The Research on Innovation Performance of China's High-Tech Industrial Development Zone

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Abstract: *This paper focuses on the influence of R&D investment on China's high-tech industrial development zone cluster enterprise innovation performance. The key of national high-tech zones improve cluster innovative performance is to increase R&D collaboration between companies and universities in order to make full use of their own R&D investment to get maximum benefits.*

Keywords: Cluster enterprise innovation performance social network analysis R & D investment cooperative network

1. Introduction

With increasingly updating and development of science and technology, economic globalization high-speed expansion with vigorous pace, the concept of science and technology is the first productive has become increasingly known and accepted by people. China constantly increasing investment in science and technology in recent years, national finance technology spending in 2011-2017 has been continued to increase. In this context, it has very important practical significance that how to allocation of the science and technology resources to promote regional science and technology input and output is more reasonable and improve the use efficiency of resources.

The existing research mainly focuses on the following aspects: First, focus on the study of R&D investment in the country as a whole, and divides the area to analyze the cause of forming R&D regional differentiation and give corresponding opinions and suggestions. for example Kuznets(1966;1971), Yong(2000), Cowgill(2001); Second, focus on starting from a region to study the situation of government investment in science and technology, then analysis the relationship between development of the enterprise and R&D spending. for example, Zukauskaite,Elena (2012), Ozcan, Sercan(2014). Third, beginning from focus on science and Technology Park, then analysis of How the cluster enterprise innovation performance interaction with the R&D spending. For example: Lee, Hyoung-joo (2011) , M. Hosein (2011) Steven (2013), Kim, Byunghoon Gazzola (2014).The existing research is mainly from area or science and Technology Park to analysis the effect of r&d R&D investment on economic growth, which has few faults: Firstly, the existing research highlights the regional differentiation and ignored in common between the regions; Secondly, the existing research emphasizes the overall impact on the regional economy and ignored the study of innovation performance. The lastly, the existing research only see the benefits of science and technology park, namely cluster advantage for economic development while ignoring the downsides of cluster development brings to the enterprise innovation performance.

According to the study of four angles, this paper focuses on the third and fourth side together, through the study of the research of China's 145 state-level high-tech zone, analysis the generality of 145 state-level high-tech zone and extracted four leading industries. And selects Shanghai zhangjiang high-tech Park to study the effects of R&D investment in the four leading industries on cluster enterprise innovation performance in 2011-2017.

2. The influence mechanism study of R&D investment to cluster innovation performance in the zone

Innovation support environment, knowledge flow and R&D strength is in the market environment and macro environment of industrial cluster. The two works together to promote the innovation output, guide industry development to create social benefits. Thus cluster environment provides the supporting environment of innovation, given the infrastructure, services, personnel, finance and government support, at the same time for the enterprise personnel flow, the cluster between inside and outside technical communication and the introduction of foreign advanced technology provides the soil and the market, in this case need more will intensify research and development of enterprises, promote the improvement of technical level and innovation performance.

3. The basis analysis of national high-tech zone leading industry

3.1 The leading industry classification of the national high-tech zone

On the basis of high and new technology ，the high and new technology industry engage in one or more of high and new technology and product research, development, production and technical services of enterprises, the key technology of this industry have often development difficult, but once it developed successful, which has the very high economic and social benefits. High and new technology industry is a knowledge-intensive, technology-intensive industry. The leading technology of products must be determined belong to the field of high technology, According to this standard,

the new and high technology industries including information technology, biological medicine, new materials technology three areas.

China's high-tech industrial development zone, hereinafter referred to as "national hi-tech zone", "national hi-tech zone", belong to the state council of the People's Republic of China approved the establishment of a national science and technology industrial park. From 1988 to now, the national high-tech zone has reached 145.

3.2 The research methods

Social relation network is a social structure composed of many nodes, usually consists of two parts, namely actors and the edges. Actor is mainly refers to participants in a social relationship network, such as people, party and government organs, enterprises, institutions and community, which has a social entity can be regarded as actor in a network of social relations. Relations (base) are regarded as two entities in a period of time or space within the scope of a link, this association on behalf of all kinds of social relations. Through the social relations, the general from a casual acquaintance to close family relationship which can put all kinds of people or organizations together. Relationship between nodes is used to construct social network.

Currently social network analysis has two main directions, a direction is a parameter to measure social networks, these parameters include: the distance between the network size, number of nodes and the nodes, the nodes reachability, clustering coefficient and so on. By analyzing the social networks of parameters will help us to reveal how the network interact with each other ,in order to learn more about social networking features and the future development direction. Another direction is to discover the local structure and key network node by analyzing the structure and content of the network of social networks, such as community recognition, community structure found in, the central figure in the network mining.

4. The empirical analysis of the R&D impact on high-tech cluster innovation performance

4.1 Construction of the model

Econometrics to research the influence of cluster innovation on the performance in is used to the production function to study, through mathematical equations to describe the impact of the input of the research and development personnel, capital investment and other factors to output. Based on a cobb Douglas production function, this paper studies shanghai zhangjiang high-tech industrial cluster innovation performance.

$$Y_{it} = AK_{it}^{\alpha} L_{it}^{\beta} e^{x}$$

in this paper, using three indicators to measure the cluster innovation performance index system, from research and development funding and research and development personnel two aspects to measure R&D investment, by considering the science and technology personnel is an important subject of research and development innovation, so the investment can be divided into funding and personnel input, this paper respectively by new product proportion of sales revenue and export accounts for the proportion of income is as explained variable, with their own money imput, government grants, loans to financial institutions and enterprises directly researchers as explanatory variables, such as building regression model.

$$NPA_{it} = CGF_{it-1}^{\beta_1} EF_{it-1}^{\beta_2} FIL_{it-1}^{\beta_3} PE_{it-1}^{\beta_4}$$

$$EP_{it} = CGF_{it-1}^{\beta_1} EF_{it-1}^{\beta_2} FIL_{it-1}^{\beta_3} PE_{it-1}^{\beta_4}$$

Among them, NPA said the new product sales income of the enterprise, EP says the patent application number of the enterprise, C as constant, GF said the government funded directly to enterprises, EF said their own research and development funding, FIL said financial institutions loans, PE said enterprise on the number of scientific research personnel, i said region, t as the time, ε as the random error term. In order to improve the fitting of the model and to reduce the effect of different variance, this paper will make logarithmic processing to the above model is as follows:

$$\ln NPA = \ln C + \beta_1 \ln GF_{it-1} + \beta_2 \ln EF_{it-1} + \beta_3 \ln FIL_{it-1} + \beta_4 \ln PE_{it-1} + \varepsilon_t$$

$$\ln EP_{it} = \ln C + \beta_1 \ln GF_{it-1} + \beta_2 \ln EF_{it-1} + \beta_3 \ln FIL_{it-1} + \beta_4 \ln PE_{it-1} + \varepsilon_t$$

4.2 The empirical analysis

Now look from the statistics of the high-tech industry cluster, Shanghai zhangjiang high-tech industrial cluster well meet the requirements of this article empirical, because its history is long, statistical data is more and index classification and statistical caliber is clear.

4.2.1 The source of the data
In this paper, on the basis of the previous section through social network analysis there are the four leading industries, so this paper will choose electronic information, biological medicine, equipment manufacturing and new materials to describe and measure from 2011 to 2017. Find and collect Shanghai zhangjiang high-tech industrial

cluster index data.

4.2.2 The results of the regression analysis

The results show that, on an enterprise's own capital investment, the impact of scientific research and the number of personnel of enterprises on current new product sales revenue significantly and positive effect, suggesting that their own capital investment and research personnel investment in new product sales revenue has very strong role in promoting. Direct influence on a government grants and loans from financial institutions on current sales of new products is not significant. The reason may be that the government through the corporate R & D projects in order to promote an increase in its own R & D investment, thus contributing to enterprises to increase their innovation output. This is an indirect process, and direct government funding for business innovation output is difficult to have a direct role in the promotion. At the same time, the company's research and innovation activities with high risk, so its lending financial institutions will be relatively cautious. Therefore, the existing external financing environment was not able to meet the needs of corporate R & D funding, companies only through increased research and development funding to get their input.

It follows that the importance of their own R & D investment of funds and personnel, in order to further analyze the underlying causes of their own R & D investment and personnel have a tremendous impact to the cluster innovation performance, below we will use social network analysis from the perspective of research cooperation network to analyze how companies full play to their R & D investment efficiency and effectiveness resulting in a better role in promoting corporate innovation and cluster innovation performance.

4.3 data collection and describe of social networks analysis

This paper selects from 2005 to 2017, Shanghai research Patent Cooperation Innovation Network as the object of empirical research, through patent national patent database searches the Shanghai Cooperative patent application between 2005 and 2017, such as the company M and N University in 2005 have a joint application patent X, and there is cooperation between M and N in 2005. At the same time, there is a certain patent production time lag, mostly scholars in the study of a 2 to 3-year lag, in reference to relevant research at home and abroad, this paper will Delays patent determined to be 2 years. As the highest-tech patents represent the original technology. Therefore, this paper mainly for universities or research institutions and enterprises jointly apply for patents for analysis.

According to the different classification of the applicant, there are three main forms of "industry-university-institute" cooperation, respectively: cooperation between university and company, the cooperation between research institutions and companies,

and the cooperation between and among universities, research institutions and companies. As shown in figure 4-2, 5 years, the number of patent application of the university and universities from 2005 is very quickly; this shows that the production policy after 2005 got rapid development. By 2016, the patent cooperation between research institutions and companies to apply for more than a patent cooperation between university and company, a growing number of colleges with enterprises (especially the comprehensive university) are more willing to establish a professional platform for the research and development, such as the form of technology research and development center, build the laboratory.

4.4 Community Network characteristic analysis

This article from the three main features to analysis the network structure of zhangjiang patent cooperation of production, which respectively is scale, network density and network Centrality. On the basis of considering the data availability, this paper selects 2005, 2010 and 2015, three years data, doing the comparison analysis of time scale. Respectively 2005, 2010, 2015, Shanghai patent cooperation network of production, study and formation of the social network analysis software Gephi symmetric adjacency matrix input, get data network structure in different periods. Respectively put the three years date of the Shanghai patent cooperation network which formed symmetric adjacency matrix input into the social network analysis software Gephi, get a different period data of network structure.

5. Conclusions

This article through the social network analysis of the national high-tech zone leading industry, it is concluded that the four leading industries: electronic information, biological medicine, new materials and equipment manufacturing, and then study the influence mechanism between cluster enterprise innovation performance of four leading industries, and then draw that their own R&D investment effect on cluster innovation performance is the largest. Further through cooperative network, it is concluded that the development of cooperation between companies and universities can more fully and make use of the enterprise's own R&D. Finally get the following conclusion: the key of the national high-tech zone to improve cluster innovation performance is to increase R&D cooperation between companies and universities so as to make full use of its own R&D, then to obtain maximum benefits.

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