

Evaluation and Empirical Analysis of Competitiveness of the Sports Industry Based on the Theory of Competitive Advantage

Yingmin Cui^{1*}

Abstract

The examination of the competitiveness of the sports industry in a region enables policymakers to comprehend the competitiveness of the sports industry in an area's current growth level and identify sports industry issues. However, previous research has prioritized the sports business's development stage over the competitiveness indices' selection and measurement. This study attempts to evaluate and experimentally examine the competitiveness of the sports sector based on the theory of competitive advantage to solve the problem. In particular, the sports industry comprises ten subindustries: the lottery industry, sports tourism, venue industry, competitive performance industry, fitness and entertainment industry, sales industry, sports product manufacturing, training industry, intermediary industry, and media industry. Then, numerous industrial clusters for manufacturing sports products and industrial programs for sports tourism were provided. Next, an evaluation index system (EIS) for the competitiveness of the sports sector was devised, and the meaning of each index was clarified. The writers then described how to evaluate the competitiveness of the sports business and its impacting elements. Various tests were conducted to demonstrate the scientific nature of the EIS and provide empirical, analytical results.

Keywords: competitive advantage, competitiveness of sports industry, sports products manufacturing, sports tourism

1. Introduction

The sports sector is a low-cost, environmentally friendly enterprise that occupies a little area, generates minimal environmental pollutants, and radiates over a large geographical area. Industry development level has become an essential indicator of social advancement (Bhatia, 2020; Ditizio, 2018; Meng, Sun, & Wu, 2015; Sawan et al., 2020; Wang, 2013; Wangchen & Tan, 2012; Zhang, 2014). China's sports business has risen at an extraordinary rate in recent years, despite lagging far behind that of industrialized nations. China has enormous potential to improve its sports business (Dong, 2017; Jiang, Zhang, & Sun, 2021; Li et al., 2021a; Li & Tong, 2017; Li, Kim, & Ding, 2021b; Ren, Shi, & Ma, 2021; Zhou, 2015). However, the development of the Chinese sports sector is increasingly hampered by factors such as a lack of sustained momentum, the slow expansion of peripheral firms, and the lack of sports service facilities (Al Rashid et al., 2020; Bhatia, 2021; Chen & Yang, 2021; Cong & Wang, 2021; Li, 2021; Li et al., 2021b; Mou & Cheng, 2021; Wang, 2021; Wen et al., 2021; Yu, 2021). The scientific and accurate examination of the competitiveness of the sports industry in a region enables policymakers to comprehend the competitiveness of the sports industry in a region's current level of growth and to identify the existing difficulties of the sports industry. It enables sports industry practitioners to determine the direction of the industry's development.

Despite the tremendous growth of the sports industry, China has very few leisure sports businesses. Zheng (2018) proposed to analyze the competitiveness of leisure sports, coupled the data of the leisure sports industry with computer technology, and utilized statistical operations to address the lag in sports development. Chang (2016) investigated the major influencing factors and evaluation principles of the competitiveness of the sports industry, established an index system for evaluating the competitiveness of the regional sports industry, weighted the indices using the analytical hierarchy process (AHP), normalized the data to process quantitative and qualitative indices, and empirically analyzed the competitiveness of the sports industry in several Chinese provinces. After analyzing the composition requirements and influencing factors of the competitiveness of the sports industry, Li (2015) designed an evaluation index system (EIS) for the competitiveness of the sports industry by combining challenging objectives with soft objectives and integrating dynamic analysis with static analysis. Through network analysis, the logic between indices was thoroughly explored, and the evaluation results were incorporated into the sports industry's development strategy, setting the groundwork for decisions about the competitiveness of the sports industry in China. Chen et al. (2014) examined the competitiveness of China's six central provinces' sports industries. Using data mining based on the entropy weight approach and the technique for order of

¹ School of Physical Education, Hangzhou Normal University, Hangzhou 311121, China.

*Corresponding author's email: yingmincui@163.com

preference by similarity to the ideal solution (TOPSIS), the competitiveness of the sports industries in the six provinces of Central China was determined. Ao (2014) correlated the rise/fall of the sports industry with the competitiveness of national sports brands, used machine learning to mine sports brand data, and developed a sports brand competitiveness model that reflects the characteristics of the sports industry and encourages the growth of sports brands.

Prior research has prioritized the development state of the sports industry above the selection of indices and evaluation of industrial competitiveness. Concerning the regional sports industry's resource competitiveness, scholars are mystified by the challenge of directly quantifying the index at the government and corporate levels. Based on the theory of competitive advantage, this study seeks to evaluate and objectively analyze the competitiveness of the sports business. Different indices were used to measure the competitive advantage of the sports industry, and empirical analysis was conducted on various factors and enterprise value types to provide a basis and reference for China's sports industry enterprises to enhance their competitive advantages. In addition, the informational quality of the various indices was evaluated, revealing insight into how to increase the value of China's sports industry businesses.

The remaining sections of this work are structured as follows: Section 2 categorizes the sports industry into ten subindustries, including the lottery industry, sports tourism, venue industry, competitive performance industry, fitness and entertainment industry, sales industry, sports product manufacturing, training industry, intermediary industry, and media industry, and provides examples of industrial clusters and programs for sports product manufacturing and sports tourism. The third section sets an EIS for the competitiveness of the sports business and defines each index. Section 4 describes the method for measuring the competitiveness of the sports industry and the methodology for analyzing the critical influencing elements. The experimental findings validate the scientific nature of the EIS and give empirical evidence. This study explores the influence of numerous measures through empirical analysis, evaluates their informational content, and provides an appropriate reference for strengthening the competitive advantage of the sports business.

2. Analysis of Competitiveness of the Sports Industry

According to current definitions, the sports industry can be divided into the following subindustries: the lottery industry, sports tourism, the venue industry, the competitive performance industry, the fitness and entertainment industry,

the sales industry, the sports product manufacturing industry, the training industry, the intermediary industry, and the media industry (Figure 1). Core subindustries include sports goods production and sports tourism. Tables 1 and 2 show examples of industrial clusters for manufacturing sports products and industrial programs for the sports tourist industry, respectively. The favorable national policies generate numerous employment and business prospects in the sports industry. However, most sports firms lack a solid understanding of sports' fundamental concepts, preventing them from formulating effective plans or developing competitive advantages. Consequently, several sports businesses struggle to exist.

Competitiveness is fundamentally a measurement of profitability and superiority, and allure. An industry's competitiveness is the aggregate competitiveness of all firms affiliated with it. The competitive advantage hypothesis can be utilized to evaluate the causes of establishing an industry's comparative advantage and to forecast the evolution of that advantage.

Based on the subindustries mentioned above in the sports business, this article examines and empirically analyses the industry's competitiveness. Referring to the traditional theory of the diamond model, Figure 2 depicts the diamond model for the sports business. According to the theory of competitive advantage, the competitiveness of the sports industry and the relevant enterprises is directly influenced by four factors: the production inputs of the sports industry, the demand for the development of the sports industry, the support of relevant industries, and the development strategy and horizontal competition of sports industry enterprises. Additionally, competitiveness is indirectly affected by two factors: development possibilities and policies geared toward the sports business. These relationships are depicted in Figure 2's diamond model of the sports industry. The next part will introduce evaluation and measuring competitive strategies for the sports industry.

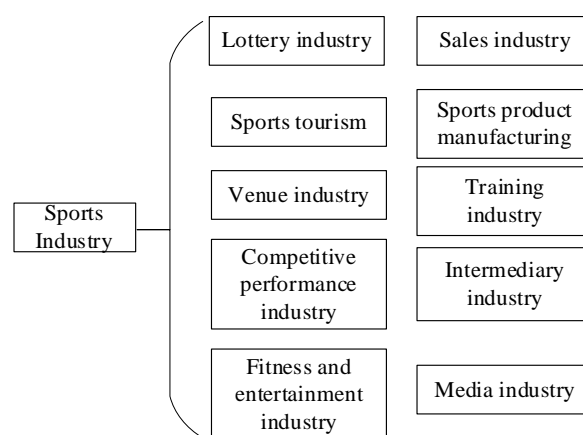


Figure 1. Categories of the sports industry

Table 1

Examples of the industrial clusters of sports products manufacturing

Serial number	Product	Brand	Main business
1	Bike	Giant, Merida, Forever, Phoenix, and Emmelle	Bike accessories and bike manufacturing
2	Sportswear	Nike, Adidas, Lining, Puma, Fila, Xtep, and Anta	Manufacturing and sales of sports shoes, sportswear, and sports materials
3	outdoor equipment	Arc'teryx, Toread, The North Face, and Columbia	Manufacturing of sports equipment and water sports equipment
4	Sporting goods	Life Fitness, Technogym, and Star Trac	Sports equipment and sporting goods

Table 2

Examples of the industrial programs of sports tourism

Natural resource	Sports item
Mountains and canyons	Mountaineering, hiking, cross-country, and rock climbing
Rivers and lakes	Swimming, sailing, rowing, and kayaking
Forests	Adventure, crossing, field operations, camping, and oxygen bath
Wetlands	Watching birds, fishing, and boating
Rural parks	Cycling, fruit/vegetable picking, camping, and folk activities
Urban parks	Aerobic exercise and extreme sports

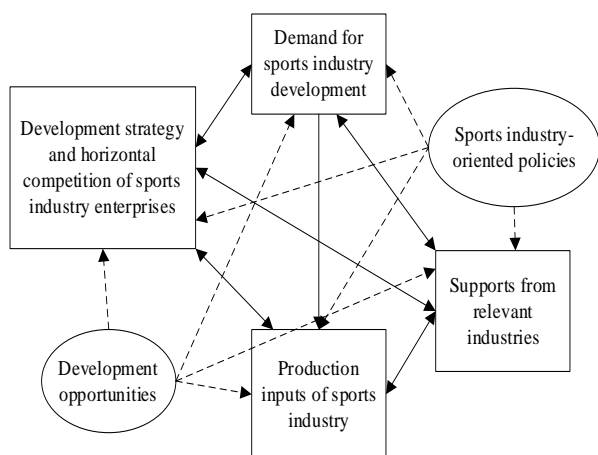


Figure 2. The diamond model of the sports industry

3. EIS Construction

3.1 Index selection

Drawing on Li (2015), this paper develops a preliminary index system for the competitiveness of the sports industry, which contains four primary indices: resource integration ability, research and development (R&D) innovation ability, market development ability, and capital operation ability. To ensure the precision and scientific level of our EIS, the authors screened the evaluation indices by the association rules. They selected the indices strongly

correlated with the competitiveness of sports industry enterprises, forming a unique EIS for the competitiveness of sports industry enterprises. The specific algorithm and steps are as follows:

Let $W=\{p_1,p_2,\dots,p_n\}$ be a set of n evaluation indices for the competitiveness of the sports industry; $I=\{i_1,i_2,\dots,i_m\}$ be the itemset of m attributes. Then, each index $p \subseteq k$ corresponds to an itemset. If itemset $X \subseteq p$, then p contains X .

The association rule between indices can be expressed as $A \rightarrow B$, where A and B are antecedent and consequent. The support SUP of $A \rightarrow B$ characterizes probability $CH(A \cap B)$, i.e., the number of cooccurrences of A and B :

$$SUP(A \rightarrow B) = CH(A \cap B) \tag{1}$$

The confidence CON of $A \rightarrow B$ characterizes conditional probability $CH(A/B)$, i.e., the ratio of the number of cooccurrences of A and B to the number of occurrences of A :

$$CON(A \rightarrow B) = CH(B/A) \tag{2}$$

The lift LIF of $A \rightarrow B$ characterizes the ratio of the cooccurrence probability of A and B to the occurrence probability of B :

$$LIF(A \rightarrow B) = \frac{CH(B/A)}{CH(B)} \tag{3}$$

3.2 Index meanings

The primary index resource integration ability covers four secondary indices: total assets, the proportion of production inputs, the number of cooperation projects

with the government, and the number of cooperation projects with large sports games.

Precisely, total asset reflects the economic strength of sports industry enterprises and guarantees the survival of the sports industry. Let IF be the fund of production inputs; IE be the total investment. Then, the proportion of production inputs DAS can be calculated by:

$$DAS = \frac{IF}{IE} \times 100 \frac{0}{0} \quad (4)$$

Let BE be the number of employees with an undergraduate and above education level; NE is the total number of employees. Then, the proportion of employees with the education level of undergraduate and above DAB can be calculated by:

$$DAB = \frac{BE}{NE} \times 100 \frac{0}{0} \quad (5)$$

The primary index of R&D innovation ability covers three secondary indices: proportion of R&D personnel for sports products, degree of the introduction of sports production technology, and ownership of sports production technology and patents. Let TE be the number of technicians and R&D personnel. Then, the proportion of R&D personnel for sports products DAT can be calculated by:

$$DAT = \frac{TE}{NE} \times 100 \frac{0}{0} \quad (6)$$

Let NR be the number of intellectual properties not obtained by independent R&D; PR be the total number of intellectual properties. Then, the degree of the introduction of sports production technology TID can be calculated by:

$$TID = \frac{NR}{PR} \times 100 \frac{0}{0} \quad (7)$$

The primary index market development ability covers five secondary indices: market share of the sports industry, annual income of sports industry enterprises, the annual income growth rate of sports industry enterprises, profit margin of the annual income of sports industry enterprises, and proportion of advertising investment for sports products. Let QC be the output of sports industry enterprises; SC is the total output of the regional industry. Then, the market share of the sports industry η_{MS} can be calculated by:

$$\eta_{MS} = \frac{QC}{SC} \times 100 \frac{0}{0} \quad (8)$$

Let AD be the advertising investment for sports products. Then, the proportion of advertising investment for sports products η_{AD} can be calculated by:

$$\eta_{AD} = \frac{AD}{IE} \times 100 \frac{0}{0} \quad (9)$$

The primary index capital operation ability covers five secondary indices: return on total asset, rate of return on total asset, rate of return on investment, return on equity, and velocity of liquid assets of sports industry enterprises. Let LE be the total profit of sports industry enterprises; AZ is the total appraised asset. Then, the return on total asset

η_{AP} can be calculated by:

$$\eta_{AP} = \frac{LE}{AZ} \times 100 \frac{0}{0} \quad (10)$$

Let LM and LE be the return on investment and the total investment of sports industry enterprises, respectively. Then, the rate of return of total asset η_{RE} can be calculated by:

$$\eta_{RE} = \frac{LM}{IE} \times 100 \frac{0}{0} \quad (11)$$

Let EQ and CA be sports industry enterprises' investment income and cost, respectively. Then, the rate of return on investment η_{VI} can be calculated by:

$$\eta_{VI} = \frac{EQ}{CA} \times 100 \frac{0}{0} \quad (12)$$

Let NM and AM be the net profit and mean net asset of sports industry enterprises. Then, the return on equity η_{NA} can be calculated by:

$$\eta_{NA} = \frac{NM}{AM} \times 100 \frac{0}{0} \quad (13)$$

Let NI and ACA be the net income and average total current assets of sports industry enterprises, respectively. Then, the velocity of liquid assets η_{CAT} can be calculated by:

$$\eta_{CAT} = \frac{NI}{ACA} \times 100 \frac{0}{0} \quad (14)$$

4. Competitiveness Measurement and Influencing Factor Analysis

4.1 Factor analysis

The competitiveness of the sports industry was subjected to factor analysis. The multidimensional data of the original indices were dimensionally reduced to facilitate the research on the complex and diverse data on sports industry indices. The specific model can be expressed as:

$$E_j = \sum L_i A_{ij} \quad (i = 1, 2, \dots; j = 1, 2, \dots) \quad (15)$$

The mathematical model of factor analysis can be expressed as follows:

$$\begin{cases} a_1 = x_{11}e_1 + x_{12}e_2 + x_{13}e_3 + \dots + x_{1l}e_l + \tau_1 \\ a_2 = x_{21}e_1 + x_{22}e_2 + x_{23}e_3 + \dots + x_{2l}e_l + \tau_2 \\ \dots \\ a_t = x_{t1}e_1 + x_{t2}e_2 + x_{t3}e_3 + \dots + x_{tl}e_l + \tau_t \end{cases} \quad (16)$$

To extend the theory of competitive advantage, this paper introduces the revealed comparative advantage index to quantify the competitiveness of the regional sports industry. Let BYS be the revealed comparative advantage index of sports product j in region i ; A_{ij} be the sales amount of sports product j in region i ; A_j be the total sales amount of sports products in region i ; A_j be the sales amount of sports product j in the country; D be the total sales amount of sports products in the country. Then, BYS can be calculated by:

$$BYS = \frac{A_{ij}}{A_j} / \frac{D_j}{D} \quad (17)$$

4.2 Analysis of influencing factors

This paper compares the development level of the regional sports industry with that of the nationwide sports industry through shift-share analysis, aiming to reveal the

competitive advantage/disadvantage of the regional sports industry against the same industry across the country.

The sample period is denoted as $[0, p]$, where 0 represents the initial year 2016, and p represents the end year 2020. For the research region i , the economic aggregates of the sports industry in the initial year and the end year are denoted as $y_{i,0}$ and $y_{i,p}$, respectively. There are m subindustries of the regional sports industry. The economic aggregate of subindustry j is marked as y_{ij} . The monetary aggregates of industry j in region i in the initial year and the end year are denoted as $y_{ij,0}$ and $y_{ij,p}$, respectively. In addition, the economic aggregates of the nationwide sports industry in the initial year and the end year are denoted as Y_0 and Y_p , respectively; the economic aggregates of national industry j in the initial year and the end year are denoted as $Y_{j,0}$ and $Y_{j,p}$, respectively. Here, the economic aggregates are substituted by the total asset.

During the sample period $[0, p]$, the change rate of the total asset of industry j in region i can be expressed as:

$$s_{ij} = (y_{ij,p} - y_{ij,0})/y_{ij,0} (j = 1, 2, \dots, n) \tag{18}$$

During that period, the change rate of the total asset of nationwide industry j can be expressed as:

$$S_j = (Y_{j,p} - Y_{j,0})/Y_{j,0} (j = 1, 2, \dots, n) \tag{19}$$

Based on the nationwide share of each subindustry, the percentage of each subindustry in the research region can be normalized by:

$$y_{ij} = y_{i,0} \times Y_{j,0}/Y_0 (j = 1, 2, \dots, n) \tag{20}$$

Let M_{ij} , T_{ij} , and W_{ij} be the shift components of growth, industrial structure, and competitiveness. Then, the total growth H_{ij} of industry j in region i can be decomposed into:

$$H_{ij} = M_{ij} + T_{ij} + W_{ij} \tag{21}$$

where,

$$M_{ij} = y_{ij} \times S_j \tag{22}$$

$$T_{ij} = (y_{ij,0} - y_{ij}) \times S_j \tag{23}$$

$$W_{ij} = y_{ij} \times (s_{ij} - S_j) \tag{24}$$

In addition, this paper also introduces $L_{j,0} = y_{ij,0}/Y_0$, and $L_{j,p} = y_{ij,p}/Y_p$. Let D be the influence of sports industry

structure on the regional economy, V be the influence of sports industry growth rate on the competitiveness of the sports industry, and K is the growth rate of the regional sports industry relative to the nationwide sports industry. Then, a formula can be constructed as $K = D \times V$:

$$K = \frac{\sum_{j=1}^n L_{j,p} \cdot Y_{j,p}}{\sum_{j=1}^n L_{j,0} \cdot Y_{j,0}} \cdot \frac{\sum_{j=1}^n Y_{j,p}}{\sum_{j=1}^n Y_{j,0}} = \left[\frac{\sum_{j=1}^n L_{j,0} \cdot Y_{j,t}}{\sum_{j=1}^n L_{j,0} \cdot Y_{j,0}} \cdot \frac{\sum_{j=1}^n Y_{j,t}}{\sum_{j=1}^n Y_{j,0}} \right] \cdot \frac{\sum_{j=1}^n L_{j,t} \cdot Y_{j,t}}{\sum_{j=1}^n L_{j,0} \cdot Y_{j,0}} = D \cdot V \tag{25}$$

5. Experiments and Results Analysis

The normalized index data were subjected to factor analysis on SPSS 22.0, yielding each primary index's PVE and cumulative PVE. The results in Table 1 show that every primary index's characteristic root's eigenvalue was more significant than 1, and the corresponding PVE (83.251%) was greater than 80%. Thus, the four selected primary indices are sufficient to illustrate the competitiveness of regional sports industry enterprises.

Comparing the competitiveness of subindustries was the first step. Table 2 displays the competitiveness of subindustries with a relatively robust competitive advantage. The competitiveness of subindustries with a general competitive advantage is shown in Table 3. As their competitiveness exceeded 45, it can be noticed that the sales sector, fitness and entertainment business, sports tourism, and sports product manufacturing have a competitive edge. In contrast, the competitiveness of the training industry, sales industry, fitness and entertainment business, competitive performance industry, venue industry, intermediary industry, media industry, and lottery sector was below 45. The businesses in the subindustries with a general competitive advantage must take measures to increase their competitiveness.

Table 1

Percentage of variance explained (PVE) and cumulative PVE of each primary index

Primary index		Resource integration ability	R&D innovation ability	Market development ability	Capital operation ability
Initial eigenvalue	Total	4.152	3.625	2.195	1.627
	Variance	25.625	17.482	11.473	8.294
	Cumulative	35.847	53.618	66.958	83.251
Extraction sums of squared loadings (SPSS)	Total	4.052	3.629	2.574	1.627
	Variance	25.195	17.162	11.528	9.486
	Cumulative	35.194	54.167	68.166	85.293

Table 2

Competitiveness of subindustries with a relatively strong competitive advantage

Subindustry	Competitiveness score
Sales industry	46.28
Fitness and entertainment industry	45.81
Sports tourism	33.26
Sports products manufacturing	65.19

Table 3

Competitiveness of subindustries with a general competitive advantage

Subindustry	Competitiveness score
Training Industry	25.94
Sales industry	42.52
Fitness and entertainment industry	10.48
Competitive performance industry	18.62
Venue industry	25.62
Intermediary industry	13.45
Media industry	22.41
Lottery industry	33.84

The authors then compared the competitiveness of businesses in the sports industry. According to the competitiveness rating of sports industry businesses in the region, the sports industry enterprises fell into two categories (step 1: positive competitiveness; step 2: negative competitiveness), as seen in Figure 3. Eight sports industry businesses were in stage one, and seventeen were in step two. In either step, the most competitive business had a substantial advantage over the least competitive business. In other words, the top-ranked organization in the sports industry has much greater relative competitiveness than the other businesses.

Furthermore, this research examines the competitiveness of two main subindustries: sports product manufacturing and tourism. First, a one-dimensional linear regression equation was developed for the income growth of sports tourism and sports goods manufacturing. As shown in Figure 4, the linear regression line had an explanatory power of 96.89%, and its goodness of fit was outstanding. To accurately portray the revealed comparative advantage of the sports industry, this article studies the revealed relative advantage indices of the sports business in five regions of the research region between 2010 and 2020. As shown in Figure 5, the comparative advantage of the sports business in the five areas changed over the course of ten years, with a general downward trend. The disclosed comparative advantage decreased from 1.42 to 1.35 between 2010 to 2020. Space-wise, there was a distinction between the development of the sports industry in the five

regions. In each year, the difference was not substantial. The competitiveness of the sports industry in regions 2 and 3, whose yearly mean revealed comparative advantage indices ranged between [1.3 and 1.35], is reasonably high.

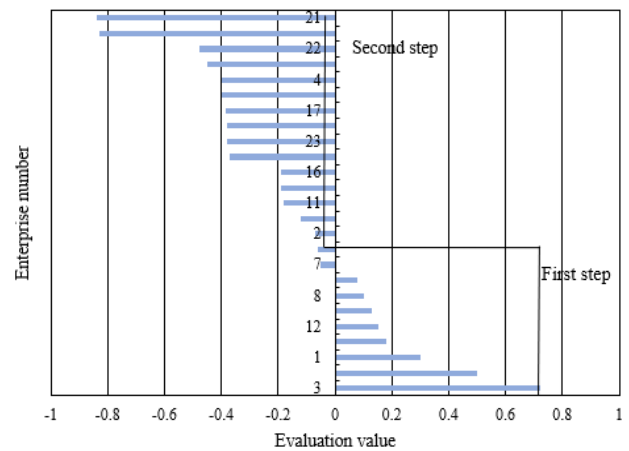


Figure 3. Overall evaluation results on the competitiveness of sports industry enterprises

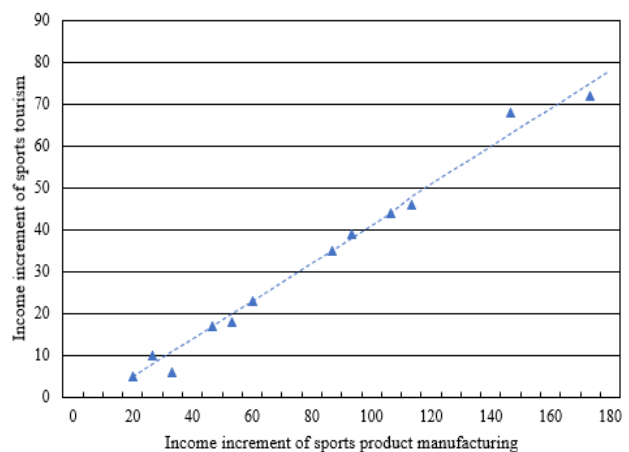


Figure 4. The linear relationship between income increments of sports tourism and sports product manufacturing

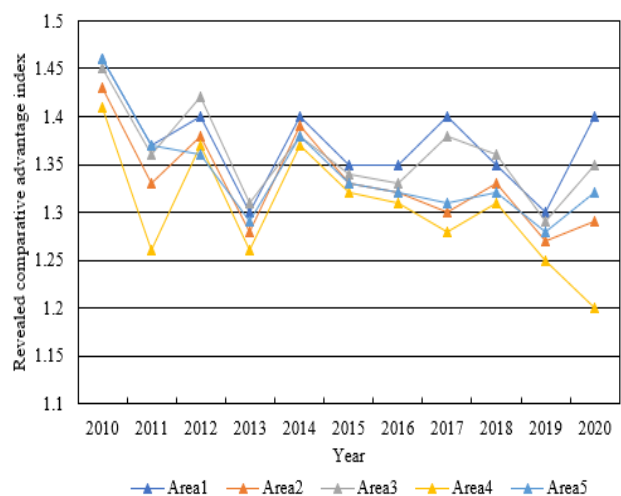


Figure 5. Revealed comparative advantage indices of the sports industry in different areas

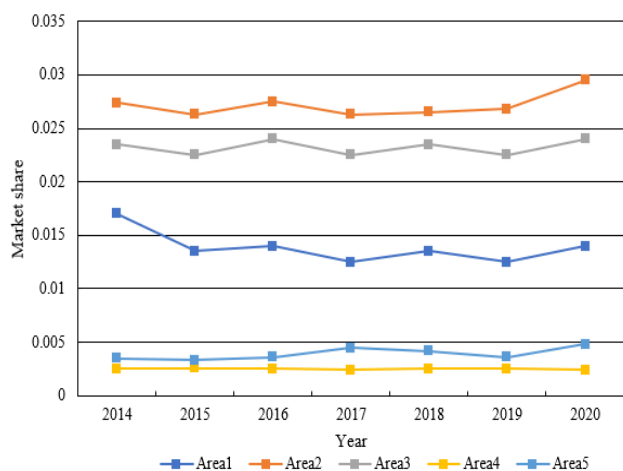


Figure 6. Market shares of the sports industry in different areas

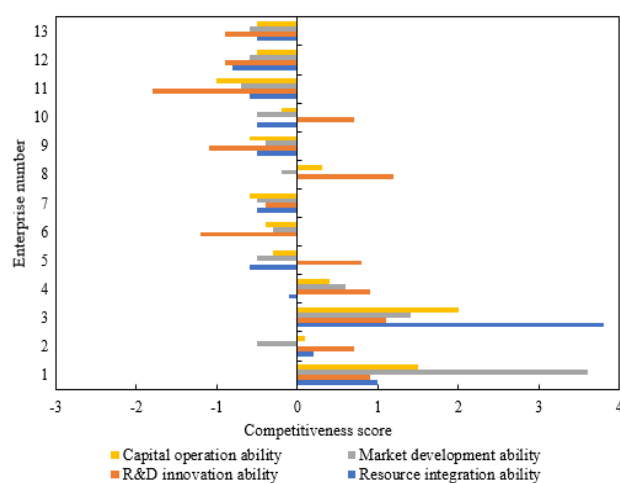


Figure 7. Bar chart of competitiveness scores of sports industry enterprises in the research region

Figure 6 depicts the market share of the sports industry in several sectors. From 2014 to 2020, the market shares of the sports industry in sectors 2 and 3 were relatively steady. The highest, minimum, and mean were 2.96, 2.71, and 2.835%, respectively. Space-wise, area 1 was the largest of the five areas, followed by areas 3 and 2. Areas four and five ranked last. Figure 7 depicts the composite ranking of sports industry firms in the research region, which is a prefecture, as determined by the competitiveness ratings of sports industry enterprises in the research region.

References

- Al Rashid, A., Khalid, M. Y., Imran, R., Ali, U., & Koc, M. (2020). Utilization of banana fiber-reinforced hybrid composites in the sports industry. *Materials*, 13(14), 3167. <https://doi.org/10.3390/ma13143167>
- Ao, D. J. (2014). Building the brand competitiveness model of sports industry based on PLS-SEM. *Journal of Chemical and Pharmaceutical Research*, 6(3), 745-754. <https://www.jocpr.com/articles/building-the-brand-competitiveness-model-of-sports-industry-based-on-plssem-3787.html>
- Bhatia, M. (2020). IoT-inspired framework for athlete performance assessment in smart sport industry. *IEEE Internet of Things Journal*, 8(12), 9523-9530. <https://doi.org/10.1109/IJOT.2020.3012440>

6. Conclusions

This paper assesses and empirically studies the competitiveness of the sports sector in light of the idea of competitive advantage. After splitting the sports business into numerous subindustries, several examples of industrial clusters for producing sports products and industrial programs for sports tourism were offered. Next, an EIS for the competitiveness of the sports business was established, and each index was described in detail. The authors then described the method for measuring the competitiveness of the sports sector and the methodology for analyzing the critical influencing elements. Experiments yielded the PVE and cumulative PVE of each primary index, suggesting that the four selected primary indices are sufficient to depict the competitiveness of regional firms in the sports industry. Coupled with example analysis, the authors provided an overall evaluation of the competitiveness of sports industry enterprises, drew a linear curve between the income increments of sports product manufacturing and sports tourism in the region, plotted the revealed comparative advantage indices of the sports industry in different areas, and obtained the market shares of sports industry in different areas of the research region.

Different competitive advantage measuring methods influence the evaluation of the source of competitive advantage in the sports sector. Consequently, the strategy is chosen by the industry to enhance competitive advantage. Therefore, there is a need for a deeper examination of competitive advantage and its quantification in linked sectors. A clearer and more complete understanding of competitive advantage measures in the sports industry helps improve strategic management policies and increase the value of sports industry firms.

Acknowledgement

Zhejiang Province Philosophy and Social Science General Project's full title is Research on the Multiple Choices and Performance Improvement Mechanism of the Government Purchasing Public Sports Services from the Perspective of Supply Chain Management. Project number: (20NDJC171YB).

- Bhatia, M. (2021). Intelligent system of game-theory-based decision making in smart sports industry. *ACM Transactions on Intelligent Systems and Technology (TIST)*, 12(3), 1-23. <https://doi.org/10.1145/3447986>
- Chang, W. (2016). Application Research of AHP in Competitiveness Evaluation of Regional Sports Industry. In *2016 International Conference on Smart City and Systems Engineering (ICSCSE)* (pp. 490-493). IEEE. <https://doi.org/10.1109/ICSCSE.2016.0134>
- Chen, L., & Yang, S. (2021). Impact of sports wearable testing equipment based on vision sensors on the sports industry. *Journal of Sensors*, 2021, 1-10. <https://doi.org/10.1155/2021/2598721>
- Chen, Q. Z., He, H., Liu, B. L., Wang, P., & Zhang, S. C. (2014). The study of sports industry competitiveness of six provinces in Central China based on entropy weight and TOPSIS integration. *Journal of Chemical and Pharmaceutical Research*, 6(3), 755-763. <https://www.jocpr.com/articles/the-study-of-sports-industry-competitiveness-of-six-provinces-in-central-china-based-on-entropy-weight-and-topsis-integr.pdf>
- Cong, R., & Wang, H. (2021). Prediction of Evolution and Development Trend in Sports Industry Cluster Based on Particle Swarm Optimization. *Scientific Programming*, 2021, 1-8. <https://doi.org/10.1155/2021/7607623>
- Ditizio, A. A. (2018). Nature and characteristics of the sport industry and its current trends impacting the industry. In *Sports Media, Marketing, and Management: Breakthroughs in Research and Practice* (pp. 284-300). IGI Global. <https://doi.org/10.4018/978-1-5225-5475-2.ch016>
- Dong, Y. (2017). Research into the Main Factors Influencing the Layout of Regional Leisure Sport Industry. *AGRO Food Industry Hi-Tech*, 28(3), 1579-1582. https://www.teknoscienze.com/tns_issue/vol_283
- Jiang, Z., Zhang, F., & Sun, L. (2021). Sports Action Recognition Based on Image Processing Technology and Analysis of the Development of Sports Industry Pattern. *Scientific Programming*, 2021, 1-11. <https://doi.org/10.1155/2021/4815097>
- Li, S. (2015). Research on the sports industry competitiveness index system construction based on Analytic Network Process (ANP). In H.-C. Liu, W.-P. Sung, & W. Yao (Eds.), *Computing, Control, Information and Education Engineering* (pp. 847-850). CRC Press. <https://doi.org/10.1201/b18828-187>
- Li, S. (2021). Supply Chain Financing Strategy in Sports Industry Based on Game Theory. In *Application of Intelligent Systems in Multi-modal Information Analytics: Proceedings of the 2020 International Conference on Multi-model Information Analytics (MMIA2020), Volume 1* (pp. 143-149). Springer. https://doi.org/10.1007/978-3-030-51431-0_22
- Li, X., Song, L., Wu, H., & Wang, Y. (2021a). Optimization of ice and snow sports industry chain structure based on sensor network communication and artificial intelligence. *Mobile Information Systems*, 2021, 1-10. <https://doi.org/10.1155/2021/7267006>
- Li, X., & Tong, Y. (2017). Selection analysis of Chinese sport industry structure and industry layout policy. *AGRO Food Industry Hi-Tech*, 28(3), 2948-2951. https://www.teknoscienze.com/tns_issue/vol_283
- Li, Y., Kim, K., & Ding, Y. (2021b). Research on Optimization of Blockchain Network and Data Communication in the Ecological Structure of Sports Industry. *Wireless Communications and Mobile Computing*, 2021, 1-11. <https://doi.org/10.1155/2021/3523681>
- Meng, X., Sun, J., & Wu, M. (2015). Market structure and case analysis of sport nutrient food industry. *Carpathian Journal of Food Science & Technology*, 7(1), 82-87. [http://chimie-biologie.ubm.ro/carpathian_journal/Vol_7\(1\)_2015.pdf](http://chimie-biologie.ubm.ro/carpathian_journal/Vol_7(1)_2015.pdf)
- Mou, C., & Cheng, Y. (2021). Research on information resource sharing and big data of sports industry in the background of OpenStack cloud platform. *Security and communication networks*, 2021, 1-12. <https://doi.org/10.1155/2021/2824146>
- Ren, L., Shi, Y., & Ma, H. (2021). Dual logic of sports violence governance in China: a comprehensive survey of law and industry autonomy. *Journal of healthcare engineering*, 2021, 4377156. <https://doi.org/10.1155/2021/4377156>
- Sawan, N., Eltweri, A., De Lucia, C., Pio Leonardo Cavaliere, L., Faccia, A., & Roxana Moşteanu, N. (2020). Mixed and augmented reality applications in the sport industry. In *2020 2nd International Conference on E-Business and E-commerce Engineering* (pp. 55-59). Association for Computing Machinery, New York, NY United States. <https://doi.org/10.1145/3446922.3446932>
- Wang, J. (2013). Study on Sport Industry of Traditional Chinese Sport Based on National Intangible Cultural Heritage. In *Proceedings of the 2nd International Conference on Green Communications and Networks 2012 (GCN 2012): Volume 2* (pp. 361-367). Springer. https://doi.org/10.1007/978-3-642-35567-7_44
- Wang, Y. (2021). Outdoor Sports Industry Platform Construction Based on Big Data Technology. In *The 2020 International Conference on Machine Learning and Big Data Analytics for IoT Security and Privacy: SPIoT-2020, Volume 1* (pp. 452-459). Springer. https://doi.org/10.1007/978-3-030-62743-0_65

- Wangchen, H., & Tan, H. (2012). An Energy-saving Industry Chain of Computer Games in Trend of Mobilization and Sport-virtualization. In *Information Engineering and Applications: International Conference on Information Engineering and Applications (IEA 2011)* (pp. 1241-1247). Springer. https://doi.org/10.1007/978-1-4471-2386-6_164
- Wen, Y., Chen, X., Gu, T., & Yu, F. (2021). Performance management of special fund for sports industry development in Jiangsu Province. *Complexity*, 2021, 1-15. <https://doi.org/10.1155/2021/5586971>
- Yu, S. (2021). Application of blockchain-based sports health data collection system in the development of sports industry. *Mobile Information Systems*, 2021, 1-6. <https://doi.org/10.1155/2021/4663147>
- Zhang, H. (2014). Sport industry strength influence factor weights research based on factor analysis. *Journal of Chemical and Pharmaceutical Research*, 6(3), 278-284. <https://www.jocpr.com/articles/sport-industry-strength-influence-factor-weights-research-based-on-factor-analysis.pdf>
- Zheng, Y. (2018). Research on the competitiveness of China's leisure sports industry based on statistical method. *Journal of Intelligent & Fuzzy Systems*, 35(3), 2855-2860. <https://doi.org/10.3233/JIFS-169639>
- Zhou, Q.-x. (2015). Application of Weighted Markov Chain in stock price forecasting of China sport industry. *International Journal of u-and e-Service, Science and Technology*, 8(2), 219-226. <https://www.earticle.net/Article/A242161>