Research on Financial Performance of Pharmaceutical Manufacturing Industry Based on Entropy Method and Super-Efficiency DEA

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Abstract: People's livelihood is an important starting point and goal of economic and social development, and medicine is the most basic demand for people's livelihood. It not only plays a decisive role in the health of residents, but also affects the quality of life of the people. With the aging of the population, the decline of environmental quality and the normalization of epidemic prevention and control, the pharmaceutical manufacturing industry has ushered in new development opportunities. This paper constructs a scientific and reasonable financial performance evaluation system. Firstly, the entropy method is used to determine the weight of each evaluation index of the financial performance of the enterprise, and the appropriate input and output indicators are selected; secondly, the DEA super-efficiency model is used to evaluate the financial performance of the pharmaceutical manufacturing industry; As a result of the evaluation, relevant improvement measures are proposed to promote the further development of the enterprise.

1. Introduction

The new crown epidemic that broke out in 2020 has spread so far. As an industry dominated by domestic demand and strong rigid demand, the pharmaceutical manufacturing industry has shown strong resilience: its investment income in 2020 is 34.41 billion yuan, a year-on-year increase of 27.6%; operating profit is 343.58 billion Yuan, an increase of 12.2% year-on-year; these have increasingly highlighted the vitality of medicine and health in economic development. The new crown epidemic has further accelerated the internal replacement process of the pharmaceutical manufacturing industry. Therefore, the development of the pharmaceutical manufacturing industry is accompanied by challenges and opportunities. Building a scientific financial performance evaluation system is the only way for pharmaceutical manufacturing companies to seize current opportunities and seek development.

2. Research Status

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Domestically, many scholars have studied corporate performance-related issues and have achieved a series of results. Xu Jian and Yao Qin (2018) conducted research on the relationship between the operating performance and capital structure of listed pharmaceutical manufacturing companies in China, and the results showed that under certain circumstances, capital structure and operating performance are negatively correlated[1]; Hu Peng and Bai Xue (2018) Sort and classify hospital financial risk status based on AHP-DEA, and provide suggestions for improving hospital financial risk[2]; Sun Yuzhong and Zhuang Yang (2019) conduct corporate financial performance evaluation and analysis based on AHP, more comprehensively Layer-by-layer analysis and calculation[3]; Wang Xinni (2020) uses factor analysis to analyze the relevant data of 25 listed Internet companies in 2017[4]; Chen Na (2019) uses a super-efficiency DEA two-stage model to study the western region above the designated size The technological innovation efficiency and influencing factors of industrial enterprises have found that their technological innovation efficiency is generally at a low level; it can be seen that with the continuous improvement of the financial performance evaluation system, domestic scholars continue to enrich the methods of analyzing corporate financial performance.

3. Research Method Selection

3.1 Entropy Method

Choosing the entropy method to determine the index weight can relatively eliminate the influence of some subjective factors, and the result is more objective and true.Construct the original matrix based on the original data of n evaluation objects and m evaluation indicators selected in the financial performance evaluation systemX= $\left(x_{ij}\right)_{n\times m}$ .Entropy calculation formula: $w_i = \frac{1-e_i}{\sum_{i=1}^{m}(1-e_{ij})}(i = 1,2,\cdots,\mathrm{m};\mathrm{j} = 1,2,\cdots,\mathrm{n})$

3.2 Super Efficiency DEA Model

The most commonly used data envelopment analysis is the BCC and CCR models, but these two models have some shortcomings. The super-efficiency DEA model among them can be used to sort the effective decision-making units in the next step. Based on the calculation results, analyze the ways to improve the financial performance of the industry.

4. Index Screening Based on Entropy Weight Method

Using the relevant formula of the entropy method to calculate and sort according to the calculation results, it can be found that although the weight ranking of each input indicator fluctuates, the overall ranking result does not change much. The top three indicators that rank in the three years are selected, and combined with industry characteristics, Select input indicators as shown in Table 3-1. Select output indicators and sort them according to the calculation results. The rankings are all the top five indicators. Considering the non-negativeness of the indicators and the fact that the selected companies are all listed companies, the following output indicators are selected. After screening, the indicators are shown in Table 3-1.

Table 3 -1 Input-Output Index Evaluation System

Indicator type	Investment index	Output indicators
Indicator name	Turnover rate of fixed assets Accounts Receivable Turnover Rate	Gross margin Net assets growth rate

	R&D investment intensity Government subsidies	Earnings per share

5. Empirical Analysis Based on Super-Efficiency DEA

This paper selects 25 listed pharmaceutical manufacturing companies as the research sample, and substitutes the input-output indicator data in Table 3-1 into the software to run, and the efficiency evaluation results obtained are as follows:

Table 4 -1 2017-2019 Input-Output Efficiency Calculation Results

Stock code	Comprehensive technical efficiency			Pure technical efficiency			Scale efficiency		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
300015	7.4514	1.1692	1.2113	1.0000	1.2252	1.2213	7.4514	0.9542	0.9918
300363	0.9631	9.5693	0.9244	1.4699	1.0000	2.2759	0.6552	9.5693	0.4062
000661	3.2032	5.1520	10.5287	1.0000	1.0000	1.0000	3.2032	5.1520	10.5287
300396	0.8796	0.8983	0.7976	0.8854	0.9028	0.8126	0.9935	0.9950	0.9815
002675	1.2175	1.5414	1.1534	1.3942	1.5546	1.2618	0.8733	0.9915	0.9141
002262	0.9655	0.8903	0.8346	1.0252	0.9398	0.8676	0.9418	0.9474	0.9620
002644	0.5516	0.9089	0.9650	0.9833	1.4532	2.0596	0.5610	0.6254	0.4685
300497	1.0877	0.7012	1.0681	1.2032	1.0553	1.1980	0.9040	0.6645	0.8916
002275	1.4660	1.3137	1.0309	1.6320	1.3250	1.0460	0.8983	0.9915	0.9855
600511	19.4455	20.4531	9.9967	28.2639	21.2338	12.8798	0.6880	0.9632	0.7762
600276	0.9727	1.0614	1.0121	4.2890	1.0000	1.8588	0.2268	1.0614	0.5445
000963	0.8089	0.8688	0.6850	1.1188	1.2428	0.8807	0.7230	0.6991	0.7778
002007	1.0801	1.1033	1.2164	1.1035	1.1137	1.2752	0.9788	0.9907	0.9539
600750	5.2882	1.4705	1.5481	7.5666	1.4723	1.5714	0.6989	0.9988	0.9852
603456	0.6377	0.7912	0.9094	1.1976	1.1563	1.3714	0.5325	0.6842	0.6631
002773	0.5090	0.5917	0.6825	1.0000	1.0000	1.0000	0.5090	0.5917	0.6825
002393	2.8642	3.1327	2.7375	3.1561	3.1622	2.7416	0.9075	0.9907	0.9985
002287	0.8787	1.0420	0.9405	2.7080	2.2922	2.4202	0.3245	0.4546	0.3886
600479	0.6325	0.5988	0.5827	0.7380	0.7014	0.7055	0.8570	0.8537	0.8259
000650	1.9306	1.7703	1.2474	2.3240	1.8546	1.3766	0.8307	0.9545	0.9061
300452	0.6541	0.5812	0.6506	1.2026	0.9138	0.9970	0.5439	0.6360	0.6525
601607	0.4083	0.3375	0.6819	1.2154	0.9981	1.4526	0.3359	0.3381	0.4694
002038	1.9687	1.2624	1.3541	1.9831	1.5340	1.6031	0.9928	0.8230	0.8447
002728	0.6109	0.7058	0.6846	0.8172	0.7900	0.7210	0.7476	0.8935	0.9495
002603	2.2372	1.0928	0.9285	2.9424	1.0974	0.9481	0.7603	0.9958	0.9793
Mean	2.3485	2.3603	1.7749	2.8888	2.0807	1.8218	1.0856	1.3528	1.1811

(1) Comprehensive technical efficiency

It can be seen from Table 4-1 that there are 10 companies that have reached the effective status of DEA within three years, accounting for 40%, and the remaining companies that have not reached the effective status indicate that there are obvious investment redundancy and inefficient use of resources. ; Among the 10 companies that have reached the effective status of DEA, the values of three companies have shown a downward trend; among the companies that have not reached the effective status, five companies for three consecutive years The effective value of comprehensive technology is lower than 0.8, indicating that these companies have problems in financial management and need to adjust the investment financial indicators in time, such as increasing the turnover rate of fixed assets: for innovative research and development industries such as the pharmaceutical manufacturing industry, timely handling of backward technical performance and consumption High and low-efficiency fixed assets.

(2) Pure technical efficiency

As can be seen from the above table, the pure technical efficiency of listed pharmaceutical

manufacturing companies in 2017-2019 has shown a downward trend, and the number of DEA invalid units in 2019 has increased by 75% compared to 2017. The pure technical efficiency values of the four companies fell to an invalid state in different time periods. Explain that these companies need to conduct financial management in a timely manner to improve their financial performance. Table 4-1 pure technical efficiency calculation results show that the overall development trend is not good, and the relevant input indicators have not reached high utilization efficiency.

(3) Scale efficiency

It can be clearly seen that the scale efficiency of most companies has not reached the effective state within three years. In 2017, there were 2 companies that reached the scale efficiency, with a scale efficiency rate of 8%; in 2019, the scale efficiency dropped to 4%. According to the calculation results, it is found that the pure technical efficiency value of most enterprises is very high, but the comprehensive technical efficiency value of the enterprise is very low. The reason is that the insufficient or excessively large scale of enterprise assets leads to low scale efficiency, which affects the overall financial performance of the enterprise.

Combined with Table 4-2, analyze the scale invalid unit, From 2017 to 2019, Kanghong Pharmaceutical and Qizheng Tibetan Medicine have been in the stage of diminishing returns to scale, indicating that although these two companies have problems with large scales, they have adjusted their scales. Improving scale efficiency has little effect; a total of 13 companies have been in the stage of increasing returns to scale from 2017 to 2019, indicating that these companies have combined their own development to expand their scale within three years, but their own operating capabilities cannot match it. According to the research results, it can be found that most small pharmaceutical manufacturing companies are still in the stage of increasing returns to scale, while large pharmaceutical manufacturing companies, such as Aier Ophthalmology and Hengrui Pharmaceuticals, have reached a certain level and continue to expand. Scale will have a certain negative effect on scale efficiency.

Table 4 -2 Return to Scale of Scale Invalid Unit

Years	Types of returns to scale	Number of DMU
2017	drs	7
	irs	16
2018	drs	5
	irs	17
2019	drs	5
	irs	19

Note:drs means diminishing returns to scale,means increasing returns to scale.

6. Conclusions

On the whole, the financial performance of listed companies in the pharmaceutical manufacturing industry has maintained a good level. Most of the companies' comprehensive financial performance has reached an effective state, but there are still some problems that need to be resolved. Most companies need to enhance their own short-term debt solvency and operational capabilities. These companies have poor liquidity and inventory liquidity. Coupled with the company's emphasis on R&D investment in new drugs, short-term returns are less likely. This is extremely easy As a result of the rupture of the chain of corporate capital activities, companies can reduce the possibility of bad debts and dead debts by appropriately reducing the number of days of account receivables, and appropriately maintain a certain proportion of liquid funds to keep the company running well. In summary, the super-efficiency DEA model can clearly show the problems

of pharmaceutical companies that have not reached the DEA effectiveness, which is conducive to a better understanding of the company's financial performance and operating conditions.

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