

Research on the Evaluation of Enterprise Competitiveness Based on AHP-Entropy TOPSIS Method—Take Xinjiang Listed Companies as An Example

Furong Li¹, Jiake Qin¹ & Xinzhi Ma

¹ Xinjiang University

Correspondence: Xinzhi Ma, Xinjiang University.

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Abstract

The study takes all listed companies in Xinjiang Uyghur Autonomous Region in the three years from 2018 to 2020 as the research sample, establishes the evaluation index system of the competitiveness of listed companies in Xinjiang, collects and organizes the values of each index using the data disclosed by listed companies in Xinjiang, assigns weights to the evaluation indexes at all levels using AHP-entropy weighting method, and combines TOPSIS method to evaluate the comprehensive competitiveness of listed companies in Xinjiang. The ranking of the comprehensive competitiveness of listed companies in Xinjiang in 2018, 2019 and 2020 is obtained respectively, and the comprehensive competitiveness of listed companies in Xinjiang is evaluated and analyzed from four dimensions of scale strength, development potential, operation capacity and social responsibility of each enterprise, in order to reflect the current situation, characteristics and trends of the development of listed companies in Xinjiang in the pressure of economic downturn of the new crown epidemic.

Keywords: listed companies, comprehensive competitiveness, Xinjiang

1. Introduction

As the main body of the capital market, listed companies represent the best group of enterprises in Xinjiang and are the barometer of Xinjiang's economy. By the end of 2020, Xinjiang Uygur Autonomous Region ("Xinjiang") had a total of 59 listed companies, with a total market capitalization of 621.16317 billion yuan, down 0.1992% year-on-year from 2019, and cumulative capital raised of 7.579 billion yuan, down 18.34% year-on-year from 2019. It can be seen that amid the pressure of the new crown epidemic and economic downturn, it is important to study how to improve the core competitiveness of listed enterprises in Xinjiang in order to promote a more efficient allocation of resources in Xinjiang's capital market and achieve sustained high-quality development, which is important to promote regional economic development.

2. Review of the Literature

2.1 Origin and Development of Enterprise Competitiveness Theory

The concept of enterprise competitiveness was first proposed by foreign scholars Prahalad & Hamel (1997) in the Harvard Business Review, and the two scholars explained enterprise core competitiveness based on the analysis of the organization's internal capabilities (Prahalad C K & Hamel G., 1997), which laid the foundation for the research development of enterprise competitiveness theory in the past twenty years or so. Along with the advent of the era of knowledge economy, foreign scholars mainly discussed the elements of enterprise competitiveness explanation from the perspectives of corporate strategy, industrial structure and market environment, etc. Momaya K (2001) analyzed that because enterprise competitiveness is affected by the complex macroeconomic regulation and microeconomic factors acting together, it is characterized by variability,

flexibility and dynamism (Wernerfelt Birger, 1995); Michael E. Porter (2002) takes the external market competitive environment of enterprises as the entry point and considers the competitive structure of the industry to which the enterprise belongs, market entry costs, and shareholders' equity as the prerequisites for its analysis of its competitive advantage (Momaya K, 2001); Falciola te al. (2020) (Porter M E & Kramer M R., 2002) summarizes the competitiveness of enterprises as their ability to meet customer needs, respond to changes in market conditions, and obtain market value information.

2.2 Current Status of Domestic Enterprise Competitiveness Theory Research

Regarding the interpretation of the theory of enterprise competitiveness, domestic scholars have expressed their own views and said different things, but now essentially formed a more unified understanding, enterprise competitiveness refers to the enterprise in a certain period of time, relative to its competitors have the ability to support its survival and development advantage (Zhou D, Wu XW & Xu FY., 2008), to expand that the enterprise in the competitive market environment, through the effective allocation of enterprise resources such as human, financial and material, more efficient and (Liu Zhongmin, Mao Zhixian & Chen Suqiong, 2011) The essence of the comparison is the competitive comparison of enterprise productivity, which is directly reflected in the enterprise's market ability and product sales performance (Zhang ZQ & Wu JC., 1999).

In a comprehensive view, the factors affecting the competitiveness of an enterprise are multidimensional. This paper argues that the competitiveness of an enterprise refers to the resources possessed by an enterprise in a competitive market environment through reasonable regulation and allocation, and finally reflects its strong or weak management ability relative to its competitors directly in three dimensions: profit and loss performance, market share, and social influence.

2.3 Enterprise Competitiveness Evaluation Method

In recent years, many domestic scholars have carried out empirical analysis on listed companies in China, and gradually formed several evaluation systems and methods. By reading a large amount of literature, we found that the existing enterprise competitiveness evaluation systems are similar, and many applied indicators rely on financial data for calculation and integration. Zhang Boze (Zhang Bo Ce, 2015) used the AHP-entropy TOPSIS method to conduct a horizontal evaluation study of the competitiveness of the construction industry in 2013 between Tianjin and seven provinces and cities, including Beijing, Shanghai and Jiangsu, to analyze the advantages and gaps between Tianjin and the development of the construction industry in these regions as a whole. Fang Guangzheng et al. (Fang Guangzheng & Wang Kun, 2016) used factor analysis to score and rank 27 listed companies in China's cultural industry; Zhu Yaqin et al. (Zhu Yaqin & Dang Huewen, 2018) introduced social responsibility contribution indicators to expand the evaluation index system for evaluating the financial competitiveness of listed companies in Liaoning; Liu Zhixiang (Liu C.C., Qin L.F. & Ding S., 2022) et al. used 30 listed companies in the cross-border e-commerce industry as an example, and applied the entropy method-mutation level method to conduct a comprehensive competitiveness evaluation.

Based on the previous research, the competitiveness evaluation index system of listed companies in Xinjiang is established by combining the current situation and characteristics of the development of listed enterprises in Xinjiang, based on the annual reports of listed companies in Xinjiang for three consecutive years from 2018 to 2020, the evaluation index values in the evaluation index system of listed companies in Xinjiang are calculated and organized separately, and finally 18 three-level specific evaluation indexes are formed, which are intended to be evaluated from the scale strength, development potential, operation It is intended to conduct comprehensive competitiveness evaluation in four dimensions: scale strength, development potential, operation capability and social responsibility contribution, with a view to making objective and comprehensive analysis of the current situation, characteristics and trends of the development of listed companies in Xinjiang and putting forward targeted policy suggestions for the development of listed companies in Xinjiang.

Table 1. Evaluation index system of competitiveness of listed companies in Xinjiang

Tier 1 Indicators	Secondary indicators	Tertiary indicators
Scale Strength	Asset Strength	Total Assets
		Net Assets
		Total Market Capitalization
	Financial Strength	Operating income
		Net income after deductions
		Current Ratio

Development Potential	Innovation Capability	Total R&D expenditure as a percentage of operating revenue
		Number of patents
	Growth Capacity	Operating income growth rate
		Net Assets Growth Rate
		Growth rate of net profit after deductions
Business Capability	Profit Level	Return on net assets after deductions
		Net operating margin after deductions
	Market Position	Revenue Industry Share
		Profit industry share
Social Responsibility Contribution	Social Responsibility Contribution	Total tax payment/total assets
		Number of employees
		Employee Compensation / Total Assets

3. Study design

3.1 Method Selection

The AHP-entropy weighting method is a method that can better combine subjective and objective factors to assign weights to the evaluation index system, avoiding the disadvantages of subjective bias due to pure subjective judgment and objective weights determined solely by the coefficient of difference of index values while ignoring whether the application of the index matches the actual situation. The study uses hierarchical analysis and entropy weighting method to obtain a comprehensive weight to reduce errors, and then combines TOPSIS method to score the performance of listed companies in Xinjiang for three years from 2018 to 2020 respectively and rank them in order.

3.2 Sample Selection and Data Collection

The samples selected for the study are listed companies in Xinjiang in 2018, 2019 and 2020, while referring to Juchao Information Network, Wind database and the company annual reports disclosed by listed companies in Xinjiang in 2018, 2019 and 2020, the index values are calculated and collated, and the sample number 0 is excluded to finally obtain 57, 57 and 59 for 2018, 2019 and 2020, respectively. 57 and 59 sample data.

3.3 AHP Method

Analytic hierarchy process (AHP) is a method of qualitative and quantitative analysis and weighting of multilevel indicators in a hierarchical system (Guo Jinyu, Zhang Zhongbin & Sun Qingyun., 2008). The calculation steps are: a number of experts in the relevant research field compare the importance of each level of indicators in accordance with the proportional scale method, and write the results of the comparison A_{jk} ($j, k=1, 2, \dots, n$) in the form of an $n \times n$ matrix A to construct a judgment matrix of indicators at each level.

$$A = (a_{ij})_{n \times n} = \begin{bmatrix} A_{11} & \cdots & A_{1n} \\ \vdots & \ddots & \vdots \\ A_{n1} & \cdots & A_{nn} \end{bmatrix}_{n \times n} \quad (1)$$

Then, the consistency test is performed on each judgment matrix, and the maximum characteristic roots of judgment matrix A and its corresponding eigenvectors are found out, and the values of consistency test coefficients CR are all less than 0.1, indicating that the judgment matrices all pass the consistency test.

Finally, normalize each column of the judgment matrix, then add the normalized columns by row, and divide each element of the summed vector by n to obtain the hierarchical analysis weight w_i .

3.4 Entropy Method

Entropy weight method (entropy weight method, EWM) an objective weighting method based on the analysis of the degree of variation between the characteristic values of each evaluation index (Lin Tongzhi, Tang Guoqiang, Luo Shengfeng, Gao Wei & Qin Liangwen., 2015; Wang Jingmin, Sun Yanfu & Kang Junjie., 2010), whose calculation steps are.

(1) The raw data of the indexes are first subjected to max-min dimensionless standardization to obtain the

standardization matrix $G_{ij} = (g_{ij})_{m \times n}$, and the max-min standardization equation.

$$g_{ij} = \frac{x_{ij} - \min(x_{1j}, x_{2j}, \dots, x_{mj})}{\max(x_{1j}, x_{2j}, \dots, x_{mj}) - \min(x_{1j}, x_{2j}, \dots, x_{mj})} \quad (2)$$

The $\max(x_{ij})$ and $\min(x_{ij})$ in Eq. (2) are the maximum and minimum values of the j th index value corresponding to the m objects to be evaluated, respectively. And the normalization matrix $G_{ij} = (g_{ij})_{m \times n}$ is obtained.

$$G_{mn} = \begin{bmatrix} g_{11} & \cdots & g_{1n} \\ \vdots & \ddots & \vdots \\ g_{m1} & \cdots & g_{mn} \end{bmatrix}_{m \times n} \quad (3)$$

(2) Then, the data of each indicator in the normalized matrix $G_{ij} = (g_{ij})_{m \times n}$ are weight transformed to obtain the characteristic weight value P_{ij} for the j th indicator:

$$P_{ij} = g_{ij} / \sum_{i=1}^m g_{ij} \quad (4)$$

(3) Calculate the information entropy e_j according to formula (5), if e_i is smaller, it means that the j th indicator has a greater degree of variation, carries more information, plays a greater role in the comprehensive evaluation, and its weight is also greater, if e_i is larger, vice versa.

$$e_i = -k \sum_{i=1}^n P_{ij} * \ln P_{ij} \quad (5)$$

Finally, the entropy weight of the j th indicator is calculated a_i :

$$a_i = 1 - e_i / \sum_{i=1}^m (1 - e_i) \quad (6)$$

3.5 Combined Weighting Method

The hierarchical analysis weights w_i of each indicator are fused with the entropy weights a_i to obtain the combined weights σ_i of each indicator, calculated as:

$$\sigma_i = a_i w_i / \sum_{i=1}^n a_i w_i (1 \leq i \leq n, i \in Z) \quad (7)$$

3.6 TOPSIS Method

It is also known as the distance between superior and inferior solutions method, which is a method of ranking a finite number of evaluation objects according to their proximity to the optimal target (Lin Tongzhi, Tang Guoqiang, Luo Shengfeng, Gao Wei & Qin Liangwen., 2015; Wang Jingmin, Sun Yanfu & Kang Junjie., 2010). The larger the C value, the closer the evaluation object is to the optimal value; that is, in this study, the larger the corresponding C value in the TOPSIS analysis results, the stronger the comprehensive competitiveness. The formula for calculating the relative proximity C is.

Relative proximity C = positive ideal solution distance D^+ / (positive ideal solution distance D^+ + negative ideal solution distance D^-).

4. Analysis of Evaluation Results

The ranking results of the three years 2018, 2019 and 2020 are compared year by year to obtain Table 2. The analysis shows that the comprehensive competitiveness ranking of Xinjiang listed companies during the three-year period from 2018 to 2020 has been affected by factors such as fierce market competition, the impact of the new crown pneumonia epidemic, the market economic downturn and their own business urgently facing transformation and upgrading to adapt to the new economic environment, and the competitiveness ranking has all undergone The competitiveness rankings have changed significantly.

In 2019, there are 25 listed companies in Xinjiang with an increase in ranking compared to 2018, accounting for 43.86%, including 14 in manufacturing, 3 in electricity, heat, gas and water production and supply, 2 in agriculture, forestry, animal husbandry and fishery, and 1 each in scientific research and technical services,

mining, wholesale and retail, health and social work, and transportation, storage and postal services; 17 listed companies in Xinjiang with a decrease in ranking, accounting for 29.82%. 29.82%, including 9 in manufacturing, 2 each in wholesale and retail trade and information transmission and software information technology services, 1 each in agriculture, forestry, animal husbandry and fishery, electricity, heat and water production and supply, construction and mining; 15 listed companies in Xinjiang with small changes in ranking (up and down 2 places or less), including 3 in manufacturing, 2 each in mining, finance, agriculture, forestry, animal husbandry and fishery and wholesale and retail trade, 2 each in leasing and business services, information transmission and software.

For the post-epidemic period, compared with 2019, a total of 18 listed companies in Xinjiang will rise in rank in 2020, accounting for 31.58%, including 8 in manufacturing, 4 in agriculture, forestry, animal husbandry and fishery, and 1 each in health and social work, information transmission software and information technology services, scientific research and technical services, wholesale and retail, electricity, heat and gas water production and supply, and construction.

3 in the electric power, heat and water production and supply industry, 2 in the construction industry, 1 each in the wholesale and retail industry, scientific research and technical service industry, mining industry and information transmission and software information technology service industry; 26 listed companies in Xinjiang with declining rankings, accounting for 45.61%, and the number of enterprises ranked backward has increased significantly compared with 2019, including 11 in the manufacturing industry, 4 in the wholesale and retail industry, 1 each in the electric power, heat and water The number of listed companies in Xinjiang with lower ranking changes (up and down by 2 places or less) is 13, including 7 in manufacturing, 2 in mining, 1 in electricity, heat, gas and water production and supply, 1 in agriculture, forestry, animal husbandry and fishery, 1 in finance and 1 in construction.

Table 2. Comprehensive competitiveness ranking of listed companies in Xinjiang, 2018-2020

Company Name	Stock Code	2018 Ranking	2019 Ranking	2020 Ranking	2019 Changes	RankingChange in ranking in 2020
Xinjiang Zhonghe	600888	9	4	6	5	-2
ST Hundred Flowers	600721	56	29	9	27	20
Bohai Leasing	000415	7	7	12	0	-5
COFCO Sugar	600737	24	17	21	7	-4
CNOOC Capital	000617	3	1	5	2	-4
Alloy Investment	000633	49	54	24	-5	30
Youhao Group	600778	33	23	52	10	-29
*ST Jitang	600090	28	43	57	-15	-14
Xinjiang Tianye	600075	22	37	10	-15	27
TBEA	600089	5	10	1	-5	9
ST China Portugal	600084	47	33	22	14	11
Dezhan Health	000813	17	35	4	-18	31
Tianshan Co.	000877	18	14	13	4	1
New Agricultural Development	600359	54	42	18	12	24
Elite	600197	21	15	14	6	1
*ST New Billion	600145	52	41	56	11	-15

Company Name	Stock Code	2018 Ranking	2019 Ranking	2020 Ranking	2019 Changes	RankingChange in ranking in 2020
Guanghui Energy	600256	20	20	19	0	1
International Industry	000159	31	47	15	-16	32
ST China Foundation	000972	53	44	59	9	-15
Markor Home	600337	14	12	23	2	-11
CNOOC Engineering	600339	4	3	3	1	0
Tianrun Dairy	600419	36	26	39	10	-13
*ST Balsam pear	600506	50	50	16	0	34
Tianfu Energy	600509	38	55	37	-17	18
Yayi Steel	600581	13	9	17	4	-8
Crown Farming Co.	600251	42	32	34	10	-2
Aozora Construction & Chemical	600425	37	13	40	24	-27
Zorro Intelligence	600545	11	19	41	-8	-22
Xinsai Corporation	600540	48	48	42	0	6
Zhongtai Chemical	002092	6	5	8	1	-3
Tiantai Bio	002100	27	21	20	6	1
Goldwind Technology	002202	1	2	2	-1	0
Guotong Shares	002205	19	22	50	-3	-28
Quasi Oil Corporation	002207	55	18	54	37	-36
Western Construction	002302	10	11	11	-1	0
Beixin Road and Bridge	002307	2	56	29	-54	27
Western Herding	300106	23	51	49	-28	2
Zong Ying Internet	002464	26	57	51	-31	6
Kwang Cheng Ophthalmology	002524	51	30	25	21	5
New Research Corporation	300159	16	53	32	-37	21
Tianshan Bio	300313	57	49	43	8	6
ST Haoyuan	002700	40	39	53	1	-14
*ST Mackie	002719	45	28	46	17	-18

Company Name	Stock Code	2018 Ranking	2019 Ranking	2020 Ranking	2019 Changes	RankingChange in ranking in 2020
Western Gold	601069	34	16	28	18	-12
Shenwan Hongyuan	000166	8	6	7	2	-1
Snow Peak Technology	603227	30	27	35	3	-8
Huijia Times	603101	39	38	47	1	-9
Tianshun Co.	002800	46	8	31	38	-23
New Gas	603393	41	25	33	16	-8
Beacon Energy	002828	29	34	48	-5	-14
Xiling Information	300588	12	46	58	-34	-12
Dexin Transport	603032	35	45	27	-10	18
Leon Technology	300603	25	24	55	1	-31
*ST Lacha	603157	15	52	45	-19	7
Xinjiang Torch	603080	44	40	44	8	-4
Oriental Ring	603706	43	36	38	10	-2
Xinjiang Jiaotong Construction	002941	32	31	30	7	1
Western Travel	300859	New	New	36	New	New
Hongtong Gas	605169	New	New	26	New	New

5. Research Conclusion

The AHP-entropy TOPSIS method was used to evaluate the comprehensive competitiveness of listed companies in Xinjiang for three consecutive years from 2018 to 2020, and to compare and analyze the changes in the competitiveness ranking of listed companies in Xinjiang year by year, and found that in 2020, listed companies in Xinjiang, which are in a period of instability of the epidemic, have problems such as slowing down growth, increasing risks, insufficient efficiency, unfavorable competition of science and technology enterprises, and even some companies are insolvent and may face the risk of delisting, while the following 5 conclusions are obtained.

(1) TBEA, Goldwind Science and Technology, CNOOC Engineering, DEZ Health and CNOOC Capital ranked in the top five of the comprehensive competitiveness ranking of listed companies in Xinjiang in 2020. Among them, Goldwind Science and Technology, CNOOC Engineering and CNOOC Capital are ranked in the top five in the three-year ranking from 2018-2020.

(2) Compared with 2019, there are 18 listed companies in Xinjiang that will rise in ranking in 2020, accounting for 31.58%. These listed companies take the initiative to adhere to the market-oriented reform and development direction, actively carry out the transformation and upgrading of industrial structure, and successfully resist the economic fluctuations under the contraction of demand, supply shock and weakening expectations to achieve the rise in ranking.

(3) Compared with 2019, there are 26 listed companies in Xinjiang with declining ranking in 2020, accounting for 45.61%, and the number of companies ranked backward is significantly higher than the comparative years of 2019 and 2018. The slow pace and poor effect of adjustment and transformation of these companies, or by shrinking consumer demand, fierce peer competition and their own poor operation, eventually led to their ranking decline.

(4) The rankings of Shenwan Hongyuan, Guanghui Energy, West Construction, CNOOC and Goldwind Technology remained basically unchanged in the two years of comparison (fluctuating by 2 places or less).

(5) Leon Technology, *ST Xinyi, *ST Jitang, Xiling Information and ST Zhongji are in the bottom five of the ranking.

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