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The effect of financial subsidies on enterprise innovation performance in Yunnan Province: a study based on DEA-Malmquist model

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ABSTRACT

The 14th Five-Year Plan and the Outline of the Vision goals for 2035 clearly put innovation at the core of China's overall modernization drive. Against the backdrop of a complex and changing international situation and accelerating changes in world industries, adhering to the strategy of innovation-driven development is a new engine for creating economic growth points. High-tech industries have high added value and strong profitability. They can not only promote their own upgrading through continuous technological innovation, but also share the results of their innovation output with other industries, which has obvious spillover and promotes the traditional industries to move upstream of the value chain. In recent years, the scale of financial investment in science and technology continues to expand in China. At this stage, the impact of government financial investment in science and technology on industrial innovation activities is studied. This investment in high-tech industry scientific and technological innovation activities is of great significance. Based on 16 prefectures (cities) in Yunnan Province from 2012 to 2021, this paper uses DEA model to measure their innovation efficiency, discuss and analyze the effect of financial subsidies on innovation efficiency.

KEYWORDS

Financial subsidies; Innovation efficiency; DEA model; Malmquist index.

1. INTRODUCTION

Since the 19th National Congress of the Communist Party of China proposed that "innovation is the primary driving force for development", China's economic development has entered a new era, and innovation has become a key force driving the transformation of China's economic growth mode from high-speed to high-quality. With the promulgation of Made in China 2025, industrial enterprises have become the main force of innovation in the country. At the same time, the government has also introduced a large number of innovation financial support policies to support enterprises' innovation research and development. However, there are some differences in resources, local government financial policies and enterprise innovation environment between different regions with vast territory in our country, and there are also big differences in innovation efficiency. Scientific measurement of enterprise innovation efficiency, research on the influencing factors of enterprise innovation efficiency and discussion of the impact of government financial policy on enterprise innovation are not only conducive to enterprise innovation at the enterprise level, but also more conducive to the government timely adjustment of financial policy at the national level to better support enterprise innovation.

2. LITERATURE REVIEW

2.1. Enterprises are the main body of innovation

Romer (1990), Grossmanetal. (1993) believe that because innovation will bring knowledge spillover, and innovation activities have positive externalities, private benefits are likely to be lower than social benefits, so the innovation level of enterprises is always below the optimal level [1-2]. Guellecetal. (2003) believe that it is because of the positive externalities of innovation and low private returns, as well as the long recovery time of benefits generated by innovation, that enterprises are reluctant to invest too much resources to support innovation, which leads to insufficient [3] investment in R&D activities.

2.2. Firm innovation and information symmetry

There are also adverse selection problems caused by information asymmetry in enterprise innovation activities. Arrow(1962), Kleer(2010),

Brown(2012) and other scholars believe that this adverse selection problem will prevent enterprises from obtaining external financing for innovation activities, and make the R&D investment level of enterprises lower than the optimal investment level[4-6] in the market. According to the relevant theories of public economics, the "visible hand" of the government can solve the innovation dilemma and effectively make up for various problems caused by the failure of market mechanism. Therefore, the relevant fiscal and tax policies issued by the government play an important role in helping enterprises alleviate the constraints of insufficient funds on innovation investment and reduce the financing costs of enterprises. Takaloetal. (2010) found that government funding can also be used as a market signal to indicate government funding to the market.The enterprise project of the government is a good investment opportunity[7].

2.3. Innovation efficiency and the role of government funding

The reason for choosing innovation efficiency to measure enterprise innovation performance is that innovation efficiency takes into account both innovation input and output, and reflects the efficiency of input-output transformation, which is a comprehensive index to measure enterprise innovation performance. Many scholars use stochastic frontier model (SFA) or data envelopment model (DEA) to measure innovation efficiency. Czarnitzkietal. (2011) used SFA method to measure the efficiency of Spanish manufacturing industry and found that the relationship between government subsidies and the technical efficiency of beneficiary enterprises was not simple and linear. Only when the scale of subsidies reached a certain amount could enterprises improve[8] their efficiency. Chen Fenghuaetal. (2017) applied the SFA method to measure the innovation efficiency of 17 sub-sectors of China's high-tech industry, and found that there was a negative relationship[9] between government R&D

subsidies and innovation efficiency of high-tech industry.

2.4. The heterogeneity of enterprises should be considered in government subsidies

When studying the impact of financial subsidies on the innovation efficiency of enterprises, the impact from the heterogeneity of enterprises should also be considered. Firm heterogeneity is usually manifested by the difference of firm size, firm age, firm location and property right nature. Huetal. (2001) argued that firm size is usually a factor [20] to be considered when the government chooses to subsidize it. The larger an enterprise is, the more prominent its innovation ability is, and the more subsidies the government will give to it. Leetal. (2009) also believe that the larger the enterprise scale, the easier it is to accumulate resources and tend to carry out continuous R&D activities, and the scale

effect brings greater benefits, thus improving the innovation performance [21] of the enterprise. Chen Fenghuaetal. (2017) found that from the perspective of enterprise scale, large enterprises should make more use of preferential tax policies; Research and development subsidy policies have a more significant [9] impact on small enterprises.

3. RESEARCH AND DESIGN

3.1. Selection of variables

With reference to the research of Liu Siyuan. (2017) and the availability of data, the internal R&D funds and new product development funds of enterprises above designated size in 16 prefectures (cities) of Yunnan Province are used as innovation investment indicators. Among them, the internal investment of R&D funds refers to the expenditure of relevant projects in the fields of basic research, applied research and experimental development related to R&D, as well as the expenditure for the management of these projects. These expenditures not only reflect the importance of R&D, but also reflect the ability of independent innovation of enterprises. In terms of innovation output variables, referring to the research of Shen Neng. (2011), the number of new products and sales revenue of new products are selected as output variables. Among them, the sales revenue of new products can be used to represent the market acceptance degree and market economic value of innovative products developed by enterprises.

3.2. Data sources and processing

This paper takes 16 prefectures (cities) of Yunnan Province as the research object, and the research time span is 2012-2021. This paper mainly uses the input-output data of scientific research in the Statistical Yearbook of Yunnan Province, and other data sources are China Statistical Yearbook, Guotai 'an Database and other official data.

4. EMPIRICAL ANALYSIS

In the method of Variable Return to Scale (VRS), DEAP2.1 software is used to analyze the comprehensive innovation efficiency of 16 prefectures (cities) in Yunnan Province from 2012 to 2021 by taking them as the research object. The results are shown as follows.

From the perspective of overall comprehensive efficiency, the average comprehensive technical efficiency of 16 prefectures (cities) in Yunnan Province was only 0.689 in 2012, indicating that there is still a large room for improvement. Among them, only four regions, Zhaotong, Lijiang, Dehong and Nujiang, basically maintained the same input and output, and reached the optimal state in terms of resource allocation ability and scale. However, the comprehensive technical efficiency of 12 regions, including Kunming, Qujing and Yuxi, is lower than the average, which indicates that the input and output structure of colleges and universities in these 12 regions need to be further optimized and adjusted, resource input has not been effectively used, and there is still a large room for improvement in the level of innovation and technology.

In 2017, the average comprehensive technical efficiency of the 16 prefectures (cities) in Yunnan Province was only 0.815, with a relatively high overall average. Among them, only Yuxi, Baoshan, Chuxiong and Nujiang had

basically the same input and output, and reached the optimal state in terms of resource allocation ability and scale. However, the comprehensive technical efficiency of 12 regions, including Kunming, Qujing and Dehong, is lower than the average, indicating that the input and output structure of colleges and universities in these 12 regions need to be further optimized and adjusted, resource input

has not been effectively used, and there is still a large room for improvement in innovative technology level.

In 2021, the average comprehensive technical efficiency of the 16 prefectures (cities) in Yunnan Province is only 0.631, indicating that there is still a large room for improvement. Among them, only four regions, Zhaotong, Baoshan, Lijiang and Xishuangfuan, basically maintain the same input and output, and achieve the optimal state in terms of resource allocation capacity and scale. However, the comprehensive technical efficiency of 12 regions, including Kunming, Qujing and Dehong, is lower than the average, indicating that the input and output structure of colleges and universities in these 12 regions need to be further optimized and adjusted, resource input has not been effectively used, and there is still a large room for improvement in the level of innovation and technology.

5. RESEARCH CONCLUSIONS AND SUGGESTIONS

5.1. Research conclusions

1). From 2012 to 2021, the overall innovation efficiency level of Yunnan

Province is good and the overall trend is developing well, but there are still obvious gaps between regions. Among them, DEA non-effective states (cities) should improve the performance of science and technology output by adjusting the coverage scale of innovation subsidies.

2). The total factor productivity shows a declining trend from 2012 to 2021, which reminds the state (city) governments of Yunnan Province to pay attention to the improvement of technological progress, innovation management, resource allocation and other all-round aspects, increase the input of financial innovation subsidies, attach great importance to the continuous improvement of technology and management and scientific research benefits, especially the ability of scientific research and technology innovation.

5.2. Research suggestions

1). Rationally allocate innovation resources and optimize the scale of innovation investment by states (cities)

Each region should invest scientific research resources in a reasonable amount, and should not blindly pursue the increase in the number of scientific research scale, research funding, research personnel, etc., but should pay more attention to optimizing the scale and funding structure of scientific research, and stimulate the improvement of the quality of scientific researchers in their innovation and creativity. In recent years, governments at all levels have been increasing their investment in innovation at the state (city) level. In this regard, all regions should have a clear understanding of their own specific conditions, adjust and optimize their own input-output scale, and improve their own scientific research benefits.

2). Strengthen the management of scientific research teams to stimulate their innovation vitality

In recent years, China has continuously deepened the reform of the scientific research system, and has achieved phased results in reducing the burden, empowering and delegating power to scientific researchers. In the face of the new round of scientific and technological revolution and the new requirements of high-quality economic development in China, local governments should further strengthen the management of scientific research teams and stimulate the vitality of scientific research and innovation. First of all, it is necessary to establish a people-oriented development concept, put the growth of talents in the first place, create an open and shared ecological environment for scientific research, and stimulate the spark of innovation and creative motivation of scientific research talents. Second, it is necessary to improve the evaluation mechanism for scientific research talents and pay attention to the evaluation and evaluation of the quality and efficiency of scientific research results.

Finally, all regions should establish a reasonable incentive mechanism to stimulate the vitality of innovation and creativity of scientific research talents and encourage them to innovate and pursue excellence.

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