

Efficiency Analysis of Listed Agricultural Company Based on DEA

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Abstract—Based on the data of 10 listed agricultural companies from 2011 to 2015, this paper analyzes the technology and scale efficiency of 10 listed agricultural companies by Data Envelopment Analysis (DEA). The results show that: the listed companies that have the best technical efficiency and economies of scale at the same time have fewer listed agricultural products, but they can be further improved. Finally, some suggestions are put forward.

Keywords—DEA; technical efficiency; scale efficiency

I. INTRODUCTION

As the primary industry in our country, agriculture has always been the focus of our country's work. According to statistics, as of 2016, China's agricultural output value has been steadily rising, but China's agricultural products processing industry is at a low level, productivity of agricultural products is low, the degree of commercialization is low. In the process of social development, the special efficiency of listed agricultural companies to achieve the technical, pure technical and scale efficiency is less than optimal. Under the current social market economy, to enhance the competitiveness of listed agricultural products and optimize the industrial structure, it is necessary to change from the most basic input-output relationship, improve business productivity and efficiency. Therefore, this paper uses data envelopment model (DEA) to conduct empirical analysis of Liaoning listed agricultural products companies, which is of great practical significance to improve the competitiveness of agricultural products processing enterprises and enhance the efficiency of listed companies.

II. LITERATURE REVIEW

In our country, agricultural listed companies play an important role in agriculture. In recent years, Chinese scholars have analyzed the agricultural listed companies from different angles, for example

Scholar Chen Hao (2013) based on technological innovation of agricultural listed companies financial comprehensive evaluation index system, and then used the principal component analysis to calculate the selected 12 agricultural listed companies financial composite score to evaluate their financial status[1].Chen Wei, Zhang Lei and so on(2014) applying the three-stage DEA model, the effectiveness of informatization construction in colleges and universities was evaluated on the basis of eliminating the influence of environment and random factors[2]. Xiong Chan, YiYuan-Yuan and so on(2014) analyze the situation of

redundant and underemployed high-tech start-ups that are non-DEA effective in all regions[3].Li Xiao-mei, Bai Xue-fei(2016)based on the panel data of 16 state-owned logistics enterprises listed in A shares from 2006 to 2015, this paper empirically tests purely technical efficiency, scale efficiency and overall efficiency of state-owned logistics enterprises from a micro perspective[4].

To sum up, Chinese scholars have conducted many research on listed agricultural products companies, using a variety of methods for analysis. This paper uses data envelopment analysis is purely technical and has nothing to do with the market price, just need to distinguish between output and output, the number of cases is not high This article mainly selects the data of 10 listed agricultural products and adopts the method of Data envelope analysis (DEA), Listed companies in the agricultural products in terms of technology and efficiency made recommendations to other listed companies of agricultural products also have reference.

III. RESEARCH DESIGN

A. Case Selection and Data Source

This article mainly elects 10 listed agricultural products as the research object, including Bei Da Huang Co., Ltd.(A1), Denghai Seed Co., Ltd.(A2), Easysight Asysight Supply Chain Management Co., Ltd.(A3), New Hope Liuhe Co.,Ltd. (A4), Gansu Ronghua Industry Group Co.,Ltd.(A5).Shandong Ruyi Woolen Garment Group Co., Ltd.(A6), New Wellful Co.,Ltd.(A7), Wellhope Agri-Tech Joint Stock Co., Ltd.(A8), Yi Qiao Sea Cucumber Co.,Ltd.(A9.), Tianbao Green Foods Co., Ltd.(A10). Data sources for Sina Finance and other securities website on the case of the company announced 2011~2015 annual report.

B. Case Index Introduction

Input and output indexes established by DEA analysis method include total assets (X), operating costs (Y), operating income (Z), net profit (H) and earnings per share (F).

IV. DATA ENVELOPMENT ANALYSIS(DEA)

This paper uses BCC model with variable returns to scale.

Processing of DEA data

The case studies in this paper must be selected from publicly listed agricultural product listed companies with guaranteed data quality, a total of 10 listed companies in agricultural products to conduct research and analysis, the data source for agricultural products listed companies open annual

reports. According to DEA analysis for data selection restrictions, the data as much as possible, so in the analysis of the data, the negative value of the case company is normalized to 1. According to DEA analysis of data cases require decision-making unit number analysis(Double the sum of input and output indicators must be less than the number of cases), the research data in this paper meets the DEA case requirements, the selected indicators are the average of the original case indicators from 2011 to 2015 as shown in Table 1:

TABLE I. THE AVERAGE OUTPUT OF THE COMPANY AND INPUT INDICATORS THE ORIGINAL DATA IN 2011 ~ 2015

Listed company	operating income	net profit	earnings per share	total assets	operating costs
A ₁	9006344000	187803000	0.15	12602992000	8921144000
A ₂	1368006000	494393600	0.78	3379654000	890584800
A ₃	1366361600	96060840	0.17	2516554800	1236471200
A ₄	69161100000	2720580000	1.15	28908340000	6825844000
A ₅	225010740	2460400	0.003	995924800	173949940
A ₆	641356800	6192272	0.04	1832196000	637328800
A ₇	1151575400	7657540	0.09	1171000800	1173967800
A ₈	8551298000	263583000	0.46	3379040000	8265578000
A ₉	446501400	180225000	0.54	2398276000	268779000
A ₁₀	1574500000	149176400	0.41	3518932000	1423364000

UNIT: YUAN

V. ANALYSIS OF TECHNICAL EFFICIENCY, PURE TECHNICAL EFFICIENCY AND SCALE EFFICIENCY

According to the variable-scale returns model, using deap2.1 software data to solve the problem, the paper obtains the comparison of technical efficiency and scale efficiency of listed companies in different agricultural products from 2011 to 2015, and reflects the efficiency difference of agricultural listed companies from the efficiency point of view (Table 2).

TABLE II. CALCULATION RESULTS OF DEA MODEL

company name years Efficiency value	2011~2015			
	ρ_0^*	θ_0^*	S_0^*	Diminishing returns to scale
A1	0.853	0.951	0.897	drs
A2	1	1	1	-
A3	0.866	0.894	0.969	irs
A4	1	1	1	-
A5	0.817	1	0.817	irs
A6	0.719	0.802	0.897	irs
A7	0.874	1	0.874	irs
A8	1	1	1	-
A9	1	1	1	-
A10	0.932	0.971	0.960	irs

Note: ρ^* represents technical efficiency value, θ^* represents pure technical efficiency value, S^* represents scale efficiency. Drs represents diminishing returns of scale, Ins represents the increasing of scale.

A. Technical Efficiency Analysis

According to the technical efficiency ρ^* shown in Table 2, we can conclude that the technical efficiency of 10 listed agricultural companies from 2011 to 2015 is only 1, about 40% of the total cases, this shows that the four companies in the 2011~2015 development momentum is good, and have reached the effective value of 1, it is possible that this is due to the support of the formulation of policies by national authorities in recent years and the improvement of their own technologies; Other companies still have inefficient DEA, accounting for 60% of the total, This shows that the above companies have experienced a certain degree of overall decline. they need to adjust their input structure appropriately and strengthen their management of resources input.

B. Pure Technical Efficiency Analysis

As can be seen from the purely technical efficiency θ^* of Table 2, there are six cases of listed agricultural product companies achieved purely technical efficiency during 2011-2015, accounting for 60% of the total cases, These figures indicate that the growth momentum of these companies is good while the pure technical efficiency of other companies from 2011 to 2015 are 0.951, 0.849, 0.802 and 0.971 respectively, accounting for 40% of the total. This shows that purely technical efficiency is not effective and DEA has not reached the effective level.

C. Scale Efficiency Analysis

According to the data from table 2, the pure scale efficiency values S^* are shown. In 2011 ~ 2015, there are four cases of listed agricultural product companies achieving economies of scale, accounting for 40% of the total cases. While the other companies scale efficiency were 0.897, 0.969,

0.817, 0.897, 0.874 and 0.960, accounting for 60% of the total cases. Indicating that the overall difference is not large, but it did not achieve economies of scale, DEA invalid. Agricultural listed companies in the smaller size of the capital mainly for the smaller size of the stock, asset size is small and the market size is small and so on.

TABLE III. ANNUAL DATA CALCULATION RESULTS OF DEA MODEL

	2011 ρ^*	2012 ρ^*	2013 ρ^*	2014 ρ^*	2015 ρ^*	2011 θ^*	2012 θ^*	2013 θ^*	2014 θ^*	2015 θ^*	2011 S^*	2012 S^*	2013 S^*	2014 S^*	2015 S^*
A ₁	0.83	0.84	0.80	0.86	0.97	0.97	0.95	0.90	1	1	0.86	0.88	0.89	0.86	0.97
A ₂	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A ₃	0.98	1	1	1	0.86	1	1	1	1	0.94	0.98	1	1	1	0.92
A ₄	1	1	1	0.97	0.96	1	1	1	1	1	1	1	1	0.97	0.96
A ₅	0.97	0.81	0.80	0.71	0.62	1	1	1	1	1	0.97	0.81	0.80	0.71	0.62
A ₆	0.67	0.73	0.67	0.70	0.75	0.67	0.75	0.67	0.70	0.89	0.99	0.98	1	1	0.84
A ₇	1	0.89	0.86	0.84	0.87	1	0.95	0.86	0.84	1	1	0.93	1	1	0.87
A ₈	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A ₉	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A ₁₀	0.89	0.86	0.77	0.79	0.82	1	0.87	0.78	0.81	0.83	0.89	0.98	1	0.98	0.99

According to the numerical results shown in Table 3, there are three cases of listed agricultural products companies achieving economies of scale accounting for about 30% of the total cases in 2011-2015. However, other companies did not reach the optimal scale, accounting for 70% of the total efficiency, at the same time, the most optimal technical efficiency, optimal pure technical efficiency and optimal scale efficiency are the most, about 20% of the total years in 2014.

VI. SUGGESTIONS

In terms of technical capabilities, first, making core innovation strategy, the primary development of technology is innovation, we should make the core innovation strategy, focus on the overall trend of economic development. Second, establishing and perfecting a scientific human resources management system, we must pay attention to the cultivation of innovative talents, we should give preferential policies to those who have innovation ability, and attract high-quality talents with higher treatment.

In terms of scale conditions, we should pay attention to the scale of operation. First, create a good external environment, nowadays, the demand for agricultural products has not changed much in the market, and the recognition of some agricultural products is not too high, we should step up product promotion. At the same time, we use the good policy support from the national government to develop our own product management[5]. Second, at the same time we can develop a strict system of rewards and punishments, award rewards and punishments, the punishment of employees severely punished, let other employees take warning, at the same time, reward some employees should be rewarded, in order to enhance the enthusiasm of staff.

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