

An Empirical Study on the Efficiency of Science and Technology Finance in Jiangsu Province Based on the DEA Model

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Abstract: In 2016, "science and technology finance" was first included in the national planning system, and science and technology finance has made great progress, but there is a large gap in China's ability and financial level in scientific and technological innovation, and there are still a series of problems that need to be solved urgently. Scholars have explored various laws of economic development through a lot of models. There are still few studies on the efficiency of technology finance, and this paper explores the efficiency of technology finance through the DEA model.

Keywords: Jiangsu Province; Technology Finance; DEA Model; Input-Output Efficiency

1. Introduction

Previously, most of the academic research on science and technology finance focused on the innovation of operating mechanisms, the construction of evaluation systems, the choice of innovative models, etc., and the research on the efficiency of science and technology finance combined with local development characteristics has not been done so far. Based on the research results of predecessors, Jiangsu province is used as the research object, and the data envelopment method is used to calculate the efficiency of science and technology finance in 13 cities in Jiangsu Province from 2010 to 2017, so as to discover the problems in the study and make a modest contribution to the development of science and technology finance in Jiangsu Province.

2. Research methods

2.1 The Data envelopment analysis

Data envelopment analysis is a method of operations research and studying the boundaries of economic production. It is commonly used to measure the productivity of some decision-making departments. With the help of mathematical programming and statistical data, DEA determines the relatively effective production frontier, and then projects the input and output of multiple decision-making units (DMU) to the determined production frontier.[1] The relative effective evaluation is carried out by comparing the deviation degree of DMU and production frontier.[2] There are a variety of DEA models, and this paper selects BCC model.

$$\begin{aligned} & \min [\beta - \epsilon(e^T S^- + e^T S^+)] \\ & \text{s. t. } \begin{cases} \sum_{j=1}^n \lambda_j x_j + S^+ = \beta x_0 \\ \sum_{j=1}^n \lambda_j y_j - S^- = \beta y_0 \\ \sum_{j=1}^n \lambda_j = 1 \end{cases} \end{aligned} \quad (1)$$

In Equation (1), $\lambda_j \geq 0; j = 1, 2, \dots, n$. $S^+ \geq 0$, $S^- \geq 0$. N denotes the number of DMUs, x is the input, y is the output, ϵ is an infinitely small quantity, e is the unit vector, and s is the slack variable. e^T
 S^+ , S^-

If $\beta = 1$ and all are 0, then DMU DEA is effective. S^+ , S^- If $\beta < 1$, the DMU is invalid.

3. Construction of the input-output index system of science and technology finance in Jiangsu Province

3.1 Index Selection

On the basis of summarizing the researches of relevant scholars, this paper selected representative input and output indicators with relatively complete data according to the availability and accuracy of data, considering that many relevant indicators of 13 prefecture-level cities in Jiangsu Province were not perfect[3] (see Table 1).

Table 1: Input-output system of science and technology finance:

Level indicators	The secondary indicators	The mean	The variance	meaning
Fintech output	Scientific and technological Achievements (Y) (item)	20445	2.80 e+08	Number of local patent grants
Fintech input	Government financial expenditure on science and technology (X1) (100 million yuan)	32	1.16 e+03	Science and technology spending in local government fiscal spending
	Science and technology loans from financial institutions (X2) (100 million yuan)	8069	6.07 e+07	Amount lent by local financial institutions for technology

Data source: Deap2.1 Calculation results collation

3.2 Data processing

Since the financial input and scientific and technological output are often not consistent, there is a certain lag in time. Therefore, based on the current situation of scientific and technological development in Jiangsu Province, this paper sets the lag period as one year, adjusts (x_i, y_i) to (x_i, y_{i+1}) , and brings it into the model. The remaining data were obtained by sorting out the statistical yearbook of Jiangsu Province.

4. Empirical analysis

4.1 Descriptive Statistics

Through descriptive statistical analysis of the input-output related indicators of 13 cities in Jiangsu Province, the data show that the variance of technology loans of financial institutions is huge, which indicates that there is a certain gap in regional economic development in Jiangsu Province, and different emphasis on fintech, which leads to the unbalanced development of fintech.

4.2 Correlation Analysis

Before using the two-stage DEA model for empirical analysis, we conducted the Person test on the original data obtained to verify whether each index met the conditions of isotensivity. The test results show that at the significance level of 5%, the input-output indicators of the sample data are positively correlated with each other, which satisfies the isotensivity condition of establishing the efficiency measurement model using the data envelopment method. It can be concluded that the results of the efficiency measurement model established with one sample data are valid.

4.3 Analysis of relative input-output efficiency of science and technology finance in Jiangsu Province

In this paper, with the help of Deap2.1 software, BCC was selected as the input-led model, and the pure technical efficiency input-output technical efficiency and scale efficiency of 13 cities in Jiangsu Province were measured. In general, the average technology and finance efficiency of Jiangsu Province is at 0.864, which is at a medium level, and the integration level of technology and finance is not high. From the perspective of time trend, the comprehensive efficiency of science, technology and finance in Jiangsu Province decreased slowly from 2015 to 2019, which was mainly caused by the decline of pure technical efficiency.

Table 2: Calculation results of integrated efficiency of science, technology and finance in Jiangsu Province in 2015

region	The comprehensive efficiency	Pure technical efficiency	The scale efficiency	Technical effectiveness	Scale effectiveness
changzhou	0.854	0.965	0.885	The effective	drs
xuzhou	0.561	0.597	0.941	The effective	drs
nanjing	0.463	0.653	0.709	The effective	drs
huaian	1.000	1.000	1.000	effective	-
nantong	0.888	1.000	0.888	The effective	drs
suqian	0.605	1.000	0.605	The effective	irs
wuxi	0.815	1.000	0.815	The effective	drs
yangzhou	0.963	0.975	0.987	Relatively effective	drs
yancheng	0.493	0.526	0.938	The effective	drs
suzhou	0.676	1.000	0.676	The effective	drs
taizhou	0.984	1.000	0.984	Relatively effective	irs
zhenjiang	1.000	1.000	1.000	effective	-
lianyungang	0.626	0.774	0.808	The effective	irs
jiangsu	0.764	0.884	0.864		

Based on the above table and analysis, the specific analysis of the 13 cities in Jiangsu Province is as follows:

As we can see from Table 2, the comprehensive efficiency of science, technology and finance in Jiangsu province gradually flattens out year by year, but the scale efficiency is improving year by year. Jiangsu Province was divided into northern Jiangsu, Southern Jiangsu and Central Jiangsu. The comprehensive efficiency of Southern Jiangsu and Central Jiangsu increased slowly, while Northern Jiangsu decreased year by year. By 2019, the comprehensive efficiency of central Jiangsu was the highest, reaching 1.00. Northern Jiangsu was in the middle with a comprehensive efficiency of 0.842. Southern Jiangsu was the lowest, with a comprehensive efficiency of 0.712.

From the perspective of prefecture-level cities in Jiangsu Province, Taizhou and Huai'an maintained the tightest state of comprehensive efficiency close to 1.00 from 2015 to 2019.[4] After 2015, the scale efficiency of Zhenjiang decreased slightly, and then recovered to the best state of comprehensive efficiency of 1 again in 2016 after adjustment. The comprehensive efficiency of Yangzhou, Xuzhou and Yancheng fluctuated from 2015 to 2017. The comprehensive efficiency of Yangzhou was high, all around 1.00, and that of Xuzhou was above 0.85, with Yancheng being the lowest. Although the cities in southern Jiangsu have developed economy and rich people, the comprehensive efficiency of science, technology and finance has been in the stage of low efficiency for a long time, lagging behind the provincial average level. The obvious inefficiency of Nanjing, Wuxi and Changzhou is reflected in two aspects: pure technical efficiency inefficiency and scale efficiency inefficiency.

5. Conclusions and Suggestions

5.1 Conclusions

In this paper, the science and technology financial data of 13 prefecture-level cities in Jiangsu Province are sorted out and processed. Under the condition of isotensitivity, DEA model is used to make an empirical analysis of the efficiency measurement of input and output. The following conclusions are drawn: (1) the comprehensive efficiency of science, technology and finance in Jiangsu province showed a

slow decline trend year by year from 2015 to 2019 and tended to be stable.(2) The input-output value of science and technology finance in southern Jiangsu has the highest proportion in the whole province, followed by central Jiangsu and Northern Jiangsu.(3) The comprehensive efficiency of southern Jiangsu in Jiangsu Province is generally low, which may be affected by the large input base of universities and incomplete statistics of input-output ratio.The efficiency of northern Jiangsu and central Jiangsu is close to 1.0, which is stable and effective.

5.2 Suggestions

Based on the conclusion of the empirical analysis, this paper makes the following recommendations:

1) Encourage innovators to pledge their intellectual property to obtain bank loans.[3] Increase the investment of financial institutions in the field of science and technology by means of market intervention

2) The government should increase the investment in science and technology finance in central and northern Jiangsu. In view of the low investment and high efficiency in science and technology finance in central and Northern Jiangsu, the future growth trend should be a stage of increasing scale in a certain period of time.[5]

3) We will establish venture capital funds for innovation and entrepreneurship. All diversified investors should enter the venture capital sector, especially in cities with scale efficiency and low technical efficiency at the present stage, and they should focus their efforts on science, technology and finance.

4) We should further adjust the layout of investment in scientific and technological talents, encourage more scientific and financial talents to pour into other areas outside southern Jiangsu, and promote the comprehensive and efficient development of science and technology and finance in Jiangsu Province.

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