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Operational Performance Evaluation of Chinese Listed Logistics and Transportation Enterprises based on DEA

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Abstract

With the rapid development of the national economy and e-commerce, the logistics industry has become an important way and necessary means of commercial trade. In this, evaluating the operational performance of logistics companies has become particularly critical. By comprehensively assessing the operational performance of logistics companies, enterprises can better understand the efficiency and benefits of their transportation,housing, distribution and other links, so as to make targeted improvements and optimizations, and improve the overall level of operational management. This paper is based on the data of 12 listed logistics and transportation enterprises in China in 2022, and uses the data envelop analysis method to evaluate their business performance comprehensively. The BCC model is used to evaluate the comprehensive efficiency, pure technical efficiency and scale efficiency of the 12 listed companies. results of the study show that the average logistics efficiency of the 12 listed logistics and transportation enterprises is 0.935, which still needs to be further improved. companies have achieved DEA efficiency, and there are some differences between enterprises, and the development is not balanced enough. Finally, corresponding improvement suggestions are put forward for enterprises with poor performance.

Keywords

Logistics Transport Enterprise; Data Envelopment Analysis Model; Operating Performance Evaluation.

1. Introduction

With the continuous development of China's economy and the advancement of globalization, the logistics industry in China has become increasingly prominent in its status role. Listed logistics companies in China undertake an important part of the national logistics network, and their operational performance is directly related to the stable development of the national economy and the of international competitiveness. According to the "2022 National Logistics Operation Report," the total cost of social logistics in China accounts for 14.7% of, showing an upward trend compared to 2021. The problem of excessive logistics costs has always restricted the development of China's logistics industry, and there is still a room for improvement in the performance of logistics enterprises. Therefore, it is of great research value to evaluate the operational performance of logistics enterprises correctly and appropriately. This not only helps logistics enterprises understand their actual performance but also reveals potential problems faced by the enterprises. Correct evaluation of operational performance is one of the important means of self-management and restraint in the logistics industry Through in-depth evaluation of operational performance, logistics enterprises can timely identify and solve existing problems, thereby improving overall operational efficiency and ensuring the sustainable development of the business.[7]

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Data envelopment analysis was proposed by the famous operational research scholar Charnes, which is a method to evaluate the efficiency of decision-making units with inputs and multiple output evaluation indicators through linear programming. Since DEA was proposed, many foreign scholars have conducted a lot of research on it. Vitaliano D F used DE model to analyze the relative efficiency of 184 libraries in the United States, and the results showed that the library efficiency was low, and the utilization rate of most resources in opening time was not high; Quan et al. selected input indicators from the perspective of social responsibility, and evaluated the comprehensive efficiency of social responsibility of listed logistics enterprises in China. on the four-stage DEA model[2], Li et al. calculated the efficiency of port logistics in China and conducted Tobit regression analysis.[1]

Domestic research on the input-output efficiency of logistics enterprises is relatively limited, but it has also achieved certain results. Lei Yuan Zhao Qian, and Zhu Yining used the stochastic frontier analysis method to empirically study the input-output efficiency of 68 listed companies and put forward corresponding policy recommendations on the analysis results. Their research not only examined the input-output situation of companies but also analyzed various factors affecting this efficiency in depth, which provided strong support for policy formulation. Zhaoping and Xue Li used the composite system coordination model and cross-efficiency DEA method to study the degree of informatization, the development level of cultural industries, the relationship between the two, and studied the coordination relationship between informatization and cultural industries.[3] Wu Zongze and Song Liangrong used the BCC model to analyze operational efficiency of logistics enterprises from a static perspective, and then used the Malmquist index to study the dynamic change trend of the efficiency value from 2017 to 021.[4] Shao Bo and others combined the analytic hierarchy process with data envelopment analysis to construct an AHP-DEA combined evaluation model and evaluate the YT logistics in Fujian Province.[5]

2. Research Methods

DEA is a non-parametric mathematical tool which can be used to evaluate the efficiency of multiple decision making units (DMUs) in an economic. [6][8]A DMU is an operating entity that can convert a set of inputs into a set of outputs. Efficiency refers to the reduced input components by the same proportion θ, the output is kept constant. If it is possible to obtain the same output with less input, it indicates that the production activity is efficient, i.e., the DMU efficient. The DEA method is based on the relative efficiency and evaluates the efficiency of similar DMUs by comparing their inputs and outputs of different indicators. In order to study the performance evaluation of listed logistics and transportation enterprises in China and master their actual business situation, this paper selects BCC model to analyze the comprehensive efficiency, scale efficiency and pure technical efficiency listed logistics and transportation enterprises in China through comparative analysis, the specific formula is as follows:

$$\begin{cases} \min \theta \\ s.t. \sum_{j=1}^{n} X_j \lambda_j \le \theta X_0 \\ \sum_{j}^{n} Y_i \lambda_j \ge Y_0 \\ \sum_{j}^{n} \lambda_j = 1 \end{cases}$$

Figure 1. formula

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where n represents the number of decision-making units, X_j is the input variable, Y_i is the output variable, λ_j represents the variable of decision-making unit, and θ is the value of pure technical efficiency. A value of θ = 1 indicates that the decision-making unit DEA is effective.

3. Data Sources and Index Selection

3.1. Data Source

In order to fully reflect the development of the logistics industry in our country, ensure the accuracy and reliability of the evaluation results, and consider the integrity of the and the non-negativity principle of the DEA output indicators, this study selects 12 listed logistics and transportation enterprises among the top 500 Chinese enterprises in 022 as the research sample, including railway transportation, shipping, express delivery, road transportation, and other transportation industries, and collects corresponding input-output data.

3.2. Selection of Input-output Indicators

Based on the past research, combined with the development characteristics of logistics enterprises and the purpose of the study, the total assets, total operating costs and expenses are finally selected as the input indicators, and the total operating income and net profit are used as the output indicators. In the input indicators, total assets refer to all assets or controlled by a certain economic entity that can bring economic benefits. The total operating cost refers to all cost expenditures incurred by logistics enterprises in their business activities; administrative expenses include the management generated by the management of production and operation activities of logistics enterprises, reflecting the level of business management of the management of the enterprise. In terms of output, the total operating income is sum of the income obtained by logistics enterprises from production and operation activities or other businesses. Net profit, also known as the after-tax profit or net income of the enterprise, to the amount after the enterprise's current total profit is reduced by income tax. Net profit is the final result of a business operation and is the main indicator to measure the operating of a business, see Table 1.

Table 1. Input-output indicators

Indicator 1	Indicator 2
	Total assets
Investment	Total operating cost
Output	Management expenses Total operating revenue Net profit

4. Empirical Analysis

4.1. Based on DEA-BCC Model Analysis

Based on the evaluation index system constructed above, the financial statements of 12 listed companies in China in 2022 were consulted to obtain the statistical data of each index. The DEAP2.1 software was used to calculate the logistics efficiency of 12 listed companies in China, see table 2.

Comprehensive efficiency can judge whether the resources invested in the logistics industry have reached an effective state. From Table 2, it can be seen that average comprehensive efficiency of 12 listed logistics companies in China in 2022 is 0.935, which still has room for improvement. Among them, comprehensive efficiency of Yuexiugang A, COSCO Road and Bridge,

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Haixia Shares, Yunda Express, Datong Railway, and Huama Logistics equal to 1, achieving DEA efficiency. However, the efficiency values of other enterprises are between 0.735-0.958, and none of has achieved efficiency and there are certain differences. Among them, the comprehensive efficiency of Zhuhai Port, China Railway Special Goods, and Central Plains High-speed is lower than average. Therefore, it is necessary to further optimize the investment structure, reduce the redundancy of inputs, improve the level of logistics management and management capabilities, achieve the rational allocation of, reduce waste of resources, and improve the level of output.

Pure technical efficiency reflects the production efficiency of DMUs (decision-making units) at a certain (optimal scale) input of factors. It be seen from Table 2 that the pure technical efficiency of cities with a comprehensive efficiency of 1 is also 1, indicating that the technical and management levels of these cities are best and the resource utilization rate has reached the best. The average pure technical efficiency of the logistics industry of 12 listed companies in China in 2022 is .952, which is better than the comprehensive efficiency, but there is still room for improvement. The pure technical efficiency of Zhuxin Stock, SF Holding, andond Stock is 1, but the comprehensive efficiency value is all lower than 1. This shows that the comprehensive efficiency has not reached the effective and has nothing to do with pure, but is related to scale efficiency.

Scale efficiency reflects the gap between the actual scale and the optimal production scale. The listed companies with a scale efficiency of 1 include Guangdong-speed A, Zhuhai Port, Merchants Road & Bridge, Strait Shares, Yunda Express, Datong Railway, and Haima Logistics and the scale returns are constant, indicating that the logistics scale in these cities is reasonable, and the logistics efficiency will not improve with the expansion of the scale. The scale benefits Zhuxuan Shares, China Railway Special Cargo, and Central Plains High-speed are increasing, indicating that the logistics resource structure allocation is relatively reasonable, and appropriate increase investment can achieve better output. The scale benefits of SF Holding and Deppon Shares are diminishing, indicating that continuing to expand the scale will reduce the output rate, and the-output structure needs to be further optimized, and it is not appropriate to rush to expand the logistics scale.

Table 2. The calculation results of the logistics efficiency of 12 listed companies in China in 2022

Enterprise	Comprehensive efficiency	Pure technical efficiency	Scale efficiency	Economies of scale
Yue High-speed A	1.000	1.000	1.000	-
Zhuhai Port	0.735	0.735	1.000	-
Ju Sheng Shares	0.926	1.000	0.926	irs
China Railway Special Cargo	0.887	0.894	0.993	irs
China Merchants Highways	1.000	1.000	1.000	-
Strait Holdings	1.000	1.000	1.000	-
SF Holding	0.943	1.000	0.943	drs
Central Plains Expressway	0.773	0.796	0.971	irs
YTO Express	1.000	1.000	1.000	-
Datong-Qinhuangdao Railway	1.000	1.000	1.000	-
Deppon Shares	0.958	1.000	0.958	drs
Hua Ma Logistics	1.000	1.000	1.000	-
Average	0.935	0.952	0.983	

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4.2. Comprehensive Efficiency Level Analysis

This paper will classify the comprehensive efficiency level into five categories and comprehensively analyze the operational performance of 12 listed logistics transportation enterprises in China. From perspective of comprehensive efficiency value, 6 listed companies have a good level of efficiency, 4 listed companies have a better level of efficiency, 2 listed companies have a general level efficiency, and there are no listed companies with a poor or extremely poor level of efficiency. Overall, the comprehensive financial efficiency of China's logistics transportation listed companies is at a medium,see table 3.

Table 3. The comprehensive performance level classification of 12 listed companies in China in 2022

Comprehensive efficiency value range	Efficiency Grade	Number of enterprises
1	Good	6
[0.8,1.0]	Better	4
[0.4,0.8]	General	2
[0.2,0.4]	Poor	0
[0,0.2]	Range	0

5. Conclusion

In this paper, DEA-BCC model is used to calculate the logistics efficiency of 12 listed logistics transport companies in China. The average value logistics efficiency is 0.935, which still needs to be further improved. 6 companies have achieved DEA efficiency. The comprehensive efficiency values of the 6 DE non-effective companies are 0.735 to 0.958, with certain differences and insufficient balanced development.

According to the above analysis, the 12 listed logistics companies in China still have a large space for optimization, the overall pure technical efficiency and scale efficiency the financial performance of the 12 listed logistics companies in China are relatively good, and certain achievements have been made, but there are still many problems that restrict the further development of the 12 listed logistics companies in China. And there are some differences between companies, and the development is unbalanced.

6. Suggestion

6.1. Reasonably Control the Company Size and Clarify the Development Ideas.

Firstly, the 12 Chinese listed logistics transport companies can adopt a more cautious and in-depth market research strategy. Through this approach, these can accurately grasp the market pulse and gain insights into the latest industry developments. They will be able to avoid hasty expansionary actions or unnecessary investments, ensuring that resource utilization maximally the core business and long-term strategic goals. Such practices not only enhance the companies' operational efficiency but also help establish a more robust and sustainable competitive advantage. With a deep understanding the market and forward-looking planning, these enterprises can better address potential challenges and opportunities in the future, creating greater value for shareholders.

Secondly, for the 12 Chinese listed logistics transport companies, in order to remain invincible in the fierce market competition, it is to fully utilize the tools and methods of financial data analysis. By precisely analyzing financial reports, companies can quickly identify potential problems and also gain insights into fleeting development opportunities. This forwardlooking analytical capability can help enterprises adjust their development strategies in a timely

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manner to cope with the ever-changing external environment. Only in this way can the 12 Chinese listed transport companies maintain a robust financial position, ensuring that they can develop sustainably and healthily, and move forward along the right track. This not only enhances the overall competitiveness of the but also creates more value for shareholders, achieving long-term success and prosperity. Therefore, attaching importance to and making good use of financial data analysis is an indispensable part of corporate strategic.

6.2. Cost Control and Management

In today's fierce market competition, logistics companies must deeply understand and implement cost control and management strategies to maintain their competitiveness. Through research and experience, we can see that companies that focus on cost management often achieve significant improvements in operational efficiency, and this positive correlation has been widely recognized within the industry. Therefore, in order achieve this goal, logistics companies need to take a series of effective measures to optimize their cost structure. For example, actively seek suppliers who can provide the same or better service at lower price; by carefully designing transportation routes to reduce transportation distance, thereby reducing the transportation cost per unit of goods; at the same time, efforts should also be made to reduce inventory to avoid unnecessary storage costs, and strictly control other related costs that may arise in the logistics process. These comprehensive management strategies will help companies to improve logistics efficiency while also effectively controlling costs bringing higher profit margins and better financial performance to the business.

6.3. Expand Financing Channels; Optimize Management Structure.

Firstly, it is crucial for the 12 listed logistics transport companies in China to explore and implement diversified financing strategies. For example, bondance and equity financing, etc. Through this approach, companies can effectively disperse their financing risks and reduce the high interest burden that may arise from a single financing source. At same time, diversified financing methods also provide greater flexibility, enabling companies to adjust their financing structure according to their own financial conditions and market conditions, to achieve more reasonable and efficient operations. This not only helps to optimize the efficiency of capital use but also enhances the company's adaptability and development potential in the fierce market competition.

Secondly, continuously optimizing and adjusting the management structure of a company is crucial for enhancing operational performance. China's 12 listed logistics and companies should strive to build an efficient decision-making team, establish a clear and meticulous responsibility allocation system, ensuring that every member is aware of their duties, thereby achieving remarkable results resource integration and strategic planning. Through this approach, companies can make more effective use of their resources and develop more precise development strategies, further propelling the entire organization towards higher efficiency and. This not only helps to improve the transparency of work processes but also stimulates the enthusiasm and creativity of employees, ultimately maximizing the overall benefits of the enterprise.

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