STUDY ON THE EVALUATION OF OPERATING EFFICIENCY OF LISTED SHIPPING ENTERPRISES IN CHINA

WANG ZHENGYIN, WANG YAN, MIAO YUNA

Shandong Jiaotong University, No.1508, Hexing Rd, Weihai City, Shandong Province, China

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Abstract. After the reform and opening-up, China's shipping industry has developed vigorously, and now it has become one of the largest economic countries, and is gradually leading the way. The shipping industry has contributed a lot to China's economic development. In recent years, the number of listed shipping enterprises in China is gradually increasing, and they are the mainstay of promoting the development of the shipping industry. How to adjust the internal structure of the enterprise, optimize the personnel allocation, make people do their best and improve the economic benefits of the industry is particularly important for this industry.

The development of shipping industry is the epitome of national rise, and it is also the economic lifeline of our country. In recent years, the trend of China's import and export trade is declining, and the international freight rate is almost depressed. The new standard of international liquid cargo maritime trade once again challenges China's shipping industry. Based on this grim international situation, it is more important to evaluate the operating efficiency of shipping enterprises. In this paper, the input-output relationship of enterprises is analyzed based on relevant data of enterprises, and the operating efficiency of 10 listed shipping companies in China from 2014 to 2018 is analyzed by DEA-Malmquist index. Through research, it is found that the operating efficiency of the whole shipping enterprises has been improved in recent years, with Malmquist index of 1.044, efficiency change of 0.989, pure efficiency change of 0.992 and scale efficiency change of 0.997. The research results show that China's listed shipping enterprises need to optimize their internal structure, and need to strengthen in some deficiencies. Finally, some reasonable suggestions are put forward.

1 INTRODUCTION

At present, China's shipping enterprises have made remarkable progress as a whole, and have become one of the largest shipping countries, but there is still a big gap compared with the real shipping powers. In 2018, the global shipping industry was affected by the downward pressure of the economy, The weak freight rate, excess capacity and high fuel price caused the profits of the shipping industry to shrink continuously. Since 2020, the new regulations stipulate that the sulfur content in ship fuel should not exceed 0.5%, which leads to the oil price will continue to be pushed up. In recent years, the depression of the international market has not been improved, and the growth rate of transaction volume of China's shipping industry has begun to decline, which shows that the overall
operating efficiency of the shipping industry is lacking and the competition among listed shipping enterprises is not intense enough. As well as the comprehensive influence of factors such as the worrying market in the future, labor surplus and other factors, there are still some problems in the overall development of China's shipping enterprises. Challenges are opportunities, and how to seek development in a depressed environment is the core problem faced by shipping enterprises. Based on this, it is of great significance to study the operating efficiency of China's shipping enterprises, point out the path for the development of China's listed shipping enterprises, and promote the steady growth of China's economy.

2 LITERATURE REVIEW

2.1 Review of Foreign Studies

Xuexin Bao (2019) and others put forward the research on freight pricing, and took liner shipping as the research object. From the perspective of supply chain, based on the pricing factors of shipping enterprises, a mathematical model was constructed, and it was concluded that differential pricing and multi-stage dynamic pricing could help shipping companies optimize freight rates and maximize corporate profits. Shang Yu (2018) verified the impact of EVA on the capital structure by building a panel data model, and then compared the impact of EVA and traditional profit indicators on the capital structure of new energy enterprises by regression analysis of EVA, EPS and ROE. Dian Sheng (2017) and others established a comprehensive model to study the economic and environmental impact of unilateral maritime emission control on unified maritime emission control. The model explicitly considers various influences of competition among regional ports and shipping companies, as well as other factors such as inventory cost. The behavior of shipping companies and ports is modeled as a two-stage game, so as to solve and compare the market equilibrium under different supervision. Mileski (2014) and others put forward whether financial risk assessment tools will affect the company's performance, and then affect the company's competitiveness and efficiency. Stochastic frontier analysis is used to determine whether different asset allocation and risk management techniques improve the performance of shipping companies.

2.2 Summary of Domestic Research

Ma Xian (2015) used DEA time window analysis method and super-efficient DEA method to analyze 22 domestic and foreign listed shipping enterprises. It is concluded that the overall relative efficiency of domestic shipping listed companies is lower than that of foreign shipping listed companies, and it is more obvious after 2008. Jerry Lee (2014) and others used EDA-Tobit two-stage analysis to carry out regression analysis, and put forward that there is a life cycle in shipping industry. It is concluded that the operating efficiency of shipping enterprises in China is generally not high, the scale efficiency is positively correlated with the operating efficiency of shipping enterprises, and the asset-liability ratio is negatively correlated with the enterprises operation. Xu Shubin and others (2019) used the three-stage DEA model to evaluate the business efficiency of enterprises without the influence of environmental factors and random factors. The results show that capital investment and regional
development contribute to the improvement of business efficiency, while the establishment time of enterprises, too high regional opening and too concentrated equity are not conducive to the improvement of business efficiency. After removing the influencing factors, the scale efficiency and operating efficiency of most enterprises have decreased, while the pure technical efficiency has increased.

2.3 Research Summary

Although the current research on shipping enterprises is relatively deep and the research on the operating efficiency of shipping enterprises is relatively extensive, the research in recent years is relatively few, and the cognition of total factor productivity of listed shipping enterprises in China is rather vague. Based on this, this paper uses DEA-Malmquist method to measure the production efficiency of major listed shipping enterprises in recent years, which fills up some research gaps in a sense. It is hoped that the research results of this paper can provide inspiration and help to some shipping enterprises and play a positive role in promoting the high-quality and sustainable development of China's shipping industry economy.

3 EMPIRICAL ANALYSIS

3.1 The Basic Principle Of DEA-Malmquist Index Analysis

Data Envelopment Analysis Method, abbreviated as EDA. This method was first put forward in 1978 by the famous American strategists A. Charnes and W.W.Coooper. This analysis method is widely used in nonparametric study of relative efficiency of decision-making units with multiple inputs and outputs. In this research method, each sample studied is regarded as a decision unit, and then these decision units are regarded as a whole. In this whole, there are assumed good input and output indicators, then, the ratio of input to output is studied and analyzed, and then the frontier of the highest efficiency is obtained by mathematical projection, finally, according to the observed data of each group, that is, input and output, whether the data envelopment analysis method is effective or not is determined.

Malmquist index and productivity index can be used as a long-term explanation of decision-making unit. It can also indicate that the production efficiency of the decision-making unit changes with time. Total factor productivity (TFP) is often used to calculate multiple inputs and outputs, by calculating the input-output relationship between t and t+1 period, we can use the form of function to calculate whether technology and efficiency have improved or not. If it is greater than 1, it means progress, and vice versa. The following is the expression of productivity index:

$$M_{t+1} X_{t+1} Y_{t+1} X_t = \frac{D^\prime X_{t+1} Y_{t+1}}{D^\prime X_{t} Y_{t}} \times \frac{D^\prime X_{t+1} Y_{t+1}}{D^\prime X_t Y_t}$$

(1)
3.2 Selection of Variables and Data Description

3.2.1 Selection of Variables

According to the existing research literature, there is not a unified method and standard for the selection of input and output variables for the calculation of the operating efficiency of the shipping industry, and the variables suitable for their own research are selected according to the different research focuses. In order to improve the distinguishing ability of DEA efficiency, this paper selects three input variables: total assets, number of employees and operating costs, and three output variables: net profit, shareholders' equity and operating income, on the basis of comprehensive consideration of the selection methods of main input and output variables and according to the two aspects (profitability and management ability) of the shipping industry's operating efficiency.

3.2.2 Data Description

Ten listed shipping companies are selected in this paper, which are: Shanghai Petrochemical, COSCO Haifa, COSCO Haikong, COSCO Hite, COSCO Haineng, Zhuhai Port, Bohai Ferry, Ningbo Shipping, CIMC and Kaile Technology. There are some large enterprises and some smaller enterprises in the selected samples of this data. The total capital of large enterprises accounts for more than 50%, which is representative. Because some enterprises merged and rectified in 2013-2014, for example, COSCO Haifa was CSCL before, COSCO Haikong was CSCL, COSCO Hite was COSCO Shipping, and COSCO Haineng developed for China Shipping. In order to avoid the influence of unfavorable factors, this paper selects the relevant data from 2014 to 2018. The data comes from the official website Annual Report of each company and the information publicly disclosed by Oriental Fortune Network, and the data source has high accuracy and authority. In addition, the net profits of Shanghai Petrochemical in 2014, COSCO Haifa in 2015 and COSCO Haikong in 2016 were all negative, to ensure the validity of the empirical analysis, the data have been specially processed.

3.3 Calculation Results of Operating Efficiency and Annual Changes

3.3.1 Calculation Results of Operating Efficiency

In this paper, the operating efficiency of listed shipping enterprises is mainly measured by DEA method, and BCC model under the assumption of variable scale return, and the Malmquist index of 10 listed shipping enterprises from 2014 to 2018 is measured, and the related measurement and decomposition results are shown in Table 3.1.

<table>
<thead>
<tr>
<th>Name of listed shipping enterprise</th>
<th>Effch</th>
<th>Techch</th>
<th>Pech</th>
<th>Sech</th>
<th>Tfpch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai Petrochemical</td>
<td>1.000</td>
<td>1.189</td>
<td>1.000</td>
<td>1.000</td>
<td>1.189</td>
</tr>
<tr>
<td>COSCO Haifa</td>
<td>0.991</td>
<td>1.058</td>
<td>1.000</td>
<td>0.991</td>
<td>1.048</td>
</tr>
</tbody>
</table>
First, looking at Malmquist index, in the past five years, the total factor productivity index of ten listed shipping enterprises has improved as a whole, with a total increase of 4.4%. Technical improvement is the only factor that changes the total factor productivity index. Efficiency changes decreased by 1.1% (including pure efficiency changes decreased by 0.8% and scale efficiency changes decreased by 0.3%). Generally speaking, the operating efficiency of listed shipping enterprises has improved.

Among them, except for Zhuhai Port and Bohai Ferry, which decreased by 4.7% and 1% respectively, all of them improved. Its rankings are Shanghai Petrochemical, COSCO Haineng, COSCO Haifa, COSCO Hite, Ningbo Shipping, Bohai Ferry, CIMC and COSCO Haikong. Malmquist indexes are 1.189, 1.144, 1.048, 1.047, 1.047, 1.032, 1.007 and 1.006 respectively.

Generally speaking, the change of total factor productivity index of listed shipping enterprises in China mainly comes from technological change, while the other changes of pure efficiency and scale efficiency are basically unchanged or in a regressive situation. These deficiencies are the weak points in the process of management and development of China's listed shipping enterprises.

### 3.3.2 Annual index change

**Table 2: Malmquist index changes of all listed shipping enterprises in each year from 2014 to 2018**

<table>
<thead>
<tr>
<th>Year</th>
<th>Effch</th>
<th>Techch</th>
<th>Pech</th>
<th>Sech</th>
<th>Tfpch</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014-2015</td>
<td>0.940</td>
<td>1.321</td>
<td>0.964</td>
<td>0.975</td>
<td>1.242</td>
</tr>
<tr>
<td>2015-2016</td>
<td>0.957</td>
<td>1.008</td>
<td>0.969</td>
<td>0.988</td>
<td>0.965</td>
</tr>
</tbody>
</table>
2016-2017    1.043    1.020    1.032    1.010    1.065
2017-2018    1.020    0.913    1.005    1.015    0.932
Average value 0.989    1.055    0.992    0.997    1.044

First of all, according to Table 3.2, Malmquist index changed by 24.2% between 2014 and 2015, the main reason for the improvement was that technological change increased by 32.1%, while other aspects declined slightly. It is precisely because of the sluggish industry in this year that many enterprises are facing the crisis of bankruptcy, the whole shipping industry is facing a big reshuffle, and some shipping enterprises encounter difficulties in development. During 2015-2016, Malmquist index decreased by 3.5%, among which technological change still increased by 0.8%, but efficiency change still decreased by 4.3%. During 2016-2017, Malmquist index changed by 6.5%, among which all aspects improved, among which efficiency changed by 4.3% and technology changed by 2%. The main reason for the relatively prosperous economy in this year is the recovery of the international market economy, accompanied by an increase in demand. During 2017-2018, Malmquist index decreased by 6.8%, which was mainly due to the decrease of technological change by 8.7%. The main reason is that each enterprise has reduced its investment in technology research and development, and because China has put forward the national strategy of "the belt and road initiative", other aspects have been improved.

On the whole, the technological changes and efficiency changes of China's listed shipping enterprises are in a circular cycle. If the technological changes are high, they ignore the technological changes, but start with other changes, and in order to the company's technological changes ignore the efficiency changes. China's listed shipping enterprises should pay attention to this behavior of tearing down the east wall to make up the west wall, so as to ensure the balanced development of the enterprises themselves.

4 CONCLUSIONS AND SUGGESTIONS

4.1 Conclusion

Through the study of shipping enterprises, this paper finds that after a long period of development, China's shipping enterprises have gradually become the world leader, but compared with the top international enterprises, they are still slightly lacking. But considerable progress has been made.

After experiencing the economic crisis, China's shipping industry once stopped. Despite the macro-control of the government, it is still helpless against the depression of the international market. However, in the following years, through the promotion of technological changes, China's listed enterprises have been helped to tide over the difficulties to a certain extent, but this action is also a helpless move for all enterprises. Affected by the depression of the whole international market, the shipping industry has a feeling that it is difficult for a clever woman to cook without rice. After the stagnation period from 2009 to 2013, all listed shipping enterprises in China are trying to change the previous situation of low technological change. Through the research and analysis in recent years, we
can know that in recent years, China's investment in technological change is relatively large, and the technological change is 1.055. The efficiency change is relatively low, just reaching 0.989, and there is still much room for improvement. Among them, the change of pure efficiency is 0.992, the change of scale efficiency is 0.997, and Malmquist index is 1.044. On the whole, it is in line with China's current situation of pursuing technological change. Although the trade volume of import and export is increasing, the foundation of listed shipping enterprises in China is not solid enough and needs to be further strengthened.

4.2 Suggestions

In recent years, China has focused on upgrading its own technology and improving the level of total factor productivity with technical level. All listed shipping enterprises in China should pay attention to other aspects to comprehensively improve their efficiency level. According to this prerequisite, the following suggestions are given:

(1) Open up new markets. Developing other businesses can diversify the business within the enterprise, so as to avoid the risks in the development of the enterprise more effectively. It can also be used as an extension to expand one's own ability. It can also get more information, increase profit points and improve customer service experience.

(2) Adopt counter-cyclical strategy. Taking advantage of the life cycle of the shipping industry, it is necessary to purchase more ships during the period of excess capacity to improve the strength of the enterprise itself, and to sell ships and other ways to make profits according to various needs in the case of capacity fatigue. However, the risk of this method is too high, because of its long life cycle, which also involves the problem of ship age, which can only be applied to short-term excess capacity, and only according to the accumulated experience of the enterprise itself can we better grasp the opportunity.

(3) Establish stable relations with large international sellers. When an enterprise develops to a certain strength, it can negotiate according to the demand side's requirements and its own principle bottom line, and open conditions to satisfy large shippers, in order to establish a long-term and stable relationship with large shippers. However, such shippers must be coveted by most enterprises, so it is particularly important to enhance their own ability to negotiate public relations.

(4) Strengthen internal management and personnel training. Because China's total factor productivity level is mainly based on technology, there is a slight lack of scale effect and efficiency change, therefore, it is urgent to solve the efficiency problem of internal personnel, which requires enterprises to optimize and adjust their own business operation system and personnel training system.

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REFERENCES


