Analysis of Investment Efficiency in Anhui Social Field based on DEA Model

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Abstract

Using DEA model, the investment completion amount in social field is selected as input index, fiscal revenue, gross national product and newly added fixed assets are selected as output index, and the investment efficiency in social field of 16 prefecture-level cities in Anhui province is analyzed. The results show that the overall level of investment efficiency in social fields in Anhui province is good, but there are great regional differences. Unreasonable allocation of regional resources has become a fundamental problem restricting the improvement of input and output efficiency in social fields in various regions of Anhui province. Research suggestions: release institutional dividends, stimulate investment vitality; Optimize industrial structure, open investment access areas; Break the constraints of institutional mechanisms, and promote regional coordinated development.

Keywords

DEA Model; Social Field; Investment Efficiency.

1. Introduction

Since the 19th National Congress of the Communist Party of China, emerging formats in China's social field have emerged continuously, the total amount of investment has been continuously expanded, and the service capability has been continuously improved. China's economic development has entered a new era, the level of productivity has been continuously improved, and the people's demand for higher-level public services in the social field has been continuously strengthened[1].The social field has a wide range, which can be divided into broad sense and narrow sense. According to the deployment requirements of the State Council, the social field focuses on five fields: medical treatment, old-age care, education, culture and sports. Investment in the social field refers to the fixed assets investment projects constructed by the government, domestic enterprises, self-supporting institutions, social organizations, non-governmental organizations and so on using their own funds or through financing. At present, investment in social field has become an important force for Anhui province to develop and expand private economy, accelerate industrial transformation and upgrading, implement rural revitalization strategy and promote high-quality development. However, aiming at the investment efficiency in the social field, how to help the development of various cities in Anhui through investment is one of the current difficulties.

Since the State Council proposed to further stimulate the vitality of investment in the social field in 2017, the scale of investment in Anhui has been continuously expanding. According to statistical data, the investment in the social field in Anhui province reached 37.2 billion yuan in 2009, while by 2020, the investment in social fields in the whole province reached 142.5 billion yuan, an increase of nearly four times. However, among all prefecture-level cities in Anhui, there are obvious differences in investment in the social field. Compared with northern Anhui and southern Anhui, Central Anhui shows a higher level. This paper will be based on the

investment situation in the social field of various cities in Anhui province, use DEA analysis method to study the investment efficiency in the social field of Anhui province, and then put forward corresponding countermeasures and suggestions according to the calculation results.

2. DEA Model and Variable Selection

2.1. DEA Model

At present, there are many methods that can be used to analyze efficiency, of which the most widely used methods in academia are parametric methods and non-parametric methods. The two most commonly used types are stochastic frontier production function in parametric method and Data Envelopment Analysis (DEA) method in non-parametric method [2]. Data envelopment analysis is an efficiency evaluation method developed by famous American scholars such as A. Charnes and W. W. Cooper in 1978 based on the concept of relative efficiency. The DEA model uses the method of linear programming to construct a non-parametric segmented surface (Frontier), and then calculates the efficiency relative to this surface [3]. As a new method of statistical analysis, the DEA method estimates the frontier of effective production according to a set of observation values about input-output. When dealing with multiple inputs, in particular, it has absolute advantages in the ability of multi-output problems [4]. Its basic theory is to form the production possibility set by combining the input and output indexes of decision-making units. These production possibility sets form the data envelopment line through combination, and produce all the best advantages on the production possibility set, the combination of these points forms the optimal frontier data envelope. The production possibility set located on the optimal frontier envelope is efficient, while the production possibility set located outside the envelope is inefficient. The advantage of DEA analysis method is that it assumes that each input is associated with one or more outputs, and there is a certain connection between the inputs and outputs, but it does not require to determine the display expression of this relationship, and without any weight hypothesis, the optimal weight is obtained through the actual data input and output of the decision unit, which excludes many subjective factors and has strong objectivity [5]. In addition, the DEA method is purely technical and does not require data integration. Therefore, the optimal efficiency index of decision-making unit has nothing to do with the selection of dimensions of input index value and output index value; there is no need to conduct dimensionless processing on the data before establishing the model, which is extremely effective for evaluating the investment efficiency [6].

The basic models of DEA include CCR model and BCC model. CCR model does not consider scale income, the basic idea is to determine the effective production frontier through the analysis of sample input and output data, and according to each decision unit (DMU) distance from production frontier, determine whether each decision unit (DMU) is DEA effective [7]. The CCR model is used to evaluate the comprehensive efficiency of decision-making units. The model has a hypothesis that all decision-making units operate on the optimal scale. in real life, due to incomplete competition and restrictions of relevant financing policies, many decision-making units cannot meet the premise hypothesis [8]. BCC model is used to measure pure technology and scale efficiency when the decision-making unit (DEA) is under the condition of variable scale compensation. It replaces the fixed scale compensation hypothesis of the CCR model, it can solve the problems existing in the CCR model. This model does not require all decision units to operate on the optimal scale. If the decision units are not running on the optimal scale, the technical efficiency obtained by using CCR model includes scale efficiency. in addition, the BCC model can also be used to judge whether the scale benefit of DMU is in the increasing or decreasing stage [9].

In addition, according to the calculation direction, DEA model includes input-oriented and output-oriented. on the premise of maintaining a certain level of output, the problem of

researching the minimization of input is input-oriented; While output-oriented refers to how to maximize the output level on the premise of maintaining a certain level of input. However, no matter which kind of orientation is adopted for evaluation, the ranking of evaluation will not be changed. Therefore, the investment-oriented BCC model is selected to evaluate the investment efficiency in the social field of all prefecture-level cities in Anhui, where the comprehensive technical efficiency (TE)= pure technical efficiency (PTE)* Scale efficiency (SE).The BBC model can be expressed as follows:

$$\begin{cases} \min[\ \theta - \varepsilon\ (e^T s^- + e^T s^+)\ ] \\ \sum_{j=1}^{n} Y_j \lambda_j + S^- = \theta X_0 \\ s.t. \sum_{j=1}^{n} Y_j \lambda_j - S^+ = Y_0 \\ \lambda_j \geq 0, S^-, S^+ \geq 0 \end{cases}$$

In the preceding formula, j = 1, 2, ..., n represents different decision-making units, X represents the input variable, and Y represents the output variable; θ represents a radial optimization quantity or "distance" between DMU and the effective frontier; S+, S-are relaxation variables respectively; ε is a non-Archimedean infinitesimal, which is essentially a linear programming problem. If θ = 1,S+ = S-= 0, then the DEA of the decision-making unit is effective; If θ = 1,S+≠ 0 or S-≠ 0, then the decision-making unit is weak DEA effective; If θ <1, then the decision-making unit is not DEA effective [10].

2.2. Variable Selection

The evaluation indexes of social field investment efficiency of each prefecture-level city participating in the efficiency evaluation include output index and input index, and the relevant selection of index is as follows:

(1) output indicators. The fiscal revenue, gross national product and newly increased fixed assets of 16 prefecture-level cities in Anhui in 2020 are selected as output indicators to reflect the economic benefits generated by investment activities in social fields in various regions.

(2) input indicators. Select the social investment completion amount of 16 prefecture-level cities in Anhui in 2020 as the input index.

3. DEA Model Calculation Results and Analysis

By substituting the data of output index and input index of 16 prefecture-level cities in Anhui in 2020 into DEAP2.1 software for calculation and analysis, we can get the comprehensive efficiency, pure technical efficiency, scale efficiency and scale reward level of each prefecture-level city, this paper analyzes the social investment efficiency of prefecture-level cities in 2020. According to the DEA calculation results, the following analyses the investment efficiency in social fields of all prefecture-level cities in Anhui from the perspectives of comprehensive efficiency, scale efficiency and scale efficiency respectively:

Table 1. Evaluation results of investment efficiency in social fields of prefecture-level cities in Anhui in 2020

Region	Comprehensive efficiency	Pure technical efficiency	Scale efficiency	Scale income
Hefei	0.548	1.000	0.548	Decreasing
Huaibei	0.776	0.974	0.797	To increase progressively
Bozhou	0.441	0.495	0.890	To increase progressively
Suzhou	0.589	0.647	0.911	To increase progressively
Bengbu	0.612	0.668	0.916	To increase progressively
Fuyang	0.408	0.424	0.962	To increase progressively
Huainan	0.580	0.701	0.827	To increase progressively
Chuzhou	0.850	1.000	0.850	Decreasing
Lu'an	0.535	0.597	0.896	To increase progressively
Ma'anShan	1.000	1.000	1.000	Unchanged
Wuhu	1.000	1.000	1.000	Unchanged
Xuancheng	0.595	0.681	0.873	To increase progressively
Tongling	0.833	1.000	0.833	To increase progressively
Chizhou	0.711	1.000	0.711	To increase progressively
Anqing	0.577	0.613	0.941	To increase progressively
Huangshan	0.360	0.521	0.691	To increase progressively
Average value	0.651	0.770	0.853	-

Note: comprehensive efficiency = pure technical efficiency × scale efficiency.

Comprehensive efficiency and scale efficiency analysis of prefecture-level cities. The first category, Chuzhou, Ma'anshan, Wuhu, Tongling. As can be seen from Table 1, the comprehensive efficiency and scale efficiency of these four cities are relatively high, and each index value is equal to 1 or close to 1, it shows that the investment efficiency level in the social field of these four cities is relatively high, and the operation efficiency and management level of the capital investment in the social field are also relatively high, the investment structure in the social field and the investment scale in the social field are relatively reasonable. The second category is Bozhou, Suzhou, Bengbu, Fuyang, Huainan, Liu'an, Xuancheng and Anqing. The characteristics of these eight cities are that the scale efficiency is relatively high, the numerical value is close to 1, but the comprehensive efficiency is relatively low, between 0.40-0.62.It shows that the current efficiency of capital utilization in the social field in these eight cities has not reached the best level, and it still belongs to the state of high investment and low efficiency. We should further increase the investment in the social field for technological transformation, improve management level and efficiency and reduce output costs. The third category is Hefei, Huaibei, Chizhou and Huangshan. The situation of these four cities is different from that of the eight prefecture-level cities of the second category. The comprehensive efficiency and scale efficiency are relatively low, which to a certain extent indicates that the investment in the social field is insufficient. It shows that the capital operation efficiency and management level in the social field of these four cities are relatively low, and the investment scale and structure in the social field are not reasonable. Therefore, there is still much room for improvement in the social investment of these four cities.

Scale-benefit analysis of social investment in various cities. It can be seen from the calculation results of scale income stage in Table 1 that 2 of the 16 cities in Anhui participated in the evaluation are in the decline stage of scale income, which are Hefei and Chuzhou respectively; there are 2 cities in the stage of constant returns of scale, which are Ma'anshan and Wuhu respectively; The other 12 cities are in the stage of increasing returns of scale. The investment in the social field of all prefecture-level cities in Anhui province as a whole presents the technical characteristics of increasing scale benefits.

According to the above analysis, Hefei, Huaibei, Chizhou and Huangshan have the problem of insufficient scale efficiency, and the scale and structure of investment in the social field need to be improved and optimized. However, only according to the scale income of each city can the adjustment direction of the investment scale in the social field of each city be further determined, and the efficiency of its investment in the social field be promoted to reach the best state. When adjusting the scale of investment in the social field, we should not "cure the foot pain, cure the head pain", but according to the situation of different cities, directional adjustment, not only pay attention to the direction of macro environment guidance, but also pay attention to micro individual differences, while paying attention to improving the amount of investment, we constantly optimize and adjust the industrial structure to avoid the phenomenon of overcapacity due to the adjustment transition. Although the first and second cities basically do not have the problem of insufficient scale efficiency, Chuzhou is in the stage of decreasing scale efficiency, so attention should be paid to controlling the development speed of investment in the social field, avoid social investment entering low-efficiency areas.

4. Countermeasures and Suggestions

According to the main problems existing in the investment development of Anhui's social field, the corresponding countermeasures are put forward in a targeted way, from continuously stimulating the investment vitality in the social field, opening up the investment access field, optimize industrial structure to improve investment performance, improve regional differentiation and coordinate the economic development of the whole province to promote the rapid development of investment in the social field of Anhui.

4.1. Release System Dividends and Stimulate Investment Vitality

To stimulate the investment vitality in the social field, we should not only consider the market and provide high-quality and effective services, so as to attract more social capital to participate in various ways, but also play the pattern of taking the government as the main body [1].To overcome the shortage of investment vitality in the social field, the key lies in breaking the bondage of the system and mechanism, promoting the relevant reforms in the social field and releasing the system dividends, which are the inevitable choices to promote its rapid and orderly development. First, we should insist on deepening the reform of "negative list", formulate a fair market access system, take the negative list of market access as the core, and gradually reduce the administrative monopoly in the market access system. Secondly, deepen the reform of the financial system, expand financing channels, innovate financing methods, play the leading role of government funds, actively innovate financial services and products, encourage the development of crowdfunding, Internet finance, inclusive finance, small and micro banks and other financial services, strengthen financial support for enterprises and institutions in the social field, guide social capital to participate in medical institutions, pension service institutions, educational institutions, construction and operation of cultural facilities and sports facilities.

4.2. Optimize the Industrial Structure and Open the Investment Access Field

Under the current macroeconomic situation, the promoting effect of investment in social field on economic growth cannot be ignored, especially the investment in social field in Anhui province has driven the continuous development and expansion of social economy, promoting industrial transformation, optimizing the economic structure, improving people's livelihood and realizing high-quality economic development have played an important role. At present, Anhui and even the whole country are facing the problem of obstacles in the field of investment access in the social field. To ensure the high efficiency of investment in the social field, we must break the obstacles in the field of investment, allow investment in the social field to enter industries and fields not prohibited by law, allow investment in the social field to enter various fields of the industry, and cancel various additional conditions for investment in the social field. The investment in the social field of Anhui presents an unbalanced distribution in industrial investment and industrial distribution. In order to give full play to the maximum potential of investment in the social field of Anhui, it is urgent to promote the optimization and adjustment of industrial structure and the upgrading of economic structure, investment in the social field is the backbone of promoting new industries, new models and new formats. At the same time, we should conform to the economic development situation, actively integrate into the fields of Internet, big data and artificial intelligence, take big data and intelligence as the core, and use intelligent high-tech technology to transform traditional industries, promote the transformation and upgrading from traditional manufacturing industry to intelligent manufacturing industry, enhance the innovation and competitiveness of investment in intelligent industry in the social field, and accelerate the economic development towards high quality through intelligent construction.

4.3. Break the Constraint of System and Mechanism and Promote Regional Coordinated Development

Troubled by problems such as insufficient investment vitality and insufficient development in the social field, Anhui's investment in the social field has shown a trend of differentiation to a certain extent. In order to solve the problem of differentiation of investment development in the social field and coordinate the economic development of the whole province, the investment vitality in the social field needs to be activated urgently. To overcome the shortage of investment vitality in the social field, the key lies in breaking the bondage of the system and mechanism. Promoting relevant reforms in the social field and releasing institutional dividends are the inevitable choices to promote its rapid and orderly development. Deepen the reform of "negative list" and formulate a fair market access system. Administrative monopoly and market control are the prominent problems restricting the development of social field at present. We should take the negative list of market access as the core, gradually reduce the administrative monopoly in the market access system, and deepen the reform of social field, through the reform of the investment approval and licensing system, loosen or cancel the regulation, break the monopoly of the industry, promote the diversified participation of investment in the social field, and stimulate the vitality of investment. At the same time, deepening the reform of the financial system, expanding financing channels and innovating financing methods are one of the channels to ease credit constraints in the social field and accelerate investment and development in the social field.

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