Research on Financial Performance Evaluation of Chinese Listed Logistics Enterprises Based on Entropy Weight Method

Linfan Li
Email: 358240942@qq.com

School of Economics and Management, Fuzhou University of International Studies and Trade, Fuzhou, China

Abstract—By collecting the financial statement data of 46 listed logistics enterprises in China from 2017 to 2020, this paper constructs the financial performance evaluation index system from solvency, profitability, operation ability and development ability, and uses the entropy weight method to determine the weight of each financial performance index, so as to construct the financial performance evaluation model. After that, the comprehensive score and ranking of the financial performance of 46 listed logistics enterprises are calculated according to the model, so as to provide some reference for the performance evaluation of the logistics industry and the development direction of enterprises.

Keywords-performance evaluation; listed logistics enterprises; entropy weight; financial indicators

1. INTRODUCTION

In recent years, with the acceleration of globalization, Internet technology and E-commerce are booming. As the main business of commercial transportation services, the logistics industry is developing rapidly. Countries are paying more attention to the logistics industry. The progress of the logistics industry will effectively improve the economic level and social efficiency. On May 20, 2020, the general office of the State Council announced the implementation opinions on further reducing logistics costs issued by the national development and Reform Commission and the Ministry of transport, including cultivating backbone logistics enterprises, encouraging logistics enterprises to be market-oriented, improving comprehensive service capacity and international competitiveness, and encouraging financial service institutions to provide standardized financing services for logistics enterprises.

Among many logistics enterprises in China, the scale and economic earnings of the listed logistics enterprises are significantly higher than those of ordinary small and medium-sized enterprises, which is also due to the relatively strict listing regulations and thresholds of listed enterprises. In China the threshold for listing on the Main Board and the Small and Medium-Size Enterprises (SME) Board is at least three years worth of profits [1]. Listed enterprises themselves need to be approved by the securities management department before they can enter the exchange for financing. Taking China's main board market as an example, the total share capital of listed enterprises before issuance needs to reach more than 30 million yuan [2]. At the

ICEMME 2022, November 18-20, Nanjing, People's Republic of China

DOI 10.4108/eai.18-11-2022.2326883

same time, they also need to meet the stability of financial status and operation, and meet certain profit requirements. Based on this, if we consider studying large and medium-sized logistics enterprises with good overall strength and certain competitiveness, listed logistics enterprises can be the better entry point and can also reflect the current development level of the China's logistics industry to a certain extent.

For listed enterprises, their financial data can reflect their business performance and sustainability, and it is also a bridge between investors and listed enterprises. Therefore, this study collects the public financial data of Chinese listed logistics enterprises for performance evaluation, which can well reflect the competitiveness of different logistics enterprises and evaluate their strength and position in the industry. In this way, enterprises can also find their own advantages and disadvantages and find the direction to improve business performance and management level. In addition, it also has a certain reference value for promoting the development of the China's modern logistics industry and measuring and evaluating the overall level of the logistics industry.

2. LITERATURE REVIEW

At present, some researchers study the performance of logistics enterprises through a hierarchical structure model [3]. However, this kind of method is rather imprecise and subjective [4], because it only constructs a general financial evaluation system and does not have enough data support. In addition, some researchers use non-financial factors to analyze the competitiveness of Chinese logistics enterprises. For example, Zhang Zongying constructed a fuzzy comprehensive evaluation model by using three main factors, including market, management and technical competitiveness [5]. However, this method does not realize that the financial situation of enterprises can also be used as a strong evaluation index, and its use of data is also limited, because most enterprises will not disclose their own data in all aspects. Even if they do, the indicators may not be comparable.

3. METHODOLOGY

This paper collects the public financial statement data of 46 Logistics Listed Enterprises (see Table 1) in China from 2017 to 2020 as the research sample. After constructing the financial performance evaluation index system of logistics enterprises, this paper uses the entropy weight method to determine the weights of different indexes, and analyzes and evaluates the financial data of 46 listed logistics enterprises according to the determined weights. Different from the analytic hierarchy process, entropy weight method is an objective weighting method [6], which is based on the collected data itself. Its principle is to use the degree of variation and the amount of information provided by each index data to determine the index weight [7]. In other words, the data itself can tell us the weight. Therefore, the entropy weight method can well avoid the negative impact on the evaluation results due to the strong subjectivity of experts. In addition, the financial data of listed companies is mandatory disclosure. This paper uses the annual report data of the listed companies. Compared with the financial data from other channels, the information disclosed by the annual report data is more detailed, because it must be audited by

accounting firms. Thus, the data is generally reliable and suitable for the entropy weight method.

TABLE 1. LIST OF SAMPLE ENTERPRISES

No.	Enterprise Name	No.	Enterprise Name
1	Haichen Co., Ltd	24	Milkeway
2	Hua Pengfei	25	Changlian Co., Ltd
3	Feilida	26	Long term Logistics
4	Xinning Logistics	27	Jiacheng International
5	Hongchuan wisdom	28	Shanghai Yashi
6	Oriental Jiasheng	29	Hengtong Co., Ltd
7	Tianshun Co., Ltd	30	Huamao Logistics
8	Pulutong	31	Wanlin Logistics
9	Longzhou Co., Ltd	32	Sonic storage
10	Hengji Daxin	33	Debang Co., Ltd
11	Shentong express	34	Sinotrans
12	SF Holdings	35	China Eastern Airlines Logistics
13	*St Pegasus	36	Bonded technology
14	Yiyatong	37	China Reserve Co., Ltd
15	Yunda Co., Ltd	38	Xiamen International Trade
16	ChuanHua Zhilian	39	Oriental Silver Star
17	Jushen Co., Ltd	40	Property Zhongda
18	Zheshang Zhongtuo	41	Yuantong Express
19	Broad Holdings	42	Ruimaotong
20	Fu Rande	43	Anton Holdings
21	Zhongchuang Logistics	44	Jianfa Co., Ltd
22	Jiayou International	45	Changjiang investment
23	Yuanshang Co., Ltd	46	Xiamen Xiangyu

4. CONSTRUCTION OF EVALUATION INDEX SYSTEM

In the past 10 years, the listing pace of Chinese logistics enterprises has accelerated, and the overall number of the listed logistics enterprises is also increasing year by year. It is more and more important to build a scientific and reasonable financial performance evaluation system that can better measure the development level of different enterprises in the logistics industry. Therefore, based on the basic financial analysis framework, combined with the business characteristics of the logistics industry, in compliance with the principles of systematicness, objectivity, comparability and availability, this paper establishes an industry-specific financial performance evaluation index system, involving four aspects: solvency, profitability, operation ability and development ability, with a total of 15 indexes, as shown in Table 2 for specific indicators.

TABLE 2. FINANCIAL PERFORMANCE EVALUATION INDEX SYSTEM OF LISTED LOGISTICS ENTERPRISES

Index Number	Index Classification	Index
I_1	Solvency	Asset liability ratio
I_2		Quick ratio
I_3		Cash flow liability ratio
I_4	Profitability	Return on net assets
I_5		Gross profit margin of sales
I_6		Net profit margin after deduction
I_7		Surplus cash cover
I_8	Operation Ability	Total asset turnover
I_9		Inventory turnover
I_{10}		Accounts receivable turnover
I_{11}		Turnover rate of current assets
I_{12}		Turnover rate of fixed assets
I_{13}	Development Ability	Average growth rate of operating income in recent three years
I_{14}		Average growth rate of net profit in recent three years
I_{15}		Average growth rate of net assets in recent three years

5. ESTABLISHMENT OF FINANCIAL PERFORMANCE EVALUATION MODEL OF LISTED LOGISTICS ENTERPRISES BASED ON ENTROPY WEIGHT METHOD

Assuming that there are n objects to be evaluated, namely 46 listed logistics enterprises (n = 46), and m evaluation indicators, namely 15 financial indicators shown in Table 1 (m = 15), the original matrix is as follows:

$$X_{ij} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \quad (1)$$

（i=1,2,3, ..., n; j=1,2,3, ..., m）

Because the dimensions of the original data to be evaluated are different with some negative numbers, we choose to use feature scaling to bring all the values into the range [0,1], which is also a standardized treatment. At the same time, some index values are not the bigger the better. Taking the asset liability ratio as an example, from the perspective of purely considering the safety of enterprise assets, the smaller the asset liability ratio should be, otherwise it is prone to insolvency, which is very risky for creditors. Although it is sometimes considered that the appropriate level of asset liability ratio is about 50%, this is the result of considering from the perspective of enterprise managers, and the asset liability ratio of some well-known leading enterprises in China has been lower than 20%, like Kweichow Moutai Company. In addition, the indicators of operating capacity in the financial performance index system in this paper can

reflect the level of enterprise asset utilization. In the process of evaluation, in order to meet that the larger the index value, the better the corresponding performance, it is necessary to forward those values of indicators which are not the bigger the better.

5.1 Index Forward and Standardization

When the larger the value of an indicator, the better it is, this paper makes the following transformation to it:

$$Z_{ij} = \frac{x_{ij} - \min\{x_{1j}, x_{2j}, \cdots, x_{nj}\}}{\max\{x_{1j}, x_{2j}, \cdots, x_{nj}\} - \min\{x_{1j}, x_{2j}, \cdots, x_{nj}\}} \tag{2}$$

（i=1,2,3, ..., n; j=1,2,3, ..., m）

When the smaller the value of an indicator, the better it is, this paper makes the following transformation to it:

$$Z_{ij} = \frac{\max\{x_{1j}, x_{2j}, \cdots, x_{nj}\} - x_{ij}}{\max\{x_{1j}, x_{2j}, \cdots, x_{nj}\} - \min\{x_{1j}, x_{2j}, \cdots, x_{nj}\}} \tag{3}$$

（i=1,2,3, ..., n; j=1,2,3, ..., m）

After the forward and standardized processing above, the data has been transformed to the matrix below:

$$Z_{ij} = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1m} \\ z_{21} & z_{22} & \cdots & z_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nm} \end{bmatrix} \tag{4}$$

（i=1,2,3, ..., n; j=1,2,3, ..., m）

5.2 Calculate the Weight Value of Each Evaluation Index by Entropy Weight Method

1) Calculate the Proportion of Each i under the Same j Index. It can be regarded as the probability used in the calculation of information entropy. The calculation formula is as follows:

$$P_{ij} = \frac{z_{ij}}{\sum_{i=1}^{n} z_{ij}} \tag{5}$$

（i=1,2,3, ..., n; j=1,2,3, ..., m）

And it is easy to verify that the sum of the corresponding probability of each index equals 1.

2) Calculate the Information Entropy of Each Index. For each j index, the calculation formula of information entropy is:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^{n} p_{ij} \ln\left(p_{ij}\right) \tag{6}$$

(j=1,2,3, ..., m）

3) Calculate the Information Utility Value d_j. When value of e_j is becoming larger, it means the information entropy of the j index is larger, and it shows that the j index itself contains less information. Therefore, the formula of information utility value is as follows:

$$d_j = 1 - e_j \tag{7}$$

(j=1,2,3, ..., m）

4) Calculate the Entropy Weight Value w_j of the j Indicator.

$$W_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \quad (8)$$

(j=1,2,3, ..., m）

Using the above formula, the evaluation weight of financial performance of 46 listed logistics enterprises is calculated. The results are shown in Table 3.

TABLE 3. WEIGHT OF FINANCIAL PERFORMANCE EVALUATION OF LISTED LOGISTICS ENTERPRISES

Index number	Information Entropy(e_j)	Information Utility Value (d_j)	Entropy Weight （w_j）	Ranking
I_1	0.9650	0.0350	0.0209	10
I_2	0.8943	0.1057	0.0633	6
I_3	0.9658	0.0342	0.0205	11
I_4	0.7940	0.2060	0.1233	3
I_5	0.9503	0.0497	0.0297	8
I_6	0.9975	0.0025	0.0015	15
I_7	0.9842	0.0158	0.0095	13
I_8	0.8744	0.1256	0.0752	5
I_9	0.7391	0.2609	0.1562	2
I_{10}	0.8377	0.1623	0.0972	4
I_{11}	0.9071	0.0929	0.0556	7
I_{12}	0.4944	0.5056	0.3027	1
I_{13}	0.9768	0.0232	0.0139	12
I_{14}	0.9577	0.0423	0.0254	9
I_{15}	0.9915	0.0085	0.0051	14

6. COMPREHENSIVE EVALUATION OF FINANCIAL PERFORMANCE OF LISTED LOGISTICS ENTERPRISES BASED ON ENTROPY WEIGHT METHOD

6.1 Analysis of Entropy Weight Value

As we can see from Table 3, with regard to solvency, the weight value of quick ratio is high, about 0.063. However, the difference between asset liability ratio and cash flow liability ratio is not obvious, and their both weight values are about 0.021. In terms of profitability, the weight of return on net assets is higher, which significantly exceeds similar indicators. In terms of operating capacity, the weight of fixed assets turnover rate and inventory turnover rate also significantly exceeds similar indicators, reaching about 0.303 and 0.156 respectively. As for development capacity, the difference between the weight values of the three indicators is not obvious.

From the perspective of overall indicator classifications, the weight of operational capacity and profitability is relatively large, reaching 0.6869 and 0.1640 respectively, followed by solvency

(weight equals 0.1047), while the weight of development capacity is quite low reaching 0.0444, as shown in Table 4.

TABLE 4. WEIGHT OF FINANCIAL PERFORMANCE INDEX SYSTEM

Index Classification	Weight	Index	Weight
Solvency	0.1047	Asset liability ratio	0.0209
		Quick ratio	0.0633
		Cash flow liability ratio	0.0205
Profitability	0.1640	Return on net assets	0.1233
		Gross profit margin of sales	0.0297
		Net profit margin after deduction	0.0015
		Surplus cash cover	0.0095
Operation Ability	0.6869	Total asset turnover	0.0752
		Inventory turnover	0.1562
		Accounts receivable turnover	0.0972
		Turnover rate of current assets	0.0556
		Turnover rate of fixed assets	0.3027
Development Ability	0.0444	Average growth rate of operating income in recent three years	0.0139
		Average growth rate of net profit in recent three years	0.0254
		Average growth rate of net assets in recent three years	0.0051

6.2 Financial performance evaluation results of listed logistics enterprises

Based on the index weights obtained by the entropy weight method, this paper multiplies these index weights with the standardized and forward matrix to obtain the financial performance evaluation results of listed logistics enterprises ranking from 1 to 10, as shown in Table 5.

TABLE 5. PART OF RESULTS OF FINANCIAL PERFORMANCE EVALUATION OF LISTED LOGISTICS ENTERPRISES

Ranking	Enterprise Name	Evaluation Score
1	Oriental Silver Star	0.4421
2	Ruimaotong	0.3736
3	Broad Holdings	0.3528
4	Debang Co., Ltd	0.2789
5	Hengtong Co., Ltd	0.2563
6	Zheshang Zhongtuo	0.2125
7	Long term Logistics	0.2124
8	Xiamen International Trade	0.2078
9	Yuanshang Co., Ltd	0.1995
10	Yuantong Express	0.1927

Generally speaking, there are considerable differences in financial performance among China's listed logistics enterprises, some of which perform well, including Oriental Silver Star and Broad Holdings, which are mainly engaged in bulk commodity supply chain services. In

addition, some well-known express enterprises such as Debang and Yuantong who have large market share are also ranked in the top 10.

7. CONCLUSION

This paper finds that entropy weight method can reflect the performance of enterprises to a certain extent, and its objectivity is high. Due to the differences in financial index data of different industries, entropy weight method is also more suitable for enterprise performance evaluation of subdivided industries. Besides, the operational performance of listed logistics enterprises varies greatly, resulting in a large proportion of this kind of weight, followed by the profitability of logistics enterprises. However, for most logistics enterprises, the difference in their development ability is very small, so it is difficult to distinguish the performance of different enterprises in the industry by this kind of index. Therefore, if logistics enterprises want to obtain an advantageous position in the competition, they probably need to make more efforts in operation capacity.

REFERENCES

[1] Wang, Jennifer Qinghua. "Financing the mining industry in China." Chinese Economy 45.3 (2012): 76-87.

[2] Sun, Ling. "Discussion on the Establishment of Transfer Board System in China's New Three Board: A Case Study." 7th International Conference on Education, Management, Information and Mechanical Engineering (EMIM 2017). Atlantis Press, 2017.

[3] Wei Xing. "Research on the Core Competitiveness of Logistics Enterprises from the Perspective of Financial Indicators". Proceedings of 2019 5th International Conference on Economics, Management and Humanities Science (ECOMHS 2019). Ed. Francis Academic Press, UK, 2019, 1295-1298.

[4] Sun, Chia-Chi. "A performance evaluation model by integrating fuzzy AHP and fuzzy TOPSIS methods." Expert systems with applications 37.12 (2010): 7745-7754.

[5] Zhang Zongying, and Liu Jie. "Research on competitiveness evaluation of logistics enterprises in China". Proceedings of 2017 2nd International Conference on Modern Management, Education Technology, and Social Science (MMETSS 2017) II. Ed. Atlantis Press, 2017, 123-126.

[6] Zhang Sui, Zhang Mei, Chi Guotai."The Science and Technology Evaluation Model Based on Entropy Weigh and Empirical Research During the 10th Five-Year of China." Chinese journal of management 7.01(2010):34-42.

[7] Gao, Cheng-lu, et al. "The risk assessment of tunnels based on grey correlation and entropy weight method." Geotechnical and Geological Engineering 36.3 (2018): 1621-1631.