

5.1 The Concept and Development of Entropy

The concept of entropy originated from the classical thermodynamic theory. In 1865, Clausius first proposed the concept of entropy when he studied the Carnot theorem [13]. Then, in 1877, Austrian physicist Boltzmann further clarified the statistical properties of the second law of thermodynamics on the basis of Clausius entropy. In 1948, American mathematician Shannon, the founder of information theory, introduced the concept of Boltzmann entropy into information theory in his article "mathematical principles of communication", and put forward the concept of information entropy, pointing out that information entropy is a measure of the uncertainty or disorder degree of random events, that is, information entropy:

$$H(X) = -\sum_{i=1}^{n} p_i \log_c p_i \tag{1}$$

At present, information entropy is widely used by scholars. Information entropy theory extends the concept of entropy from physics research to random event set of any level and category, greatly expanding the meaning and application scope of entropy. Therefore, information entropy, also known as pan entropy or generalized entropy, is widely used in sociology, economics, informatics, life science, chemistry and other fields, In order to measure the uncertainty or disorder degree of any system operation, this paper will also use information entropy to build the structural performance evaluation model and functional performance evaluation model of regional innovation system.

5.2 The Significance of Entropy in RIS Performance Evaluation

From Clausius entropy to Boltzmann entropy and then to information entropy, the research object of entropy gradually develops from closed system to open system, from equilibrium state to non-equilibrium state, from thermodynamic process involving energy transformation to non thermodynamic process, and from equal probability event to non equal probability event [14]. The Jordan condition and application scope of entropy are constantly released and expanded. Although there are some differences among Clausius entropy, Boltzmann entropy and information entropy in concept, their connotation comes down in one continuous line, that is, entropy is a measure of the degree of "uselessness, disorder, confusion or uncertainty" of the system. At present, the most common method used by scholars is information entropy, which measures the degree of dispersion of index data by calculating the information entropy value of the index, and determines the index weight according to the amount of information carried by the index data. It can be said that entropy has great advantages in determining the index weight, but few scholars pay attention to the "system structure information" carried by entropy, such as the system structure order degree information reflected by entropy (Fig. 1), and no scholars clarify the essential meaning of entropy (rather than entropy weight) in the performance evaluation of regional innovation system.

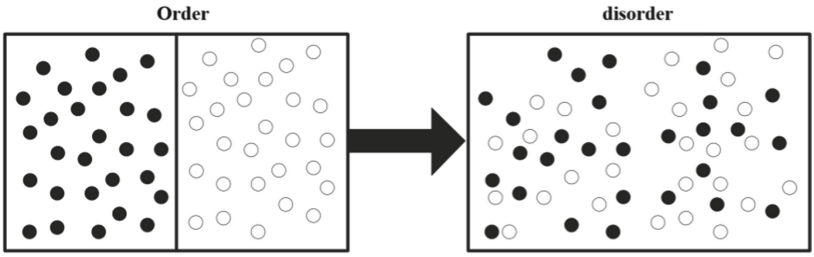

Fig. 1. Diagram of ordered structure and disordered structure

6 Performance Evaluation Model of Regional Innovation System

6.1 Construction of Evaluation Index System

Regional innovation system is a complex self-organization system. Considering the collectability and consistency of index data, this paper deconstructs regional innovation system into knowledge innovation subsystem, technology innovation subsystem and innovation support subsystem. Among them, the main body of the knowledge innovation subsystem is universities and various scientific research institutes, which are the leading force of knowledge innovation, while the main body of the technological innovation subsystem is enterprises. They apply the new knowledge formed by the knowledge innovation subsystem to the production practice of enterprises, form new technologies and new processes, and realize the market value of innovation, Innovation support subsystem provides environment guarantee and policy support for knowledge innovation subsystem and technology innovation subsystem.

6.2 Structural Performance Evaluation Model

If there are n evaluation indexes and M evaluation objects, there is a cross section data table x every year

$$X = (X^1, X^2, X^3, \cdots, X^T), X^T = x_{ij}(t) \tag{2}$$

Where: $x_{ij}(t)$ represents the j-th index value of the regional innovation system in year t.

7 Empirical Analysis on Performance Evaluation of Regional Innovation System and Simulation Analysis

7.1 Empirical Analysis

In the aspect of data collection, there is a big difference in the statistical indicators between the science and technology statistical yearbook before 2009 and the science and technology statistical yearbook after 2009. Considering the consistency and comprehensiveness of the evaluation indicators, according to the constructed regional innovation system performance evaluation index system [15, 16]. From the China Statistical

Yearbook and the China Science and technology statistical yearbook, the relevant index data of 31 provinces (autonomous regions and municipalities) in mainland China from 2009 to 2017 were selected as sample data, and the dynamic performance of the regional innovation system in China was evaluated under the framework of "structure function" two dimensional analysis [17].

The further development of functional performance has accumulated momentum, and its structural performance has fluctuated in the last two or three years, which shows that Ningxia regional innovation system is developing towards a new orderly structure. Tianjin regional innovation system represents another kind of evolution track, that is, with the improvement of system function performance, its structural performance is also rising slowly, which is a very unique evolution mode. This shows that Tianjin regional innovation system has great development prospects. Under the background of the great historical opportunity of coordinated development of Beijing, Tianjin and Hebei, Tianjin regional innovation system continues to deepen regional collaborative innovation of science and technology, By optimizing the ecological environment for scientific and technological innovation, striving to improve the transformation ability of scientific and technological achievements, and giving full play to the first role of talents, Tianjin regional innovation system is being built into an important source of independent innovation and an important source of original innovation in China.

7.2 Simulation Analysis

In this paper, we use entropy as the main research tool, and use entropy in teaching evaluation, so we can get the distribution of teaching evaluation model. we can get the following conclusions: In teaching evaluation, the whole evaluation presents normal distribution, so the simulation results shown in Fig. 2 meet this requirement In teaching evaluation, we hope to make an evaluation around a certain center, and Fig. 3 is also in line with the expectation. In Fig. 3, the blue part we see is the one with high evaluation [18–23]. This shows that the method we use is correct and positive.

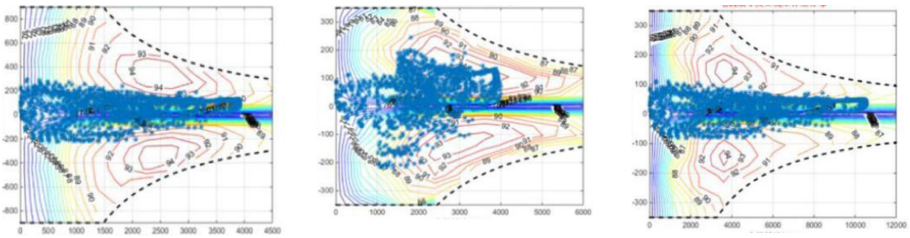

Fig. 2. Entropy distribution

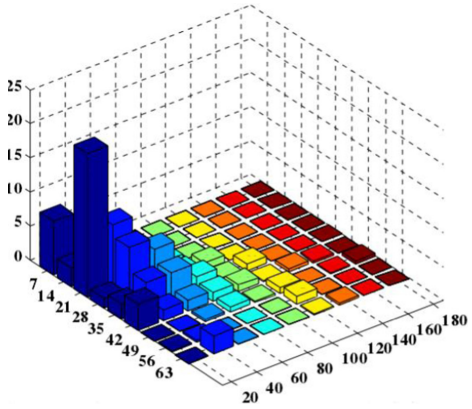

Fig. 3. Algorithm evaluation simulation model

8 Conclusions

Entropy represents "structural potential energy" of regional innovation system, and measures "prospect", "space" and "possibility" of system structural evolution. The higher the entropy value is, the smaller the dispersion degree of the index performance level of each subsystem of the regional innovation system is, the closer the structure of the system is to the equilibrium state, and the less space and possibility for the system to evolve. On the contrary, the smaller the entropy value is, the more discrete the index performance level of each subsystem of the regional innovation system is, the more the structure of the system deviates from the equilibrium state, and the system will further develop and evolve in a certain direction under the influence of "structural potential energy", until it approaches the equilibrium state again and forms a new system structure.

Restricted by various historical factors, the functional performance of China's regional innovation system is still "high in the East and low in the west". The functional performance of the regional innovation system in the eastern provinces is generally high, followed by the central region, and the western region is the lowest. However, the functional performance of the regional innovation system in the northeast region is similar to that in the central region. From the perspective of development trend, the average functional performance of the eastern region, the central region and the western region shows a rising trend year by year, especially the central region, which has the fastest growth rate, rapid development and obvious catching up momentum, while the average functional performance of the regional innovation system in the Northeast region shows a declining trend year by year, Northeast China is changing from a region with relatively high innovation performance to a region with relatively low innovation performance.

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