The Influence of Green Finance Level on Input-output Efficiency of Science and Technology in Sichuan

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Abstract: At the end of the 13th Five-Year Plan in 2020, green finance, which takes green, low-carbon and high-quality development as its top priority and fundamental commitment, has ushered in a new upsurge in development. Based on the data of Sichuan Province from 2000 to 2019, this paper calculates the level of green finance and the input-output efficiency of science and technology in Sichuan Province through the super-efficiency DEA model, and analyzes the impact of green finance on the input-output efficiency of science and technology in Sichuan Province by combining the grey correlation regression. It is found that green finance has a significant impact on the input-output efficiency of science and technology, and some suggestions are put forward.

Keywords: Green fintech, input-output efficiency, grey correlation, regression analysis

1 Introduction

In recent years, under the guidance of innovation-driven strategy and with financial services serving the real economy as the core, it is very important to promote the joint development of science and technology and finance, rationally allocate limited financial resources and fully improve the operation efficiency of science and technology. The research group of "Greening China's Financial System" of the Development Research Center of The State Council (2016) believes that the purpose of green finance is to form a sustainable financial system to complete economic transformation or maintain economic stability and growth [1].

Jiang Yong, Yan Xiaoxu (2017) and other scholars used DEA model to measure the efficiency of the integration of finance and technology [2]. Yao Dandan and Xia Weili (2016) used DEA-Malmquist index to measure the level of agricultural science and technology progress [3]. Gong Xinmin and Zhao Guodong (2019) and other scholars believe that green finance can effectively curb the negative externalities of non-green behaviors by internalizing external costs [4]. Scholars such as Zhu Xiangdong and Huang Yongyuan (2021) show that green finance can promote the technological progress of polluting heavy industry and light industry in different regions [5]. This paper uses the super-efficiency DEA model to measure the efficiency of science and technology input-output, and selects 20 time-series sample points in Sichuan Province from 2000 to 2019 as the research period. The original index data comes from China Statistical Yearbook, China Financial Yearbook, and the International Institute of Green Finance of Central University of Finance and Economics. This paper aims to explore the influence of green finance level on the input-output efficiency of science and technology.

2 Green finance and input-output efficiency of science and technology

This paper draws on the research of Green Finance Development Research Institute of Central University of Finance and Economics to measure the level of green finance, and sets four first-level indicators, including green credit, green investment, green insurance and government support. MATLAB is used to calculate the efficiency of science and technology input-output efficiency by the super efficiency DEA model, and two input indexes (R&D research funds, the number of R&D personnel) and three output indexes (patent application authorization, technical market contract turnover, new product sales) are adopted. As shown in **Figure 1**, the overall efficiency shows an increasing trend. The low efficiency value in the first ten years proves that the development level of our country is relatively backward at that time, and we pay attention to improving the representation index while ignoring the effective resources allocation. In the last decade, the data fluctuated greatly, which was effective in resource allocation but fluctuated greatly and unstable.
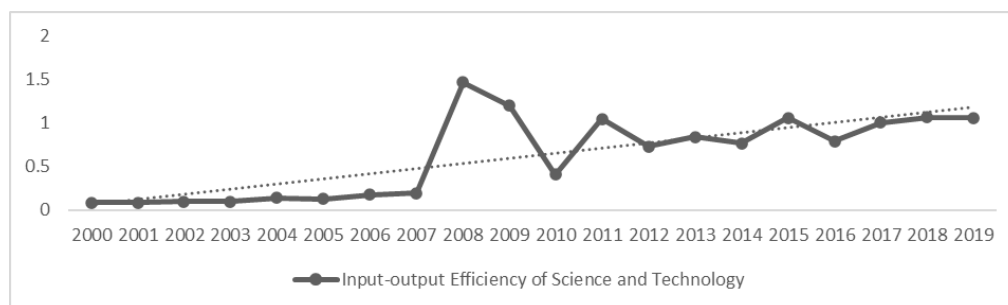

Fig. 1. Architecture of a typical wireless sensor node.

3 Analysis of the influence of green finance level on the input-output efficiency of science and technology

3.1 Grey correlation analysis

Firstly, a new data column is formed by non-dimensional processing of the original series: Green finance index (x0), R&D expenditure (x1), number of R&D personnel (x2), number of patent application authorization (x3), technical market contract turnover (x4), sales volume of new products (x5); Then, the correlation coefficient of xi to x0 ξ_i is calculated by means method. They are 0.7773, 0.7851, 0.7553, 0.7628, 0.7991, and sorted as $\xi_5 > \xi_2 > \xi_1 > \xi_4 > \xi_3$. Several factors have a high impact on green finance to some extent, among which the influence of science and technology output is slightly greater than that of science and technology input.

3.2 Control variables

Profit level of high-tech industry (PL): it directly affects the investment and talent attraction of the industry. High attraction corresponds to high development.

Education level (UR): according to the proportion of education expenditure, good education level directly affects the level of science and technology output.

Government participation (GM): using the ratio of the government's annual fiscal expenditure to GDP, the government changes the direction and intensity of investment through regulation and control to guide the improvement of scientific and technological efficiency.

Urbanization development level (UL): according to the ratio of urban population to total population at the end of the year, urbanization attracts the agglomeration of various factors to cities and provides the basis for the development of science and technology.

Foreign investment level (FL): according to the proportion of foreign investment in total investment, capital input will help the efficiency of science and technology input and output.

3.3 Model construction

Due to the influence of many factors, five control variables were introduced to increase the degree of fit and significance of the model. Logarithm was taken to reduce the negative impact brought by heteroscedasticity, and pseudo-regression was avoided through ADF unit root test. After first-order difference, all variables were stable at the significance level of 1%, and all variables were first-order single integrations.

Establish the following model, see equation (1):

$$IE=\beta_1 lnGL+\beta_2 lnPL+\beta_3 lnUR+\beta_4 lnGM+\beta_5 lnUL+\beta_6 lnFL+\mu \tag{1}$$

The independent variable and dependent variable are used as regression function, and the P value is 0.0003, which is significant. The residual was extracted for ADF test. P value was 0.0000, the residual was stable, they have a co-integration relationship. The Granger causality test results show that P value is 0.09 and F value is 2.91507, indicating that the improvement of green finance level can promote the improvement of science and technology input-output efficiency.

3.4 Empirical results and regression analysis

The regression results of the processed model are shown in Table 1:

Table 1 . Model estimation results

variable	
lnGL	$0.7020^{***}(12.5540)$
lnPL	$0.0830 (1.4530)$
lnUR	$0.3240 (1.3870)$
lnGM	$0.7480^{***}(3.5300)$
lnUL	$2.0190^{***}(3.7930)$
lnFL	$0.3340^{**}(2.3560)$
-cons	$3.4860^{**}(2.7670)$
After adjustment R^2	0.9800
F	157.9930

There is a significant positive correlation between the level of green finance and the input-output efficiency of science and technology at the level of 1%. (1) The profit level of high-tech industry promotes the output of science and technology, which has certain effect on attracting investment and high-tech talents. (2) Education level provides knowledge accumulation for the development and innovation of science and technology, trains needed talents, and creates conditions for the transformation of science and technology into productive forces. (3) The

government's participation in restricting the optimization and upgrading of industrial structure is significant, which indicates that the expenditure capital flow of Sichuan provincial government does not match the implementation of the policy. (4) The urbanization development process has a negative impact on the input-output efficiency of science and technology in Sichuan Province. On the one hand, it attracts the concentration of human resources and capital, and promotes the integration and extension of regional industries. On the other hand, Sichuan is a big agricultural province. The excessive and fast urbanization process may neglect agricultural development and fail to integrate the green development concept well. (5) The foreign funds, technologies and projects attracted by foreign investment in our province are more concentrated in green ecology and high-tech industries to promote the development of science and technology.

4 Conclusions and suggestions

Based on the measurement of green finance level and input-output efficiency of science and technology in Sichuan Province, it is found that the science and technology input-output efficiency of Sichuan Province fluctuates greatly, and there is a waste of science and technology input resources. The regression analysis found that there was a significant positive correlation between the level of green finance and the efficiency of science and technology input-output at the level of 1%, indicating that green finance could promote the improvement of the efficiency of science and technology input-output, the profit level of high-tech industry, the level of education and the level of foreign investment had a positive impact on it, and the government participation and the process of urbanization had a negative impact.

To this end, some suggestions are put forward: First, we should give full play to the leading and driving role of the government. The government should actively promote the construction process of green financial system and grasp the overall implementation direction of green financial policy. Increase policy preference and actively promote the implementation of green investment and financing incentive policies applicable to the province, such as guarantee, financial discount and other incentive measures; We should do a good job in promoting the concept and policies of green finance and penetrate the concept of green development. On the other hand, in terms of urbanization development, the basic provincial conditions of Sichuan should be fully considered, the direction of urbanization development should be reasonably evaluated, and the concept of green and sustainable development should be maintained. Second, financial institutions can set differentiated interest rate policies, give preferential interest rates to green ecological, energy conservation, environmental protection and new energy enterprises, and reduce the proportion of "three high" industries. Third, we should encourage research and development of green environmental protection technologies, innovate green projects in energy conservation and emission reduction, attach importance to professionals in high-tech industries, and give play to the driving role of technology.

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