Performance Evaluation of China's Agricultural Listed Companies Based on DEA Model

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Abstract In order to evaluate the performance of China's agricultural listed companies, we analyze the overall efficiency, pure technical efficiency and scale efficiency of China's agricultural listed companies on the basis of input-output data concerning 34 agricultural listed companies, using BCC model in data envelopment analysis (DEA) model. Then we analyze input-output redundancy situation using the slack variable derived from the model. The results show that the overall efficiency of China's agricultural listed companies is good, and the gap in efficiency between sub-industries is small; there is significant difference in performance between listed companies engaged in the same sub-industry, and the reason for invalid DEA in companies within the industry is complex; total assets and asset-liability ratio are high, and the effective output is not fully realized. Finally corresponding recommendations are put forward for promoting the performance of agricultural listed companies as follows: strengthening brand awareness; promoting the level of production technology; adjusting the input structure; transforming the agricultural growth mode.

Key words Performance evaluation, DEA model, Agricultural listed companies

Agriculture is the foundation for the development of the national economy as a whole. China is a country with the vast majority of rural population, and agriculture, in particular, has a unique strategic position. Agricultural listed company, playing a leading role in agricultural industrialization, is an important carrier for achieving agricultural industrialization management, increasing farmers' income, and resolving the issues concerning agriculture, countryside and farmers. Agricultural listed companies have played an important role in driving the development of agricultural economy in the region, increasing farmers' income and ensuring the healthy functioning of the national economy. The overall operating efficiency level of agricultural listed companies plays an important role in the development of agriculture in China. In recent years, the agricultural listed companies develop by leaps and bounds, but at the same time, a series of problems loom large, such as poor market performance, and exacerbated trend of polarization in operation performance, which have made the overall efficiency of agricultural listed companies slump. Therefore, conducting technical evaluation of the overall efficiency, pure technical efficiency and scale efficiency of agricultural listed companies, and putting forward the schemes and recommendations for improving the management of operators in agricultural listed companies, is of important practical significance.

Data envelopment analysis (DEA), formally developed by the logistics sociologists A. Charnes and W. Cooper, is a non-parametric method in operations research and economics for the estimation of production frontiers. Data envelopment analysis is a linear programming methodology to measure the efficiency of multiple decision-making units (DMUs) when the production process presents a structure of multiple inputs and outputs[1]. Shen Yuan conducted empirical analysis of the operating performance of the agricultural listed companies in 2006, using C^2R model and C^2GS^2 model in data envelopment analysis method. He found that the overall efficiency of agricultural listed companies was not high, and there were significant differences in efficiency; there was not only the impact of pure technical efficiency, but also the impact of scale efficiency, responsible for low overall efficiency of agricultural listed companies[2]. Chen Yongkang conducted objective and scientific analysis and evaluation of the overall efficiency, technical efficiency, scale efficiency and scale merit concerning the business activities of agricultural listed companies in 2006 and 2007. He found that the majority of agricultural listed companies with poor overall efficiency, were engaged in diversified operation based on non-agricultural industries, and the non-agricultural expansion was serious; agricultural listed companies did not attend to their proper business concerning agriculture, but deviated from agriculture conspicuously[3].

On the basis of the annual report data concerning the agricultural listed companies in China's Shanghai and Shenzhen stock markets in 2010, we use BCC model in data envelopment analysis method, to evaluate the overall efficiency, pure technical efficiency and scale efficiency of 34 agricultural listed companies, analyze the reason for DEA inefficiency in China's agricultural listed companies, and propose corresponding improvement methods, in order to provide a reference for promoting the operating performance of China's agricultural listed companies.

1 Research method and data source

1.1 Research method Data envelopment analysis (DEA) is the optimal performance evaluation technique used for multi-input and multi-output, and a kind of non-parametric statistical method for measuring the relative effectiveness of work per-

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formance of the same type of organization on the basis of the idea of linear programming. The basic idea is as follows: each unit to be evaluated is regarded as one decision-making unit (DMU), and many decision-making units constitute the group to be evaluated; through comprehensive analysis of the ratio of input to output, the weights of all inputs and output indicators of DMU are taken as variables for evaluation and computation, to determine the efficient production frontier, and determine whether DMUs are DEA-efficient according to the distance between DMUs and the production frontier; at the same time, the projection method can be used to point out the reason for non – DEA efficiency or weak DEA efficiency of DMU, as well as the direction and extent yet to be improved[4].

Data envelopment analysis (DEA) model is divided into input-oriented DEA model, and output-oriented DEA model. For the efficiency value measured by input-oriented DEA method, it is the ratio of the smallest possible cost to the actual cost under the established volume of output; for the efficiency value measured by output-oriented DEA method, it is the ratio of the actual output to the maximum possible output under the established cost[5]. This study uses the input-oriented DEA model, mainly the BCC model in DEA model, to measure the overall efficiency, pure technical efficiency and scale efficiency of agricultural listed companies, and proposes appropriate measures for improving efficiency. The derivation process of model is as follows:

assuming that there are n decision-making units $DMU_j(j=1,2,\cdots,n)$, and each decision-making unit produces s products using m kinds of inputs; m-dimensional vector X_j and s-dimensional vector Y_j denote the inputs and outputs of production unit j, respectively. Efficiency is defined as the ratio of outputs to inputs as follows:

$$h_j=\frac{\sum_{k=1}^{s}u_k y_{kj}}{\sum_{i=1}^{m}v_i x_{ij}},\ j=1,\ \cdots,\ n$$

Appropriate u and v are selected, to make $h_j\leqslant 1$. If h_{j0} is big, it indicates that DMU_{j0} can use relatively small inputs to get relatively large outputs. Using the method of exhaustion to change u and v as much as possible, we can find that whether DMU_{j0} is relatively optimal in n DMU_j, so as to evaluate DMU_{j0}. Then using Charnes and Cooper's Charnes-Cooper transformation of fractional programming in 1962, we can get the following equivalent linear programming form:

$$\max\mu^t y_0=v_p$$
$$s.t.\begin{cases}w^T x_j-\mu^T y\geqslant 0,\ j=1,\ \cdots,\ n\\ w^T x_0=1\\ w\geqslant 0,\ \mu\geqslant 0\end{cases}$$

For a selected DMU_{j0}, the duality rule of CCR model for judging the effectiveness of it can be expressed as:

$$\min\theta$$
$$s.t.\begin{cases}\sum_{j=1}^{n}\lambda_j x_j+s^-=\theta x_0\\ \sum_{j=1}^{n}\lambda_j y_j-s^+=y_0\lambda_i\geqslant 0,\ j=1,\ \cdots,\ n\\ s^-\geqslant 0,\ s^+\geqslant 0\end{cases}$$

(i) When $\theta=1$ and $s^+=s^-=0$, DMU_0 is DEA-efficient, that is, in the economic system composed of n decision-making units, the output Y_0 obtained on the basis of the original input X_0, has reached the optimum.

(ii) When $\theta=1$ and $s^+\neq 0$ or $s^-\neq 0$, DMU_0 is DEA-weakly efficient, that is, in the economic system composed of n decision-making units, the input X_0 can be reduced by s-but the original output Y_0 is maintained invariable, or in the case of invariable input X_0, the output can be increased by s^+.

(iii) When $\theta<1$, DMU_0 is DEA-inefficient, that is, in the economic system composed of n decision-making units, through combination, we can reduce the input to proportion θ of the original input X_0, and keep the original output Y_0 invariable[6].

BCC model with variable returns to scale is as follows:

$$\min\theta$$
$$s.t.\begin{cases}\sum_{j=1}^{n}\lambda_j x_j+s^-=\theta x_0\\ \sum_{j=1}^{n}\lambda_j y_j-s^+=y_0\lambda_i\geqslant 0,\ j=1,\ \cdots,\ n\\ s^-\geqslant 0,\ s^+\geqslant 0\end{cases}$$

1.2 Data source and processing According to the national standards of the *National Economic Industrial Classification*, we select 34 companies listed in Shanghai and Shenzhen stock markets in 2010, which are engaged in business activities concerning agriculture (crop farming), forestry, animal husbandry and fishery, as the standard agricultural listed companies for research. All the sample data are collected from the annual report data concerning all agricultural listed companies examined and approved by the China Securities Regulatory Commission.

Based on the DEA evaluation theorem, the less input the better, the more output the better. Therefore, when using the DEA model for evaluation, we should regard the indicators which are better when smaller as input indicators, the indicators which are better when bigger as output indicators.

We select 3 indicators as input data. (i) Total assets. Assets can bring future earnings and create wealth to the company, and the company's assets use efficiency has a direct impact on the returns of the company. (ii) Asset-liability ratio. This indicator is an overall indicator for evaluating corporate debt levels and solvency, and also an important indicator for measuring risk. (iii) Prime operating cost. It is the cost and outlay of the company corresponding to prime operating revenue in a certain period of time. The combination of prime operating cost and prime operating revenue can reflect the profitability of the company.

We select 4 indicators as output data. (i) Prime operating revenue. It can reflect the profitability of companies in the main business. (ii) Net profit. It can fully reflect the company's profitability, which is the ultimate profit of the company, numerically equal to the surplus remaining after income tax is deducted from total profit. (iii) Profit rate to net worth. It can reflect the net profit created from every ¥ 1 of assets, which can reflect the overall profitability of the corporate assets. (iv) Profit margin on net assets. From the perspective of relative amount, profit margin on net assets is used to measure the owner's interests, reflecting the relative owner's profit from assets input.

The combination of profit margin on net assets and net profit can fully reflect the company's output status.

Since the data input in data envelopment analysis (DEA) model can not be negative, and large gap in the same indicator data between different DMUs may have impact on the calculation results, we need to carry out standardization processing of the data before data are input. The specific processing standard is as follows: let $\max Z = a$, where Z represents the original input-output data, and a represents the maximum value of the original input data or output data; let $\min Z^* = b$, where b represents the minimum value of the original input data or output data, and Z^* represents the standardized data. According to min-max standardization method, we conduct linear transformation of the original data, then $Z^* = (Z - b)/(a - b)$. According to the above-mentioned standardization process, we conduct standardization processing of the original data to get the standardized dimensionless data, and input the dimensionless data into DEA processing software DEAP 2.1.

2 Results and analysis

After the standardized data are input into DEA processing software DEAP 2.1, we get the efficiency distribution of 34 agricultural listed companies through calculation (Table 1).

Table 1 Efficiency distribution of 34 agricultural listed companies

Sub-industry	Name of company	Overall efficiency	Net technical efficiency	Scale efficiency	Returns to scale
Crop farming	Gansu Yasheng Industrial(Group) Co.,Ltd.	0.843	0.893	0.945	drs
	Zhongken Agricultural Resource Development Co.,Ltd.	1	1	1	–
	Gansu Dunhuang Seed Co.,Ltd.	0.985	1	0.985	drs
	Xinjiang Talimu Agriculture Development Co.,Ltd.	0.861	0.881	0.978	drs
	WanXiang Doneed Co., Ltd.	1	1	1	–
	Xinjiang Sayram Modern Agriculture Co.,Ltd.	0.905	0.906	0.998	drs
	Hefei Fengle Seed Co.,Ltd.	0.962	0.962	1	–
	Yuan Longping High-Tech Agriculture Co.,Ltd.	0.923	0.927	0.996	drs
	Starway Bio-Technology Co., Ltd.	0.896	1	0.896	irs
	Mean	0.931	0.952	0.978	
Forestry	Jilin Forest Industry Co.,Ltd.	0.842	0.842	1	–
	Yunnan Jinggu Forestry Co.,Ltd.	0.809	1	0.809	irs
	Fujian Zhongfu Industries Co.,Ltd.	0.794	0.844	0.941	drs
	Fujian Yongan Forestry (Group) Joint-stock Co., Ltd.	0.648	0.681	0.951	drs
	Mean	0.773	0.842	0.925	
Animal husbandry	Hunan New Willful Co.,Ltd.	0.910	0.995	0.915	irs
	Shangdong Minhe Animal Husbandry Co.,Ltd.	0.975	0.976	1	–
	Dalian Yi Qiao Marine Seeds Co.,Ltd.	1	1	1	–
	Shandong Yisheng Livestock & Poultry Breeding Co., Ltd.	0.902	0.904	0.998	drs
	Chuying Agro-pastoral Group Co.,Ltd.	1	1	1	–
	Xinjiang Western Animal Husbandry Co.,Ltd.	0.917	1	0.917	irs
	Mean	0.951	0.979	0.972	
Fishery	Dahu Aquaculture Co.,Ltd.	0.803	0.810	0.991	drs
	Hubei Wuchangyu Co.,Ltd.	0.804	0.821	0.979	drs
	Shandong Homey Aquatic Development Co.,Ltd.	0.975	1	0.975	drs
	CNFC Overseas Fishery Co.,Ltd.	1	1	1	–
	Shandong Oriental Ocean Sci-Tech Co., Ltd.	0.871	0.895	0.973	drs
	Ningbo Tech-bank Co., Ltd.	0.949	0.952	0.997	irs
	Zhanjiang Guolian Aquatic Products Co., Ltd.	0.945	0.946	0.999	irs
	Mean	0.907	0.918	0.988	
Agriculture, forestry, animal husbandry, fishery service industries	Xinjiang Guannong Fruit & Antler (Group) Co., Ltd.	0.712	0.719	0.989	drs
	Shanghai Dajiang (Group) Stock Co., Ltd.	0.885	0.903	0.980	irs
	Hunan Zhenghong Science and Technology Develop Co.,Ltd.	0.993	1	0.993	irs
	Beijing Shunxin Agriculture Co., Ltd.	0.946	1	0.946	drs
	Sichuan New Hope Agribusiness Co., Ltd.	1	1	1	–
	Jiangxi Zhengbang Technology Co.,Ltd.	1	1	1	–
	Zhejiang Shanxiahu Pearl Group Co., Ltd.	0.921	0.938	0.982	irs
	Fujian Sunner Development Co.,Ltd.	1	1	1	–
	Mean	0.932	0.945	0.986	
Mean		0.911	0.935	0.974	

Note: irs = increasing returns to scale; drs = decreasing returns to scale; – = constant.

2.1 Analysis of overall efficiency

2.1.1 The performance level of the current agricultural listed companies is high. As reported in Table 1, in 2010, the agricultural listed companies reaching DEA efficiency included 8 companies (Zhongken Agricultural Resource Development Co., Ltd., WanXiang Doneed Co., Ltd., Dalian Yi Qiao Marine Seeds Co., Ltd., Chuying Agro-Pastoral Group Co., Ltd., CNFC Overseas Fishery Co., Ltd., Sichuan New Hope Agri-

business Co., Ltd., Jiangxi Zhengbang Technology Co., Ltd., Fujian Sunner Development Co., Ltd.), accounting for nearly 24% of samples. The pure technical efficiency and scale efficiency of these companies all have reached 1, indicating that in terms of total assets, total liabilities, prime operating cost and allocation of resources, all these companies have reached optimum, with no room for improvement. DEA inefficiency in some companies is caused by invalid pure technical efficiency, or invalid scale efficiency. In general, it is caused by the combination of the two factors. Invalid scale efficiency can be further divided into increasing scale efficiency and diminishing scale efficiency. The mean of the overall efficiency of 34 agricultural listed companies reaches 0.911. On the whole, the performance level of agricultural listed companies is high. The reason is as follows: on the one hand, the scale of agricultural listed companies is generally large, with strong innovation and market risk resistance ability; on the other hand, in recent years, the central government has strengthened policy support for agriculture, countryside and farmers, so that the operating environment of agricultural listed companies experiences fundamental changes, and the prices of agricultural products are gradually improved, promoting the operating performance of agricultural listed companies to some extent. Table 1 also shows that the relative efficiency of agriculture, forestry, animal husbandry and fishery service industries is higher than that of crop farming, forestry and fishery, and the average overall efficiency is up to 0.932, which is the requirement and basic result of China vigorously developing agricultural science and technology innovation at present, and constructing modern agriculture in the new era. With great improvement in the living standards of the urban and rural residents, people's consumption of animal products is rising, the supply and demand are relatively huge for livestock products market. In 2010, the prices of hog climbed sharply, leading to rise in the prices of meat products, so that the relative efficiency of animal husbandry in 2010 was the highest, bringing high returns for the animal husbandry companies. Agriculture, forestry, animal husbandry, fishery service industries have characteristics of deep processing, and employ science and technology to increase the added value of products, which makes such type of company make better performance, thus having greater relative efficiency.

2.1.2 The gap in the performance of relevant listed companies engaged in sub-industries pertaining to agriculture is small. The main business of agricultural listed companies is mainly distributed in crop farming, forestry, fishery, animal husbandry, as well as agriculture, forestry, animal husbandry, fishery service industries. Table 1 shows that there is little difference in the operating performance of agricultural listed companies engaged in different sub-industries; only the difference in relative efficiency between forestry and animal husbandry is large, with an average overall efficiency difference of 0.177; the difference in relative efficiency between other 4 sub-industries is small, basically around the mean of 0.911.

2.1.3 There is significant difference in performance between listed companies engaged in the same sub-industry[7]. There are differences in the performance between listed companies engaged in agriculture, forestry, and service industries of agriculture, forestry, animal husbandry, fishery. The internal polarization within the sub-industry is obvious, for example, in agriculture, the overall efficiency of Gansu Yasheng Industrial (Group) Co., Ltd. is only 0.843, but the overall efficiency of Zhongken Agricultural Resource Development Co., Ltd. and WanXiang Doneed Co., Ltd. reaches 1; in fishery, the overall efficiency of Dahu Aquaculture Co., Ltd. is 0.843, but the overall efficiency of CNFC Overseas Fishery Co., Ltd. reaches 1. In addition to the impact of the external macroeconomic environment, the operating performance of all agricultural listed companies is also affected by the enterprise's own management, technological progress and deep-processing degree.

2.2 Analysis of pure technical efficiency and scale efficiency We know from Table 1 that there is small difference in the average pure technical efficiency between 5 sub-industries and entire agriculture, and the average scale efficiency of 5 sub-industries is close to that of entire agriculture, indicating that there are no significant differences in pure technical efficiency and scale efficiency between all sub-industries. In 26 DEA-inefficient companies, there are 14 companies in the state of decreasing returns to scale; 9 companies in the state of increasing returns to scale; 11 companies in the state of constant returns to scale. It indicates that the operating scale of China's agricultural listed companies is relatively large. Taking the case of Xinjiang Talimu Agriculture Development Co., Ltd., its overall efficiency is 0.861, in the state of DEA inefficiency; its pure technical efficiency is 0.881 and scale efficiency is 0.978, in a state of diminishing returns to scale. It indicates that in order to achieve the state of efficient DEA, on the one hand, it should promote the production efficiency of the input elements; on the other hand, it should reduce the scale of production.

2.3 Analysis of input-output redundancy The slack variable distribution of technical invalid company can be shown in Table 2.

From Table 2, Starway Bio-Technology Co., Ltd., Hunan New Willful Co., Ltd., Shanghai Dajiang (Group) Stock Co., Ltd., and Beijing Shunxin Agriculture Co., Ltd. need to reduce the inputs of prime operating cost, while the remaining 22 companies do not need to change the inputs of prime operating cost. The inputs of the majority of companies in total assets and asset-liability ratio are unreasonable, and there is the phenomenon of waste, therefore, they need to reduce total assets or decrease asset-liability ratio, to improve the use efficiency of the assets. The output of 85% of the companies (22 companies in 26 companies), has not yet reached optimum, with room for improvement. High asset-liability ratio in Shanghai Dajiang (Group) Stock Co., Ltd. is the major factor responsible for invalid DEA, thus it should improve the use efficiency of the factors by optimizing the allocation of the input factors, to promote the output. Taking the case of Hunan New Willful Co., Ltd., S_2^-, S_3^-, S_2^+, S_3^+, S_4^+, are 0.087, 0.007, 0.032, 0.221, 0.163, respectively, indicating that Hunan New Willful Co., Ltd. need to decrease asset-liability ratio by 0.087, re-

duce prime operating cost by 0.007, increase net profit by 0.032, increase profit rate to net worth by 0.221, and increase profit margin on net assets by 0.163. Similarly, Dahu Aquaculture Co., Ltd. can promote profit by reducing asset-liability ratio. In addition, we find that there is room for improvement in terms of inputs and outputs basically for 26 companies in the table; they should not only increase or decrease the amount of inputs, but also learn how to optimize the combination of inputs, how to change the scale of production to make the input constant but output increase, in order to make DEA efficient, creating value for enterprises.

Table 2 The slack variable distribution of technical invalid company

Name of company	S_1^+	S_2^+	S_3^+	S_4^+	S_1^-	S_2^-	S_3^-
Gansu Yasheng Industrial (Group) Co.,Ltd.	0	0.101	0.329	0.341	0.129	0	0
Gansu Dunhuang Seed Co.,Ltd.	0	0.12	0.23	0.131	0	0.12	0
Xinjiang Talimu Agriculture Development Co.,Ltd.	0	0.277	0.351	0.566	0	0.016	0
Xinjiang Sayram Modern Agriculture Co.,Ltd.	0	0.181	0.306	0.309	0	0.09	0
Hefei Fengle Seed Co.,Ltd.	0	0.053	0.088	0.04	0	0	0
Yuan Longping High-Tech Agriculture Co.,Ltd.	0	0.067	0.204	0.143	0	0.126	0
Starway Bio-Technology Co., Ltd.	0	0	0	0	0.028	0	0.005
Jilin Forest Industry Co.,Ltd.	0	0.181	0.356	0.345	0	0.024	0
Yunnan Jinggu Forestry Co.,Ltd.	0	0	0	0	0.013	0	0
Fujian Zhongfu Industries Co.,Ltd.	0	0.018	0.132	0.062	0.017	0.07	0
Fujian Yongan Forestry (Group) Joint-stock Co., Ltd.	0	0.081	0.426	0.308	0.007	0.363	0
Hunan New Willful Co.,Ltd.	0	0.032	0.221	0.163	0	0.087	0.007
Shangdong Minhe Animal Husbandry Co.,Ltd.	0	0.026	0.086	0.108	0	0	0
Shandong Yisheng Livestock & Poultry Breeding Co., Ltd.	0	0.049	0.222	0.157	0	0.03	0
Xinjiang Western Animal Husbandry Co.,Ltd.	0	0	0	0	0.037	0.014	0
Dahu Aquaculture Co.,Ltd.	0	0.002	0.134	0.023	0	0.159	0
Hubei Wuchangyu Co.,Ltd.	0	0.047	0.448	0.107	0.163	0.686	0
Shandong Homey Aquatic Development Co.,Ltd.	0	0.006	0.035	0.014	0.025	0	0
Shandong Oriental Ocean Sci-Tech Co., Ltd.	0	0.056	0.211	0.202	0	0.047	0
Ningbo Tech-bank Co., Ltd.	0	0.004	0.031	0.054	0	0	0
Zhanjiang Guolian Aquatic Products Co., Ltd.	0	0.078	0.197	0.151	0	0	0
Xinjiang Guannong Fruit & Antler (Group) Co., Ltd.	0	0.012	0.024	0.018	0	0.19	0
Shanghai Dajiang (Group) Stock Co., Ltd.	0	0.045	0.294	0.118	0	0.484	0.001
Hunan Zhenghong Science and Technology Develop Co.,Ltd.	0	0.075	0.032	0.028	0	0.021	0
Beijing Shunxin Agriculture Co., Ltd.	0	0	0	0	0.058	0	0.012
Zhejiang Shanxiahu Pearl Group Co., Ltd.	0	0.034	0.28	0.173	0	0.29	0

Note: 0 indicates that there is no need for improvement.

3 Conclusions and recommendations

3.1 Conclusions

3.1.1 The overall efficiency of China's agricultural listed companies is good, and the gap in efficiency between sub-industries is small. The mean of the overall efficiency of 34 agricultural listed companies reaches 0.911; the overall efficiency of 8 companies in 34 companies reaches 1, in the efficient production frontier, and the minimum overall efficiency is 0.648; the standard deviation of the whole industry reaches 0.0889. The reason is as follows: on the one hand, the scale of agricultural listed companies is generally large, with strong innovation and market risk resistance ability; on the other hand, in recent years, the central government has strengthened policy support for agriculture, countryside and farmers, so that the operating environment of agricultural listed companies experiences fundamental changes, and the prices of agricultural products are gradually improved, promoting the operating performance of agricultural listed companies to some extent[8]. There is little difference in the operating performance of agricultural listed companies engaged in different sub-industries; only the difference in relative efficiency between forestry and animal husbandry is large, with an average overall efficiency difference of 0.177; the difference in relative efficiency between other 4 sub-industries is small, basically around the mean of 0.911.

3.1.2 There is significant difference in performance between listed companies engaged in the same sub-industry, and the reason for invalid DEA in companies within the industry is complex. There are differences in the performance between listed companies engaged in agriculture, forestry, and service industries of agriculture, forestry, animal husbandry, fishery. The internal polarization within the sub-industry is obvious. In addition to the impact of the external macroeconomic environment, the operating performance of all agricultural listed companies is also affected by the enterprise's own management, technological progress and deep-processing degree. DEA inefficiency in some companies is caused by invalid pure technical efficiency, or invalid scale efficiency. In general, it is caused by the combination of the two factors. From the slack variable distribution, we can find the problems existing in the companies whose overall efficiency is invalid: there are excessive total assets; the asset-liability ratio is very high; the cost control is not ideal; the yield rate of the input factors is not high. From the perspective of scale efficiency, in 26 DEA-inefficient companies, there are 14 companies in the state of decreasing returns to scale;

9 companies in the state of increasing returns to scale; 11 companies in the state of constant returns to scale.

3.1.3 Total assets and asset-liability ratio are high, and the effective output is not fully realized. In 26 technical invalid companies, there are 17 companies with too high asset-liability ratio, and they can promote the output by decreasing asset-liability ratio; 9 companies can promote the output by reducing total assets, and improving the use efficiency of assets. All of 26 technical invalid agricultural listed companies can promote the output by improving technical efficiency, because at present, the major output growth mode of China's agricultural listed companies is extensive mode, promoting output levels by the expansion of inputs, with low technology rate.

3.2 Recommendations Since China's accession to the WTO, China's agricultural products have been facing competition with the foreign high-tech, and low-price agricultural products. Through the relevant data, we can find that the use of technology for deep processing of the product, can increase the added value of products, create wealth for enterprises, and promote the performance of enterprises, which requires the agricultural listed companies to actively develop and introduce new production technology, improve the technological content and deep processing degree of agricultural products; to actively adapt to WTO rules in terms of operation and management, strengthen brand awareness, and accelerate the process of internationalization of enterprises. In addition, China's agricultural listed companies are still universally in the stage of decreasing returns to scale at present, so when determining the development scale of companies, we must take into account whether it is compatible with the requirements of the level of production technology. Based on the above analysis, we put forward the following recommendations.

3.2.1 Strengthening brand awareness and promoting the quality of products. In order to gain a secure foothold in the world market competition, China's agricultural listed companies must establish awareness of brand competition, seize the favorable opportunity that currently the world agricultural market has not formed stable brand awareness of agricultural products to establish their own brands, improve product quality, and achieve standardized production. China's agricultural listed companies should also actively improve the quality standard system of agricultural products, to establish the standard system covering the whole process of production, processing, storage and sales, operating environment, security control, *etc.*, and strive to be connected with the international rail; strengthen the construction of quality certification system of agricultural products, and strive to obtain certification by the foreign authoritative certification and inspection agency; strengthen the construction of quality safety supervision system of agricultural products.

3.2.2 Optimizing the structure of products and promoting the technological content of products. In comparison with international competitors, in China's agricultural listed companies, the technological content of agricultural products is not high; the added value of products is not high; there is a shortage of deep-processed local agricultural products. Therefore, effectively promoting the level of production technology in China's agricultural listed companies has become urgent. On the one hand, agricultural listed companies should increase input of scientific research and intangible assets based on the specific situation, for independent research and development, technological improvement; on the other hand, agricultural listed companies should rationally use the preferential policies granted by the state, actively introduce advanced technology at home and abroad, rely on the science and technology advantage of agricultural institutions and research institutes to strengthen regional innovation, and develop high-tech agricultural products[9].

3.2.3 Adjusting the input structure and rationally controlling the scale. These studies have shown that 41% of agricultural listed companies are in the state of decreasing returns to scale, and agricultural listed companies should not pursue more profits by blindly expanding production scale. When determining the development scale of the company, operators must consider the enterprise size, and whether the size structure is compatible with the requirements of level of production technology.

3.2.4 Transforming the agricultural growth mode from extensive mode to conservation-minded mode. Currently, an important factor restricting the development of China's agricultural listed companies is that the major growth mode of agricultural companies is the extensive growth mode featuring increasing inputs[10]. In order to improve the level of performance of agricultural listed companies and achieve the development of agricultural industrialization, technology-based, deep-processing-based agricultural listed companies will the future development direction of China's agricultural listed companies.

We only conduct empirical analysis of the performance of agricultural listed companies at the end of 2010, and the financial data of companies in a given year is difficult to avoid the impact of accidental factors, therefore, the empirical analysis results of this study can only serve as a reference, and the analytical methods employed can provide a reference for agricultural listed companies to analyze performance. We propose to use time series data to analyze the development trend of the performance in the future researches. Through horizontal and vertical contrast, the better evaluation of operating conditions of agricultural listed companies is more favorable for the operators' decision-making.

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The Rural Development Foundation (RDF), founded in 1996, is an Indian nonprofit organization with the mission of providing quality education for underprivileged rural children. RDF founded and continues to operate five schools and one junior college in Andhra Pradesh State, taking a unique holistic approach to education through innovative programs and methodology. Rather than using the conventional method of rote memorization, RDF focuses on cultivating critical thinking skills and encouraging students to understand and apply concepts. RDF does this through special programs such as Social Awareness, Youth Empowerment, Student Leadership, and Sports. RDF strives to develop students who will become empowered leaders of their communities, thus working towards the vision of a transformed and prosperous rural India.