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Analysis of Agricultural Investment Efficiency Based on the Ultra-Efficient Dea Method

Liu Huina[1], Pan Helin*[2] and Zhang Zongze[3]

[1]*School of of Finance, Zhongnan University of Economics and Law, China*

[2]*Zhongnan University of Economics and Law, Executive Director of the Digital Economics Research Institute, China*

[3]*Graduate School of Economics, Central China University of Science and Technology, China*

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***Corresponding author:** Pan Helin, Yongzhou City, Hunan Province Professor of Industrial Upgrading and Regional Financial Synergy Innovation Center, Zhongnan University of Economics and Law, Executive Director of the Digital Economics Research Institute

Abstract

To cope with the impact of the financial crisis on China's economy, China has implemented a "four trillion" investment policy to enable China to smoothly weather the financial crisis. However, the growth of investment has led to a decline in investment efficiency. Based on the research sample of 23 provinces from 2008 to 2017, this paper studies the efficiency of Agricultural Investment in China and puts forward some suggestions.

Keywords: Ultra-efficient DEA; Agriculture; Investment Erficiency

Literature review

At present, multi-factor model is the mainstream method to analyze the comprehensive efficiency of investment efficiency. The earliest appearance of this method is traced back to Jefferson (1990) [1], who used the packet model (DEA) to analyze the technical efficiency of China's steel industry, the results show that China's steel industry technology efficiency is low, and some improvement methods are proposed. In the process of rapid development of this method, the whole factor productivity (TFP) method began to emerge, the specific research method is divided into two categories, one kind of scholars use Cobb-Douglas production function, CES production function, etc. to calculate the total factor productivity changes by using the potential output method, by estimating the forward production function, and then calculating the distance between the actual input-output combination and the cutting-edge function. Later, Malmquist S proposed the concept of Malmquist index, but the method was widely used after the DEA method became popular. When the research on investment efficiency of the overall economy matures gradually, many scholars in China have started to combine the current situation of our country and carry out the research on investment efficiency for different sub-industries [2], analyzed the investment efficiency of cultural industry in Hubei Province and concluded that the investment efficiency of cultural industry in this region is in a state of fluctuation and higher than the average of other provinces, but still not effective in DEA, studies the investment efficiency of cultural industry in Shandong Province and concludes by DEA method that the overall investment efficiency of cultural industry in Shandong Province is high, but there are fluctuations in scale efficiency in different years [2]. Puts the perspective on the investment efficiency of hydropower industry and thinks that the investment efficiency and electricity efficiency of hydropower industry in China are low, and the potential for improvement is huge.

Efficiency calculation of agricultural investment

Model selection

The DEA model: At present, the academic method of measuring efficiency is divided into the following two categories, one is the parameter method, mainly includes the amendment of the least square, the cutting-edge production function method and so on, the other is the non-argument method, and the packet analysis method (DEA) is the representative of it. Packet analysis (DEA) is a nonparametric method to measure the relative efficiency value of a decision unit (DMU) in the case of multiple inputs and multiple outputs. For other parameter methods, the DEA model has its unique advantages: 1, the method does not need

to set a specific function form, which avoids the error caused by artificially setting the efficiency function equation; The deA model uses input and output data to build an efficiency frontier with all decision units (DMUs) by mathematical planning, and the closer the DMU is to this frontier, the more efficient the DMU efficiency value is 1. Assuming the existence of N decision units (DMU), I input indicators, and J output indicators, the specific form of the DEA model is shown in equations 1-1.

$$Max\phi^n = \frac{\sum_{j=1}^{J} u_j^n y_j^n}{\sum_{l=1}^{I} v_i^n x_i^n} \quad 1\text{-}1$$

$$s.t. \frac{\sum_{j=1}^{J} u_j^n y_j^n}{\sum_{l=1}^{I} v_i^n x_i^n} \le 1$$

$$u_j^n, y_j^n, {}^n, x_i^n \ge 0; i = 1,...,I; j = 1,...J; n = 1,.....,N$$

In (1-1)

x_i^n and y_j^n The ith input indicator and the j output indicator of DMU_n

u_j^n and v_i^n Weight of input and output indicators

ϕ^n The efficiency value of DMU_n

It can be found that the traditional DEA model may have multiple efficiency units equal to 1, at this time cannot distinguish between good and bad in all valid units, so this paper chooses the super-efficiency DEA model for efficiency analysis.

Ultra-efficient DEA model: In view of the disadvantages of the traditional DEA model, Banker et al (1988) puts forward the super-efficient DEA model, the principle is to exclude the DMU to be evaluated from the reference set, so that the effective decision-making unit reorders the advantages and disadvantages. The model is specific to see 1-2. In (1-2), The indicator means the same as the normal DEA model. At this point, the calculated efficiency value of the ϕ_k^{super} can be greater than 1, in this paper, the use of DEA solver Pro5.0 software for efficiency analysis.

$$Max\phi_k^{super} = \frac{\sum_{j=1}^{J} u_j^k y_j^k}{\sum_{l=1}^{I} v_i^k x_i^k} \quad (1\text{-}2)$$

$$s.t. \frac{\sum_{j=1}^{J} u_j^k y_j^k}{\sum_{l=1}^{I} v_i^k x_i^k} \le 1$$

$$u_j^n, y_j^n, {}^n, x_i^n \ge 0; i = 1,...,I; j = 1,...J; n = 1,.....,N; r = 1,...,N, and r \ne k$$

The efficiency calculation of agricultural input and output

Input and output indicator selection: The data are from the China Statistical Yearbook, the China Financial Statistics Yearbook, the statistical yearbook of the provinces, as well as the wind database, CSMAR database. Agricultural investment efficiency reference [4] selected agricultural fixed asset investment, the end of the year commonly used arable land area, rural working population, rural electricity consumption as input indicators detailed indicator information see Table 1.

Table 1: Index of input and output of industrial investment efficiency.

Efficiency Category	Indicator Category	Specific Indicator
Efficiency of agricultural investment	Input indicators	Investment in agricultural fixed assets
		Acreage
		Fertilizer dosage
		Rural electricity consumption
		Number of people in the workforce
	Output indicators	Gross output value of agriculture, forestry, animal husbandry and fisheries
		Primary industry GDP

The results of the calculation: [4], the method of super-efficiency DEA model is not radially improved, so this paper contains the following assumptions: 1, scale compensation variable, because it is difficult to achieve efficiency under fixed-scale compensation due to legal system, market competition and other reasons; The results are shown in (Tables 2,3) (1) On the whole, the overall investment efficiency of China's agriculture is not high, even in the highest eastern region, the efficiency value is still less than 0.9. In terms of agricultural investment efficiency, the eastern region is much higher than the central region and the western region, and the investment efficiency of the central region and the western region industry is not very different. (2) In terms of comprehensive investment efficiency ranking, Zhejiang, Jiangsu and Fujian ranked first in the agricultural investment efficiency ranking, while Henan and Shandong, the traditional agricultural provinces, ranked lower, indicating that some areas of agriculture are larger, but the investment efficiency is not high the agricultural investment efficiency is high in inner Mongolia [5-7].

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Table 2: Superficial DEA calculation results.

Province	AIE	Arank	Reigon
Shandong	0.5113	15.8	Eastern
Guangdong	0.5715	11.4	
Jiangsu	0.8762	7.7	
Hebei	0.4712	19.5	
Zhejiang	1.0625	4.1	
Fujian	1.0119	7.8	
Liaoning	0.9125	8	
Jilin	0.5029	16.5	Central
Anhui	0.3697	25.8	
Shanxi	0.279	30.9	
Jiangxi	0.4809	19.3	
Henan	0.3498	27	
Hubei	0.4796	19.2	
Hunan	0.5463	12.7	
Heilongjiang	0.8105	11.6	
Yunnan	0.3693	25.8	Westward
Inner Mongolia	0.4694	19.6	
Sichuan	0.5535	13	
Guangxi	0.4909	17.9	
Xinjiang	0.5154	19.7	
Gansu	0.3399	28.1	
Guizhou	0.4088	24	
Shanxi	0.3805	25	

Table 3: Regional Efficiency Calculations.

Region	AIE	Arank
Eastern	0.7739	10.61
Central	0.4773	20.37
Westward	0.441	21.64

Conclusion

Based on the macro data of 23 provinces in China from 2008 to 2017, this paper calculates the efficiency of agricultural investment in China and finds that the overall investment efficiency of agriculture in China is not high, and there are obvious regional differences, and there is still a lot of room for improvement in the level of agricultural modernization and large-scale construction. As a basic industry, the state should give more policy support to improve china's agricultural modernization and large-scale construction level. Microcosmicly, to improve the efficiency of agricultural investment needs to give enterprises more freedom, improve the agricultural economic subject "small, scattered, chaotic" status quo, improve the construction of agricultural industry system, promote industrial integration and development, and thus improve the efficiency of agricultural investment.

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