MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

SUMY NATIONAL AGRARIAN UNIVERSITY

Manuscript

LIU ZIMING

UDC: 338.64

DISSERTATION

MANAGEMENT OF SPORT INDUSTRY FOR SUSTAINABLE DEVELOPMENT

073 Management

07 Management and administration

Submitted for a scientific degree of Doctor of Philosophy (PHD)

The dissertation contains the results of own research.

The use of ideas, results and texts of other authors have

references to the relevant source   Liu Ziming

Scientific supervisor Tetiana Kharchenko PhD (Economic Sciences), associate

professor

Sumy-2023

ABSTRACT

Liu Ziming. Management of Sport Industry for Sustainable Development – Manuscript.

Thesis for the degree of Doctor of Philosophy in specialty 073 - Management. - Sumy National Agrarian University, Sumy, 2023.

The Chinese economy has achieved tremendous development in recent years. People's living standards have gradually improved. With the development of the economy, people's pursuit of quality of life is increasingly improving, laying the foundation for the development of China's sports industry. At the same time, the development of the sports industry to a certain stage will also promote economic growth. For example, in some developed Western countries, the contribution of the sports industry to the economy has far exceeded that of traditional industries. It has become a new growth point for economic development. China's sports industry has made some progress, but it is still in its infancy. Compared with developed Western countries, the development of China's sports industry is still relatively slow. There are still some problems in the development of the sports industry. On the basis of studying and referring to relevant theories and practices, this paper follows the main line of "systematic interpretation, system evolution trend, systematic evaluation, and system optimization" in systematic science theory. It comprehensively employs specific research methods such as literature data analysis, complex network analysis, simulation experiments, econometrics, and statistical analysis. Following the research paradigm of "theoretical research-qualitative and quantitative analysis-practical

application," this paper systematically outlines the framework for optimizing sustainable development in the sports industry in our country. Furthermore, it explores key issues including goals, appropriate paths, and implementation strategies for optimizing sustainable development in our country's sports industry.

Through theoretical analysis and empirical research, this study draws the following conclusions:

The sustainable development of the sports industry is an extension of industrial sustainable development. It is essential to understand the boundaries of sustainability systems within our industry. This study does not focus on the external sustainable development of the sports industry, the sustainable development of the sports economy, or factors influencing its sustainable development and evolution. Instead, it examines how the structure of the sports industry is formed as society develops to a certain stage. This structure reflects the composition, spatial distribution, economic links, and technological connections involved in resource reproduction within the sports industry. It also explores how sustainability correlates with resource allocation within this sector. There are five fundamental patterns related to product sustainability in the sports industry: sustainable development of products themselves, internal output sustainability within this sector, and spatial layout sustainability.

The sustainable development of the internal network in the sports industry is based on industrial division of labor. The universality of assets, technological innovation, residents' disposable income level, and institutional factors are key determinants for realizing the transmission mechanism of internal correlation changes within the sports industry. Currently, a circular network economy has been established

within our country's sports industry, with different industries holding distinct positions and functions in terms of sustainable development. Notably, the sports industry exerts a significant positive driving effect on various departments within its domain, while cross-integration between sports product circulation and economic/technological sectors exhibits a more pronounced reverse driving effect on other industries. The sporting goods manufacturing sector plays a pivotal role in radiating influence and controlling sustainable development within the sports industry; thus serving as its leading industry at present. Internal factors such as correlation levels, degrees, and quality play crucial roles in promoting China's sports industry towards sustainable development and optimization. Enhancing coordinated industrial correlation to establish more rational division of labor represents an intrinsic direction for achieving sustainability within the sports industry.

The optimization of sustainable development in the sports industry entails a multidimensional assessment of its "compatibility" with sustainable development itself, as well as its internal components of economic and social development, and the external environment. This process exhibits certain stage characteristics. Currently, China's goal for the sustainable development of the sports industry is to cultivate new growth points for the national economy and promote rationalization and high-level development within this sector. It aims to meet people's needs for an improved quality of life by focusing on domestic circulation, promoting overall balanced and coordinated product structure within the sports industry, and ensuring sustainable consumer consumption. To achieve a transformation in both quality and benefits within this industry, it is necessary to further optimize resource allocation internally while

promoting efficient and sustainable development. This will serve regional coordinated development strategies by facilitating spatial spillover benefits within the sports industry layout at a regional level, thus fostering coordinated socio-economic environmental developments. Additionally, it should adapt to modernization stages that prioritize pursuing a higher quality of life by promoting sustainable product developments within the sports industry along three levels: basic level, developmental level, and core level.

This paper establishes a theoretical optimization model for the sustainable development of the sports industry, explores the rationalization, advancement, efficiency, coordination standards of regional spatial layout in the sports industry, and formulates modernization goals for sustainable development. Based on this foundation, an evaluation index and measurement method are designed to verify the feasibility of the evaluation model, index system, and methodology.

In order to promote the sustainable development and optimization of the sports industry, a comprehensive regulatory strategy is required to achieve the desired outcome. In the context of supply-side sustainable development reform, it is more appropriate for demand-side reform to drive supply-side reform and for supply-side reform to stimulate demand in order to ensure the sustainable development of the current sports industry and adjust policy orientation. Promoting coordinated regional development within the sports industry involves modifying "unity", content, indicators, batch items, and work mode configuration. This is an essential requirement for China's sports industry spatial strategy. Leveraging science and technology, capital, talent, and data in industrial innovation can further advance efficient and intensive development

towards sustainability in the sports industry. Strengthening coordination among various components of the sports industry by promoting horizontal integration with other sectors ("sports +") as well as vertical integration into large-scale project industries and high-quality industrial clusters will enhance sustainable development quality while fostering leading enterprises that serve as chain masters or experts in their respective fields. Promoting a dual-pronged hard resource allocation mechanism along with improving relevant legislation within the sports industry should prioritize cultivating market players through carefully formulated multi-level policies aimed at comprehensive governance coordination. These efforts not only expedite transforming scientific advancements into tangible productivity but also enhance efficiency and transformation capabilities regarding internal resource allocation within the sports industry.

Key words: sports industry, sustainable development, China, management, economic growth, reform, analysis, policy, technology, regulation, innovation, economic system, stability, mathematical model, development strategy.

АНОТАЦІЯ

Люй Цзімінь. Менеджмент спортивної індустрії для сталого розвитку – рукопис.

Дисертація на здобуття наукового ступеня доктора філософії за спеціальністю 073 - Менеджмент. – Сумський національний аграрний університет, Суми, 2023.

Китайська економіка за останні роки досягла величезного розвитку. Рівень

життя людей поступово покращувався. З розвитком економіки прагнення людей до якості життя все більше поліпшується, закладаючи основу для розвитку спортивної індустрії Китаю. Водночас, розвиток спортивної індустрії до певного етапу також сприятиме економічному зростанню. Наприклад, у деяких розвинених західних країнах внесок спортивної індустрії в економіку значно перевищив внесок традиційних галузей, вона стала новою точкою зростання економічного розвитку. Спортивна індустрія Китаю досягла певного прогресу, але вона все ще перебуває на початковому етапі. У порівнянні з розвиненими західними країнами, розвиток спортивної індустрії Китаю все ще відбувається відносно повільно. У розвитку спортивної індустрії все ще є певні проблеми. Ґрунтуючись на вивченні відповідних теорій, практики дотримуються основної лінії «систематичної інтерпретації, тенденції еволюції системи, систематичної оцінки та системної оптимізації» в теорії систематичної науки. Дана теорія передбачає всебічне використання специфічних методів дослідження, таких як аналіз даних літератури, комплексний мережевий аналіз, імітаційні моделі, економетричний та статистичний аналіз. Дотримуючись дослідницької парадигми «теоретичні дослідження формують якісну складову, кількісний аналізи виступає основою для практичного застосування» в дисертаційному дослідженні системно окреслено рамки оптимізації сталого розвитку спортивної індустрії в Китаї. Крім того, автором досліджено ключові питання, включаючи цілі, відповідні шляхи та стратегії впровадження для оптимізації сталого розвитку спортивної індустрії Китаю.

Шляхом проведеного теоретичного аналізу та емпіричних досліджень було

обґрунтовано наступні висновки:

сталий розвиток спортивної індустрії є продовженням промислового сталого розвитку. Важливо розуміти межі систем сталого розвитку досліджуваної галузі. Дане дослідження не фокусується на зовнішньому сталому розвитку спортивної індустрії, сталому розвитку спортивної економіки або факторах, що впливають на її сталий розвиток та еволюцію. Замість цього автором досліджено, як формується структура спортивної індустрії в міру розвитку суспільства до певної стадії. Ця структура відображає склад, просторовий розподіл, економічні зв'язки та технологічні зв'язки, пов'язані з відтворенням ресурсів у спортивній індустрії. Він також досліджує, як сталий розвиток корелює з розподілом ресурсів у цьому секторі. Існує п'ять фундаментальних закономірностей, пов'язаних зі стійкістю продукції в спортивній індустрії: сталий розвиток самих продуктів, внутрішня стійкість виробництва в цьому секторі та стійкість просторового планування;

звичайний розвиток внутрішньої мережі в спортивній індустрії базується на індустріальному розділі роботи. Універсальність активів, технологічні інновації, рівень доступного доходу жителів і інституційні фактори є ключовими ідентифікаторами для реалізації механізму передачі внутрішніх змін в кореляції із спортивною промисловістю. Зараз у Китаї формується мережева економіка у спортивній індустрії, в розрізі різних напрямів, які мають певні позиції і функції з точки зору тривалого розвитку. Зокрема, спортивна індустрія має значний позитивний ефект керування різними департаментами в досліджуваній сфері, а кросінтеграція між обертанням спортивних продуктів та

економічними/технологічними секторами показує більш визначний зворотний ефект. Сектор виробництва спортивних товарів відіграє ключову роль у забезпеченні впливу та контролі тривалого розвитку в спортивній індустрії, тим самим визначаючи її ключову роль. Внутрішні фактори, зокрема рівень кореляції, якість, відіграють важливу роль у підтримці спортивної індустрії Китаю для постійного розвитку і оптимізації всіх процесів галузі. Покращення координованої індустріальної кореляції, щоб встановити раціональніше розділення роботи, є внутрішнім напрямком для досягнення стійкості в спортивній індустрії.

Оптимізація процесів орієнтованих на досягнення сталого розвитку у спортивній індустрії призводить до багатовимірного оцінювання його "сумісності" з самим стійким розвитком, а також його внутрішніх компонентів економічного та соціального розвитку та зовнішнього середовища. Цей процес показує певні фізичні характеристики. Зараз, стратегічною метою державної політики Китаю для забезпечення тривалого розвитку спортивної індустрії є вирощування нових точок зростання національної економіки, раціоналізація та високий рівень розвитку досліджуваного сектору. Стратегічним вектором розвитку є забезпечення потреб людей щодо покращення якості життя, підтримуючи загальну збалансовану і координовану структуру продуктів та послуг у спортивній індустрії. Щоб досягнути перетворення якості і переваг у цій індустрії, необхідно продовжувати оптимізувати розподіл ресурсів внутрішньо, а також підтримувати ефективний і стійкий розвиток. Це служить основою для впровадження регіональних координованих стратегій розвитку,

поглиблюючи корисність їх розповсюдження у спортивній індустрії на регіональному рівні, підтримуючи координований соціально-економічний розвиток серед різних регіонів. Крім того, вона повинна адаптуватися до стадій модернізації, які визначають, в якості базового пріоритету, досягнення вищої якості життя, підтримуючи тривалий розвиток продуктів у спортивній індустрії в розрізі трьох рівнів: основний рівень, рівень розвитку і сталий розвиток.

Даний документ створює теоретичну модель оптимізації для сталого розвитку спортивної індустрії, досліджує напрями раціоналізації, ефективності, стандарти координації регіонального просторового компонування в спортивній індустрії і формулює напрями модернізації. На основі цієї основи індекс оцінювання і метод виміру створено для перевірки можливості моделі оцінювання, системи індексу і методології.

Щоб досягти сталості розвитку та оптимізувати процеси управління спортивної індустрії, для досягнення бажаного результату потрібна діюча регуляційна стратегія. У контексті реформ сталого розвитку, в частині оцінки пропозиції, краще підтримувати реформу, в частині оцінки попиту, доцільним є забезпечення сталого розвитку спортивної індустрії. Підтримка координованого регіонального розвитку у спортивній індустрії включає зміну вмісту, індикаторів, елементів і налаштування робочого режиму. Окреслені інструменти виступають основою для розробки місцевих стратегій Китайської спортивної індустрії. Розширення науки та технологій, капіталу, таланту та даних у індустріальних інноваціях може далі підвищувати ефективний та інтенсивний розвиток для забезпечення сталості розвитку спортивної індустрії. Посилання координації між

різними компонентами спортивної індустрії, формування горизонтальної інтеграції з іншими секторами, а також вертикальна інтеграцію у величезні проектові індустрії та високоякісні індустрійні кластери, підвищує якість стійкого розвитку. Впровадження двійкового механізму, розподіл ресурсів разом з покращенням відповідних законодавств у спортивній індустрії повинно пріоретувати культивування ринкових учасників за допомогою обережного формулювання багаторічних політик. Ці зусилля не тільки прискорюють перетворення наукових досягнень на матеріальну продуктивність, але також підвищують ефективність і можливості перетворень у відношенні до внутрішнього розподілу ресурсів в спортивній промисловості.

Ключові слова: спортивна індустрія, сталий розвиток, Китай, управління, економічне зростання, реформа, аналіз, політика, технології, регулювання, інновації, економічна система, стабільність, математична модель, стратегія розвитку.

LIST OF THE PUBLICATIONS ON THE TOPIC OF THE DISSERTATION

Articles in scientific publications included in the list of specialized scientific publications of Ukraine:

1.Tetiana Kharchenko & **Liu Ziming** The Relationship between Sports Industry Development and Economic Growth in China. Oblik i finansi, Institute of Accounting and Finance. 2021. issue 1 (91), pages 136-140, March. DOI: 10.33146/2307-9878-2021-1(91)-136-140. (The author researched the relationship between sports industry development and economic growth in China)

2.**Liu Ziming**, Kharchenko T.O The impact of sport industry on economic development. Economy and Society, 2022. (39). https://doi.org/10.32782/2524-0072/2022-39-6 (The author analyzed the impact of sports industry on economic development).

3.**Liu Ziming**, Tetyana O. Kharchenko UNDER THE BELT AND ROAD BACKGROUND OF THE NEW PATH OF SPORTS TOURISM INDUSTRY DEVELOPMENT IN CHINA. Mechanism of an Economic Regulation, 2022. (1-2(95-96), 127-130. https://doi.org/10.32782/mer.2022.95-96.19 (The author made the background of the new path of sports tourism industry development in China).

Articles in periodical scientific publications indexed in the Web of Science Core Collection and/or Scopus databases:

4.**Ziming, L.** Management of sports industry: moving to economic development. Marketing and Management of Innovations, 2021. 4, 230-236. http://doi.org/10.21272/mmi.2021.4-18 (Scopus)

5.**Liu Ziming**, Tetiana Kharchenko INNOVATIONS IN THE FIELD OF SPORTS INDUSTRY MANAGEMENT: ASSESSMENT OF THE DIGITAL ECONOMY'S IMPACT ON THE QUALITATIVE DEVELOPMENT OF THE

SPORTS INDUSTRY. Baltic Journal of Economic Studies. Vol. 9 No. 3, 2023. Pp. 10-21. DOI: https://doi.org/10.30525/2256-0742/2023-9-3-10-21 (WoS) (The author made the assessment of the digital economy's impact on the qualitative development of the sports industry)

Other publications:

6. **Liu Ziming**, Kharchenko T.O. Determining the Degree of Connection between the Development of the Sports Industry and Economic Growth in the Regional Context: Evidence from 31 Provinces in China. ECONOMIC OF DEVELOPMENT. Vol.20 No.2 (2021), 8-18. DOI: 10.57111/econ.20(2).2021.8-18. (The author researched the degree of connection between the development of the sports industry and economic growth in the regional context: evidence from 31 provinces in China)

7.**Liu Ziming**, Тетяна Харченко. Research on the development of rural sports industry and sports economy. Наука онлайн: Міжнародний електронний науковий журнал. 2021. №3. https://nauka-online.com/publications/economy/2021/3/22-2/ (The author analyzed the development of rural sports industry and sports economy)

8. **Liu Ziming**, Kharchenko T.O. Research on the countermeasures for the sustainable development of sports economy in Ukraine. International Journal of Recent and Development. Vol. 8, Issue, 12 (C), pp.114-116. Online ISSN: 2349-4182, Print ISSN: 2349-597 (The author researched the countermeasures for the sustainable development of sports economy in Ukraine)

9.**Liu Ziming**, Kharchenko T.O. Research on the Development Path of Sports Industry in the Context of Belt and Road. Turkish Journal of Computer and Mathematics Education. Vol.12 No.14 (2021), 3780-3783. https://turcomat.org/index.php/turkbilmat/article/view/11019/8201. (The author researched the development path of the sports industry in the context of Belt and road)

10. **Liu Ziming**. Research on the Relationship between China Sports Industry Added Value and Economic Development Index Based on Grey Correlation

Analysis. Current issues of world and national economy: estimates and development strategies: Proceedings of the international scientific-practical conference (Lviv, March 27, 2021). NGO "Lviv Economic Foundation". p. 100-103.

11. **Liu Ziming**. (2021). VAR model parameter estimation of the Relationship between Sports Industry Development and Economic Growth in China. Modern Movement of Science: abstracts of the 12th International Scientific and Practical Internet Conference (April 1-2, 2021), P1. Dnipro.p.97-100. (The author justified the VAR model parameter estimation of the relationship between sports industry development and economic growth in China)

13. **Liu Ziming**, Kharchenko T.O. Impact of sports industry development on rural economy. Глобалізація: співвідношення міжнародних та національних економічних інтересів під впливом нових викликів: матеріали VIII Міжнародної науково-практичної конференції (м. Одеса, 9 квітня 2021 р.). МГУ, 2021. С. 60-63. (The author analyzed the impact of sports industry development on rural economy)

14. **Liu Ziming** ANALYSIS ON THE CONNECTIVITY OF SPORTS INDUSTRY AND ECONOMIC DEVELOPMENT. Collection of abstracts XVIII International scientific and practical conference of young scientists (Ternopil, May 6, 2021). p. 48-52. (The author analyzed the connectivity of sports industry and economic development)

15. **Liu Ziming**. RESEARCH ON THE COUNTERMEASURES FOR THE SUSTAINABLE DEVELOPMENT OF SPORTS ECONOMY IN UKRAINE. Today economy in the context of global changes in society: a collection of materials of the scientific-practical conference (Zaporozhye, September 4, 2021). Zaporozhye: NGO "SIEU", 2021. p. 29-33.

CONTENTS

INTRODUCTION

The actuality of the research topic. The sports industry is a key national support direction, and China plans to become a sports power by 2035. The Fifth Plenary Session of the 19th Central Committee of the CPC put forward the strategic plan for building a strong sports country by 2035, which is the highest strategic goal of sports development and an important part of the great cause of building socialism with Chinese characteristics and realizing the great rejuvenation of the Chinese nation in the new era. The status and role of the sports industry in the national economy have been significantly improved, and the total scale of the national sports industry has jumped from 1.71 trillion yuan in 2015 to 3.16 trillion yuan in 2023, with an average annual growth of 14.6%. During the 14th Five-Year Plan period, China's sports development is still in an important period of strategic opportunities, with new changes in both opportunities and challenges. The vision goal of building a strong sports country by 2035 proposed by the Fifth Plenary Session of the 19th CPC Central Committee is encouraging, and the position of sports in the new journey of building a strong modern socialist country in an all-round way is more prominent. Productive forces determine the relations of production, and productivity progress, production relations should also adapt to the adjustment, the sports industry continues to develop and progress, sports industry management should also be gradually developed and improved[1, 2]. At present, the development of China's sports industry has made great achievements, but there are also many problems, lack of systematic and comprehensive sports industry policies, poor guidance to the development of sports industry, sports market standardization is not high. Examining the problems faced by the development of China's sports industry, it is not difficult to find that the crux of the problem lies in the lagging management of the sports industry. Therefore, it is necessary to study the management of sports industry. In the theoretical sense, through the research of sports industry management, it provides theoretical basis for guiding the reform and development of sports industry[3].In a practical sense, the study of sports industry

management can clarify the rights and responsibilities of the government and social subjects, regulate the behavior of the sports industry subjects, create a good environment for industrial development, straighten out the management and operation mechanism of the sports industry, and promote the healthy and coordinated development of the sports industry. It is of great significance to study the management of the sustainable development of the sports industry to promote the sports industry to become the pillar industry of the national economy and stimulate the internal vitality of the sports industry. This paper analyzes the evolution, current situation and problems of China's sports industry, analyzes the specific mechanism of China's sports industry development based on theoretical analysis and empirical test, and then puts forward corresponding countermeasures and suggestions. In order to provide some theoretical guidance and experience enlightenment for the efficient development of China's sports industry and the acceleration of the construction of sports power and healthy China.

Connection of work with scientific programs, plans, topics. The dissertation work was carried out in accordance with the research plan of the Sumy National Agrarian University on the topic: "Management of sport industry for sustainable development", within which the applicant investigated the internal and external mechanisms of the management of sports industry in China.

The purpose and tasks of the research. The dissertation research aims to substantiate the theoretical foundations and develop practical recommendations regarding that influence and promote the development management system of the sports industry. Determine internal and external mechanisms that influence the development of the sports industry. Expand the boundaries of the theory, and improve methods and application principles of the management of the sports industry. In accordance with the goal, the following tasks were set and solved:

-        to improve the relevant theories of sports industry development;
-        to analyze the sports industry sustainable development mechanism theory;

-        to reveal the internal and external mechanisms that influence and promote the development of the sports industry;

-        to analyze the development status of sports industry;

-        to compare and analyze the development status of sports industry between China and higher developed countries;

-        to develop the sustainable development of China's sports industry management strategy.

The object of the study is to the internal and external mechanisms of management of the sports industry for sustainable development, summarize the relevant theories, development status of the sports industry and justify China's sports industry management strategy.

Research methods. The methodology of the dissertation research is based on generally accepted principles of complex scientific research. The theoretical and methodological basis of the dissertation work is literature analysis, theoretical and empirical analysis, and normative and empirical analysis. In the process of specific research and implementation, specific methods such as induction, deduction and comparative analysis will be used, and research methods such as situational analysis and case analysis will be used to study special phases and regions of the development of the sports industry. Induction and analysis of literature data. The sustainability mechanism of the sports industry is analyzed by combing related literature. Summarize the development curriculum, models, and experiences of the sports industry in representative developed countries. Combining the tools of theoretical and empirical analysis allowed the research evolution and development status of the Chinese sports industry. By sorting out the relevant theories of sustainability in the sports industry and analyzing the various relevant factors that influence and manage the sustainability of the sports industry, this content forms the category of literature analysis methods. Through historical induction and mathematical statistics analysis, this paper discusses the development course and current situation of China's sports industry, analyzes the problems and deficiencies in the

development of China's sports industry, and empirically tests various management mechanisms for sustainable development of China's sports industry, which belongs to the category of empirical analysis. Based on theoretical analysis, this paper analyzes the management mechanism of the sustainable development of the sports industry. Based on the theoretical and empirical analysis results, this paper proposes a series of policy implications on how to promote the sustainable development of China's sports industry, which belongs to the scope of normative analysis. Graphical and tabular methods were used for visual presentation of the obtained results.

The information base of the dissertation research consists of primary information obtained as a result of own research and observations, publications of domestic and international scientists, monographic publications, internal documentation of enterprises in the agro-industrial sector, official materials of the State Statistics Service of China, data comes from China Statistical Yearbook and so on.

Scientific novelty of the obtained results. The most important research results that reveal the content of the dissertation, characterize its scientific novelty and are presented for defense include the following:

The practical significance of the research results lies in: establishing and enriching the new theory and method principles, putting forward new solutions to scientific problems, and providing a set of scientific provisions and conclusions for demonstrating the sustainable development strategy and practical suggestions of China's sports industry. The practical and methodical proposals put forward were implemented in the activities of the Henan Development and Reform Commission and the sports economy. The main theoretical provisions outlined in this work have reached the level of methodological developments and practical recommendations, are used and implemented in management practice. In particular:

For the first time:

-the evaluation index system for sustainable development of the sports industry is proposed based on the developmental theory of the sports industry, encompassing an

assessment of both internal and external factors as well as evaluating the management capacity for sustainable development in a multi-agent sports industry;

Improved:

- theoretical and methodological foundations of the theory of empirical study of the behavior sports industry multi-agent;

- the index system for a thorough assessment of the sports industry to multi-agent management capabilities, foster sustainable economic development within the sector, and enhance the managerial proficiency for ensuring its sustainable growth;

- the TOPSIS entropy weight model through calculating the weights of the government factor and grassroots governance as primary drivers of economic influence for the sustainable development of the sports industry;

- methodological principles for assessment fundamentally impact the industrial structure the management capacity for sustainable development in the sports industry.

Acquired further development:

-the concept of improving the sustainable development management ability of the sports industry and ensuring the sustainable and balanced development of the sports industry (structure strengthening, structure reconstruction, structure time and space). This will help improve the management capabilities of the various management players, solve the tasks facing the sports industry and achieve the management goals set by the state;

- approaches of sustainable development management ability of sports industry by optimizing the main factors of sports industry development management, which is based on correctly promoting the scale of digital economy agglomeration and planning agglomeration areas are the embodiment of the national management ability, which is conducive to improving the quality of sustainable development of the sports industry and achieving the national management objectives.

Personal contribution of the acquirer. A dissertation is a completed scientific study. Scientific statements, conclusions and recommendations are the result of personal scientific research. Published scientific works are independent developments and reflect

the main content of the dissertation.

Approbation of dissertation results. A dissertation is a completed scientific study. Scientific statements, conclusions and recommendations are the result of personal scientific research. Published scientific works are independent developments and reflect the main content of the dissertation.

Publications. The main results of scientific research are published in 15 scientific papers :3 in professional publications in Ukraine, 2 in journals included in the scient metrics database Scopus and Web of Science, and the rest in other journals and conference proceedings.

Structure and scope of work. The paper consists of an introduction, three chapters, conclusions, references, appendices, the volume of 167 pages of computer text and contains 27 tables, 6 figures.

CHAPTER 1. THEORETICAL AND METHODOLOGICAL APPROACHES TO MANAGING THE SPORT INDUSTRY FOR SUSTAINABLE DEVELOPMENT

1.1 Theoretical approaches to justified the essence of the sport industry for sustainable development

With the rise of the technological revolution, the overall level of social productivity jumped, the division of social production deepened, and the various subdivided industrial sectors of the national economy gradually took shape. The traditional concept and category of industry began to gradually expand from "material production sector" to "all sectors characterized by production and service". During industrial development and evolution, the traditional industrial structure has continuously changed, and culture, entertainment, education, and sports have gradually been incorporated into the industrial system. Among them, the sports industry has seen rapid growth in developed Western countries such as the United Kingdom and the United States. It has become a pillar industry in the developed West as countries around the world have increasingly paid attention to the sports industry.

Various scholars at home and abroad believe that sports industry refers to the collection of enterprises that produce and manage sports goods or services. From the perspective of domestic research, Wu Shaozu (1995) summarized the sports industry as the sports ontology industry (managed by the sports department to provide sports services), the sports-related industry (sports-related production and management activities) and the sports industry[4].That is, the sports industry is the sum of all sports-related production and commercial activities. Lu Yuanzhen (2001) believe that the sports industry is a collection or the sum of sectors of the same kind of economic activities that provide sports products for society based on the function and radiation of sports itself[5]. Similar to Lu Yuanzhen (2001), Li Jianshe (2006) believes that sports products include sports material

products and sports service products, and their statistical caliber spans the second and third industries[6]. Fang hunni (2009)also holds a similar view and divides the sports industry into sporting goods manufacturing and sports service industry[7].

Some foreign scholars also have the same understanding and definition of the sports industry as the above views. American scholar Meek (1997) believes that the sports industry consists of sports performance and entertainment, sports products and services, and sports support organizations[8]. Pitts (1994) defined the sports industry as all sports and related products - goods, services, places, people, and ideas - provided to customers, including sports performances, sports products and sports marketing[8]. Japanese scholar Harada Sohiko proposed that the sports industry is composed of the sports goods industry, sports venues industry and sports information service industry, and with the development of modern formats, sports logistics, venue management and mixed industries began to appear and become a part of the sports industry[9].

Some scholars take a different view and believe that sports industry refers to the sum of the sectors that produce and provide sports services or labor products. Shi Hongjun (2001)believes that the sports industry cannot include manufacturing and sports industry[10]. Cong Huping (2001) held a similar view, arguing that enterprises producing material sports products should not be included in the sports industry, and classified the construction of sports venues as the construction industry, the production of sports equipment products as the manufacturing industry, and the production of sports clothing as the clothing industry. Based on the basic theory of industrial economics[11].Yang Yue (2003)proposed that the scope of the sports industry is limited to the collection of enterprises that produce and provide sports services or labor products[12]. Yang Yehong (2011) defined the production and operation activities of sports services or labor services directly used for consumers as sports industry activities[13]. Moreover, some scholars divide the sports industry into a broad and a narrow sense. The broad movement approaches the first view, and the narrow movement approaches the second. Liu Yanwu (2007) defines the sports industry in a broad sense as a collection of enterprises or

departments engaged in the production of sports products to meet the leisure and entertainment needs of consumers watching or participating in sports activities. The narrow definition of the sports industry is defined as the collection of corporate organizations engaged solely in the production of sports products[14].The specific composition is shown in Table 1.1.

Table 1.1- National Bureau of Statistics sports industry categories

Industry Classification
1. Sports management activities
2. Sports Competition Performance Event
3. Sports, Fitness and Leisure Activities
4. Sports venues and facilities management
5. Sports brokerage and agency, advertising and exhibition, performance, and design services
6. Physical Education and Training
7. Sports Media and Information Services, Inc
8. Other sports services
9. Manufacturing of sporting goods and related products
10. Sports Goods and Related Products Sales, Rentals and Trade Agents
11. Sports facilities construction

Source: According to the Sports Industry Statistical Classification (2019)

China's academic and social understanding of the sports industry has experienced two clear turning points. The first turning point came after the Third Plenary Session of the 11th CPC Central Committee in 1978. With the further liberation of ideology and the establishment of economic construction work centers, people have a different understanding of the role of the sports economy in the national economy and have begun to focus on the economic functions of sports. There is a recognition that sport is no longer simply a business of consumption and welfare, but also a business of production. The second leap forward came after the party's 14th National Congress in 1992[15]. With the establishment of the socialist market economy system, China's sports industry began to enter a new era of "ontology advancement and all-round development".

Governments and sports commissions at all levels continue to expand the scope of original sports business projects and deeply explore the various economic values contained in sports to provide a diverse range of paid sports services to the public[16]. At

the same time, the process of professional and commercial development of Chinese sports has been considerably advanced by actively promoting the reform of the professional club league system, using football as a pilot. Much progress has been made in the connotation and extension of the sports industry.

The country's understanding of the sports industry has undergone a lengthy and complex transformation. To understand the source of the idea of sustainable development of the sports industry, we must first clarify the historical process and evolution logic of the development of the sports industry in China. Scholars divide the development stage of China's sports industry into the following five stages based on major events and the growth rate of the sports industry. This will provide a historical basis for the sustainable development of the sports industry[15].

The period from 1978 to 1991 marked the nascent phase of the Chinese sports industry. After the reform and opening, the Party Central Committee established the basic line of socialism with "economic construction as the center", and the social and economic system changed from the previous planned economy system to the market economy system, and the social and economic system entered a stage of rapid development. To adapt to the modern requirements of the market economy system as soon as possible, the Party and the state have gradually changed their thinking on sports management and started to pursue the extension of sports in the market economy sector. In 1979, the former State Sports Commission formally proposed at the National Sports Work Conference to shift the focus of work to "grasp the sports business work" and put forward the guidelines of "taking competitive sports as the guide and driving the overall development of sports". In 1983, the first reform measure requested by the National Sports Commission on Further creating a different situation in sports was to "mobilize social forces to run sports", and the market operation activities in the field of sports were gradually active. In 1985, the "GNP calculation Plan" classified sports as the tertiary industry, thus establishing the commodity attributes and industrial attributes of sports. In 1986, the "Decision on the reform of the sports system" was issued, which required the field of sports to further

emancipate the mind, deepen the reform of sports, and strive to solve the problems of tight sports funds, insufficient social enthusiasm and creativity, and low efficiency of sports work. Substantial reform of the country's sports associations followed between 1987 and 1991. During this period, sports goods manufacturing, fitness, and entertainment industries, which had little to do with competitive sports, began to develop rapidly in eastern regions such as Zhejiang and Fujian. As of 1991, the total revenue of the Chinese sports industry was 1.6 billion yuan, with an average annual growth rate of 4.937 million yuan. Overall, it was during this period that the economic function of sport was first recognized in the country, that it formed a comparatively rudimentary industrial system in our country, and that the industrial properties of sport first emerged[17].

From 1992 to 2000, this period marked the inaugural phase of our nation's sports industry. During this time, the state clarified the direction for magnetization and industrialization of sports development, and the term "sports industry" began to appear in work reports from sports departments. The launch of the 14th National Congress of the Party in 1992 symbolized an increased intensity in reforming socialist market economic systems. In that same year, Wu Shaozu, then director of State Sports Commission proposed the famous "six transformations" at Zhongshan Conference to promote sports reform and introduced the concept of "sports industrialization" for the first time. In 1993, State Sports Commission formulated Opinions on Deepening Sports Reform which suggested including development of sports industry in overall national economic development plan. The Outline of Sports Industry Development categorized sports industry as a main category within sports work and emphasized facing market with industrialization as its direction while providing official classification for it for first time in 1995. In 1996, during National People's Congress it was proposed that "sports should take road towards socialization and industrialization". In 2000, the 5th Plenary Session of the 15th CPC Central Committee clearly recognized the sports industry as an industry capable of meeting the demand for service-oriented consumption. Overall, at this stage, both the Party and the state have become acutely aware of the economic benefits

associated with the sports industry[18]. Driven by reforms in the sports system, this industry has gradually grown and speed. Related documents and meetings have provided policy support for its development, making it a core element within the sports system alongside competitive and mass sports. The sports industry has made significant progress from its initial stages.

The period spanning from 2001 to 2013 marked the nascent stage of China's sports industry. In 2001, the development of our country's sports industry ushered in a major development opportunity. Against the backdrop of Beijing's successful bid to host the 29th Summer Olympics, the development of China's sports industry has been given great importance by government departments at all levels, the sports market system has been continuously improved, and sports consumption has become active. Related policies for the development of the sports industry have been issued by the General Administration of Sport of the People's Republic of China, and great progress has been made in planning and management practices compared with the previous phase. With the country's rapid economic development, the country's sports industry continues to expand in size and gradually become a new growth point for the national economy. The Outline of Sports Reform and Development from 2001 to 2010 proposed that "the total output value of the sports industry in our country should account for 1.5% of GDP within 10 years". In 2006, the 11th Five-Year Plan for the Sports Industry set out clear development goals to nurture the sports industry into a new growth point of the national economy. In 2007, the General Administration of Sport of China once again clarified the idea of the whole society working together to develop the sports industry. China's sports industry has grown rapidly in the wake of the Beijing Olympics. In 2010, the Guiding Opinions on Accelerating the Development of the Sports Industry was issued, which proposed the development goal of "significantly increasing the proportion of the added value of the sports industry in the GDP", and the sports industry entered a period of high-speed reform with multiple policies. In 2011, the 12th Five-Year Plan for the sports Industry proposed the development goal of "increasing the added value of the sports industry at an average annual rate of more

than 15%, and the added value of the sports industry will exceed 400 billion yuan". Overall, during this period, China's sports industry has developed rapidly and achieved remarkable achievements. Statistics show that from 2006 to 2013, the added value of the country's sports industry increased from 98.289 billion yuan to 356.369 billion yuan, an unprecedented progress compared to the previous phase[19].

The period spanning from 2014 to 2018 has witnessed a remarkable phase of accelerated growth within the Chinese sports industry. In 2014, Opinions of The State Council on Promoting Sports Consumption and Accelerating the Development of Sports Industry (State Development (2014) No. 46) was promulgated, which elevated national fitness to a national strategy and actively affirmed the positive role of sports industry in meeting people's sports consumption demand, promoting economic transformation and development, and accelerating the construction of a sports power. It has been proposed to include the development of the sports industry in the national economic and social development plans of the regions[20]. The document is a key milestone in the development of China's sports industry, with the guideline setting a development target of "the total size of the sports industry exceeding 5 trillion yuan by 2025". After that, the country's sports industry entered a high-speed development phase. In terms of growth rate, from 2014 to 2018, the nominal average annual growth rate of China's sports industry was 21.96%, far exceeding the 9.63% nominal average annual growth rate of the national economy in the same period and exceeding the 14.06% nominal average annual growth rate of the cultural industry in the same period. In terms of industrial scale, the added value of the sports industry was 404.098 billion yuan in 2014 and reached 1,007.8 billion yuan in 2018, doubling in five years. In terms of industrial structure, the proportion of China's sports industry in GDP increased from 0.63 percent to 1.12 percent from 2014 to 2018. For the first time in 2016, the proportion of sports services exceeded the proportion of sports goods and related products manufactured, ending a long period in which, the manufacturing of sports goods and related products dominated the development of the sports industry. The internal and external structures of the country's sports industry have

been continuously upgraded and optimized. In terms of industrial efficiency, the labor productivity of all employees in the sports industry in China was 94,900 yuan per person in 2014 and 227,700 yuan per person in 2018, indicating that the efficiency of the sports industry has increased rapidly. In terms of industrial system, it has basically established the current sports industry system with the common development of 11 sports industries, such as fitness and leisure, competition and performance, and venue services. Overall, during this period, China's sports industry officially entered a period of great development, showing a blowout development trend[21].

From 2019 to now, this is the sustainable development phase of China's sports industry. In line with the changes in the economic situation, the sports industry, as an important part of the "five happy industries", "six consumption fields" and the national industrial system, has gradually shifted to the direction of sustainable development after the 19th National Congress of the Communist Party of China, and the development orientation aiming at realizing the "quality and efficiency" of the sports industry from "many to good" has gradually emerged. It shows that the satisfaction of people's sports needs and industrial benefits, industrial efficiency and the power of innovation have become one of the important indicators of the development of the sports industry during this period. During this period, based on deepening the reform of the sports system, the Party and the state have continuously integrated the concepts of "innovation" and "integration" into the development of the sports industry. Marked by the issuance of Opinions on Promoting National Fitness and Sports Consumption to Promote the Sustainable Development of the Sports Industry (State Office of the People's Republic of China (2019) No. 43), the sustainable development of the sports industry entered the stage of sustainable development in 2019[22]. At this point, the rapid development of the previous phase has laid a certain foundation for the sustainable development of the sports industry. In practice, China's sports industry has accumulated a certain amount. In 2014, the total size of the sports industry was 1,357.471 billion yuan, and in 2019 it reached 2,948.3 billion yuan. In terms of industrial structure, China's sports industry accounted for

1.14 percent of GDP in 2019 and the added value of sports industry services accounted for 1.43 percent of the added value of tertiary industries. Sports, fitness and leisure activities and sporting competitions and performances showed outstanding growth. The added value of these two types of businesses increased by 542.89% and 132.51%, respectively, compared to 2015, with the proportion of sports, fitness, and leisure activities in the added value of the sports industry increasing from 2.40% in 2015 to 7.40% in 2018. In terms of industrial efficiency, the labor productivity of all employees in the Chinese sports industry reached 227,700 yuan per person in 2018, an increase of 139.20 percent from 94,900 yuan per person in 2014. In terms of industrial benefits, the contribution of the sports sector to the economy reached 3.10 percent in 2018 and the contribution of the sports services sector to the tertiary sector reached 4.89 percent. The economic benefits of the sports industry have become increasingly prominent. In terms of social benefits, the sports industry has made positive contributions to "targeted poverty alleviation" and begun to play an important role in the rural revitalization strategy[23]. So far, the General Administration of Sports has designated and acknowledged 352 national sports industry bases in 31 provinces, autonomous regions, and municipalities throughout the country. This has played a crucial role in fostering industrial agglomeration, cultivating high-quality market players, establishing characteristic industry platforms, and promoting the development of the sports industry.

In summary, the current development of China's sports industry has gradually entered the "sustainable era" from the "speed era". In the future, sustainable development will be the main direction and theme of the development of the sports industry.

Existing foreign research on the development of the sports industry has focused on the factors that influence the development of the sports industry, and most of the research has been conducted in the areas of financial policies, policies and regulations, and sports development models. Xu Tong (2008) the United States has driven the growth of its sports industry through institutional factors such as the National Hockey League, Major League Baseball, National Football League, and Major League Soccer. The UK has chosen to

encourage greater participation in sport by issuing policies and regulations such as the Future of Mass Sport and the Game Plan to clarify the division of actors and responsibilities for sporting activities[24]. In summary, to promote the development of the sports industry, most developed countries have focused on the leading role of industrial policies, implemented block development strategies, established industry dynamic evaluation mechanisms, and strengthened sports communication and consumer market development through sports events. Taking tax policy as an example, most economies implement favorable tax policies for sports industry-related activities, especially in Eastern and Western countries. Tax reduction and exemption is one of the important means to promote the development of sports. In England and France, for example, income from charitable-minded public-spirited activities is exempt from tax. In the UK, however, organizations that organize sporting events are recognized as charities if they are approved by the Charity Commission and their income is exempt from tax. Spain provides tax incentives for companies that sponsor sporting events[25].

Hyysalo S (2010) emphasized the role mechanism of user participation and adaptation and micro-innovation in the development of the sports industry[26]. Fredberg T (2011) took Adidas as an example to conduct research, and the research conclusion emphasized the essential role of innovation in the development of sports enterprises[27]. In addition, Mulligan J G (2011) found through research that at the present stage[28], some developed countries actively used advanced technologies to drive the development of sporting goods and equipment manufacturing while pursuing the industrial integration of "sports + tourism."

To sum up, within the sports industry in developed countries, the service industry dominates. Moreover, the development of sports industry generally adopts the development mode of market leading and government participation. The role of the government tends to be a service-oriented government. which supports the development of the sports industry by formulating a series of industrial plans and preferential fiscal and tax policies, while the operation and management of the sports industry are deeply

participated by mature sports social organizations.

Research by domestic scholars on the development of the sports industry has focused on the factors that influence the development of the sports industry, most of which are dominated by market mechanisms and government intervention. Ye Lin (2018) believed that the development mechanism of the sports industry is reflected in how to regulate the government's industrial management behavior, stimulate the vitality of market players, and optimize the system and system design of sports industry environment[29]. Liu Jiangnan (2001) analyzed and summarized the sociological factors influencing the development of the sports industry in developed countries, and believed that the relevant factors affecting the development of sports industry include: market economy, population growth and urbanization, abundant money, time and good infrastructure, the investment of social funds, the renewal of life concept, the government's sports policy and public legislation, it was suggested that the development of the sports industry in China requires the establishment of a supporting management and operation mechanism and the training of sports industry professionals. To realize the development of the sports industry, it is important to provide a good social and economic environment while strengthening the team building purpose of the sports industry[30]. Yang Xiaosheng (2001) analyzed the factors hindering the development of China's sports industry from the aspects of financial support and sports consumption preference[31]. Xin Li (2002) discussed the dynamic mechanism in the process of sports industrialization management in our country from the aspects of driving force of reform, government regulation and control, promoting science and technology, sports innovation, and sports business operation[32]. Liu Yuanxiang (2004) analyzed the correlation between the development of China's sports industry and the lack of effective demand from the consumption function of Keynes and the distinct influencing factors of sports consumption (consumption space, leisure time, consumption desire and sports skills)[33]. Liu Changjiang (2010) believed that cluster development plays an essential role in the formation of competitive advantages in the sports industry[34]. Zhang Shiwei (2010) based on the analysis of the current situation of China's

sports industry development and the factors of competitive advantage in the development of sports industry, combined with the theoretical advantage effect of regional "growth pole" possessed by regional central cities and the factors of serious correlation with the competitive advantage of sports industry, put forward the strategic thought of building the growth pole of sports industry in regional central cities[35]. Wang Xianliang (2010) believed that the development mechanism of China's sports industry showed obvious stage characteristics overall: it mainly went through three stages: planned management of sports industry, exploration of market-oriented management and development of market-oriented management. As the sustainable development of the sports industry has become a national strategy, the mechanism for sustainable development of the sports industry presents the development characteristics and trends of deepening reform and diversification progress[36]. Luo Jianying and Cong Huping (2011) analyzed the formation mechanism of regional core competitiveness of sports event industry from the aspects of resource flow, disposable income, hardware environment of sports event industry and labor market environment[37].

Based on the new era, China's sports industry is undergoing profound changes in its development environment and ushering in new opportunities. The sustainable development mechanism of the sports industry has also undergone new changes. Jiang Tongren (2013) summarized the development models and experiences of sports industry powers such as Europe, the United States, and Japan to discuss effective driving mechanisms for promoting sustainable development in China's sports industry through absorbing foreign advanced experience, scientific and technological innovation, reform, and carrying forward excellent traditional culture. Furthermore, to accelerate the development of the sports industry further, The State Council issued Several Opinions on Accelerating Sports Industry Development and Promoting Sports Consumption (hereinafter referred to as "the Opinions") in October 2014. These opinions extensively explored and sorted out the developmental mechanism of China's sports industry while clarifying relevant government functions, financial input policies planning structural

adjustments among other elements related to industrial developmental mechanisms[38]. At the same time, Jiang Tongren (2016) also discusses the development mechanism of Chinese sports industry based on policy adjustment[39].Guang Zhengliang (2018) analyzed sustainable developments within this sector from a perspective that considered technological progress alongside industrial integration with systematic studies conducted regarding "Internet plus" sport's industries' novel format developmental mechanisms[40]. Wang Zipu (2018) conducted a comprehensive analysis of the underlying logic of the sports industry mechanism, examining its promotion of sustainable development from various perspectives including top-level design, theoretical research, mechanisms, development environment, industrial integration, and policy[41]. Pan Wei and Shen Keyin (2022) argue that China's sports industry is driven by external forces such as economy, policy, and consumption environment while internal driving forces are reflected in technological change, industrial transformation, and format innovation[42]. He Xinjia (2022) found through research that factor productivity plays an increasingly important role in the supply-driven mechanism for current sports industry development while demand is mainly driven by urban residents' consumption and export[43].

Based on the existing research, it is not difficult to find that there is still little literature on the sustainability mechanisms of the sports industry as an independent study. Moreover, most of the research has been qualitative, and there is little literature that analyzes the related issues of sustainability in the sports industry with the help of mathematical methods. In recent years, the development of China's sports industry has shown a favorable development trend, with the industry gradually expanding in size and contributing more and more to economic and social development every year.

Luan Kaifeng (2007) believed that the development of China's sports industry has some problems, such as unbalanced distribution, few well-known brands, scarce specialized talents in senior sports industry, lag of mechanism reform, insufficient government policy research and guidance, and lag of sports industry theory research, which gravely restrict the development of China's sports industry[44]. Tian Shichang

(2009) argued that the convergence of the sports industry structure in the eastern region was obvious. In addition to Beijing, the similarity coefficient of sports industry structure in the eastern region (Zhejiang, Guangdong, Jiangsu, and Liaoning) is extremely strong, and the development of the sports service industry lags the development of the sports goods industry[45]. Liao Pei (2005) believed that the structure of China's sports industry was unreasonable, the development scale of the main industry was modest, and the development quality needed to be improved[46]. Xie Hongwei (2009) believed that China's regional sporting goods manufacturing industry was at the low end of the global value chain and had problems such as insufficient innovation ability and insufficient ability to acquire value[47]. Huang Haiyan (2016) argued that the current sports industry in China is not large on scale and has an unreasonable structure; the market players were underdeveloped; a large number of sporting resources, such as sports rights and venues, have not been developed effectively; the decisive role of the market in resource allocation has not been sufficiently exploited; the channels for social forces to participate in the development of the movement were not smooth; the mechanism by which the government promotes the sports industry is not perfect. a comprehensive and mature linkage system that spans across multiple sectors has yet to be established, accompanied by a corresponding set of challenges[48]. Zhu Qiying (2021) believed that the current sports capital market effective supply shortage, system structure deviation, risk preference dislocation and other factors restrict the healthy development of China's sports industry[49]. Xiao Jun (2021) found that the overall technical efficiency of China's sports industry was low, and most listed sports companies were in an ineffective state[50].

Fletcher J E (1989) was the first to discuss this issue. When studying the industrial effect of tourism, the article mentioned that the development of the sports industry would have a positive driving effect on economic growth[51]. Mato B (1997) found that the development of the sports industry in Croatia had a significant role in promoting economic growth[52]. Lin Xianpeng (2006) pointed out that the development of China's sports industry is subject to the influence of its stage characteristics, and it and economic

development not only promote each other but also restrict each other[53]. Zhao Nie (2009) argued that: Since the reform of the market economy in China, the macro economy has developed rapidly and people's living standards have improved significantly, which has created a decent economic foundation for the development of the sports industry. However, China's economic growth in the early years of reform and opening-up has been overly dependent on demographic dividends, foreign investment, and exports, which fundamentally determines that this growth model is not sustainable. As traditional growth engines gradually weaken or even fail, emerging industries such as sports will become the focus and breakout point for economic growth[54]. Chen J Q, Yuan J L (2009) pointed out that in the early stage, economic growth can significantly promote the development of the sports industry. However, the extent to which the development of the sports industry will boost economic growth needs to be tested further[55].

Li Na (2010) pointed out that at the present stage, with the continuous development of China's economy, the role of the sports industry in promoting economic growth has undergone structural changes compared with the past. In the early years of reform and opening-up, the per capital income of Chinese residents was relatively low, and rigid consumption such as food, housing and clothing accounted for most of the income at this time. However, due to the limited room for growth in the demand for rigid consumer goods, its share in the per capital income of residents has decreased significantly as the economy and society have continued to develop. Instead, there has been a gradual focus on consumption needs that improve quality of life, such as sports consumer goods. As a result, the boost to economic growth from the development of the sports industry at the present stage is significantly stronger than before. And it will rise again[56]. Jie Yunfeng (2010) argued that: Before China's entry into the WTO, the interdependence between the development of the sports industry and macroeconomic growth was mainly reflected in the fact that economic growth built an economic foundation for the development of the sports industry[57]. As a result, it has a huge driving effect on household consumption and export production, and then it becomes an essential link in economic growth.

Zhang Ruilin (2011) made a detailed statistics and description of the national sports statistical survey conducted by the General Administration of Sport of China from 2006 to 2008. The added value of sports-related industries in China reached 98.3 billion yuan in 2006, or 0.46 percent of annual GDP, the article noted. In 2007, this figure accounted for 0.49% of GDP, with a growth rate of up to 23% on a comparable statistical scale; In 2008, its share of GDP exceeded 0.5 percent for the first time, reaching 0.52 percent with a year-on-year growth rate of 16 percent. This series of indicators shows that the driving effect of the development of the sports industry on economic growth has become increasingly significant[58].

Yu Zhenfeng (1998) have pointed out that China's sports industry has made significant progress during the 20 years of reform and opening, with a relatively high growth rate of sports consumption compared to the average macroeconomic growth rate, indicating an increasingly prominent role in the national economy. However, there are still several structural issues reflected in sports consumption at this stage that require attention from the government: firstly, sports consumption remains a small part of GDP; secondly, compared to foreign developed economies, the type of sports consumer goods is too monolithic and not conducive to industrial diversification; thirdly, the development of related industries for sports-related consumption remains low and their potential has yet to be fully tapped. Therefore, it is crucial for both government finance departments and National Sports Commission to prioritize adjusting the structure of China's sports industry over time by promoting its diversified development while stimulating related service industries' long-term healthy and rapid growth[59].

Ji Jianqiu and Chen Yingchuan (2001) examined the correlation between sports consumption and the sports market, concluding that: Currently, China's sports market is in its nascent stage. Therefore, to promote healthy development of the entire sports industry and effectively stimulate residents' interest in sports consumption, it is necessary to first study and segment the sports market, identify different consumer groups, expand market space, explore potential markets, and create a reasonable path for diversified

development of the sports industry[60].

Lian Guihong (2002) approached the issue of aggregate volume and highlighted that, despite entering the current century, China's sports industry consumption has yet to exceed 0.5% of GDP. The author further delves into this matter by acknowledging the rapid growth in per capita income levels since market economy reforms; however, this has resulted in a structural problem of significant income disparity[61]. Nevertheless, intrinsic properties govern sports industry consumption and cannot be expanded through individual wealth accumulation alone. Therefore, it is imperative for governments to address various issues such as large income gaps and dual urban-rural economic structures during economic development.

Wang Wenfeng and Guo Xiting (2004) have emphasized the crucial role of sports industry consumption in driving long-term economic growth[62]. However, sustained government support is still necessary for the development of China's sports industry, which is constrained by limited overall sports consumption, a narrow range of consumer options, and incomplete development of related industries

At the export level, sporting goods play a crucial role in driving economic growth. According to KSA's 1998 survey data, China emerges as the dominant producer, exporter, and processor of sporting goods worldwide, commanding an impressive global production share of up to 65 percent. In 2003, sports goods exports accounted for a substantial 1.8 percent of China's total exports, surpassing the sector's contribution to GDP. These findings underscore the influential impact of Chinese sports manufacturing on our nation's export trade[63-65].

QiaoYu (1998) conducted a quantitative analysis on the driving effect of export trade on economic growth and found that from 1982 to 1994, export trade played a significant role in promoting economic growth. However, during this period, the sporting goods processing industry was still in its infancy and did not make a significant contribution to export trade[66]. XU He-lian and AI Ming-yong (2002) further researched this topic and discovered a stable connection between export growth and economic growth.

Nevertheless, there was only one conditional equation reflecting that exports were the Granger cause of economic growth[67]. Zhang Xiaoxia (2007) pointed out that although sports goods processing and sports goods exports have an obvious impact on China's economic growth, it is necessary to treat this issue rationally due to China's sustained high-speed economic development since the reform and opening thirty years ago as well as gradually losing demographic dividends at present stage[68]. To ensure long-term sports industry exports drive economic growth, it is essential to modify traditional sports consumer goods' operation mode for exporting trades so that the country's sport exports can transform from processing exports into self-owned brand exports.

Feng Guoyou (2007) emphasized that for the sustainable development of the sports industry, it is imperative for government financing to effectively guide resource allocation. Without such guidance, China's sports consumer goods manufacturing sector will remain reliant on outsourced processing and export models[69].Only through substantial government investment can we foster research and development of domestic brands, facilitate brand exports, and establish a more inclusive model for sports goods exports. Furthermore, this approach will contribute to the growth of China's high-end sub-sports industry, enhance the global recognition of Chinese sports within international sporting communities, and drive comprehensive industry advancement.

Based on a comprehensive analysis of the developmental characteristics of China's sports industry, Shi Yan (2014) provides a detailed explanation that highlights the role of the sports industry in driving rapid socio-economic progress in China[70]. Fosters healthier and faster growth within the sports industry itself while yielding enhanced social and economic benefits. It is believed that promoting the development of this sector will contribute to stimulating national economic growth, facilitating industrial structural adjustments and optimizations, improving employment opportunities for society at large, and ensuring sustained economic and social stability in China. Xu Zhengdong and Chen Xi delve into the fundamental essence of China's sports industry by examining its economic and social benefits as well as its impact on ecological environments. They

explore ways to effectively promote both economic and social development while fostering sustainable outcomes within modern sports industries[71].

Through the classification and analysis of relevant literature, the following conclusions have been drawn: The continuous development of the Chinese sports industry has established its integral role in driving economic growth through exports, consumption, investment, and various other channels. However, research on the domestic sports industry remains relatively sparse and lacks depth. Particularly, there is a dearth of unique research that provides systematic definitions and generalizations. While recognizing the importance of marketing communication to enhance the industry's development and strengthen theoretical foundations, insufficient attention has been given to this sector. Therefore, it is imperative to explore how to establish comprehensive and targeted management research for sustainable development within China's sports industry. By defining concepts accurately, determining developmental trajectories based on practical experiences, analyzing theoretical frameworks and disciplinary backgrounds related to these practices while summarizing their generality and developmental processes as models; we can enhance both influence and competitiveness within China's sports industry.

1.2 Conceptual Approaches to the Implementation of Components of Sustainable Development in the Sports Industry

International academic research on sustainable development is mainly conducted in the following directions: from the perspectives of ecology, sociology, economics, science and technology, and systems theory. Ecological research is one of the earlier disciplines to conduct research on sustainability issues[72]. It is generally believed that ecological research in the direction of sustainable development takes ecological balance, nature protection, sustainable use of resources and environment as the basic content and tries to "achieve a reasonable balance between environmental protection and economic development" as an important indicator and basic principle of sustainable development.

Therefore, sustainable development is defined in the World Conservation Strategy as the maintenance of basic ecological processes and life support systems, the preservation of genetic diversity, and the sustainable use of species and ecosystems[73, 74]. From this perspective, it is widely believed by scholars that agricultural systems, forests, coastal and freshwater systems are the most important life support systems for humans, and at the same time, they are facing the greatest threats. If economic development is to be sustainable, the necessary condition is that the ecosystems on which economic activity ultimately depends must be sustainable. The economic research direction of sustainable development takes regional development, productive forces layout, economic structure optimization, material supply and demand balance as the basic content, and focuses on "the contribution rate of scientific and technological progress to offset or overcome the marginal efficiency decline rate of investment." This direction is represented by the World Bank's World Development Report and some economists. The World Bank defines sustainable development as "development based on cost-benefit comparisons and prudent macro analysis that enhances environmental protection and leads to the improvement and maintenance of welfare levels." Among mainstream economists, it is Mr Solow, the guru of growth economics, who has said most about sustainability. In his view, capital, resources, and human capital are all replaceable, so the destruction of certain ecological elements does not necessarily harm the future welfare of humanity. In recent years, mainstream economics has changed, and their views have converged with those of non-mainstream economics. The LSE is currently the most active and influential non-mainstream economics research center on sustainable development. The school believes that development cannot be described by the growth of gross national product (GNP), that development is more concerned with the quality of life, such as education, nutrition, personal freedom and spiritual happiness, than growth, and that sustainable development implies the need for a policy effort that makes such development goals infinitely sustainable. Sociological directions in the study of sustainable development[75]. In the view of sociology, inequality in income distribution and inequality between the rich and

the poor are the main causes leading to unsustainable social economies[76]. Barbier understand sustainable development as "the ability to maintain desirable social values, traditions, institutions, cultures or other elements of society"; brown proposed that social sustainability is the normal operation and existence of social infrastructure (transport and communication), service facilities (health, education, and culture) and government (agreements, laws and their implementation)[73]. While Tindell (2018) considered social sustainability to be the sustainability of political and social structures, Norgaard added cultural sustainability to the list of predecessors, primarily including the sustainability of values and belief systems[77]. The Human Development Report, compiled under the auspices of the United Nations Program, uses the Human Development Index as a measure of social development, which fully demonstrates the wide recognition and significance of this research direction. Scientific and technological research for sustainable development attaches great importance to the role of scientific and technological progress and emphasizes that without the support of science and technology, sustainable development of humanity will not be possible. The excitement in this research direction, which focuses on sustainable processes and technologies, is clear from its provisions on sustainability on behalf of the World Resources Institute and several experts. The World Resources Institute defines sustainable development as "the establishment of processes or technological systems that produce little waste and pollutants". Some scholars believe that sustainable development is to shift to cleaner and more efficient technologies, using as close to "zero emission" or "closed" process methods as possible, to reduce the consumption of energy and other natural resources. Some scholars have proposed that sustainable development is the establishment of processes or technical systems that produce few wastes and pollutants[78].

In their view, pollution is not an inevitable result of process activity, but rather a manifestation of poor technology and low efficiency. The systematic direction was initiated by Chinese scholars. The focus is on sustainable development as a global, integrated, and systematic project. Fairness in sustainable development should be

maintained, and all-round coordination is required. Sustainable development should reflect the harmonious balance of the two fundamental relations between man and nature and between man and man, which have their specific manifestations in the system of sustainable development[79]. From the standpoint of systematics, the sustainable development system consists of five support systems that are closely related to each other, namely, the survival support system, the development support system, the environmental support system, the social support system, and the intellectual support system. Of these, the first three subsystems are the embodiment of the relationship between man and nature, and the other two subsystems are manifestations of the relationship between man and man. The formation of sustainable development capacity must "simultaneously" depend on the joint contribution of these five support systems. If any one of them fails, the overall sustainable capacity is compromised until the sustainability system breaks down. These different directions of sustainability research do not imply a fundamental antagonism between individual theoretical claims. Instead, they represent different phases and different aspects of sustainable development theory and practice, and jointly explore the comprehensive, complex, extensive and systematic features of sustainable development as a process of contemporary transformation of human society[78, 80].

The problem of sustainable development of the sports industry has been paid increasing attention by scholars in our country and gradually become a research hotspot. To verify this hypothesis, the year and the number of relevant papers published each year are taken as parameter variables, and the year 2018 is taken as the starting point to establish a database with the data retrieved from CNKI, establish relevant regression equations, and predict the results in 2024，the data and results are shown in Table 1.2:

Table 1.2 Table of the number and annual relationship of papers related to sustainable sports development

Year	2018	2019	2020	2021	2022	2023…..	2024	p	
Number of papers published	65	80	88	139	199	280	382	—	
Equation of regression	$Y=84235.6+42.114x$							0.05	

Source: The data were acquired through a comprehensive search of the Chinese

Journal Full-text Database on April 17, 2023 (http://www.cnki.net).

As can be seen from Table 1-2, the closer to the 12th World Games held in Chengdu in 2025, the more relevant papers there are, and the regression equation between the number of papers and the time is established, and it is found that the correlation is extremely significant, with a linear positive correlation. Using the regression equation, the number of such papers is predicted to reach 382 by 2025. The hosting of the World Games has become one of the reasons why academics focus on the sustainable development of the sports industry, which is likely to reach its peak by 2025. The second reason why the sustainable development of sports in our country has become a hot topic is that the academic community in our country is focused on sustainable development. To test this hypothesis, the published sports sustainability research papers (N; denotes), and the total number of papers on sustainability published in all journals (denoted by N_2). Use the data to build a database and then conduct a correlation analysis,The results are shown in Tables 1.3.

Tables 1.3.-Table of correlation numbers between sustainability journal literature and related sports industry literature

Y	2018	2019	2020	2021	2022	2023	The correlation coefficient between Y and N1	0.9492
N1	65	80	88	130	199	280	The correlation coefficient between N_1 and N_2	0.9957
N2	10875	11275	12245	14210	21073	27104	The correlation coefficient between Y and N_2	0.9174

Source: The data were acquired through a comprehensive search of the Chinese Journal Full-text Database on April 17, 2023 (http://www.cnki.net).

The correlation coefficients presented in Table 1.3 demonstrate a strong association between the sustainability-related sports industry categories and all journal categories, with the highest coefficient indicating the total number of such categories. This statistical

evidence confirms that research on the sustainability of the sports industry is significantly influenced by academic trends. Furthermore, this analysis suggests that scholars have increasingly focused on this topic in recent years, as evidenced by their publication patterns. Notably, China's General Administration of Sport has emphasized sustainable development as a key direction for social science research projects related to sports.

Research into sustainable development in our country started in the late 1980s. In the research field, while learning from foreign research ideas, there have also been innovations, and research directions recognized by international academia have been further studied in China. For example, Zeng Qingcun (1996) member of the Chinese Academy of Sciences, proposed natural cybernetics[81]. It explores the rational and coordinated development of human activities and the natural environment with the help of the achievements of natural sciences and technological sciences. Wang Huijiong (1999) the Development Research Center of the State Council focuses on sustainable development from an economic perspective, particularly highlighting the impact of economic structure on the sustainable development of the economy[82]. The innovation is twofold. First, scholars in the country have opened and deepened the systematic direction of research on sustainable development. Second, it strengthens and enriches the basic theory of sustainable development philosophy. The systematic direction of sustainable development research, pioneered by Niu Wenyuan (2008) and others at the Center for Sustainable Development Research of the Chinese Academy of Sciences[83], features the use of systematic theories and principles to explore the origin and evolution of sustainable development. The mutual adaptation and co-evolution between man and nature is the "external condition" for the sustainable development of human civilization, while the correct handling of the relationship between man and man is the "internal condition" for the continuation of human civilization. The essence of sustainable development is to reflect the harmonious balance of the two fundamental relations between man and nature and between man and man, which have their specific manifestations in the system of sustainable development. Liu Peizhe (2004) the research

project "Theoretical Research and System Analysis of Sustainable Development". From China Agenda 21 Management Center belongs to another branch and achievement of the systematic direction of sustainable development research[84]. First, its contribution is to give a new connotation to sustainability from the point of view of 3D composite systems. In their view, the so-called sustainable development refers not only to economic development, social development, and environmental protection, but also to the composite system of the three-dimensional structure of "economy, society and nature". The characteristics of this development model can be summarized in three points: economic growth as the premise, conservation of nature as the foundation, and improvement and enhancement of social quality as the purpose. Another contribution of Liu Peizhe et al. is to present for the first time the concept of sustainable development management, emphasizing the importance of management in the practice of sustainable development. They gave a new orientation of the theory of sustainable development, holding that the theory of sustainable development reveals the evolution law of "economy-society-ecosystem" from the perspective of comprehensive strategy and the height of management decision-making, puts forward the regulation principle and method of "economy-society-ecosystem", and guides the "economy-society-ecosystem" to sustainable development. Thus sustainability theory can also be called the management science of composite systems of 3D structures. To properly manage this system and achieve sustainable development, some basic principles must be followed, namely, the principle of symbiosis, the principle of circulation, the principle of constraint and the principle of substitution and transformation. From the above-mentioned theoretical perspectives, they elaborated on the general policy priorities and priorities for achieving sustainable development in our country and put forward concrete proposals to move our country towards sustainable development.

Although the sustainable development system for the sports industry was proposed only a few years ago, research in this area is already lagging. Consequently, it is not surprising that there is a dearth of studies on the sustainable development system specific

to the sports industry. A literature review reveals that only Pan Yingxu and Zhong Bingshu (2004) have mentioned the term 'sustainable development system of sports industry[85]. It becomes evident that the author has provided a concise discussion on both the structure and essence of our country sustainable development in the sports industry. While comprehensiveness and rationality are not paramount, these ideas introduce novel concepts.

However, in accordance with the fundamental principles of systems theory, once the concept of the system has been defined, the object of investigation clarified and the scope established, it is necessary to examine the elements of the system and identify their interrelationships as well as those between different systems. This will enable us to determine its structure, function, and relationships so that we can study how materials, energy and information are exchanged within a system. By conducting a comprehensive analysis of these factors and how they form an organic whole with specific functions, we can develop an evaluation system that reflects both its structure and function for effective management and control. A review of literature reveals that research on competitive sports index systems in our country has only focused on topics such as Liu Zhimin's & Yu Zhonggan's (2002) sustainable development evaluation index system for competitive sports or Chen Po (2007) construction of an evaluation index evaluation system for sustainable development in this field. The former addresses the construction of evaluation indices[86], while the latter establishes a comprehensive index system and determines index weights through the Delphi method[2]. However, such an indexing system serves only as a tool and cannot achieve what an evaluation indexing system truly aims to accomplish - evaluation. This is a common issue in developing moving indicator systems, which focuses solely on constructing indicators without considering their ability to efficiently evaluate data. Limited research exists on sustainable development systems for sports, indicating that this field is still in its early stages.

Sustainable development represents the optimal model and ultimate objective for advancing the sports industry, necessitating a comprehensive understanding of both

natural and societal laws that are intertwined with their own internal mechanisms. However, previous theories and research methodologies on sustainable development have failed to adequately address the issues at hand, reflecting both the complexity of sustainability itself as well as the need for further theoretical exploration. The integration of systems science into sustainable development research has opened up new avenues for inquiry that hold strategic significance in both theory and practice, leading to novel theories on sustainable development within our country's sports industry.

From a systems science perspective, the sustainability of the sports industry hinges on effective coordination between the sports industry system and the social environment system. Both systems are complex and massively open, with interconnections, constraints, interactions, and close links. Social environmental factors such as politics, economy, culture, science and technology exert significant influence on the functioning and structure of sports systems. The overall system of sports sustainability encompasses not only the sports system itself but also its dependence on social and geographical environmental systems. Therefore, achieving sustainable development in the sports industry requires an understanding of this open and complex system through a specific directive function provided by systems science.

Firstly, the investigation into the sustainability of the sports industry necessitates guidance from system theory, specifically focusing on the theory of open complex systems and its associated methodology. As an intricate problem within an open complex system, a methodological foundation for systematic research on sustainable development in the sports industry is established through a comprehensive integration approach that progresses from qualitative to quantitative analysis.

Secondly, the sustainable development system of the sports industry shares common characteristics with general complex systems, namely comprehensiveness, systematicity and dynamism. From a systems science perspective, this necessitates that research on sports sustainable development should first draw upon knowledge from multiple disciplines such as natural sciences, social sciences and engineering technology

while also incorporating human wisdom and experience. Additionally, it is imperative that the sustainable development system of sports considers the interrelatedness and coordinated development of economy, society, resources, and environment in a comprehensive, holistic and systematic manner.

The theory and methodology of the sustainable development system in the sports industry should be gradually established, serving as a fundamental framework and tool for researching and implementing descriptive, systematic evaluation, predictive, control-oriented, managerial, monitoring-based, and decision-making approaches towards sustainable development in this sector. Following the general model theory of systems, systematic research on sustainable development in the sports industry can be categorized into three aspects: firstly, a comprehensive analysis and evaluation process of sustainable development; secondly, an effective management and decision-making process for promoting sustainability. Thirdly, an information feedback mechanism to support continuous improvement within the system.

The evaluation process of sustainable development in the sports industry involves establishing a comprehensive set of evaluation indices for the sports system, employing scientific and systematic evaluation methods to assess the current state and level of regional sports industry's sustainable development, predicting its future trends, potential, and capacity for sustainable growth. Based on this analysis, identifying factors that impede the industry's sustainability is crucial. This approach aims to provide objective and scientifically sound information to support capacity building and strategic planning within the regional sports industry.

The management and decision-making process for sustainable development in the sports industry involves gathering and processing information from each subsystem and its evolution, analyzing interactions within and between subsystems as well as with the external environment, establishing a coordination mechanism for sustainable development systems, and achieving coordinated development of subsystems at different scales to optimize overall sustainability.

The information feedback process of the sports industry's sustainable development system involves adjusting the future system's behavior based on current situation evaluation and empirical analysis, establishing feedback mechanisms within each subsystem and the entire sustainable development system. This is primarily achieved through economic, legal, administrative, and educational adjustment measures to ensure that the system's development trajectory aligns with sustainable development goals.

The sustainable development of sports industry is a highly complex problem involving many social fields, which is destined to make the research and practice of the sustainable development of sports industry a complex social system engineering, which makes the research and practice of the sustainable development of sports industry have the following characteristics of system science:

The connotation of sustainable development in the sports industry is multifaceted and complex, making it difficult to describe and determine system goals. In managing, controlling, evaluating, and decision-making within the system, a single criterion is often insufficient; multiple criteria must be used based on time and place. These criteria may even conflict with each other at times. For instance, when sports have political needs, economic benefits are not the only measure of success; instead, economic interests take precedence over political significance.

Due to the intricate and dynamic nature of the sports industry's sustainable development, it is challenging to construct a mathematical model using a single modeling method and acquire relevant data, thereby making it exceedingly difficult to address its current state. For instance, when examining the impact of political factors on our country's sports sector, obtaining suitable quantitative data proves arduous. Politics primarily manifests through document formulation, policies, and regulations; thus, we can only access the number of pertinent policies and regulations. However, this numerical representation fails to reflect the gravity of their influence; instead, it is the extent and breadth of their impact on sport that truly signifies their significance.

The application of quantitative analysis tools in system analysis and research poses

significant challenges, particularly due to the difficulty in establishing a standardized index system. Consequently, technical obstacles are likely to arise. To address the complex challenges facing sustainable development in the sports industry, it is imperative to effectively integrate knowledge, experience, models, and data.

Therefore, in the study of sport sustainability, it is imperative to focus on these characteristics to consciously apply systematic scientific theories and methods to guide research. Defining a system is the initial step in studying it, serving to clarify the objects of investigation and establish the scope of inquiry. In this study, the sustainable development system for the country's sports industry encompasses policies and regulations, population demographics, economic factors, scientific and technological advancements, resource allocation, as well as additional subsystems. The external environment includes political climate, economic conditions, cultural influences, scientific progress, and environmental resources; while competitive sports industry and mass sports industry serve as core components that exchange material energy and information with each subsystem before transferring absorbed elements to promote stable growth within both sectors. Ultimately achieving full human development requires an interconnected mesh layer of subsystems surrounding macro-layered external environments with micro-layers at its core consisting of both mass sports industry and competitive sports industry.

1.3 Methodological Framework for Evaluating the Efficacy of Sustainable Management in the Sports Industry

Theory of multiplier. Song Guangchun and Yan Bin (2006): China's sports industry emerged in the sports industry plays a pivotal role in national economic development[87]. Over the past three decades, the industrial framework of this sector has been essentially established, particularly experiencing remarkable growth after the 2008 Beijing Olympic Games. A conducted by Shi Bing (2002) revealed that the Beijing Olympics would

generate two million job opportunities, increase tourist numbers by 20%, and boost residents' average annual income by $2 billion. Presently, the sports industry has become a new driving force for national economic growth [88].

The multiple multiplier theory is one of the most commonly employed theories to examine the relationship between sports industry and economic growth. The multiplier represents how changes in discretionary spending lead to changes in national income. It is widely believed that British economist Professor Kahn first introduced this concept in his renowned article "The Relationship between Domestic Investment and Unemployment Rate" published in 1991[89]. However, its earliest origins can be traced back even further! As early as the 1880s, British economists referred to this concept when developing demand theory: "In an economic system, each that one person's loss spreads like a multiplier." Additionally, it takes time for downturn within any major trading market to fully manifest its impact as it must circulate among sectors before reaching completion. Following Berger's initial work on multipliers came numerous other scholars who further explored this concept. The multiplier model was examined by economist Joe Himes in the 1930s, who put forward the principle of multiplication.

British economist John Maynard Keynes formulated the multiplier theory based on Kahn's (1931) research, specifically focusing on aggregate demand and income generation in order to explore and quantify the relationship between demand, input, and income within the sports industry. The employment creation theory plays a pivotal role in macroeconomics, particularly in relation to the sports sector. In this context, the essence of the multiplier theory lies in its ability to trigger an expansionary movement that impacts not only sporting goods but also stimulates overall economic growth[89]. It is important to note that multiplier theory encompasses both an increase in effective demand for sports products as well as a rise in income and within the sports industry itself.

A simplified model of the multiplication theory. In the sports industry, a simplified model of the multiplier effect is shown in formula (1.1) through formula (1.6). Y represents the total output caused by the sports industry, and $\triangle Y$ represents the added

value of the total output. I represents independent expenditures in the sports industry that do not depend on national savings, such as investment expenditures; $\triangle I$ represents the increase in investment expenditures in the sports industry; K represents the multiplier, S represents the marginal consumption propensity of the sports industry. Formula (1.1) is the definition of the multiplier, which shows that the increase of the total output of the sports industry is the product of the increase of the multiplier and the increase of the investment expenditure of the sports industry, so the multiplier is the ratio of the increased resident income to the increase of the investment expenditure of the sports industry. For example, when the revenue multiplier of the sports industry is 5, it indicates that an additional $1 million in investment spending in the sports industry can increase the national economic income by $5 million. Formula (1.2) is derived from formula (1.1), which shows that the increased investment expenditure in the sports industry is the ratio of the increased income to the income multiplier. Formula (1.3) is the definition of marginal consumption tendency, that is, the marginal consumption tendency of residents in the sports industry is equal to the ratio between the increased consumption of sports products and the increased output, that is, the impact on sports consumption when the total output of sports increases by $1. Formula (1.4) is derived from formula (1.3), which shows that the increased sports industry consumption expenditure is the product of the increased sports output and the marginal propensity to consume of the sports industry. Formula (1.5) is the definition of sports incremental output, which is the sum of the increase in sports investment expenditure and sports consumption expenditure. Formula (1.6) can be obtained by bringing formula (1.2) and formula (1.3) into formula (1.5). Formula (1.7) can be obtained by canceling the AY on both sides of formula (1.6), and formula (1.7) can be deform (1.8), that is, the relationship between the multiplier and marginal propensity to consume. The meaning of formula (1.8) is that, for example, when S is 0.8, when the total output of sports increases by $1, the consumption of sports products will increase by $0.8. At this time, the multiplier can be calculated by formula (1.8) as 5, that is, an increase of $1 million in the investment expenditure of sports industry can increase the national

economic income by \$5 million. Since the marginal propensity to consume is general less than 1, the multiplier is generally greater than 1. In other words, the increase in investment in will result in a twofold rise in national economic income. If we have knowledge of the value of marginal propensity to consume sports products, we can calculate the sports industry multiplier using equation (1.8).

$$K = \Delta Y / \Delta I \quad (1.1)$$

$$\Delta I = \Delta Y / K \quad (1.2)$$

$$S = \Delta C / \Delta Y \quad (1.3)$$

$$\Delta C = S \Delta Y \quad (1.4)$$

$$\Delta Y = \Delta I + \Delta C \quad (1.5)$$

$$\Delta Y = \Delta Y / K + S \Delta Y \quad (1.6)$$

$$1 = \frac{1}{K} + S \quad (1.7)$$

$$K = 1 / (1 - S) \quad (1.8)$$

The concepts of investment multiplier and consumption multiplier are currently under study. Keynes (1936) posited that, given a constant marginal propensity to consume, an increase in investment would result in a doubling of income and employment or gross national product (GNP). This theory suggests that exogenous investment or government expenditure can amplify the final total investment or expenditure times over [90]. For instance, if the government increases financial expenditure for hosting a major sporting event (such as an international tournament), the relevant enterprises involved in organizing the event will hire more employees and provide higher wages. Consequently, this rise in purchasing power and wage payments will lead to increased consumption expenditure. Wang, Xu & Liu (2010) argue that this iterative feedback mechanism ultimately leads to output expansion. Thus, initial fiscal expenditures by the government generate a multiplier effect on the economy, resulting in multiple times stimulus impact[91].

The economic impact of the sports industry is magnified through a multiplier effect.

Li Jianshe (2004) defines industry as the integration of all enterprises involved in sports-related business activities. These activities encompass both production and service of sports products[92]. According to Yang Ming and Wang Xinping (2009), prominent figures in modern economics, consumption serves as a driving force for promoting sustainable national economic development[93]. In general, an expansion in total output can lead to prosperity in the market for sports consumer goods. The increase in sports consumption will further impact total output, generating a multiplier effect that stimulates regional analysis is provided below:

First, according to general Equilibrium theory, prices and quantities in product and factor markets are determined by supply and demand curves. The supply and demand curves phase and shift to an equilibrium point, where the price corresponding to the equilibrium point is the equilibrium price and the quantity corresponding to the equilibrium point is the equilibrium quantity. The whole economy tends to move towards equilibrium, and changes in supply and demand may disrupt this equilibrium, shifting the supply or demand curve and eventually reaching a new equilibrium. Elasticity is an important concept in general equilibrium theory.

The concept of elasticity refers to the responsiveness of the dependent variable to changes in the independent variable. Essentially, it quantifies the percentage change in one economic variable that leads to a change in another. Notable elasticities in economics include supply price elasticity, demand price elasticity, and demand income elasticity among others. By examining income elasticity of demand, we differentiate between normal goods, inferior goods, luxury goods, and necessities. Specifically, income elasticity of demand measures the sensitivity of demand to changes in income by quantifying the percentage change in demand resulting from a 1% change in income level (Equation 1.9). Within the context of the sports industry, E represents the demand income elasticity for sports products while Q denotes the quantity demanded for such products. ΔQ signifies any observed changes in sports product demands whereas Y indicates levels of income and AY captures variations within those level. When the demand income

elasticity of sports products is greater than 0 and less than 1, it means that the commodity is a necessary product among normal goods, that is, the increase of income will lead to the increase of demand, but the increase percentage will be smaller than the increase percentage of income. When the income elasticity of sports product demand is greater than 1, it means that the product is a luxury among normal products, that is, the increase of income will lead to the increase of demand, and the increase percentage even exceeds the increase percentage of income. When the demand income elasticity of sports products is less than 0, it means that the goods are inferior, that is, the increase of income will lead to the decrease of demand. Jia Zhenjia (2002) believes that generally speaking, sports consumer goods belong to the category of normal goods with the increase of residents' income level, the demand for sports consumer goods will increase [94]. With the decline of residents' income level, the demand for sports consumer goods will decline. The demand income curve of sports consumer products is shown in Figure 1.1. Therefore, sports consumer goods and national economy are growing synchronously, and the improvement of national income level will bring the growth of sports consumer goods market.

$$E = \frac{\Delta Q/Q}{\Delta Y/Y} \quad (1.9)$$

Furthermore, the growth of the sports industry can significantly stimulate national consumption. Sports consumption encompasses not only state-related expenditures, such as those on raw materials and human capital during the construction of national sports venues but also includes a wide range of expenditures by enterprises and individuals. According to Yang Ming and Wang Xinping (2009), as the economy has residents' consumption patterns have shifted from basic necessities towards entertainment and enjoyment[93]. Consequently, sports-related consumption (such as attending sporting events or purchasing sports goods) has been increasing annually. For instance, within the national economy, Olympic Games-related spending plays a significant role in promoting economic development. Fang Fuqian (2004) argued that in the short term, the Olympics substantially level domestic and foreign companies' investment expenditure levels, as well

net exports for the country; in the long term, infrastructure development like Olympic venue construction along with technological innovation and increased employment rates also contribute significantly to macroeconomic growth[95]. Moreover, Olympic consumption serves as a guiding force for both shaping future directions for the national economy.

Thirdly, the expansion of the sports industry can generate a significant multiplier effect on consumption. Numerous previous demonstrated that sports consumer goods are classified as normal goods, with an income elasticity of demand between 0 and 1. Chen Wei and Xu Jiapeng (2005) argue that given the marginal propensity to consume falls within this parameter range, equation (1.8) implies an output multiplier exceeding 1. Therefore, mathematical analysis clearly the sports industry can yield a substantial consumption multiplier effect. In the short term, the magnitude of this multiplier relies on the marginal propensity to consume. To enhance this consumption multiplier effect, public demand for consumption can be moderately guided[96], thereby precisely augmenting short-term changes in marginal propensity to consume through fostering in the sports industry. the sports industry will stimulate increased expenditure on sports-related products among consumers, which will subsequently elevate residents' marginal propensities to consume and ultimately exert a systemic impact on total, Tan Jianxiang (2002) pointed out pronounced regional disparities in China's sports industry development; while rapid progress is observed in eastern regions, central and western regions significantly lag behind. Moreover, there exists a conspicuous phenomenon of cross-domain consumption within China's sports industry primarily due to hosting large-scale sporting events across different regions. This spatial transfer of expenditure related to sports enables the generated multiplier effect by the sector to operate across diverse areas and consequently establish poles for consumption growth driving overall economic expansion.

The various forms of inter-industry connections. Since the pioneering research of Rasmussen (1956) and Chenery and Watanabe (1958), a multitude of scholars have

employed input-output technology to examine the interdependence between economic sectors and formulate development [97, 98]. As an emerging industry, the sports industry its potential as a new driver of national economic growth due to its ability to attract substantial investments and consumption. Moreover, the growth rate of sports industry's added value has significantly outpaced that of GDP, while exhibiting strong industrial correlations. According to Lin Xianpeng (2006) calculations based on the Leontief function in Beijing, Liaoning, Sichuan, Yunnan, Guangdong, and Anhui provinces (and municipalities directly under central government administration), by 2010 the sports industry could potentially drive GNP up 660.467 to 185.735 billion yuan[99] .

At present, the research on the correlation between sports industry investment and economic growth is in depth, and the research is mainly as follows:(1) the analysis of the change characteristics of sports industry investment;(2) the analysis of the correlation between the speed of sports investment growth and economic growth rate; (3) the systematic impact of sports investment risk on economic growth.

In the first aspect, many scholars have done a lot of research. Wang Lingling (2006) pointed out that in recent years, the investment of China's sports industry has developed rapidly, especially the investment in leisure sports industry has gradually become a new growth point of investment in this field. Tian Zuo (2009) on this basis of the further study, The results found that the wide audience, Stable cash flow recovery and other factors are the leading reasons for the increasingly rich investment in leisure sports, However, it should be noted that, Although the proportion of leisure sports investment in the sports industry investment and even in the process of national investment is increasing, But it still has no shape, the reason for a larger scale is that its capital recovery cycle is longer, Uncontrollable risk cause, which is relatively large, And it also faces structural problems such as financing difficulties. Chen Qing (2008) further pointed out: if you want to expand the investment in the sports industry, it is bound to develop the concept of whole, people fitness and national sports, so that the broad masses of the people can participate in sports activities, popularize sports knowledge and promote more inclusive sports culture.

As for the connotation of China's sports industry, the mainstream views can be found through consulting books and literature. The scholar Zhang Yan (2020) believes that the sports industry refers to the comprehensive component of all the production, management and activity units related to sports[100]. Guo Qiang(2020) believes that in western developed countries, the sports industry has become the domestic pillar industry, accounting for a large proportion of the national economy, the American sports industry is more developed, the sports industry mainly by fitness and entertainment industry, professional sports, sports industry and sports brokerage and several parts, are according to the needs of consumers and the market, to provide high-end consumer goods for sports[101]. Germany is a major economic power in Europe, and the sports industry is also in a pillar position in the German national economy. Wu Feng introduced the development experience of the sports industry in the United States, the United Kingdom, Germany and South Korea and other countries, and summed up the enlightenment for the development of China's sports industry. First, we will use tax policies to regulate the orderly development of the sports industry. Second, vigorously develop sports events to promote the rapid development of the sports industry. Third, to use the development of the club to improve the enthusiasm of residents to participate in sports. Fourth, we will use the "Internet + technology" to promote the development of the sports industry. She qi pointed out that under the new normal economy, the disadvantages of the traditional economic growth mode have gradually emerged, and accelerating the economic structural adjustment and reform is the focus of the current economic reform[102]. Jin Yinghua scholars believe that, China's domestic sports industry market development started late and small scale, With the recent years due to China's economic and social and national economic stimulus, Therefore, the sports industry has also achieved a very good and rapid development, Recently, the development scale of China's sports industry is also continuing to expand rapidly, In 2011 to 2014, the highest average annual economic growth rate of the economic added value of China's sports industry was 12.74%, respectively, obvious, Its growth rate was faster than its GDP growth rate in that year,

How the development of China's sports industry will continue to develop rapidly in the future has gradually become an important strategic hot spot to directly promote the healthy development of China's domestic sports industry market[103].

On the theoretical basis of in-depth analysis of the development characteristics of China's sports industry, Wang Peng explained in detail that the sports industry plays a role in promoting the rapid development of China's social economy, which can then promote the better, faster and healthy development of China's sports industry and obtain better social and economic benefits. It is believed that promoting the development of the sports industry will be conducive to promoting and driving the growth of the national economy, promoting and driving the adjustment and optimization of China's industrial structure, promoting the improvement of the employment level of social labor, and maintaining China's economic and social stability. Cong Hu-ping（2013） discusses the basic connotation of China's sports industry, the economic and social benefits and economic and ecological environment, on the basis of promoting the economic and social development between the industrial economic and social benefits and promoting the sustainable development of economic and social benefits of modern sports industry and problems, puts forward the basic way to effectively promote the economic and social development[104].

Kang Tiexiang (2008) also agreed that the premise of digital economy development is digital technology, and pointed out that the digital economy, the transaction mode of generation is carried out through bit flow, and it is believed that the development of digital economy is virtual and highly addictive. Regarding the characteristics of high permeability, the paper also points out that the digital economy includes basic industries and this industry is conductive to digital industry development, for the second part of the value-added calculation method is borrowed from Maclup and the United States is measurement system, and puts forward the specific measurement method, to measure the development of the digital economy in China in 2002 research[105]. Turcan Viorica, Gribincea Alexandru and Birca Iulita. (2014) pointed out that the key to the development

of digital economy lies in information, which can promote the generation of new products and services in the development of digital economy, and create new value for society in the process of economic development[106]. Le Ying Co-authors of the publication (2020) pointed that the core of digital economy between digital knowledge and information[107], digital technology is the premise of the development of the Internet, the purpose is the digitalization throughout the process of the development of the real economy, promotion of economic reconstruction and development, and points out that the characteristics of the digital economy is: information technology development as the premise, In this projection databases become the main mode of digital development. Zhang Tao and Zhang Zhi (2020) say that digital economy is on the premise of digital technology development, with the help of digital platform of economic activities, digital economy rapid development is mainly reflected in promoting the development of traditional industry in a digital format, mainly includes three parts, infrastructure, digital trading and trading products, and the measurement results are compared with other countries[108]. Analyzed studies confirm of the role of digital economy in promotion of economic growth.

The academic circle has made a preliminary exploration on the construction of high-quality development index system and the evaluation operation mechanism of sports industry. Guo Han and Ren Bao (2020) believes that the high-quality development of the sports industry includes five dimensions: product supply, market entities, industrial integration, development power and high quality of the governance system[109]. Li Rong and Liu Ning (2020) puts forward the high-quality development evaluation structure of sports industry in the new era composed of core elements and system elements[110]. Zhang Yin (2020) and other officials put forward the realization path of high-quality development of sports industry from the overall performance of low development quality of sports industry, the main restrictive factors and the internal reasons of development difficulties[111]. Wang Xianliang and Zhang Ruilin (2020), based on the "three-level" theory and two-dimensional evaluation theory of high-quality development, he explored the direction, value, power and approach followed by the high-quality development of the

sports industry[112].

Ren Bo and Huang Haiyan (2021) analyzed the value and power of the supply-side reform of the sports industry and the connotation and power of high-quality development, and clarified the difficulties in the current supply-side reform of the sports industry. In the future, the internal logic of the supply-side reform of the sports industry in the government, market, society and industry should be improved[113].

Shen Keyin (2022) believes that digital economy can improve the efficiency of government management and governance, promote the all-round transformation and refined operation of the sports industry, and enhanced the competitive awareness and scene building ability of sports enterprises[114]. WANG Jian-xun (2022) based on the nature and characteristics of digital economy, from the perspective of industrial integration, innovation and development, long tail effect, supply and demand, explain the theory of promoting the development of sports industry, the economic environment, policy environment, consumption environment. Traction digital economy boosts sports industry quality external power, and technological change, industrial change, business innovation is the digital economy driving sports industry transformation and upgrading endogenous power[115]. LI Yan-li (2022) believes that digital economy mainly reduces industrial costs and improves industrial efficiency by forming platform economic effect, supplemented by business model upgrading, and enabling digital innovation to achieve a leading role in the sports industry[116]. Ren Bo, Huang Haiyan (2021) analyzed the connotation and dimension of sports quality development and the role and significance of digital economy, at the macro level, digital economy can increase production factors, change resource allocation, improve total factor productivity, drive the sports industry organization, promote sports industry structure, at the micro level, digital economy can drive sports enterprises to produce scale economy and economy of scope. Wang Jian xun[113], Shen Keyin (2020) point that digital economy era to realize the development of sports industry high quality, can speed up the sports industry supply chain and the global value chain, build and demand supply system to support the transformation to accelerate the digital

sports industry, accelerate the sports industry in the field of digital chain and establish special digital economy policies and regulations[114].

The formulation of a sustainable development index system for the sports industry. The sustainable development index system in the sports industry refers to the identification of several interconnected groups of indicators, as well as a single group of indicators, for conducting comprehensive measurement of sports development sustainability. The establishment of this index system not only involves specifying which indicators are included but also determining their interrelationships, which serve as structural indicators. An indicator system is generally considered an information system that comprises various elements and include the conceptual meaning of each index, calculation range, unit of measurement, and the relationships within the structure of the system. study, sustainable development in sports is viewed as comprising subsystems related to sports population, sports economy, sports culture, and sports science and technology theory is applied to integrate these subsystems with relevant groups of indicators into a cohesive whole.

The establishment of a comprehensive index system for sustainable development in the sports industry. Index system structure for sustainable development in the sports industry comprises two main components: the set structure of index elements, represented by I, and the relationship structure between these elements, represented by S. This results in a mathematical table: IS = ⟨I, S⟩, The structure is as follows:

The diagram of the index system in the sports industry is presented on figure 1.1.

According to the previous definition of China's sports industry sustainable development system, the indicator system should encompass sports policies and regulations that directly reflect the political influence on the sports industry. However, there are two reasons why the sub policies and regulations is not considered in the aggregate structure diagram of the above indicator elements.

```
┌─────────────────────┐
│ The      sustainable│
│ development system of│
│ the sports industry │
└─────────────────────┘
```

```
┌──────────────┐ ┌──────────────┐ ┌──────────────┐ ┌──────────────┐
│ The    social│ │ The economic │ │ The ecological│ │ The institutional│
│ subsystem of the│ │ subsystem of │ │ subsystem   of│ │ subsystem    of│
│ sports industry│ │ the    sports│ │ sports industry│ │ sports    industry│
│ population.  │ │ industry.    │ │ science      │ │ culture      │
└──────────────┘ └──────────────┘ └──────────────┘ └──────────────┘
```
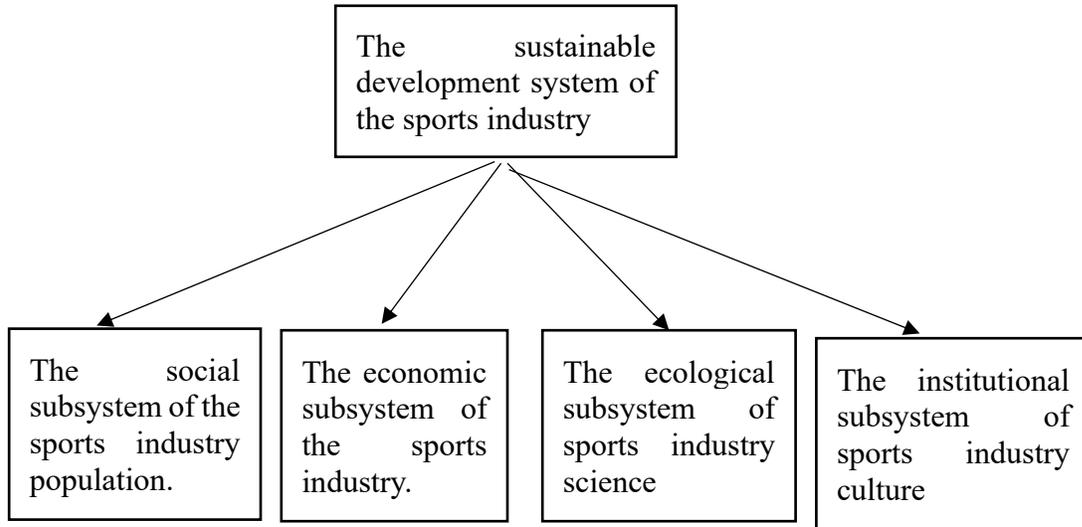
Figure 1.1 - The index of sustainable development system in the sports industry

Source: authors' own elaboration

Firstly, it is clearly reflected through indicators such as economy, culture, science and technology. If a country's economic development, cultural prosperity and scientific and technological progress indicate a favorable social environment and political stability; conversely, if a country experiences political instability and turmoil, its economy, science and technology cannot develop to their full potential.

Secondly, at present it is challenging to find indicators within the sub-system of sports policies and regulations that accurately measure their impact on major sports industry projects with available data. The depth and breadth of impact on sports are not captured in current relevant statistical yearbooks. Including some indicator data into the system may hinder accurate evaluation.

Similarly, for these reasons, the influence of politics on various institutions is also not considered in terms of sustainable development in economic geography or resource/environmental sciences. Therefore, this study system also adopts this approach by excluding direct consideration of the sub-system of sports industry policy regulation related to both sport and politics.

The sustainable development index system of China's sports industry mainly

highlights the following characteristics: When adopting a multi-index comprehensive formulation system in four different subsystems, the index system demonstrates strong comprehensiveness and wide coverage, encompassing all information that influences and reflects the industry's development. The sustainability of the system aims to reflect the overall requirements for maintaining organic unity and coordination in all aspects of sports industry development. Therefore, the levels and conditions reflecting sustainable development are interrelated but cannot be substituted for one another. The overall sustainable development of our country's sports industry system is measured through various aspects.

The sports industry encompasses a range of activities that provide sports products and services to the public. The production departments involved in these activities are interconnected, with varying degrees of market supply and demand relationships. This interconnection is based on resource allocation, market exchanges, technological complementarity, and the formation of extensive, complex, and closely intertwined economic and technological relations. It reflects the intricate coupling relationship between different sectors within the industry. Consequently, through resource flows, market exchanges or technological complementarity various departments within the sports industry become interdependent; they interact and mutually influence each other's operations ultimately forming a complex and interconnected organic system. This system is embedded in an internal correlation network known as the structure of the sports industry.

The main body refers to the production activities that provide various sports products (goods and services) and sports-related products to the society, including sports management activities, sports competition and performance activities, sports fitness and leisure activities, sports services, sports intermediary services, sports training and education, sports media and information services. Other sports related services, sports goods and related products manufacturing, sports goods and related products sales, trade agency and leasing, sports facilities construction 11 departments. The main body is the

sports industry. The quality of the association network within the structure mainly includes two levels:

The density of the network in relation to the sports industry is one factor that influences the functioning of the sports industry. The performance of the sports industry relies on the level of integration among subjects within its network structure. The density of the correlation network within the sports industrial structure can be interpreted as a measure of the strength of relationships between subjects. With the acquisition and allocation of sports resources in different departments, the industrial structure network undergoes changes in density. A closely-knit industrial structure network facilitates mutual provision or sharing of resources among departments, optimizing production factor allocation to its maximum potential. Coordinated development across various departments within the sports industry is essential for maintaining proportional internal contacts and leveraging complementary advantages. In general, higher density in the correlation network within the sports industrial structure signifies increased interdependence and interaction between departments, leading to greater complementarity and overall spillover benefits.

Second, the impact of the industrial sector lies in the differential control of resources and relationships within the networked structure. The imbalanced flow of resources within this structural network, as well as the varying interconnections between different industrial sectors, result in divergent levels of network influence for sectors occupying different positions. Sectors with absolute resource control and robust relationships often serve as central nodes within the internal correlation network of the sports industry structure. The greater a general industrial sector's influence, the stronger its ability to optimize resource exchange between other industries in both the industrial structure network and supply chain. Consequently, any inefficiency or reduction in investment by an industry situated at a pivotal point can disrupt or even collapse this delicate balance.

The resource serves as the medium for activity coordination among different departments within the sports industry. As a resource integrator, not only do we rely on

internal resources to produce products, but we also seek high-quality resources across borders. This cross-border behavior of resource acquisition necessitates a larger system of cooperation for the development and production of sports industry products. While each production department is part of this cooperative system, sub-departments maintain loose coupling and adjust their business activities according to environmental requirements, thereby influencing the structure and condition of the cooperative system. The resources disseminated and shared within the internal network of the sports industry structure encompass not only material, human, and information resources but also relationship resources generated through interactions between industrial departments; these include market dynamics, technological advancements, and service capabilities in each sector.

The behavior of the sports industry structure is the fundamental focus of complex network research. It encompasses the continuous exchange of diverse resources between production departments through competition and cooperation, resulting in a specific directional correlation relationship known as the industrial chain. This industrial chain represents an objectively formed chain-like relationship within actual sports economic activities, driven by internal technical and economic links. Due to variations in the development of different components within the sports industry, its system exhibits repetition. The intricate connections among numerous action nodes with distinct properties and sizes form a correlated network.

The system structure itself is a "transformation" process, that is, the formation of the system structure, the composition or function of the system is constantly absorbing elements and materials from the outside and processing new materials under the rules of specific rules, forming or displaying the function of the system structure. The structure of the sports industry itself is the transformation and allocation of production factors. The adjustment of the sports industry structure is actually the reconstruction of the relationship between the external environment system and resource factors of the sports industry system, so as to show the capacity institutional factors of the new structure of the sports industry system itself, and promote these resources from neglect and allocation to the

optimal transformation effect, so as to achieve the optimal state of the sports industry structure. To realize the coordination and coupling of sports industry structure and development external environment. Industrial ecosystem is a new frontier of the cross-development of ecological economy and industrial economy. Its core thesis is to study the relationship between various industries and the laws of interdependence formed between industrial sectors and the external environment. It is based on the organic circulation mechanism transformation of natural ecological materials and energy to the industrial system, natural environment and social system in a specific regional space, as well as the connection and relationship between these systems, in order to achieve the purpose of coordination and sustainable development of industrial system and natural, economic and social external environment. The connotation of the optimization of the sports industrial structure is as follows: the essence of the optimization of the sports industrial structure is a satisfactory judgment of the sports industrial structure system and economic and social development, and the law and direction of its change need to study the relationship between the internal composition of the sports industry and the development and change law formed by the interaction and symbiotic relationship between the external environment from the large system of the ecology of the sports industrial structure.

The external environment system of the sports industry structure is primarily composed of production factors provided by the operation of the sports industrial structure system, which significantly impact the functioning and evolution of the industrial structure.

According to structuralists, changes in income elasticity of sector demand and variations in productivity growth rate serve as two driving forces that propel alterations in the sports industry structure. Evolutionists argue that the formation and development of the sports industry structure result from interactions among demand structure, supply structure, trade structure, and social structure. Managed Sports Industry Sustainable Development System is presented on figure 1.2.
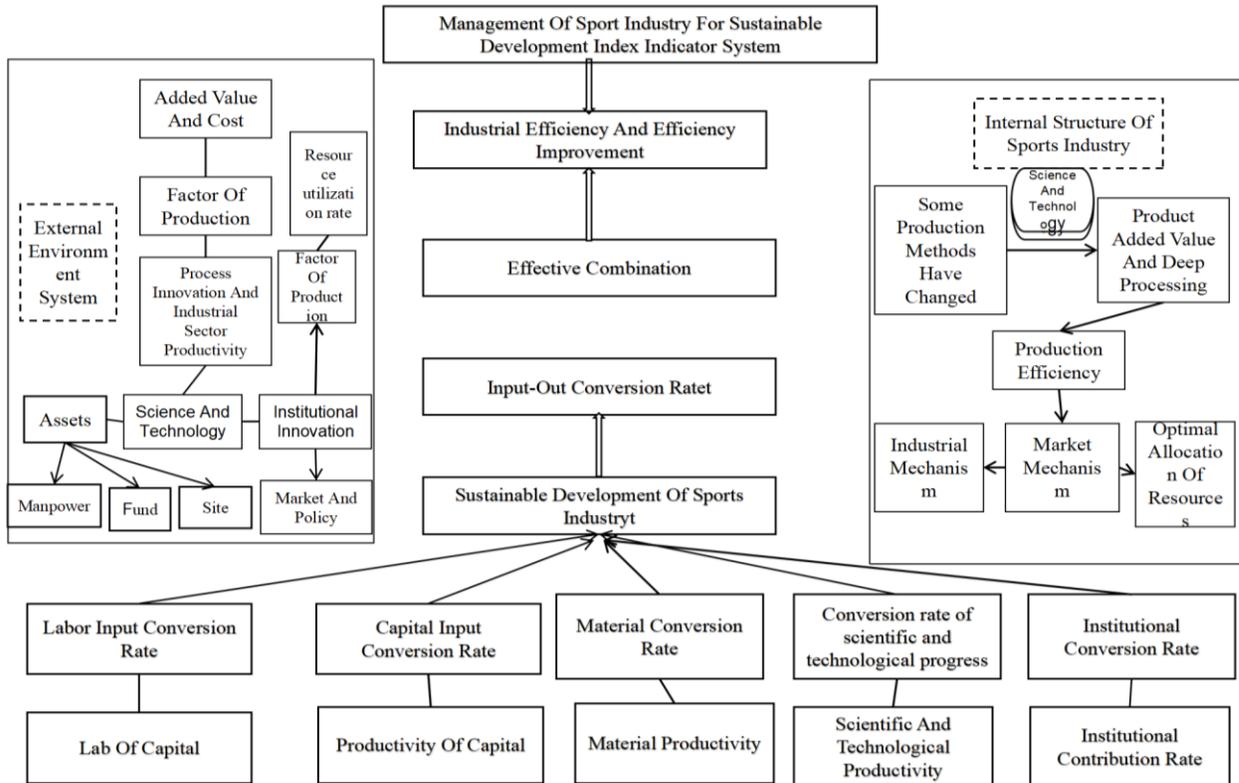
Figure 1.2 - Managed Sports Industry Sustainable Development System

Source: authors' own elaboration

The school of economic growth maintains that external factors such as economic development exhibition, demand structure, supply structure, science and technology advancements, institutional environment, and international economic relations objectively facilitate the process of restructuring and optimizing the sports industry. In the ecosystem of the sports industry structure, the exchange and circulation of technology, information, capital, and talent among various systems constitute a closed-loop operating mechanism with two-way flow.

Among them, the economic environment system and the sports industrial structure system facilitate the transfer of material, capital, and technology flows to maximize economic benefits. The sports consumption atmosphere and demand signal play a crucial role in this process. Additionally, the sports industry system adjusts product nodes and structures to promote maximum exchange between industrial departments. By

maximizing resource allocation benefits and achieving resource intensification goals, the structure system of the sports industry ensures efficient utilization of resources. Technology environment transfer involves technology flow while improving productivity development levels through processing basic elements is an essential aspect of the industrial structure system. Communication serves as a combination of technology and technological innovation within this context.

Conclusions to chapter 1

Firstly, this chapter examines the current state of China's sports industry development and analyzes the experiential models of sports industry development in representative developed countries abroad. In general, China's sports industry development mode is primarily characterized by the organic integration of government leadership, market guidance, and promotion of large-scale sporting events, demonstrating stage-specific characteristics of "manufacturing" and "service".

Secondly, despite continuous optimization in scale and industry, there still exists a series of challenges that need to be addressed. These challenges mainly include the need for detailed policy guidance, clear delineation of government functions, lagging development in governance structures within social organizations related to the sports industry, unbalanced growth within core sectors of the sports industry, as well as improvements needed in product and service quality.

Thirdly, was justified that the typical approach adopted by developed countries for sports industry development predominantly focuses on the market-led model with government participation; furthermore, governments tend to adopt a proactive role. Additionally, active involvement from social organizations has also significantly contributed to advancing their respective national sports industries. Currently, there remains a substantial gap between China's level of sports industry development compared to that observed in developed nations.

CHAPTER 2. THE CURRENT STATUS OF THE MANAGEMENT PROCESS FOR SUSTAINABLE DEVELOPMENT IN THE SPORTS INDUSTRY IN CHINA

2.1 The current status and dynamics of sustainable development in the Chinese Sports Industry

The current management system of China's sports industry is based on a comprehensive review of the experience and lessons learned from the four stages of management system reform. While certain institutional structures have changed, others have remained intact. Officially, it constitutes an integrated government-community managed management system. In essence, the government still retains dominant responsibilities and rights, indicating a preference towards a government-centric management system. However, as China's politics, economy, culture, and other fields continue to develop in tandem with the market economy, there will be a gradual increase in the proportion of responsibility, power, and interests allocated to the social system within the sports industry management framework. The current management system of China's sports industry is primarily comprised of two components: the government management system and the social management system. These components can further be categorized into a general management system and a specialized management system based on their specific nature.

The current government management system for China's sports industry consists of both a general and specialized system, responsible for overseeing and regulating this sector. XIN Li （2002）the general system includes various departments such as public inspection law, national and local taxation, and civil labor, which oversee organizations and individuals involved in this field. Meanwhile, the specialized system comprises China's State General Administration of Sport along with its affiliated offices at local sports bureaus[117]. This dedicated framework provides specific business guidance for

the sports industry while handling relevant affairs through The Department of Sports Economy under China's State General Administration of Sport. The Sports Economy Department consists of four departments: General Affairs Department, Finance Department, Infrastructure Management Department, and Industrial Management Department. All local sports bureaus shall, under the administration of the General Administration of Sport of the State, carry out effective administration of sports industry activities in their respective regions[117]. In some areas where the sports industry has developed well, the sports bureau has set up departments and institutions to manage the sports industry in the region. For example, the Sports Industry Department of Xinxiang Sports Bureau is mainly responsible for formulating the development plan of the city's sports industry and organizing its implementation; To administer high-risk sports projects in the city according to law; To supervise and administer the safety work of the open-air sports venues managed by the Municipal Sports Bureau; To be responsible for the administration of municipal sports lottery issuance; To supervise the use and management of public sports facilities; To undertake relevant administrative examination and approval matters announced by the municipal government.

The social management system of sports industry in China comprises two components: the social professional management system and the social non-professional management system. The social professional management system is overseen by sports industry associations under the guidance of the General Administration of Sport, including prominent organizations such as Chinese Sports Association, China Sports Goods Federation, and provincial/municipal sports industry associations (Beijing Sports Industry Association, Guangdong Sports Industry Association, Shanxi Sports Industry Association). The social non-special management system refers to mass groups comprising members from sports industry organizations, which are not directly under the leadership of the General Administration of Sport of the State but oversee the activities of their members. Examples include China Enterprise Association, China Quality Association, and China Culture, Education and Sports Goods Association. These social

organizations encompass a significant number of sports industry organizations whose members adhere to self-disciplined management practices. The future development of China's sports industry management will gradually shift from a government-centric system towards a more socially-driven approach, with an increasing emphasis on the managerial role played by the social management system[118].

The power division within China's current sports industry management system primarily consists of the government system and the social system. Currently, while the government system retains predominant authority over sports industry management, there is a gradual shift towards decentralization of power to the social system, resulting in an increasing influence of the social system on sports industry management.

The comprehensive management department of the sports industry within the government system is responsible for overseeing general industrial management functions, such as civil affairs and industry and commerce departments that primarily focus on the nature of the sports industry. Additionally, the tax department manages taxation aspects related to enterprises or activities in this sector, while the labor and social security department supervises human resources with a social oversight role. Furthermore, the resource department exercises social supervision over the sports industry. The statistical department performs tasks like establishing classification standards, setting guidelines for statistical management within this field, and administratively overseeing organizations or activities associated with it. On the other hand, within the government system's sports industry management department lies responsibility for managing specific business operations pertaining to this sector. For instance, China's General Administration of Sport is accountable for researching and formulating policies concerning the sports industry as well as developing its markets. Moreover, they establish working conditions and approval procedures for various sporting business activities.

The social system's comprehensive management department for the sports industry includes members such as the China Sports Enterprise Association, China Quality Association, and China Culture, Education and Sports Goods Association, all of which

are under administrative supervision. Specialized administrative departments within their respective jurisdictions are responsible for supervising, managing, and regulating economic activities in this sector. For example, the Sports Project Management Center manages projects within its designated fields; meanwhile, enterprises and organizations operating within the realm of sports industry are governed by the China Sports Goods Federation.

The power division within the current management system of the sports industry in our country primarily consists of the government and social systems. Currently, while the government system still maintains predominant control over sports industry management, there is a gradual transfer of power from the government to the social system, resulting in an increasing influence of the social system on sports industry management.

The general management department within the government system for the sports industry is responsible for ensuring comprehensive management functions, including identification of the nature of the sports industry by civil affairs and commerce departments, tax administration of sports industry enterprises or activities by tax departments, and labor and social security administration of sports industry enterprises or activities by relevant departments. Statistical departments carry out administrative oversight functions on classification standards, establishment, and statistical management of sports industry organizations or activities. The special administrative department for the sports industry within the government system is responsible for managing specific operational aspects related to this sector. For example, China's General Administration of Sport formulates policies concerning sport market development while also establishing working conditions and approval procedures for sporting events. The local sports bureau is entrusted with comparable managerial obligations in fostering the growth of the local sports industry.

The comprehensive management department of the sports industry in the social system refers to administrative agencies such as China Enterprise Association, China Quality Association, and China Culture, Education and Sports Goods Association. It is

responsible for overseeing and managing members and entities within the sports industry. Under the guidance of the General Administration of Sport of the State, this specialized administrative department supervises, manages, and operates economic activities specifically related to the sports industry under its jurisdiction. For instance, sports management centers are tasked with managing activities within their respective domains; meanwhile, China Sports Goods Federation oversees enterprises or organizations operating in the field of sports industry.

The operation mechanism refers to the interconnected rules, procedures, and overall structure formed by various essential elements for the smooth functioning of entities. Guo Rong-juan （2017）This implies that firstly, only a system comprising multiple elements encounters the issue of an operation mechanism, namely the operational mechanism of systemic entities. Secondly, while each element within the system possesses its own specific function, it serves the collective purpose as a whole. Therefore, studying the operation mechanism necessitates adopting a holistic perspective. Concerning China's sports management system, its operational mechanism primarily manifests in government management systems, social management systems, regulations and procedures governing interactions between these two systems, and subsequently resulting in an overarching order.[119]

Currently, the management and operation of China's sports industry is primarily dominated by administrative control from the State General Administration of Sport (SGAS). This is reflected in SGAS's responsibility for formulating development plans for public sports facilities, guiding their construction, supervising their administration, managing sports statistics and standardization, overseeing sports lottery issuance, handling budgeting and final accounts, financial management, capital construction planning and investment plans for the State Administration. Additionally, SGAS administers state-owned assets of government organs and units directly under them while undertaking financial management and market development management for both the Chinese Sports Federation (CSF) and Chinese Olympic Committee (COC), as well as

other tasks assigned by the State Administration. In terms of government management system implementation related to documents or regulations pertaining to the sports industry are mainly carried out top-down through executive orders. Meanwhile in social management systems, individual sports associations are responsible for supervising, managing, planning and operating within their respective fields. The current overlap between the functions of the Sports Association and the Sports Management Centre necessitates professional refinement. The State General Administration of Sports serves not only as a governmental management department but also as a social management entity, thereby possessing dual nature and functions. This unique arrangement results in the sports industry management and operation mechanism in China being subject to a distinctive management system. Essentially, through its direct control over various offices, the State General Administration of Sports integrates macro-control, guidance, micro-management, and administration into one cohesive entity. Consequently, the sports industry management conducted by the State General Administration of Sports is closely intertwined with both macro-level regulation and guidance as well as micro-level supervision and administration. This operating mechanism distinctly reflects characteristics reminiscent of a planned economy system while simultaneously presenting numerous challenges within the framework of a socialist market economy.

The organizational structure serves as the cornerstone of a management system and provides the essential foundation for achieving management objectives. To effectively implement a sports industry management system, it is imperative to establish a rational sports industry management organization. However, the current setup of our country's sports industry management system lacks coherence and requires improvement.

In the government management system, the sports economic department has already established the sports industry; however, there is ambiguity in terms of management functions, powers, and responsibilities, leading to fluctuations in quality. Moreover, local sports bureaus have primarily focused on developing the sports industry without adequate financial or regulatory departments to effectively manage it.

Additionally, there is a lack of close coordination between the Sports Industry Management Office under the Ministry of Sports Economy and local sports industry management bodies within the comprehensive government management system. Consequently, both central and local sports industry management agencies operate in a relatively disorganized manner with no unified standards or institutional settings.

In terms of the professional social management system, there is a dearth of industry associations on one hand, while on the other hand, industry associations are subject to the leadership and control of the General Administration of Sports of China, lacking autonomy. This is due to the unique relationship between the management center and association: firstly, when issues arise in sports programs, they utilize their "non-profit organization" status as a shield to evade administrative accountability; secondly, management actively avoids fulfilling its service function. Additionally, within the general social management system, both the number and managerial capacity of sports civil associations and sports intermediary organizations are severely limited, hindering effective performance in their management functions.

The current sports industry management system in China suffers from an unreasonable establishment of administrative departments, which is further reflected in the lack of separation between government and enterprise. Government departments, institutions, and enterprises within the sports industry operate without effective supervision. Pang Xiao-jie（2008）Despite the transformation of the State Sports Commission into the General Administration of Sports, there have been minimal changes to specific functional departments within the sports industry. This has resulted in a mixed management approach for competitive sports, sports industry development, and public sports initiatives[120]. Consequently, achieving reasonable unity and coordination in institutional setup remains challenging for both the General Administration of Sports and local sports bureaus. Moreover, duplication of functions persists among various departments under the State General Administration of Sports as well as at local levels.

It can be argued that currently, China's sports industry is monopolized by the State

General Administration of Sports due to the government and enterprise separation. Other monopolies, administrative monopolies lack checks and balances from external parties, rendering them immune to any form of restriction or regulation. Consequently, once an administrative monopoly takes hold, it becomes impervious to challenges from any authority, making it more detrimental than a market monopoly. The failure or inadequacy of government oversight in this regard not only poses significant risks to society but also leads to an alarming squandering of resources.

The sports industry and its related sectors encompass a diverse range of industries. On one hand, apart from the conflicts between the government and society, there are also disputes among local sports bureaus in addition to the State General Administration of Sports and the General Administration of Sports at both national and state levels. Within the professional sports management system implemented by the government as well as within the professional management system adopted by society, numerous interdependencies exist among departments such as the State General Administration of Sport, sports associations, and sports industry associations; however, their objectives and value orientations often diverge.

The government's level of concern, the individuals who are concerned, and the methods employed to address these fundamental questions vary significantly. The lack of consensus has led to a state of confusion in the management of the sports industry, with a significant prevalence of "long management regardless" phenomenon. On one hand, various departments including sports administrative bodies, cultural administrative bodies, and radio, film and television departments are competing for control over the content and authority of sports market management. On the other hand, essential government functions related to industry management such as developing industry development plans, formulating development policies, collecting and disseminating sports industry information, as well as providing scientific guidance on sports investment and consumption are not being effectively carried out by any specific department.

Revised sentence: Based on the benefits of sports industry development in our

country, it is evident that the current sports industry management system has not yielded expected results. The "Guo system" of sports management in China has not been fundamentally adjusted to manage the sports industry, resulting in government monopolization of sports industry resources and low social investment enthusiasm for this sector. As a result, most sports industry products cannot be supplied through market competition mechanisms. In a three-element system consisting of government, industry, and market, the government regulates industrial economy to maintain market efficiency, social equity, and ideology by preventing monopolies from abusing their power and promoting social justice. Purpose of government supervision in China's sports industry is to rectify the inefficiency caused by market failure and maintain a functioning market order. However, what we observe is that the government replaces market monopoly with administrative orders and monopolistic practices. This situation of monopoly and absence results in high investment but extremely low efficiency in China's sports industry. The contradiction between increasing operating costs in the domestic sports industry and insufficient capital investment exacerbates this issue, leading to a weakening marginal effect of the current sports industry management system.

In the field of macro industry, the term industrial structure optimization is widely used and commonly referred to as "industrial structure rationalization" and "high industrial structure," collectively known. Regarding the former, it emphasizes enhancing objective economic and technological linkages to deepen internal relevance within the industry and improve correlation quality and aggregation. Its essence lies in strengthening coordination between industries and improving the dynamic process of achieving a high level of correlation, including: optimizing supply-demand relations within the industry (maximizing internal correlation), maximizing efficiency in industrial structure, coordinating output proportions. As for the latter, it highlights the evolution of industrial structure from a low level to a high level; that is, progressing towards high technology, knowledge-intensive, capital-intensive, highly processed degrees with added value. Under specific technical conditions, it continuously enhances industrial quality and promotes

sports-industry structural evolution towards knowledge-technology intensity with higher processing degrees and added value directions. The dynamic process aims at constantly developing overall industry structural quality and efficiency to reach higher levels.

The influence coefficient and induction coefficient of the input-output method are utilized by scholars to quantitatively express the correlation between the economy and technology of each industry within the industrial structure. However, these two indicators primarily focus on inter-industry correlations, lacking a comprehensive understanding of system-level correlations. To effectively adjust the sports industry structure, it is necessary to adopt a systematic approach that considers industry characteristics and correlations, scientifically determining the role of industries in industrial connections. By incorporating complex figures into research on "sustainable development" in sports industrial structures, not only does this enhance previous studies but also provides new ideas and tools for vertically promoting sports industrial structures.

The core of input-output analysis lies in a matrix consisting of intermediate input and output, which records the utilization of factors across different industries and can generate a direct consumption coefficient table, serving as the foundation for traditional input-output analysis data. By combining the direct consumption coefficient table with social network analysis, we can fully leverage the advantages of these two methods to examine industrial structure-related issues from a fresh perspective. Due to the directionality and disparity in relationships among various industrial sectors, they are embedded to varying degrees within the sports industry's internal correlation network, thus forming distinct characteristics. This paper analyzes China's sports industry structure by exploring its internal correlation network, side structures, and network features from three perspectives: overall view, sub-structure examination, and individual point investigation. Through generating an industrial structure network, identifying node states within this network, and proposing sub-networks, we aim to elucidate the composition of internal correlations within the sports industry structure as well as understand the roles and statuses held by different departments within this sector. Additionally, we seek to

classify its internal divisions and explore its industrial chain relationships.

The increase in capital injection will result in higher output and expedite the formation of the sports industry structure. However, it is important to recognize that the market itself operates as a complex system. Different services and products hold varying significance for investment formation, and the conditions and challenges associated with developing and nurturing different markets also differ significantly. This often leads to a misalignment between investment adjustments and transformations within an industry and its existing stock. In other words, there exists an inverse relationship between the sports industry structure and investment structure. This inverse relationship encompasses directionality, regional distribution, production-consumption dynamics, resource allocation, and industrial composition. Nonetheless, without comprehending the level of specialization within the sports industry's division of labor or understanding its industrial chain composition thoroughly enough, excessive concentration of financial resources in specific areas may occur or investments in relatively surplus sectors may be reduced inadvertently exacerbating imbalances within the sports industry structure. Cai Wang-Jun (2020) Beijing Sports Power, Tencent, CEIBS, Yunyi Guokai, Wanda and Suning are competing for the rights to sports events. However, the growth of the sports economy resulting from investment in sports events remains relatively low due to factors such as the educational system, cultural traditions, economic conditions, and especially payment habits[121].

The investment in new fixed assets is essential for the maintenance and expansion of production capacity. Insufficient investment in fixed assets can lead to a gradual decrease in output capacity, hindering inter-departmental allocation and causing an imbalance in the industrial structure. ZHANG Lei (2021) For instance, some large stadiums and facilities built in Chinese cities prioritize sports events without considering their post-game utilization and comprehensive functions adequately[122]. Instead of fulfilling their intended purpose, they become burdensome, resulting in a disruption of the industrial chain. To address this issue, it is recommended to transform single-function

venues into sports service complexes that integrate sports, leisure, fitness, entertainment, trade, and other functions. This approach can stimulate the development of sectors such as sports exhibition, sports tourism, sports leisure fitness, and sports trade.

In the process of labor, sports service not only requires the knowledge and skills possessed by ordinary workers but also necessitates a certain level of sports knowledge, experience, and expertise. This is crucial for engaging in the production of high-quality sports services within the sports industry, as well as being an essential factor in shaping its structural direction. It can be argued that the optimization process of the sports industry structure always demands a specific quantity and quality of labor force, which is continuously accumulated over time. The excessive growth of population can potentially transform this labor force into skilled individuals capable of contributing to various sectors within the sports industry. Consequently, it lays a solid foundation for accumulating human capital to meet the fundamental needs of specific segments within this industry sector while simultaneously increasing both the supply of sports-related human resources and demand for related products.

The essence of industrial structural change lies in the economic and technological transformations occurring across industries. Structural economics posits that technological progress expands resource flows, facilitating increased inflow of resources, amplifying supply and demand dynamics, and enabling inter-industry resource exchanges. Technology extends the chain of industrial linkages. As production technology advances within the manufacturing sector, downstream sectors correspondingly adjust their own demands to align with changes in supply. Simultaneously, alterations in downstream industries compel upstream production sectors to undergo technological restructuring, thereby impacting the interconnectedness between production's supply structure and demand structure. Consequently, a combination of factors including technological innovation reshapes the economic and technological relationships among industries, ultimately leading to formation and evolution of the entire industrial structure.

The advancement of sports science and technology enhances the efficiency in

allocating and converting production factors within the sports industry sector, thereby influencing the evolution of its structure through input-output relationships among industrial sectors. Zhang Qing-Song (2022) the level of scientific and technological innovation within different departments of the sports industry determines variations in their production efficiency. As the value generated by this industrial sector is determined by product quantity and corresponding market prices, its realization further relies on product demand, market demand, and inducement factors. Following the principle of comparative advantage flow and allocation across various sectors, there is a shift from low labor productivity sectors to high labor productivity ones. With the transfer of production factors and optimization of resource allocation, accordingly, there will be changes and upgrades in the structure of the sports industry[123].

Advancements in sports science and technology have given rise to new markets, influenced the expansion and contraction of individual industrial sectors, and facilitated the upgrading of the sports industry structure through production, supply, and demand. The amalgamation of the sports industry with science and technology can foster novel products and technologies that generate fresh market demands. Once these demands reach a certain scale, they can propel the growth and development of emerging product industries. For instance, scientific and technological progress has propelled intelligent and convenient internet services for sports equipment and fitness gear, significantly fostering the advancement of sports, leisure, and fitness services. The integration of sports facilities with the internet has led to smart sporting venues that greatly promote venue service industry growth. Scientific training methods in sports along with high-tech sporting goods/equipment substantially enhance competition levels while augmenting enjoyment derived from athletic events—thus significantly advancing performance-oriented sport industries. Furthermore, advanced broadcasting technology coupled with internet advancements has spawned both sports advertising as well as media industries dedicated to covering sporting events. Sports products offered by this industry exhibit high demand elasticity; hence technological innovation will considerably reduce costs within this sector

while simultaneously adapting to evolving market demands accordingly. Under market mechanisms (price mechanism), resources must flow from sectors exhibiting low elasticity towards those demonstrating higher elasticity in order to optimize the structure of the sports industry.

The advancement of sports science and technology determines the succession of leading industries and influences the restructuring of the sports industry through the interplay between supply and demand across sectors. In accordance with the theory of imbalanced development, the transition of leading industries serves as a crucial mechanism for adjusting and transforming industrial structures. Industrial sectors that swiftly assimilate cutting-edge technological achievements and foster greater innovation will undergo rapid growth. The escalation in economies of scale within these sectors indicates both absolute and relative expansion, while the intricate relationship between economic-technological supply-demand dynamics shapes a diffusion effect encompassing front-end, back-end, and lateral impacts, ultimately giving rise to emerging leading industries.

The advancement of sports science and technology has blurred the boundaries between traditional industrial sectors in sports product development. The sports industry is centered around physical exercise or a combination of sports skills that can be observed. Through the utilization of production equipment, specialized departments, and co-production factors, enhanced by the spillover effect of technological innovation, there is an increased synergy and complementarity in production, leading to the formation of a certain scale of industrial organization module. However, taking the sports service industry as an example distinguishes it from sports goods manufacturing and sports facilities. Although considered a black box system, it is understood that the production of sports service products requires inputs such as stadiums (halls, swimming pools), sporting equipment, sportswear, management personnel, coaches etc. Therefore, the sports service industry should not be seen as separate from the sports goods industry or sport facilities; rather they are interrelated through systematic symbiosis.

2.2 The intrinsic motivation and external regulatory mechanisms for fostering sustainable development in the sports industry in China

On the basis of weighing the comprehensiveness of the index system and data availability, the data of 31 provinces in China from 2010-2019 (excluding Hong Kong, Macao and Taiwan) are selected, and the data are processed as follows: firstly, the missing data is interpolated or compared; secondly, the proportion of some indicators is calculated on the basis of the original indicators. The data are from China Statistical Yearbook, China Science and Technology Statistical Yearbook, China Population and Employment Statistical Yearbook, China Education Statistical Yearbook, China Information Yearbook, Sports Yearbook, provincial statistical yearbooks and China digital economy development report over the years.

In the index system weight method is mainly divided into subjective empowerment and objective empowerment, in terms of subjective empowerment, it is based on the relative importance between the indicators through subjective judgment to give corresponding weight, such as principal component analysis, AHP, and objective empowerment is based on the original information to empowerment, such as cluster analysis, standard deviation, entropy and extreme method. In the selection of measurement method, some scholars believe that the subjective weight method will be disturbed by human factors, which will bias the calculation results, and can respond to authenticity[124]. In view of this, this paper adopts the entropy method to measure the high-quality economic development level and digital economy development level in 31 provinces in China from 2010 to 2019.The calculation steps are as follows:

Step 1: Standardize the data:

forward pointer: $$X_{ij}^{*} = \frac{x_{ij} - m_j}{M_j - m_j} \qquad (2.1)$$

Negative indicators: $$x_{ij}^{*} = \frac{M_j - x_{ij}}{M_j - m_j} \qquad (2.2)$$

$$M_j = \max\{x_{ij}\} \quad m_j = \min\{x_{ij}\}$$

Step 2: Calculate the index proportion:

$$p_{ij} = x_{ij} / \sum_{i=1}^{n} x_{ij}$$

(2.3)

Step 3: Calculate the information entropy of each component based on the specific gravity:

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^{m} p_{ij} \ln (p_{ij})$$

(2.4)

Step 4: calculate the information entropy redundancy:

$$d_j = 1 - e_j$$

(2.5)

Step 5, calculate the weight of each index:

$$w_j = d_j / \sum_{i=1}^{n} d_j$$

(2.6)

Step 6: Calculate the final composite score.

We find that the research of current scholars mainly focuses on: the calculation of digital economy comprehensive index, it is only scientific interpretation, lack of empirical research; second, the lack of existing research on digital economy indicators, mostly only from a single perspective; and finally, the lack of analysis of regional heterogeneity of digital economy development[125]. How to construct and measure the development of digital economy development is an important proposition to pursue the high-quality development of the sports industry in the new era, which is particularly important for the sustainable and healthy development of China's sports industry. This paper constructs three subsystems and 11 basic indicators to construct the evaluation index of digital economy development, and three subsystems and 9 basic indicators to evaluate the high-quality development of sports industry[126]. It is as follows in table 2.1/

In order to explore the spatial spillover effect of the development of digital economy on the high-quality development of sports industry, the high-quality development of sports industry in China in 2011-2020 was taken as the explanatory variable, and the development of digital economy as the explanatory variable.

Table 2.1- Digital Economy Development Index System

Overall performance	Secondary indicators	Basic indicators	Indicator measure	Unit	Indicator attribute
digital economy	Digital infrastructure	Internet penetration rate	Internet broadband access users / permanent resident population at the end of the year	%	+
		Long-distance optical cable line density	Long-distance optical cable line length / urban area * 10,000	%	+
		Internet infrastructure	Total assets of the information transmission, computer services, and software industries	Wan Yuan	+
		The proportion of Internet users	Internet access number / permanent resident population at the end of the year	%	+
	Digital industry scale	Software business revenue	Total software business revenue	Wan Yuan	+
		Number of Internet-related employees	Information transmission, software and information technology services employment personnel	thousands of people	+
		The proportion of high-tech products exports in the export volume of commodities	Exports of high-tech products / total commodity exports	%	+
	Digital R & D investment	Computer and office equipment manufacturing industry investment	Total expenditure for the computer and office equipment manufacturing industry	Wan Yuan	+

		Electronic and communication equipment manufacturing industry investment	Total expenditure for the electronic and communication equipment manufacturing industry	Wan Yuan	+
		Investment in introducing high-tech industries	Total funds for the introduction of high-tech industries	Wan Yuan	+
High-quality development of the sports industry	Sports industry structure	Rationalization of the sports industry structure	added value of sports industry / GDP	%	+
		Advanced sports industry structure	Sports attendant added value / GDP	%	+
	Sports industry scale	Sports industry operating income	Sports industry, the total income	Wan Yuan	+
		Number of people in the sports industry	Number of people in the sports industry	thousands of people	+
		The number of sports enterprises	The number of sports enterprises	individual	+
		Sports industry patent	Sports industry application for a patent	piece	+
	Sports industry research and development investment	Investment in sports science and technology	Sports expenditure on science and technology / total sports expenditure	%	+
		Investment in new technology introduction in the sports industry	Total funds for the introduction of new technology in the sports industry	Wan Yuan	+
		Sports enterprise innovation and research and development investment	Total amount of innovation and research and development funds of sports enterprises	Wan Yuan	+

Source: author's own elaboration

Six control variables were constructed from other scholars. Specifically expressed as follows in table 2.2.

Table 2.2 - Variab Digital Economy Development Index System le setting

Type of variable	Variable name	Measure	Variable symbol	Unit
explained variable	High-quality development of the sports industry	The entropy value method was calculated	HQDS	
explanatory variable	Digital economy development	The entropy value method was calculated	DIGIT	
controlled variable	Sports industry, the infrastructure	Number of stadiums	Sta	Pcs
	Economic development level	GDP per capita	Eco	yuan
	Financial support	Investment in the sports industry	Fis	%
	Sports industry scale	Value-added value of the sports industry	Spo	%
	Level of urbanization development	Urbanization rate	Urb	%
	Educational input	Number of sports institutions	Edu	Pcs

Source: author's own elaboration

The spatial correlation of the study subjects should first be tested before determining whether the spatial measurement method is used. The spatial measurement method can be used only if there is a spatial correlation. Therefore, the spatial correlation of high-quality economic development and the development of digital economy is first tested.

Spatial correlation test method，Global autocorrelation. To investigate the spatial interaction and spillover effect of digital economy on high-quality development of sports industry, the global Moran's I index is used to test the spatial correlation. The calculation formula is as follows:

$$\text{Moran's I} = \frac{n \sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j}(Y_{it} - \overline{Y})(Y_{jt} - \overline{Y})}{S^2 \sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j}}$$

(2.7)

$w_{i,j} \overline{Y} Y_{it} Y_{jt}$ The weight matrix defined above, as the mean of the development level, is the development level of the year t of i and j provinces, respectively

Local autocorrelation. The local Moran index is calculated as follows:

$$\text{Local Moran's } I_i = \frac{(Y_{jt} - \overline{Y})}{S^2} \sum_{i=1}^{n} w_{i,j} (Y_{jt} - \overline{Y})$$ (2.8)

The value range of Moran's I index is [-1,1], if the index is positive, there is a spatial positive correlation; otherwise, there is a spatial negative correlation.

Spatial weight matrix setting. $W_{i,j}$ Through the spatial weight matrix, can reflect the spatial interaction relationship and dependence characteristics, so adopt the adjacent spatial matrix; geospatial matrix; economic space matrix:

Adjacency space matrix, a simple binary space weight matrix, is set as follows:

$$W_{i,j} = \begin{cases} 1, & i = j \\ 0, & i \neq j \end{cases}$$ (2.9)

Geospatial matrix, Wang Shoukun (2013) believes that the closer the distance between the two regions, the greater the weight, which is set as follows:

$$W_{i,j} = \begin{cases} \dfrac{1}{d_{ij}}, & i \neq j \\ 0, & i = i \end{cases}$$ (2.10)

$W_{i,j}$ It means the traffic distance between the two provincial capitals, which better reflects the relationship between social and economic development between the cities.

Economic spatial matrix, geographical factors are not the only factor leading to spatial effects. Using the construction based on the inverse distance matrix (Lin Guangping 2006), the economic matrix is defined as follows:

$$W_{i,j} = \begin{cases} \dfrac{1}{|Y_i - Y_j|}, & i \neq j \\ 0, & i = i \end{cases}$$ (2.11)

$Y_i Y_j$ Economic variables representing region i, and those in region j, were measured by per capita GDP.

Spatial Measurement Model Construction. In order to further analyze the impact of digital economy on the high-quality development of sports industry, spatial auto regression model (SAR), spatial error model (SEM) and spatial Du bin model (SDM) are established respectively, and then the most appropriate model is determined through various tests for empirical analysis. Details are as follows:

Spatial autoregressive model (SAR)

$$y = \lambda W y + X \beta + \varepsilon \qquad (2.12)$$

They indicate the high-quality development level of the sports industry, the W is the spatial weight matrix, the X is the n * k data matrix, the corresponding coefficient, and the regression coefficient.

Spatial Error Model (SEM)

Spatial dependence may also be reflected by error terms, which builds a spatial error model (SEM)

$$y = X \beta + \varepsilon$$
$$\mu = \rho M \mu + \varepsilon, \varepsilon \sim N(0, \sigma^2 I_n) \qquad (2.13)$$

ρM is the spatial weight matrix, representing the spatial error coefficients, X, y, and above.

Spatial Durbin Model (SDM)

$$y = \lambda W y + X \beta + W X \delta + \varepsilon \qquad (2.14)$$

$W X \delta$ Explain the effect of variables for adjacent regions, X, y in dicate ibid.

The threshold regression model. Digital economy may have heterogeneity in the high-quality development of sports industry. Therefore, construct the threshold panel model:

$$HQDS_{it} = \beta_0 + \beta_1 DIGIT_{it} I(q_{it} \leq \gamma) + \beta_2 DIGIT_{it} I(q_{it} > \gamma) + \alpha Z_{it} + \mu_i + \varepsilon_{it} \qquad (2.15)$$

$HQDS_{it} DIGIT_{it} Z_{it} \mu_i \lambda_t \varepsilon_{it} q_{it}$ The control variable indicating individual fixed effect; time fixed effect and residual term.; Represents the threshold variable, indicates the digital economy development level or regional economic growth degree in the threshold panel model estimation, indicates the threshold value, and indicates the impact of digital economy development on the high-quality development of sports industry when the threshold variable is greater than and less than the threshold value, respectively. If there is no non-linear effect on regional economic growth, digital economy development, or in underdeveloped areas

$$\gamma, \beta_1, \beta_2; \beta_1 = \beta_2 \beta_1 < \beta_2, \beta_1 > \beta_2. \qquad (2.16)$$

Spatial autocorrelation analysis. Based on the high-quality development and digital economy development level index of China's sports industry measured by the entropy method, and combined with four spatial weight matrices, the global Moran's I index of the high-quality sports development and digital economy development in China in 2011-2020 is calculated respectively, as shown in Table 2.3.

Based on the above measures, the comprehensive index of China's digital economy development level and high-quality development level of sports industry, combined with the setting of adjacent space matrix, geographic matrix and economic space matrix and nested matrix, respectively calculated the global Moran's I index of digital economy and sports industry in China from 2010-2019, as shown in Table 2.3.

Table 2.3 - Global Moran's I Index for High-quality Development of Digital Economy and Sports Industry

Year	Adjacency space matrix		Geographic distance matrix		Economic space matrix		Nested matrix	
	DIGIT	HQDS	DIGIT	HQDS	DIGIT	HQDS	DIGIT	HQDS
2011	0.098*	0.120*	0.053	0.081	0.302***	0.344***	0.572***	0.537***
2012	0.110*	0.165**	0.002	0.092*	0.267***	0.367***	0.567***	0.577***
2013	0.065	0.185**	-0.003	0.097*	0.253***	0.369***	0.551***	0.529***
2014	0.068	0.194**	-0.012	0.099*	0.217***	0.364***	0.517***	0.274***
2015	0.051	0.168**	-0.016	0.104*	0.222***	0.339***	0.512***	0.569***
2016	0.029	0.163**	-0.016	0.108*	0.184***	0.340***	0.584***	0.540***
2017	0.038	0.143*	-0.011	0.097*	0.173***	0.328***	0.513***	0.438***
2018	0.043	0.162**	0.001	0.124**	0.171***	0.320***	0.511***	0.512***
2019	0.012	0.136**	0.002	0.087*	0.141***	0.278***	0.531***	0.558***
2020	0.002	0.139**	0.006	0.096*	0.133***	0.262***	0.540***	0.535***

Source: The author calculated it by using STATA16.*** is significant at 1% significance; * * significant at 5% significance; * significant at 10% significance.

From the Moran's I index of the four spatial weight matrices in the above table, the high-quality development of digital economy and sports industry has passed the significance test under the four weight Spaces, and the embedded matrix is the most significant under the economic space weight matrix. Digital economy and sports industry high quality development in four space weight matrix has certain differences, but in

general China's digital economy and sports industry high quality development has significant positive global space autocorrelation, that China's digital economy and sports industry high quality development is not completely in a state of random development, and will be affected by similar spatial characteristics.

In order to further investigate the agglomeration characteristics of the spatial distribution of the high-quality development of the digital economy and the sports industry, this paper uses the nested matrix to draw the local Moran index distribution table for the high-quality development of digital economy and sports industry in China in 2011 and 2020.

Table 2.4 - Local Moran index distribution of digital economy in 2011

Quadrant	Space-related patterns	Region	Amount
1	H-H	Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong	7
2	L-H	Inner Mongolia, Anhui, Shandong	3
3	L-L	Hebei, Shanxi, Jilin, Heilongjiang, Jiangxi, Henan, Hubei, Hunan, Guangxi, Guizhou, Yunnan, Xizang, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	17
4	H-L	Liaoning, Hainan, Chongqing, Sichuan	4

Source: author's own elaboration

Table 2.5 - Local Moran index distribution of digital economy in 2020

Quadrant	Space-related patterns	Region	Amount
1	H-H	Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Shandong, Guangdong	7
2	L-H	Inner Mongolia	1
3	L-L	Hebei, Shanxi, Jilin, Liaoning, Heilongjiang, Fujian, Jiangxi, Henan, Hunan, Guangxi, Sichuan, Guizhou, Yunnan, Xizang, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	19
4	H-L	Anhui, Hubei, Hainan, Chongqing	4

Source: author's own elaboration

Table 2.6 - Local Moran index distribution of sports industry in 2011

Quadrant	Space-related patterns	Region	Amount
1	H-H	Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong	8
2	L-H		0
3	L-L	Hebei, Shanxi, Jilin, Liaoning, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	22
4	H-L	Inner Mongolia	1

Source: author's own elaboration

Table 2.7 - Local Moran index distribution of sports industry in 2020

Quadrant	Space-related patterns	Region	Amount
1	H-H	Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong	8
2	L-H		0
3	L-L	Hebei, Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	19
4	H-L	Hebei, Liaoning, Jilin and Heilongjiang	4

Source: author's own elaboration

As can be seen from table 2.7, in the Moran scatter map of the high-quality development of China's digital economy and sports industry under the economic space matrix, the vast majority of provinces are in the first and third quadrant, which further shows that there is a high degree of spatial agglomeration in the high-quality development of China's digital economy and sports industry.

Spatial measurement model test. Through the aforementioned spatial autocorrelation test, we found that the digital economy has a significant spatial correlation with the high-quality development of the sports industry. In order to obtain the best regression results, series of tests are needed to determine the specific form of the spatial measurement model before analyzing the spatial measurement model. Select the space

panel model based on the following steps.

In the first step, the LM test was performed. The nested spatial weight matrix was used for the SEM model and SAR model, through the spatial correlation test of ordinary static panel regression (OLS), including LM-Lag and robust LM-Lag test and LM-Error and robust LM-Error test. If the LM test passes one or two of the models, the choice of the spatial model needs to be determined using the Wald test. If the test results reject both null assumptions, the spatial Dubin model is selected.

Table 2.8 - Spatial dependence test

LM checkout	LM	P
LM_test_Error	18.830	0.000
R obustLM_test_Error	16.250	0.001
LM_test_L ag	20.730	0.000
R obustLM_test_L ag	27.432	0.000

Source: The author calculated it by using STATA16

Table 2.8 shows that LM_test_Error and robust LM_test_Error pass the 1% significance test, while LM_test_Lag and robust LM_test_Lag also pass the 1% significance test, indicating that the study subjects have the dual effect of both spatial lag and spatial error autocorrelation, and should consider the selected spatial Dubin model.

In the second step, the LR test and the Wald test were performed. Whether the spatial Dubin model can be converted into spatial lag model (SDM SAR) and spatial error model (SDM SEM), using LR test and Wald test, respectively, the test results show that the SDM model can reject the null hypothesis of SAR model and SEM model, and accept the SDM model. Table9 shows that the LR test values are 25.75 and 19.91 respectively, and the null hypothesis is rejected at the 1% significant level, indicating that the spatial Dubin model does not degenerate into spatial lag model and spatial error model, and the most appropriate to choose SDM model for empirical analysis.

The third step, the hausman test, after selecting the SDM model, the SDM model will determine whether to choose a fixed effect or a random effect for analysis. The test results showed a chi2 (7) value of 38.79 and a P-value of 0.000 through a level of

significance of 1% indicating that the SDM model should be analyzed using fixed effects.

Table 2.9 - Results of the L R test and the Wald test

LR checkout	Likelihood-ratio test	L R chi2(9)	25.75
	(A s umption:sar nested in sd m)	P rob>chi2	0.0022
	Likelihood-ratio test	L R chi2(9)	19.91
	(A s umption:semested in sd m)	P rob>chi2	0.0022
wald checkout	Wald Test for SAR	c hi2(7)	15.2
		P rob>chi2	0.0335
	Wald Test for SEM	c hi2(9)	26.66
LR checkout	Likelihood-ratio test	L R chi2(9)	25.75
	(A s umption:sar nested in sd m)	P rob>chi2	0.0022

Source: The author calculated it by using STATA16

Spatial Durbin model regression analysis. Column (1) - (3) respectively said time fixed effect, regional effect and double fixed effect of digital economy under the influence of high quality of the sports industry development coefficient, (4) - (6) column respectively represents time fixed effect, regional effect and double fixed effect of digital economy for other areas of sports industry development of high-quality space spillover coefficient.

We can draw some conclusions based on the regression results of the spatial Dubin model, the combined significance test of regional fixed effect, time fixed effect and the study of this paper. The P value is 0.0003 for the regional fixed effect and two-way fixed effect test. For the temporal fixed effect test, the P value is 0.0000, which is significant at 1% significance level, indicating that the null hypothesis is rejected and the regression results of the double fixed effect model prevail.

Main refers to the influence coefficient of the variable to the region, Wx refers to the spatial overflow coefficient of the variable to other regions, and rho should be the spatial overflow coefficient of the explained variable to the surrounding area.

Table 2.10 - Results of the S D M model

	（1）	（2）	（3）	（4）	（5）	（6）
DIGIT	0.5860***	0.1359***	0.1313***	-0.0413	-0.1325*	-0.1246
	(0.0200)	(0.0331)	(0.0325)	(0.0609)	(0.0736)	(0.0759)
Sta	0.0000**	0.0000	0.0000	0.0000**	0.0000**	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Eco	-0.0001	0.0005	0.0003	-0.0002	0.0010*	-0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0006)	(0.0005)	(0.0007)
Fis	2.0133***	1.0073***	1.1304***	0.7182	0.1069	1.5609**
	(0.2791)	(0.2163)	(0.2106)	(0.6558)	(0.4713)	(0.5733)
Spo	0.0000	0.0000	0.0001	0.0001	-0.0001	0.0001
	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Urb	-0.0005	0.0026***	0.0042***	-0.0016**	-0.0042**	-0.0029*
	(0.0004)	(0.0007)	(0.0009)	(0.0006)	(0.0016)	(0.0017)
Edu	0.0005*	0.0008**	0.0009***	0.0001	-0.0006*	0.0002
	(0.0003)	(0.0002)	(0.0002)	(0.0007)	(0.0003)	(0.0005)
Spatial rho	-0.1230	0.1284	-0.0360	-0.1230	0.1284	-0.0360
	(.)	(0.0896)	(0.0984)	(.)	(0.0896)	(0.0984)
Variance sigma2_e	0.0008***	0.0002***	0.0002***	0.0008***	0.0002***	0.0002***
	(0.0001)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)
N	310	310	310	310	310	310
R2	0.957	0.688	0.690	0.957	0.688	0.690

Source: The author calculated it by using STATA16*** is significant at 1% significance; * * significant at 5% significance; * significant at 10% significance.

Effect decomposition. The spatial Dubin model is decomposed, and the direct effect of the influence of the digital economy represents the influence of the change of the digital economy on the high-quality development of the sports industry in the surrounding area.

Table 2.11 - The SDM model effect decomposition

	Direct	Indirect	Total
DIGIT	0.1333***	0.1198*	0.2531***
	(0.0331)	(0.0707)	(0.0780)
Sta	0.0023**	0.0031**	0.0054***
	(0.0330)	(0.0870)	(0.7600)
Eco	0.0003*	-0.0000	0.0003**
	(0.0003)	(0.0007)	(0.0008)
Fis	1.1178***	1.4277**	2.5455***
	(0.2079)	(0.5446)	(0.5686)
Spo	0.0021***	0.0031**	0.0052***
	(0.0321)	(0.0042)	(0.0022)

Urb	0.0043***	-0.0031*	0.0012
	(0.0009)	(0.0016)	(0.0018)
Edu	0.0009***	0.0002	0.0010**
	(0.0002)	(0.0005)	(0.0004)
N	310		
R2	0.890		

Source: The author calculated it by using STATA16*** is significant at 1% significance; * * significant at 5% significance; * significant at 10% significance.

According to the results of the effect decomposition of SDM model, the coefficient of digital economy in the region is 0.1333, promoting the digital economy in the region and further shows that the sustainable development of sports industry.

Threshold model estimation. In the threshold model 1, the digital economy level was used as the threshold variable, with a corresponding threshold of 3.121. In regions with digital economy level below 3.121, the coefficient of digital economy variables is-0.003; in regions with digital economy level above 3.121, the coefficient is 0.169. To some extent, this shows that in the places with a high level of the digital economy, the development of the digital economy can better promote the high-quality development of the sports industry, and the backward areas have a digital disadvantage, because the coefficient and threshold P value of the digital economy variables are not significant. In the threshold panel model 2, per capita GDP was used as the threshold variable, with a corresponding threshold value of 12.9.In regions where per capita GDP is lower than 12.9, the coefficient of digital economy variables is 0.279; in regions with digital economy level higher than 12.9, the coefficient of digital economy variables is 0.592, and the coefficient and threshold P value of digital economy variables are significant at 10%.Therefore, in areas with a high level of economic development, the development of digital economy can better promote the high-quality development of the sports industry.

Endogenity analysis. In the basic model, in this paper, more control variables are introduced, and it controls time fixed effects and regional fixed effects, aiming to minimize the possible endogenous problems. The endogenous problem mainly comes

from two aspects: one is the omission of explanatory variables; the second is the bidirectional causality.

Table 2.12 - Estimation results of the panel threshold panel model for the impact of digital economy development on regional economic growth

variable	Threshentry panel model 1		Threshentry panel model 2	
	DIGIT≤3.121	DIGIT>3.121	PGDP≤ 12.900	PGDP>12.900
DIGIT	-0.003(-0.00)	0.169(1.01)	0.279*(1.86)	0.592***(3.69)
Sta	-5.939**(-2.20)	-5.939**(-2.20)	-3.893(-1.58)	-3.893(-1.58)
Eco	-0.0002(-1.27)	-0.0002(-1.27)	-0.0003(-2.35)	-0.0003(-2.35)
Fis	-0.225***(-4.13)	-0.225***(-4.13)	-0.0648(-1.14)	-0.0648(-1.14)
Spo	-10.348***(-6.19)	-10.348***(-6.19)	-7.929***(-5.06)	-7.929***(-5.06)
Urb	-0.433(-1.42)	-0.433(-1.42)	-0.213(-0.77)	-0.213(-0.77)
Edu	1.382(0.39)	1.382(0.39)	5.810*(1.78)	5.810*(1.78)
constant term	-1312.248***(-5.33)	-1312.248***(-5.33)	-781.079***(-3.32)	-781.079***(-3.32)
sample capacity	310	310	310	310
R2	0.739		0.77	
Gate limit P value	0.157		0.007	

Source: The author calculated it by using STATA16 *** is significant at 1% significance; * * significant at 5% significance; * significant at 10% significance.

Based on this, the 2SLS method is used to reduce the regression error caused by endogeni. Draw on the practice of Chen Xiaohui et al. (2020), 2SLS regression took the lag phase of the average square of digital economy development in other provinces and municipalities as the instrumental variable of the development level of digital economy. The results are shown in Table 2.13. Regardless matter whether variables are controlled, the coefficient of digital economy variables in the two models is significantly positive, indicating that the development of digital economy can still promote the high-quality development of sports industry after considering endogenous problems.

Table 2.13 - Results of the endogenous regression

Variable	2SLS	
	model 1	model 2
DIGIT	0.751***(6.45)	10.38**(2.35)
constant term	4.133***(10.20)	12.495(0.92)
controlled variable	deny	yes
Area fixed	yes	yes
Sample fixed	yes	yes
sample capacity	310	310
R2	0.561	0.523

Source: The author calculated it by using STATA16*** is significant at 1% significance; * * significant at 5% significance; * significant at 10% significance.

Robustness test. First, the nested space weight matrix is replaced with adjacent space weight matrix, economic distance space weight matrix and geospatial weight matrix, and then the double fixed effect space Dobbin model is used for regression analysis; second, the lag phase of digital economy development level is taken as the core explanatory variable, and then the double fixed effect space Dobbin model is used for regression analysis.

Table 2.14 - Results of the robustness test

Variable	Adjacency matrix	Geospatial matrix	Economic distance matrix	First order lag term
DIGIT	0.142***	0.0777***	0.0860***	0.327*
	(0.0249)	(0.0358)	(0.0267)	(0.1344)
W*DIGIT	0.101**	0.135	0.0346	0.655*
	(0.0411)	(0.1455)	(0.0583)	(0.3218)
direct effect	0.218***	0.0749***	0.0868***	0.3510*
	(0.0333)	(0.0420)	(0.0329)	(0.1343)
indigo effect	0.0862*	0.188**	0.0295**	0.3960**
	(0.0607)	(0.2448)	(0.0462)	(0.2552)
gross effect	0.3042**	0.2629**	0.1163**	0.7470***
	(0.0480)	(0.2641)	(0.0592)	(0.2269)
Individual fixed	yes	yes	yes	yes
Time fixed	yes	yes	yes	yes
Log-L	766.5266	.4735647	73342.53	275.0553
R-squared	0.8127	0.8755	0.8974	0.8823
N	310	310	310	279

Source: The author calculated it by using STATA16

The regression results in Table 2.14 show that the symbols of each explanatory variable are basically consistent with the previous results, so the spatial spillover effect of the development of digital economy on the high-quality development of the sports industry is robust.

2.3 The analysis of empirical test results regarding the efficacy of sustainable management in the sports industry

China's socialist market economy continues to develop and grow, and the rapid development of the sports industry is gradually progressing steadily. The sports industry is gradually developing and has become an important supporting emerging industry to directly promote the healthy economic growth of China in the new era.COVID-19 outbreak brought adverse effects for China's sports industry development, in order to promote the outbreak era of Chinese sports industry high quality development, accelerate the reform and innovation, opening up to the outside world, accelerate industrial transformation and development and upgrading of modern economic and social development innovation mode of important formation stage, the critical time is to promote the construction of contemporary sports revitalization, promote the rapid and healthy development of the sports industry in this important historical critical moment. It is conducive to promoting the further development of China's sports industry, promoting China's sports industry to accelerate the in-depth development of the supply-side industrial structural restructuring reform, and realize high-quality economic development.

To analyze the coordinated development level of things. The degree of coupling refers to the influence of the interaction between two or more systems, achieving the dynamic correlation of the coordinated development, which can reflect the degree of mutual restriction between the systems [13]. Coordination refers to the size of the degree of benign coupling in the coupling interaction relationship, which can reflect the coordination situation [14]. The phenomenon of sports industry and high-quality

economic development interact and influence each other depends as the sports industry-economic efficient growth coupling. The sports industry influences and interacts economic development, and determines the level of connection between there. First of all, the development of sports industry accelerates the development of sports industry scale and the speed of sports industry, which will surely drive the high-quality economy with coordinated economy and growth, innovation and opening up, sharing by the whole people, and green and sustainable economy.

First of all, the development of sports industry has a direct impact on sustainable development of region. Secondly, sport industry can be surely drive the high-quality economy that are based on innovation, green and opening up. [15]

Therefore, build efficacy function to measure the sports industry and economic quality development two subsystem development effect, then build the coupling function and coupling matching function respectively from pure quantitative and "qualitative quantitative" two angles measure the sports industry and economic quality development coupling development efficiency [16].

Because the original data units are not the same, it is impossible to compare and compute directly, standardized processing is required, as well as treatment utilizing (extremely standardization) treatment, and also have forward indicators and reverse indicators, so get the following formula：

– forward indicators：

$$Y_{ij} = \frac{x_{ij} - x_{j_{min}}}{x_{j_{max}} - x_{j_{min}}};$$

(2.17)

– reverse indicators:

$$Y_{ij} = \frac{x_{j_{max}} - x_{ij}}{x_{j_{max}} - x_{j_{min}}}.$$

(2.18)

x_{ij} is the value in i year, j region, $x_{j_{min}}$ is the minimum in region j, and $x_{j_{max}}$ is the maximum in region j, Y_{ij} is the value after normalization.

The coupling function. According to the n-dimensional system interaction coupling

degree model:

$$C_n = n\left(\frac{U_1 U_2 \cdots U_n}{\prod(U_i + U_j)}\right)^{\frac{1}{n}}. \qquad (2.19)$$

The dual coupling function between the sports industry and high-quality economic development is obtained:

$$C_2 = 2\left(\frac{U_1 U_2}{(U_1 + U_2)(U_2 + U_1)}\right)^{\frac{1}{2}}. \qquad (2.20)$$

C is the coupling between the sports industry and high quality economic development, between 0 and 1, when C tends to 0 is, the coupling system of development of Sports Industry and high quality economic development, indicating that development of Sports Industry fails to well promote high quality economic development, when C tends to 1, development of Sports Industry and high quality economic coupling system is in effective coupling state, indicating that development of Sports Industry can promote high quality economic development.

Coupling matching degree function. The established coupling degree function can effectively calculate the coupling system composed of the development of sports industry and high-quality economic development, but due to the lack of data, it does not better reflect the real economic state, and cannot reflect the actual economic significance between U1 and U2. In this case it is appropriate to build a coupling matching degree function [17; 18], performing exactly as follows:

$$\begin{cases} D = (CT)^K \\ T = aU_1 + bU_2 \end{cases} . \qquad (2.21)$$

D is the coupling matching degree, and C is the coupling degree between the development of sports industry and high-quality economic development; T is the matching and reconciliation index between the development of sports industry and high-quality economic development, indicating the matching effect between the development of sports industry and high-quality economic development; k, a, b is the pending coefficient, K=0.5, a=0.6, b=0.4.

According to the standardized index values and their weights, the comprehensive index of each subsystem using the above formula （2.17） - （2.20） is calculated, and

the comprehensive index of sports industry and high-quality economic development system in each region. Due to the limited length of the article, the data results of 2010 and 2020 are listed here. Details are given in Table 2.15.

Table 2.15 - Comprehensive index of sports industry and high-quality economic development system in various provinces and cities in China

Region	Sport industry U1			High-quality economic development of the U2		
	2010	2020	Mean value	2010	2020	Mean value
Beijing	0.48	0.59	0.54	0.72	0.88	0.80
Tianjin	0.34	0.55	0.45	0.54	0.59	0.57
Hebei	0.36	0.56	0.46	0.34	0.35	0.35
Shanghai	0.58	0.58	0.58	0.8	0.85	0.83
Jiangsu	0.65	0.81	0.73	0.64	0.66	0.65
Zhejiang	0.49	0.69	0.59	0.57	0.69	0.63
Fujian	0.42	0.60	0.51	0.48	0.57	0.53
Shandong	0.24	0.62	0.43	0.45	0.58	0.52
Guangdong	0.89	0.85	0.87	0.48	0.57	0.53
Hainan	0.14	0.53	0.34	0.34	0.46	0.40
Shanxi	0.2	0.58	0.39	0.32	0.39	0.36
Anhui	0.37	0.59	0.48	0.3	0.43	0.37
Jiangxi	0.16	0.59	0.38	0.31	0.42	0.37
Henan	0.17	0.57	0.37	0.29	0.4	0.35
Hubei	0.17	0.58	0.38	0.34	0.45	0.40
Hunan	0.16	0.58	0.37	0.32	0.5	0.41
Nei Monggol	0.12	0.37	0.25	0.33	0.4	0.37
Guangxi	0.13	0.37	0.25	0.31	0.39	0.35
Chongqing	0.15	0.54	0.35	0.41	0.51	0.46
Sichuan	0.22	0.59	0.41	0.35	0.47	0.41
Guizhou	0.14	0.55	0.35	0.26	0.28	0.27
Yunnan	0.12	0.55	0.34	0.32	0.43	0.38
Xizang	0.11	0.34	0.23	0.3	0.36	0.33
Shaanxi	0.17	0.56	0.37	0.37	0.46	0.42
Gansu	0.12	0.53	0.33	0.17	0.34	0.26
Qinghai	0.09	0.58	0.34	0.31	0.33	0.32
Ningxia	0.09	0.34	0.22	0.38	0.47	0.43
Xinjiang	0.12	0.43	0.28	0.41	0.38	0.40
Liaoning	0.46	0.55	0.51	0.4	0.51	0.46
Jilin	0.24	0.53	0.39	0.29	0.43	0.36
Heilongjiang	0.37	0.53	0.45	0.29	0.44	0.37

Source: author's own elaboration

According to the standardized index values and their weights, the comprehensive

index of each subsystem is calculated using the above formula（2.21）, and the coupling and coordination degree between the sports industry and the high-quality economic development are calculated using the formula. The calculation results are in the Table 2.16.

Table 2.16 - Calculation results of the coupling degree of China's sports industry and economic development from 2010-2020

Region	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Mean value
Beijing	0.78	0.89	0.87	0.83	0.94	0.89	0.93	0.94	0.95	0.9	0.89	0.89
Tianjin	0.53	0.59	0.6	0.64	0.83	0.73	0.67	0.64	0.61	0.66	0.65	0.65
Hebei	0.46	0.44	0.43	0.47	0.61	0.61	0.58	0.55	0.53	0.53	0.53	0.52
Shanghai	0.72	0.70	0.72	0.79	0.99	0.87	0.8	0.84	0.75	0.81	0.8	0.80
Jiangsu	0.69	0.81	0.87	0.81	0.8	0.93	0.85	0.92	0.83	0.85	0.83	0.84
Zhejiang	0.61	0.67	0.69	0.69	0.81	0.84	0.78	0.81	0.78	0.76	0.75	0.74
Fujian	0.54	0.56	0.56	0.58	0.96	0.71	0.7	0.7	0.68	0.68	0.66	0.67
Shandong	0.45	0.59	0.62	0.63	0.83	0.76	0.7	0.71	0.68	0.68	0.67	0.67
Guangdong	0.71	0.85	0.94	0.87	0.91	0.98	0.95	0.97	0.98	0.93	0.9	0.91
Hainan	0.35	0.43	0.44	0.47	0.46	0.6	0.56	0.52	0.55	0.51	0.5	0.49
Shanxi	0.38	0.41	0.39	0.43	0.47	0.58	0.53	0.48	0.49	0.48	0.47	0.46
Anhui	0.45	0.44	0.46	0.45	0.63	0.61	0.56	0.56	0.56	0.54	0.54	0.53
Jiangxi	0.35	0.43	0.45	0.43	0.57	0.6	0.55	0.56	0.55	0.52	0.51	0.50
Henan	0.34	0.41	0.42	0.41	0.65	0.59	0.53	0.52	0.53	0.51	0.51	0.49
Hubei	0.36	0.46	0.49	0.47	0.89	0.63	0.58	0.61	0.56	0.58	0.57	0.56
Hunan	0.35	0.44	0.46	0.47	0.7	0.63	0.58	0.63	0.57	0.56	0.54	0.54
Guangxi	0.33	0.40	0.41	0.41	0.43	0.54	0.5	0.46	0.49	0.46	0.46	0.44
Nei Monggol	0.39	0.47	0.48	0.52	0.6	0.67	0.61	0.59	0.59	0.57	0.55	0.55
Chongqing	0.4	0.48	0.51	0.51	0.74	0.65	0.61	0.61	0.59	0.58	0.56	0.57
Sichuan	0.31	0.37	0.39	0.35	0.51	0.55	0.51	0.47	0.49	0.45	0.45	0.44
Guizhou	0.33	0.39	0.39	0.41	0.42	0.54	0.5	0.46	0.5	0.46	0.45	0.44
Yunnan	0.38	0.29	0.48	0.49	0.77	0.64	0.6	0.56	0.55	0.55	0.56	0.53
Xizang	0.25	0.16	0.33	0.35	0.33	0.45	0.41	0.42	0.46	0.4	0.39	0.36
Shaanxi	0.29	0.21	0.35	0.35	0.32	0.51	0.48	0.43	0.46	0.45	0.42	0.39
Gansu	0.33	0.24	0.4	0.41	0.41	0.58	0.48	0.51	0.54	0.45	0.43	0.43
Qinghai	0.33	0.24	0.41	0.43	0.47	0.53	0.53	0.48	0.5	0.57	0.55	0.46
Ningxia	0.39	0.47	0.48	0.52	0.6	0.67	0.61	0.59	0.59	0.58	0.56	0.55
Xinjiang	0.4	0.48	0.51	0.51	0.74	0.65	0.61	0.61	0.59	0.46	0.44	0.55
Liaoning	0.53	0.53	0.52	0.52	0.68	0.67	0.63	0.61	0.61	0.6	0.58	0.59
Jilin	0.38	0.42	0.43	0.46	0.47	0.58	0.54	0.47	0.53	0.63	0.6	0.50
Heilongjiang	0.45	0.42	0.44	0.44	0.54	0.59	0.54	0.5	0.51	0.64	0.62	0.52

Source: author's own elaboration

From 2010 to 2019, the coupling degree of China's sports industry and high-quality

economic development tends to increase, and in 2020, the influence of novel coronavirus tends to decline. Before 2020, the eastern region was in a state of high coupling. The central and western regions ranging from imbalance and moderate coordination to good coordination show that the overall level of coupling between China's sports industry and high-quality economic development is high. Then the authors analyze the spatial and temporal evolution from the coupling degree of sports industry and high-quality economic development.
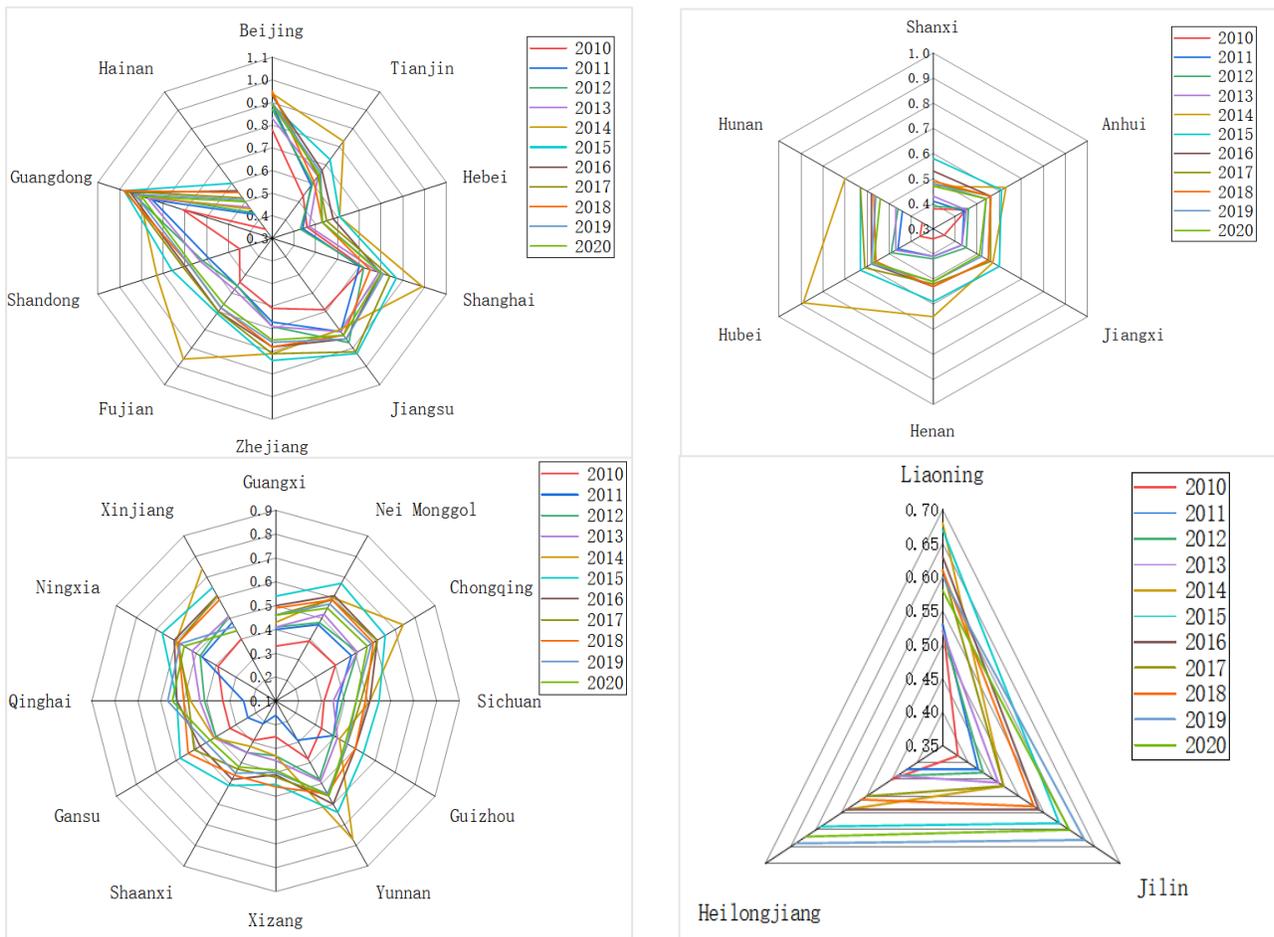

Figure 2.1 - Statistical diagram of the coupling degree of sports industry and high-quality economic development in four regions
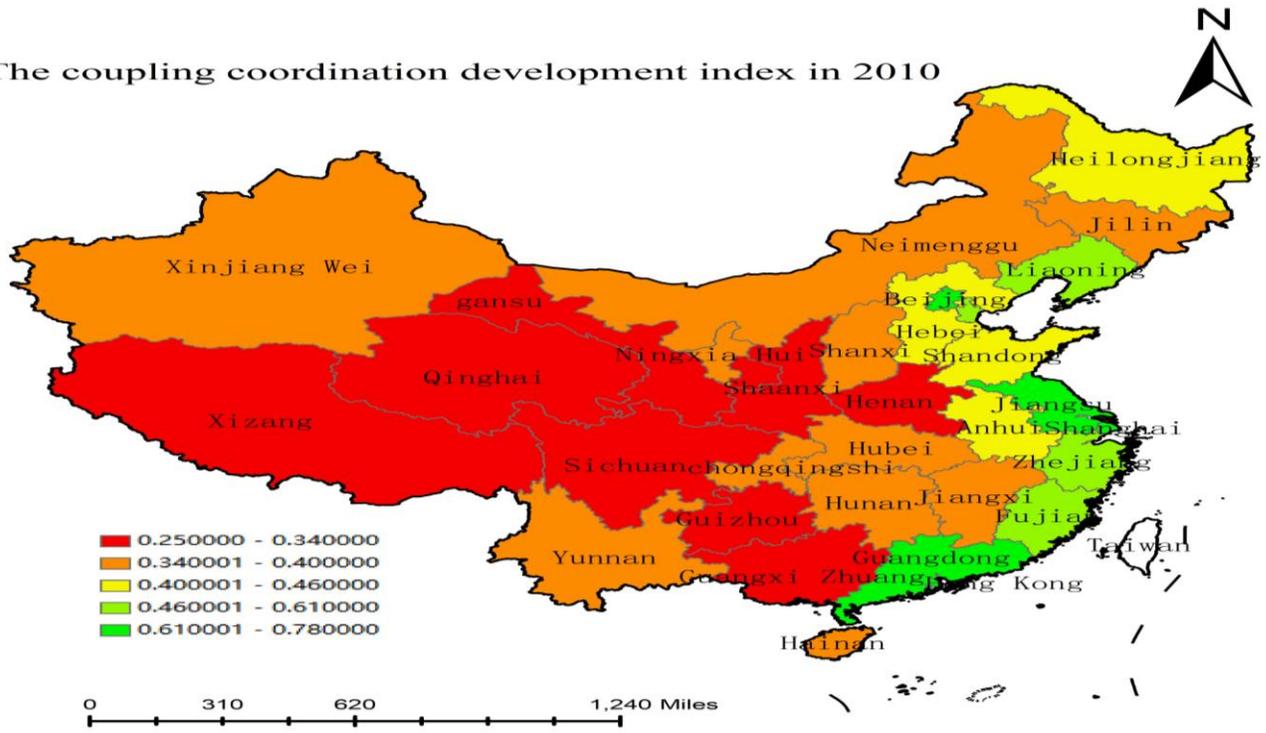
Source: author's own elaboration

Analysis of the time evolution. Based on the statistical data from 2010–2020 and the above coupling model, the relationship between sports industry and high-quality economic

development in provinces and cities was calculated. it is divided into economic development level: eastern region, central region, western region, northeast region, the authors analyze them from the regional time change level, the Figure 2.1:

As can be seen from Figure 1a, the coupling degree of sports industry and high-quality economic development in eastern China shows an overall trend of increasing year by year, among which the coupling degree of Hainan Province was the lowest in 2010 and developed slowly increased year by year. In 2019, the coupling value of sports industry and high-quality economic development exceeded that of Hebei Province. The coupling degree of sports industry and high-quality economic development in central China is generally between 0.4 and 0.7 (Figure 2.1b). Among the central provinces and cities, Hubei Province sports industry and economic development develop well, and the index in 2010 is 0.88, which is a good breakthrough and leap. From 2010 to 2014, the coupling index of sports industry and high quality economic development in all provinces in western China was lower than 0.5; from 2014 to 2019, it was in barely coordination and loss coordination (Figure 2.1c). The coupling index of sports industry and high-quality economic development in the three northeastern provinces is on the rise. From 2010 to 2014, the coupling index of sports industry in northeastern China was between 0.45 and 0.5 (Figure 2.1d); from 2014 to 2018 and grew rapidly，2019-2020 is in a downward trend，further proving that COVID-19 has a great impact on the sports industry.

Spatial evolution analysis. In order to further explore the spatial differences in the development level of sports industry and high quality economic development, the visual analysis of the sports industry and economic development types in 2010, 2016, 2019 and 2020 year coupling coordination development index which is as follows (Figure 2.2). The spatial coefficient of coupling with high-quality economic development in Chinese provinces and cities changed significantly in 2010, 2016 and 2019, which further shows that the coupling coordination between regions is obvious. It's researched that in 2010 (Fig. 2a), sports industry and economic development in 2010 are Beijing, Guangdong, Jiangsu Province.

The coupling coordination development index in 2010

Heilongjiang

Jilin

Neimenggu

Liaoning

Beijing

Hebei

Xinjiang Wei

gansu

Ningxia Hui Shanxi Shandong

Qinghai

Shaanxi

Jiangsu

Xizang

Henan

Anhui Shanghai

Hubei

Zhejiang

Sichuanchongqingshi

Hunan Jiangxi

Fujian

Guizhou

Guangdong

Yunnan

Guangxi Zhuang Hong Kong

Taiwan

Hainan

0.250000 - 0.340000
0.340001 - 0.400000
0.400001 - 0.460000
0.460001 - 0.610000
0.610001 - 0.780000

0   310   620   1,240 Miles

(a) 2010

The coupling coordination development index in 2016

Heilongjiang

Jilin

Neimenggu

Liaoning

Beijing Tianjin

Xinjiang Wei

Hebei

gansu

Shanxi

Shandong

Ningxia Hui

Qinghai

Shaanxi

Henan

Jiangsu

Shanghai

Anhui

Shandong

Xizang

Hubei

Zhejiang

Sichuan

chongqingshi

Hunan

Jiangxi

Fujian

Guizhou

Guangxi Zhuang

Guangdong

Yunnan

Hong Kong

Taiwan

Hainan

0.410000 - 0.500000
0.500001 - 0.560000
0.560001 - 0.670000
0.670001 - 0.800000
0.800001 - 0.950000
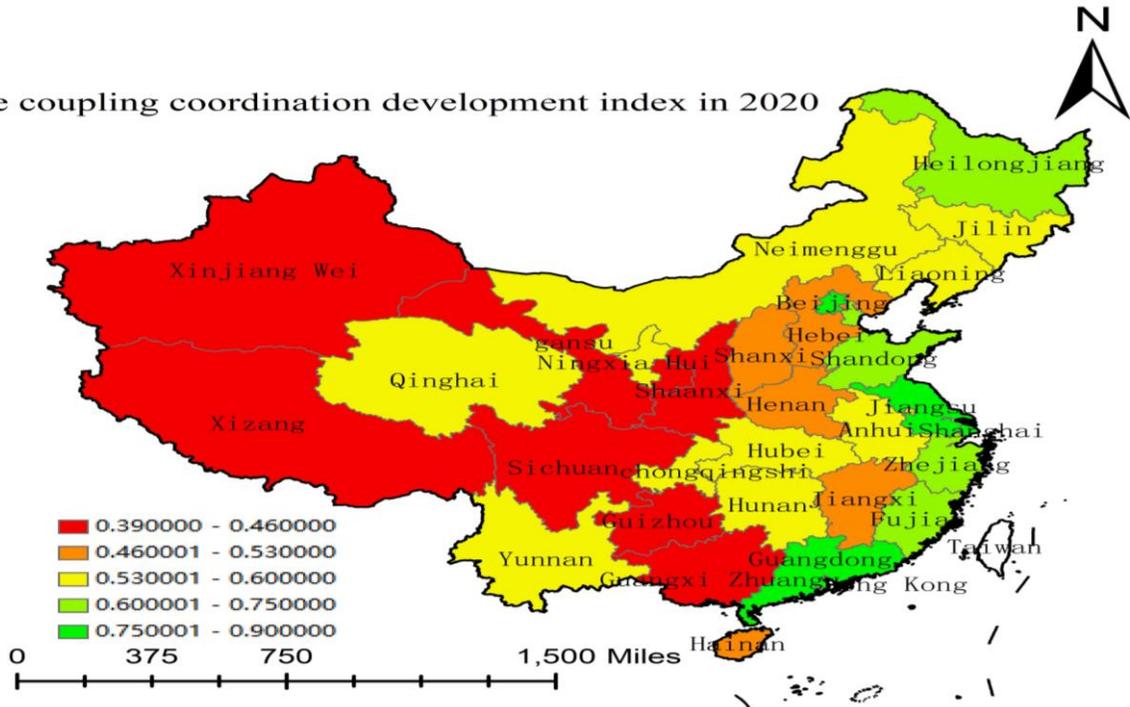
0   300   600   1,200 Miles

(b) 2016

The coupling coordination development index in 2019
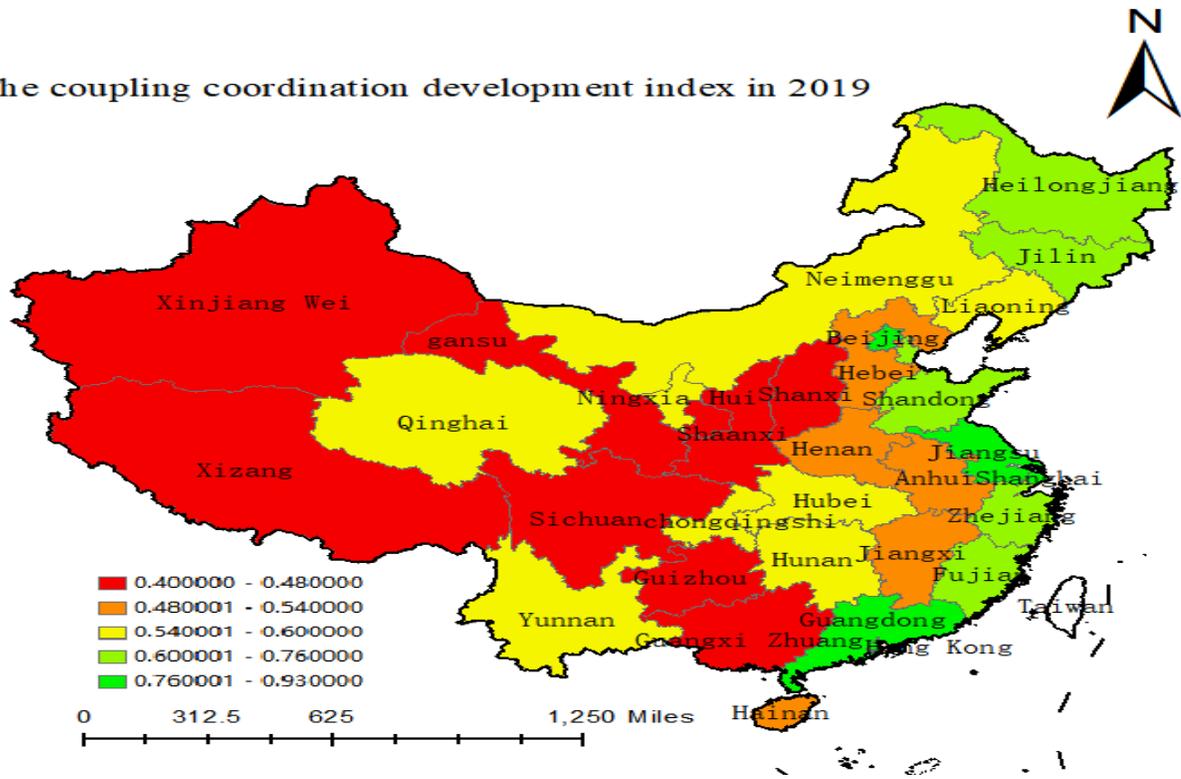
(c) 2019

The coupling coordination development index in 2020

(d) 2020

Figure 2.2 - High-quality coupling coefficient between Chinese regional sports industry and economy in the four years

Source: author's own elaboration

The eastern region is high, while the central and northeast are at the second level, which further shows the rapid economic development in the central and eastern regions. In 2016 (Fig. 2b), the coupling coefficient of high-quality development of sports industry and economic development at a high level were: Beijing, Guangdong Province, Jiangsu Province, Shandong Province, etc. In 2019 (Fig. 2c), the coupling coefficient of sports industry and high-quality economic development in China was higher than 0.5, but the changes between provinces and regions were obvious. The investment in green science and technology in the eastern region is still at the first level, the central and northeast are the second, and the development of the western region is the last. In 2020 (Fig. 2d), the coupling coefficient of sports industry and high-quality economic development in all provinces is lower than that in 2019. The COVID-19 has an obvious impact on the high-quality development of China's sports industry and economic economy.

By using the coupled coordination model, selecting the data from 2010-2020, according to calculate the coordination degree between the sports industry and high-quality economic development system between 31 provinces and cities in China, and mean the coordination value of the high-quality economic development in 11years and the authors obtained the following results (Table 2.17).

Table 2.17 - Calculation results of the coupling degree of China's sports industry and economic development from 2010-2020

Region	Mean value	Rank	Coupling coordination values	Coordination level
Guangdong	0.91	1	$0.9<D\leq1$	High quality and coordinated development
Beijing	0.89	2	$0.8<D\leq0.9$	Good coordinated development
Jiangsu	0.84	3		
Shanghai	0.80	4	$0.7<D\leq0.8$	Intermediate coordinated development
Zhejiang	0.74	5		
Fujian	0.67	6	$0.6<D\leq0.7$	Primary coordinated development
Shandong	0.67	7		
Tianjin	0.65	8		
Liaoning	0.59	9		
Chongqing	0.57	10		

Hubei	0.56	11	0.5<D≤0.6	Barely coordinate development
Xinjiang	0.56	12		
Ningxia	0.55	13		
NeiMonggol	0.55	14		
Hunan	0.54	15		
Yunnan	0.53	16		
Anhui	0.53	17		
Hebei	0.52	18		
Shaanxi	0.51	19		
Heilongjiang	0.51	20		
Jiangxi	0.50	21	0.4<D≤0.5	The verge of dysregulation and recession
Jilin	0.50	22		
Henan	0.50	23		
Hainan	0.49	24		
Shanxi	0.49	25		
Qinghai	0.45	26		
Guangxi	0.44	27		
Sichuan	0.44	28		
Guizhou	0.44	29		
Gansu	0.44	30		
Xizang	0.36	31	0.3<D≤0.4	Mild dysregulation declined

Source: author's own elaboration

The results of coordination between sports industry and high quality economic development show that the coupling coordination in Guangdong province is between 0.9 and 1, between Beijing and Jiangsu Province between 0.8 and 0.9, between 0.3 and 0.4, indicating the great difference between the provinces.

The internal motivation for optimizing the structure of the sports industry refers to the discrepancy between the internal conditions of the sports industry and its optimal structural state. From a network system perspective, the various elements within the sports industry form a complex overall structure due to their organic connections and orderly combinations of resources from different departments. The higher the extension degree of this internal correlation network, the greater resource utilization becomes, resulting in a sports industry structure system that possesses more functions than simply adding up individual elements. Currently, an economic circulation network has been established within the sports industry; however, there is relatively loose economic and technical

connectivity among its various components. Due to low correlation among departments within this sector, transactions are hindered, leading to increased use of intermediate products and serious resource wastage[127]. Consequently, achieving structural benefits through synergy becomes challenging. Furthermore, interdependence within China's sports industry is not only at a low level but also takes on a single form of correlation characterized by one-way connections. In other words, excessive reliance on support from one direction weakens linkage benefits derived from an overall industrial structure system and hampers its capacity for resource conversion and comprehensive output capability. Lastly, there is insufficient quality in terms of correlation as divisions lack effective coordination.

According to the system concept, under normal circumstances, the combination of elements in the system adheres to "1+1=2". BAI Yang (2018) when conditions change, it is possible for "1+1 < 2" or even "1+1 > 2" to become the optimal state of the system structure. This represents the internal performance of coordinated development within the sports industry, including its level, extent and quality of structural correlation. In a market economy context, various departments within the sports industry have established a close supply-demand relationship based on resource correlation and technical complementarity[128]. The higher the level of inter-industry supply and demand relationship becomes, the stronger will be sports industrial structure resources' ability to transform; similarly, as industries strengthen their supply and demand relationships with each other, there will be an increase in output capacity within sports industrial structure. Moreover, higher inter-industry quality leads to greater division of labor between industries and increased roundabout processing degree which ultimately enhances overall added value within the sports industry[129]. Only through this approach can we fully realize the value potential of sports products. To achieve leapfrog development in China's sports industry while ensuring its sustainable and healthy growth requires maintaining a reasonable proportion between input and output within this sector. It also necessitates promoting correlation levels among industries along product chain, resource chain service

chain innovation chain and value chain dimensions; making departmental division of labor more rational; reducing barriers that hinder industry progress; better guiding production factor flow; establishing virtuous cycles for self-reproduction and expansion mechanisms - all these represent internal directions towards optimizing and upgrading structures within today's era.

The optimization of the sports industrial structure is commonly referred to as finding a balance between the operational output of the sports industry and its external environment system, which is also known as the critical point. When the energy input from the external environment system fails to reach a certain threshold value, it becomes an external constraint on optimizing the sports industry structure. Similarly, when the coefficient representing the output of the sports industry structure does not meet a specific threshold value, adjustments and transformations are necessary for improving this structure[130]. Therefore, it can be understood that achieving optimal benefits within the ecosystem of sports industrial structures does not rely on an absolute ideal mode or level but rather establishes a mutually reinforcing virtuous cycle relationship between these structures and their environmental systems. This ensures that both energy inputs from within its own system and those derived from external environments become crucial factors.

When examining the equilibrium of interaction between the structure of the sports industry and its external environment, it becomes evident that there is not a singular system support but rather a multi-system interaction. This aligns with the intricate adaptive nature of the sports industry structure. As an intermediary, the sports industry structure can also be perceived as a "black box" due to its opaque characteristics[131]. Therefore, when considering the external and systemic desirability within a specific environment, it is essential for the sports industry structure system to analyze both content and in teractive environmental systems in order to clarify optimization directions. The balance point of interaction between the sports industrial structure and its external environment lies in maximizing social needs fulfillment, achieving optimal economic

benefits, adapting to current stages of economic and social development, effectively utilizing contemporary scientific and technological advancements, fully exploiting resources, as well as ensuring coordinated development within regional sports production layouts.

The ultimate objective of sports industry production is to fulfill the material and spiritual needs arising from people's increasing demand for sports. A well-structured sports industry can adapt to changes in residents' consumption demands, ensuring a dynamic equilibrium between their sports consumption patterns and overall supply when adjusting their demand structure[132]. This not only serves as an internal requirement for achieving sustainable development in managing the sports industry but also aims at realizing its developmental value. Additionally, as one of the five major happiness industries, the sports industry plays an irreplaceable role in meeting people's growing aspirations for a better life[133]. Therefore, it is crucial to adjust the product structure of the sports industry, expand sports consumption further, and optimize residents' consumption patterns in order to effectively enhance production and deepen social aspects of supply-side structural reform. Consequently, by assessing the stage of the sports industry structure alongside social demands and economic development stages with coordination, we can prioritize maximizing social needs as our fundamental direction towards optimizing the structure of this sector.

From the perspective of the ultimate goal, meeting the growing material and cultural needs of people can only be achieved through sustained and effective output. The optimization of the sports industrial structure aims to maximize the benefits derived from this structure. Currently, China's economic development has reached a stage where improving quality and efficiency is crucial, with supply-side structural reform playing a vital role in surpassing fundamental driving forces and support thresholds[134]. As an emerging industry within the national economy, it is imperative for the sports industry to promote its structural optimization as it aligns with cultivating new economic growth and achieving high quality outcomes. In 2014, it was clearly stated that "by 2025, the total

scale of the sports industry will exceed 5 trillion yuan, becoming a significant force in promoting sustainable economic and social development." The Opinions on Promoting National Fitness and Sports Consumption to Facilitate the High-quality Development of the Sports Industry [(2019) 43] and the Outline for Building a Robust Sports Nation [(19) 40] have clearly defined the objective of developing the sports industry, which is to establish it as a key sector in the national economy. Internationally, industries with added value accounting for over 4% of the national economy and aligned with industrial structural evolution are referred to as pillar industries. Considering China's sports industry's total output value in 2017, its scale should maintain an average annual growth rate exceeding 11% from 2018 to 2025. Furthermore, if this growth rate persists until 2035, the overall size of China's sports industry will reach approximately ¥13 trillion yuan, with an added value of ¥5.11 trillion yuan, contributing around 1.96% to GDP (excluding development rates). This implies that without restructuring its industrial form, achieving desired economic development goals within the sports industry would be challenging. Therefore, promoting structural transformation within this sector becomes crucial in order to maximize economic benefits while facilitating national economic development and ensuring sustainable growth[135].

In essence, the structure of the sports industry represents a form of resource allocation. The optimization process of the sports industrial structure aims to enhance the efficiency and effectiveness of resource input conversion, while maximizing the benefits derived from this industrial framework through adjustments in input, combination, and functionality of production factors[136, 137]. Currently, the development of the sports industry faces inherent contradictions between limited sporting resources and infinite citizen demand, as well as extensive input without commensurate output efficiency. This necessitates a transformation in China's sports industry structure to achieve an improved "effect" rate for sports industry development.

In the ultimate analysis, the optimization of sports industrial structure is constrained by productivity development level, and scientific and technological progress - as a core

element of productivity - has become the fundamental driving force to promote the evolution of sports industrial structure[138]. The core of the new industrial revolution has undergone significant changes, which are reflected in shifting from an industrial perspective that stimulates growth through factor input to one driven by science and technology innovation for growth; from improving intensive production efficiency in a single society to enhancing demand matching efficiency through application of new technologies and product upgrades. Therefore, China's sports industry cannot rely solely on factor input or market demand occupation; instead, future transformation should focus more on high-tech intelligent technology development with high added value to drive change in promoting sports industry "power" development while meeting rapid consumer demands for diversification, fast food consumption trends.

The operation of the sports industry structure is realized through spatial implementation. Only by fully utilizing regional resources and fostering coordinated development of spatial combinations can industries in different regions achieve maximum benefits from the overall industrial structure[139]. The coordinated development of the distribution structure of the sports industry within a region not only ensures rational allocation of regional sports resources and balanced, comprehensive development of the sports industry but also serves as a fundamental embodiment of implementing regional coordinated development strategies effectively. Therefore, promoting complementary advantages in the regional sports industry layout structure and facilitating reasonable flow and efficient agglomeration of various elements are crucial factors for balancing regional economic development strategies, resource supply, and optimizing the layout structure within the sports production industry.

In different stages of economic development, the requirements for the structure of the sports industry vary, and this process also signifies the growth of the sports industry structure. The evolution of the sports industry structure and its adaptation to economic development stages are primarily manifested in two aspects: firstly, it aligns with people's increasing aspirations for a better quality of life.

Conclusions to chapter 2

Firstly, the theory and methodology of complex networks offer a novel perspective and analytical approach for the "qualitative" analysis of the structure within the sports industry. The internal correlation network of the sports industry structure is established based on industrial division of labor, with varying degrees of intricacy forming a three-dimensional industrial chain. Asset universality serves as the "resource valve" for network conduction related to the sports industry structure. Due to assets' strong versatility, different departments within various industries control distinct resources, resulting in differing levels of network influence among departments with varying network statuses. Technological innovation plays a pivotal role in shaping directional correlation networks within the sports industry structure. Technology integration and leading-edge technologies impact the associated industry chain within the sports sector. The amalgamation of product functionalities and collaborative market expansion establishes an industrial chain lock transmission mechanism, fostering non-institutional cluster "modules" among small groups sharing common external relations. The level of disposable income among residents affects both the density of relevant networks within the sports industry structure and subsequently influences overall functionality and spillover benefits derived from this sector. Market allocation of sporting resources under institutional factors represents a key element in realizing positive transmission mechanisms facilitating structural changes across related industries and ministries.

Secondly, the sports industry has established an internal economic network system, with different sectors playing distinct positions and roles within the sports industry structure association. Notably, the sports industry sector exerts a significant positive driving force on the internal sector of the sports industry. On the other hand, the sector responsible for sports product circulation, economic integration, and technological integration plays a more prominent role in driving backward effects on other industries. The manufacturing of sports goods holds considerable influence and control over the

network structure of the sports industry, particularly in distributing and transferring economic activities among departments. It stands as a leading industrial sector at present.

Thirdly, sports competition performance and related networks serve as intermediate departments within the overall industrial structure of sport. They play crucial roles in facilitating spillover effects throughout this structure while optimizing its configuration. Consequently, based on this internal structure of the sports industry, a division of labor system has been formed encompassing main industry modules, basic data modules, auxiliary modules, and distributed service industries. The intricate interconnections between these modules create an orderly yet complex structural system within the realm of sport.

Fourthly, the development planning of the sports industry can be unequivocally stated as not a mere sequential plan, nor is it a "zero-sum game" model where one aspect gains at the expense of another; rather, it exhibits a vicious cycle akin to "sunrise in the East, rain in the West". The optimization of the sports industry structure should encompass both the advantages derived from imbalanced development theory and short-board theory, while emphasizing on achieving coordinated growth across all sectors. A rational approach to developing the sports industry should not only draw insights from how specific industries contribute to both national economy and sports sector but also adopt a perspective rooted in complex system thinking and internal interdependencies within this field. This entails accurately analyzing economic and technological correlations within industrial structures and strategically nurturing key sectors for targeted cultivation and advancement. By adopting an integrated approach that encompasses related industry chains, China's sports industry can truly thrive during its current stage which represents a golden period for its development rather than being confined to just one golden era. The level of internal correlation, degree of interdependence, and quality of these connections are intrinsic factors driving optimization efforts towards enhancing China's sports industry structure. Promoting coordinated development among interconnected industries necessitates establishing reasonable division of labor between various departments with

an aim to enhance overall correlation effects within the sports sector while maximizing industrial benefits – ultimately serving as an endogenous direction guiding further improvements in optimizing its structural framework.

Fifthly, the upgrading of sports industrial structure is placed in the large system of industrial ecology, and the factors and mechanisms affecting the formation and evolution of sports industrial structure are deeply analyzed, as well as the motivation of the current optimization of sports industrial structure, and the optimization direction of sports industrial structure is demonstrated, thus constituting the external logic of the optimization of sports industrial structure. Therefore, the research shows that economic development environment, social demand environment, resource supply environment, scientific and technological innovation environment and institutional environment are the main external environment affecting the optimization of sports industry structure. The mechanism affecting the evolution of sports industry structure is as follows: economic development environment, the premise of the evolution of sports industry structure, determines the direction and process of the evolution of sports industry to a certain extent; Social demand environment -- the basic direction of the optimization of sports industrial structure; Resource supply environment & Objective conditions of the evolution of sports industry structure; Science and technology progress environment - the fundamental driving force of the evolution of sports industry structure; Institutional environment - the fundamental guarantee of the evolution of sports industry structure. The reform and development stage of the current economic development mode objectively requires the optimization of the sports industry structure; The transformation of social contradictions and consumption preference are the direct reasons for the optimization of sports industry structure. The restriction of resource factors and the extensive development of sports industry are the indirect reasons for the optimization of sports industry structure. The change of sports resources allocation is an important condition for sports production to optimize the industrial structure. The arrival of the fourth industrial revolution has provided the fundamental driving force for the optimization of the sports industry structure.

In finally, from 2010 to 2020, the coupling degree (C) and the coordinated degree of development value (D) values between the sports industry and the high-quality economic development system of various provinces and cities are steadily increasing year by year, indicating that the correlation and closeness between the systems are getting closer and closer. In terms of the spatial gathering situation, 31 provinces and cities are manifested as the spatial development pattern of the eastern region> western region> northern region> northeast region> western region. In further, this research can be oriented on urban district of provinces but need to conduct a survey and form of the data from currently selected indicators. The development of sports industry can provide impetus for China's economic growth, and the further development of economy can also promote the rapid development of sports industry. The two are interconnected and promote each other, which is a benign circular industry system. Only by constantly optimizing the development mode of China's sports industry and creating a high-quality market operation mechanism can the double development of sports economy and Chinese economy be realized.

CHAPTER 3. THE ENHANCEMENT OF THE MANAGEMENT SYSTEM FOR SUSTAINABLE DEVELOPMENT IN CHINA'S SPORTS INDUSTRY

3.1 The methodology for establishing a sustainable development framework within the Chinese sports industry

Based on the external influencing factors of sustainable development optimization in the sports industry and the internal correlation mechanism and effect of sustainable development, this study proposes an alternative path for optimizing sustainable development in the sports industry from both internal and external perspectives. Sustainable development optimization is a long-term strategy for the sports industry that requires consideration of China's economic and social development as well as specific conditions and laws within the industry. However, it is challenging to apply existing models or those used by developed countries to achieve optimal solutions for China's sports industry. Currently, academic research on sustainable development adjustment strategies in the sports industry generally follows a "status-countermeasure" paradigm. This paper utilizes qualitative reasoning and analysis based on relevant statistical data and experiences from Western countries to propose appropriate strategies. Nevertheless, there are complex technical, economic, and quantitative relationships among different sectors within the sports industry that need to be considered during adjustment optimization processes. The current approach often overlooks these complexities along with nonlinear dynamics associated with sustainable development changes in the sector, resulting in potential deviations from reality. Therefore, this chapter employs simulation experiments using system dynamics research methods to simulate and predict outcomes.

3.1.1 The construction of a simulation model for the optimal path selection towards the sustainable development of the Chinese sports industry.

The academic community has been utilizing the current composition of output value to analyze the optimization path, as well as the influencing factors and development trends,

in order to discuss the sustainable development optimization of the industry. Some researchers have employed gray system theory to predict the evolution of sustainable development in the sports industry and analyze its future optimization path. However, when analyzing sustainable development in the sports industry, our country can only provide a judgment on its optimization path rather than serve as a basis for such judgment. It fails to scientifically and reasonably explain the complexity, optimization, dynamics, cooperation, and nonlinearity inherent in the sustainable development system of this industry. Moreover, mathematical models established by grey system theory often rely on uncertainty and yield optimal solutions that are unrealistic assumptions; making it difficult for them to become a foundation for formulating policies related to sustainable development in sports industry.

The dynamic simulation modeling of optimizing sustainable development in the sports industry should be conducted through the following five steps: delineating system boundaries and determining subsystems; identifying system variables; establishing a causality diagram for the evolution of the sustainable development system in the sports industry; analyzing the dynamic flow of this evolution; constructing a data model for tracking its progress; and designing a simulation scheme to simulate the evolutionary process of sustainable development in the sports industry.

The definition of the system boundary refers to determining the scope of the sustainable development system in the sports industry and its auxiliary systems based on research objectives. According to the "Industrial Sustainable Development Adjustment Catalogue" issued by the National Development and Reform Commission in 2019, the sustainable development system of the sports industry can be divided into 11 sub-systems, including sports management activities, sports competitions and performance activities, sports fitness and leisure activities, and sports venue services. However, constructing a dynamic simulation model for optimizing sustainable development in this industry requires comprehensive and consistent statistical data. Unfortunately, due to changes in statistical criteria within the sports industry, existing data lacks integrity and

continuity[140]. Consequently, it is practically impossible to scientifically construct a simulation model for optimizing sustainable development in this field. Therefore, this study adopts a broad classification method used by China's National Bureau of Statistics and General Administration of Sport which divides the sustainable development system into three subsystems: sports service industry; manufacturing industry for sporting goods and related products; as well as construction of sports facilities. The evolution of sustainability within this sector relies on non-linear interactions and feedback mechanisms between components within its own system as well as with its environmental context. Based on an external logical analysis regarding optimization strategies for sustainable development within sport's domain，it is situated primarily within an economic framework[141].

The sustainable development of the sports industry is not a linear process, and the quantitative analysis of economic movements has several limitations. Numerous factors influence the industry's sustainable development, making it impossible to encompass all aspects and rendering full quantification unattainable. Based on these considerations, we propose the following recommendations:

Setting 1: The sustainable development system of the sports industry is considered to be a relatively self-contained entity, with temporary disregard for the impact of regional sustainable development optimization on the overall benefits of the sports industry. The industry in a region is influenced by numerous external factors, and capturing their corresponding variable relationships accurately through a comprehensive dynamic model poses challenges. Hence, this assumption is made in this paper.

Setting 2: The diverse trajectories of optimizing sustainable development in the sports industry are shaped by the interplay of various influential factors within the system.

Setting 3: The diverse trajectories of optimizing sustainable development in the sports industry are shaped by the interplay of various influential factors within the system.

Setting 4: The impact of capital investment on the sustainable development of the sports industry is simplified, and the simulation of path selection in optimizing

sustainability within the sports industry is also simplified. The model design primarily the influence of fixed capital investment. This choice is made because investments in fixed assets serve as the foundation for material production.

Setting 5: To streamline the optimization system for sustainable development in the sports industry, this study primarily focuses on two variables: government macro-control policies and market reform factors. This is because enhancing the resource allocation mechanism is crucial for achieving sustainable development in the sports industry. It involves maximizing the market's decisive role in resource allocation, leveraging the macro advantages of government, and rectifying negative externalities caused by market forces. We aim to enhance the market system and facilitate efficient allocation of economic resources based on industry supply and demand dynamics as well as price signals. In designing a simulation model for sustainable development and optimization path selection in the sports industry, we primarily measure market-oriented reforms in capital allocation and government macro-controls through assessing the proportion of non-state-owned assets in fixed asset investments within this sector, along with evaluating how much of the sports public finance budget is allocated to support activities within this domain.

Setting 6: Considering the challenges associated with variable selection and the quantifiable extent of such selection, this study does not hold significant relevance in assessing the impact of major national changes and policy shifts resulting from major events (such as the 2020 COVID-19 epidemic) on the sustainable development system of the sports industry.

Determination of the key variables. The first step in system dynamics modeling is to address the complex interdependencies and functions within industrial sustainable development systems, including multi-loop and nonlinear time-varying elements. Various methods are then employed to tackle these challenges effectively. Therefore, it is crucial to elucidate the system's state variables, rate variables, and auxiliary variables while describing the dynamic behavioral characteristics of the system and its feedback

relationships among different factors. The term "state variable," also known as an endogenous variable, represents the cumulative impact of various factors on the dynamic evolution of sustainable development in the sports industry. On the other hand, speed variables and auxiliary variables, also referred to as exogenous variables, capture both the rate of change and influencing factors affecting state variables[142].

The primary objective of human economic activities is to fulfill the increasing material and cultural demands of individuals, which can only be accomplished through continuous and rapid economic development. This principle also applies to the sports industry and its economic endeavors. Therefore, the selection of "sports industry added value" not only assesses its contribution to the sports industry but also directly reflects its position within the national economy's functioning[143]. Additionally, it serves as a crucial observation indicator for adapting to evolving social contradictions and meeting people's growing aspirations for an improved quality of life. The national physical fitness rate indirectly mirrors the growth in output value within the sports industry[144]. The most distinctive feature that sets apart the sports industry from other sectors lies in its focus on providing products and services centered around people's health and developmental needs. It significantly differs from general industries in terms of engagement, experience, and exerts a profound impact on consumers' physical and mental well-being: According to the Cobb Glass, the production function, the following function can be established: LNY The rate of physical conformity=$\alpha+\beta$LNC Added value of sports industry (3.1)

Table 3.1- National physical fitness compliance rate and added value of sports industry from 2009 to 2019

Year	Added value of sports industry	National physique up to standard rate
2009	982.89	87.54%
2010	1265.23	87.88%
2011	1554.97	88.22%
2012	1835.93	88.56%
2013	2220.12	88.90%

2014	2689.06	89.13%
2015	3135.95	89.36%
2016	3563	89.60%
2017	4040.98	89.60%
2018	5494.4	89.72%
2019	6474.8	89.83%

Source: The national physical fitness standard rate comes from the second (2009), the third (2014) and the fourth (2019) of China

Civil Health Monitoring Bulletin; other relevant years are calculated by the annual average growth rate.

Table 3.2- National physical fitness compliance rate and added value of sports industry from 2009 to 2019

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C X	-0.229451 0.013884	0.010022 0.001243	-22.89445 11.17192	0.0000 0.0000
R-squared	0.919006	Mean dependent var		-0.117898
Adjusted R-squared	0.911642	S.D.dependent var		0.010434
S.E.of regression	0.003102	Akaike info criterion		-8.573169
Sum squared resid	0.000106	Schwarz criterion		8.486254
Log likelihood	57.72560	Hannan-Quinn criter.		8.591034
F-statistic	124.8117	Durbin-Watson stat		0.390913
Prob(F-statistic)	0.000000			

Source: author's own elaboration

The data presented in Table 3.2 demonstrates that each incremental increase in the added value of the sports industry contributes to a 0.013 percentage point improvement in national physical standards. Consequently, the added value of the sports industry represents the ultimate outcome delivered to society through various departments within its production process, serving as a crucial means towards achieving the objective of "enhancing the physical fitness and health level of the Chinese population" within this sector.

The membership relationship between the dynamic subsystem of sports industry sustainable development optimization and the interpretation index of external variables is presented in Table 3.3.

Table 3.3- The optimization of the speed variable and auxiliary variable in the sustainable development system of the sports industry.

The sports industry's potential for sustainable development lies in the innovation of power shampoo cream.	Velocity variable	Auxiliary variable
Economic development power system	Level of economic development	GDP
Social dynamic demand system	Consumption demand	Per capita disposable income
		Per capita sports consumption
	Sports material supply	Per capita sports field area
Resource supply system	Sports capital resources	The fixed assets investment in the cultural, educational, and sporting goods manufacturing industry has witnessed an increase
		The capital expenditure on cultural, entertainment, and sports services.
	Sports labor supply	The percentage of cultural, entertainment, and sports personnel within the workforce.
Institutional environment dynamic system	The government's control policy of macro-control	Fiscal expenditure
		Expenditure for sports undertakings
	Market-oriented reform of resource allocation	Number of legal persons of cultural, entertainment and sports units
		Sports industry non-state-owned new fixed assets investment accounted for Specific gravity
Science and technology environmental power system	Condition of scientific and technological progress	Science and technology (R&D) expenditure in the public budget of the sports industry system
		Culture, education and sports' products manufacturing; ik scale to Jb enterprises: industry R & D funds
	Effect of technological progress	Innovation revenue from sporting goods manufacturing (one billion yuan)
		Labor productivity in the sports service industry

Source: authors' own elaboration

When constructing a simulation model for optimizing the structure of China's sports industry, it is necessary to first abstract and simplify the interactions between the various components and related variables[145]. Therefore, this paper employs system dynamics methodology to depict these complex causal chains and establish a dynamic causal diagram for optimizing the sports industry structure. Figure 3.1 represents the graphical illustration.

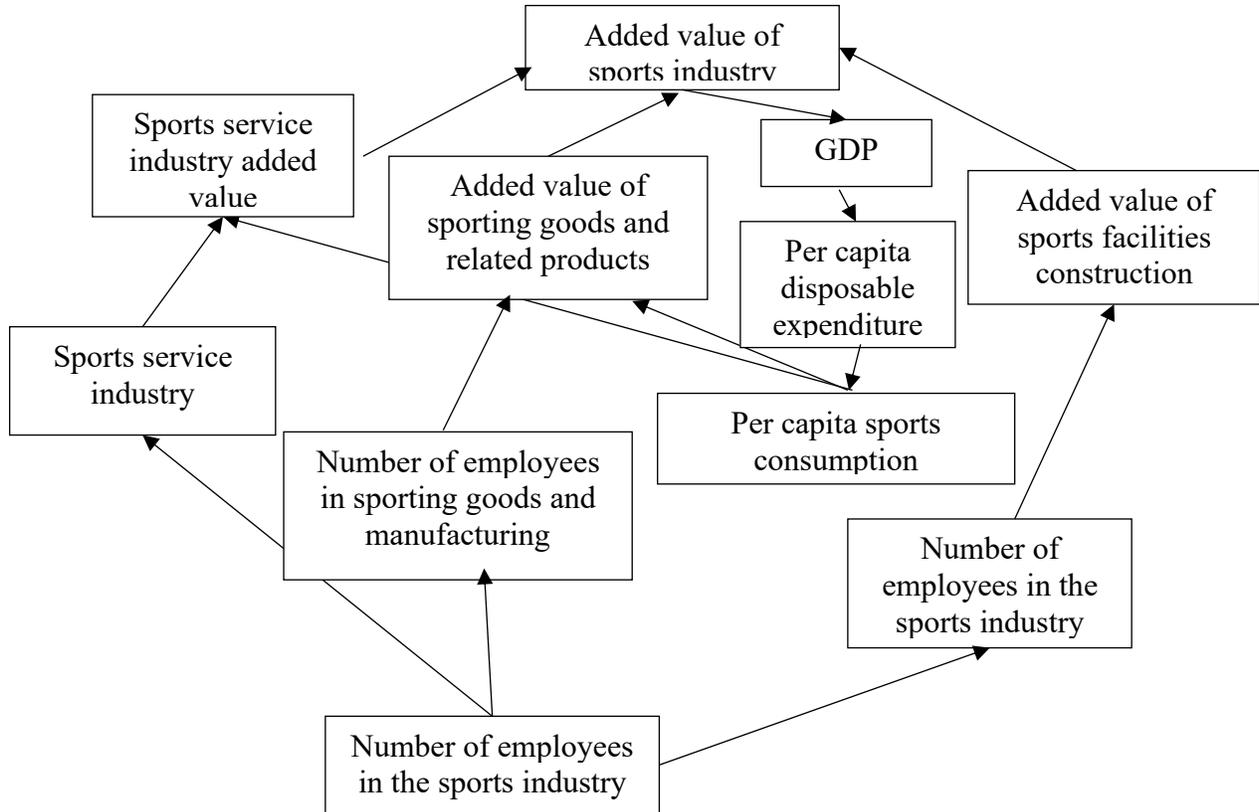
Figure 3.1 - Dynamic diagram of sports industry sustainable development optimization system

Source: author's own elaboration

3.1.2 System dynamics model for optimizing sustainable development in the Chinese sports industry

The model utilizes the sustainable development of the sports industry in 2009 as the base period for system simulation, with a simulation timeframe from 2015 to 2030. The

parameter correlation between state variables and ratio variables, as well as auxiliary variables, is derived from data sources:

The per capita GNP, per capita disposable income, proportion of culture, education, sports and entertainment consumption in disposable income, Engel coefficient, fiscal expenditure, educational fiscal expenditure, proportion of workers with a bachelor's degree or above, culture data on R&D funds of entertainment and sports goods manufacturing enterprises, product innovation income of sports products manufacturing enterprises and the proportion of new non-state-owned fixed asset investment in the sports industry are primarily sourced from the China Statistical Yearbook[146].

The data on the value added in the sports industry, industry value added, labor productivity in the sports industry, expenditure on research and development of sports science and technology system, number of employees in the sports industry, and per capita sports area mainly come from official publications such as the Statistical Communique on the total scale and value added of China's sports industry, China Sports Yearbook, China Mass Sports Development Report, reports by the State General Administration of Sport, and leadership speeches.

Due to the limited availability of comprehensive statistical data on sports in China, there is a lack of strong statistical continuity and completeness regarding related parameters such as the number of employees in the sports industry and per capita sports consumption. To address this issue, an annual average growth rate method is employed.

The year 2030 is selected as the temporal reference point for simulating the optimization of sustainable development in the sports industry due to several reasons: firstly, there are fluctuations and lack of stability in statistical measurements within the sports industry; secondly, there is a need for more refined statistical data; thirdly, auxiliary variables that can be applied to optimize sustainable development in the sports industry are limited compared to rate variables and other relevant data. Consequently, this leads to an increase in variable coefficients during system modeling and parameter determination of phase view variables over time, which ultimately affects the overall accuracy of the

model.

The academic community typically employs the Cobb-Douglas form and utilizes econometric methods to determine the parameters of the model when it comes to discerning the influence factors among state variables, rate variables, and auxiliary variables.

The production function form is follows:

$$Y = AL^a K^\beta \mu \quad (3.2)$$

The gross product is denoted by Y, where A represents the comprehensive conditions. Manpower input and capital input are represented by L and K respectively. The influence of random interference is indicated by μ, with $\mu \leq 1$. The output elasticity coefficients of labor and capital are represented by a and β respectively. Replace formula (1) with concrete quantity model as follows:

ln $Y = A + \alpha$ln (L)βln (K) $+ \mu$, So $Y = \exp (A + \alpha$ln (L)βln (K) $+ \mu)$ (3.3)

Based on the per capita sports area and sports expenditure, the Cobb-Dougl is used to establish the relationship equation:

Furthermore, the unary regression equation was estimated using the measurement software Stata software, and the results are shown in Table 3.4 below:

Table 3.4 Enhanced spending on athletic endeavors.

Variable	Coefficient	Std Error	T-statistic	Prob
C	0.032585	0.002407	13.53521	0.0000
X	0.032677	0.001330	24.57193	0.0000
R-squared	0.98217	Mean dependent var	0.087806	
Adjusted R-squared	0.980481	S.D. dependent var	0.022279	
S.E. of regression	0.003113	Akaike info criterion	-8.566091	
Sum squared resid	0.000107	Schwarz criterion	-8.479176	
Loglikelihood	57.67959	Hannan-Quinnciter	-8.583956	
F-statistic	603.7796	Durbin-Watsonstat	1.255714	
Prob(F-statistic)	0.000000			

Source: author's own elaboration

By manipulating model parameters and observing their effects, we can explore an enhanced development plan that offers decision support for the sustainable growth and

optimization of China's sports industry. The adjustable variables in the optimization simulation model selection for the sustainable development system of the sports industry include: per capita sports consumption, investment in culture, education, and sporting goods; investment in fixed assets for culture and entertainment; investment in new non-state-owned fixed assets for the sports industry; research and development (R&D) expenditure from public budgets within the sports system; R&D expenditure from designated cultural education and sporting goods manufacturing enterprises; employment proportion within the sports goods manufacturing industry as well as construction of sporting facilities; expansion of sport services, production of sporting goods, and construction of sporting facilities.

In the past, numerous approaches were employed to optimize the sustainable development of the sports industry. However, due to constraints imposed by objective conditions, a comprehensive decision-making scheme could not encompass all these approaches. Therefore, controllable parameters had to be designed based on optimizing both internal and external paths. By combining variables, representative scheme designs for different paths could be achieved. As depicted in Figure 3.4, four paths—traditional development simulation, sports service-driven approach, leading industry-driven approach, and coordinated and balanced development-driven approach—are part of the planning level optimization for sustainable development in the sports industry. Additionally, they contribute to optimizing sports resource allocation and driving scientific and technological innovation. On the other hand, three demand optimization-driven paths fall under factor optimization.

The so-called traditional development simulation path scheme refers to a systematic simulation experiment aimed at maintaining the current state of sustainable development in China's sports industry without altering the original parameters of sustainable development conditions[147]. In the model of the initial foundation stage, the new fixed asset investment for culture, education, and sports goods amounts to 18.735 million yuan, while the new fixed capital investment for culture, entertainment, and sports services

reaches 750 billion yuan and 370 million yuan respectively.

Table 3.5 The simulation scheme for optimizing the structure of the sports industry.

Scheme type	Scheme path	Scheme content
The industry's macro-orientation.	The sports service industry is propelled by various factors.	By enhancing the comprehensive aspects of human resources, capital, policies, and other factors in sports services, we aim to facilitate the advancement of the sports service industry and thereby stimulate sustainable development and optimization within the sports sector.
	The sporting goods industry takes the lead in driving the market.	The overall growth of the sports economy can be driven by enhancing manpower, capital, and scientific and technological investment in the manufacturing sector of sporting goods through its diffusion effect.
	The progress is propelled by synchronized development.	Promote the integration of technology, products, and markets within the internal components of the sports industry to expand the industrial chain and achieve sustainable development benefits through a "1+N" approach.
The optimization of economic factors in the industrial sector.	The effective allocation of resources plays a crucial role in harnessing the synergistic benefits of the multiplier and division effects, thereby maximizing their respective advantages.	The effective allocation of resources plays a crucial role in harnessing the synergistic benefits of the multiplier and division effects, thereby maximizing their respective advantages.
	The mode of resource allocation has been optimized.	The strengthening lies in the utilization of science and technology to upgrade and transform the sports industry, with the ultimate goal of achieving sustainable development and overall quality improvement.
	Optimization driven by demand	The government will make efforts to enhance residents' income levels and facilitate the sustainable development and optimization of sports consumption.

Source: author's own elaboration

The employment rate in the sports service industry is 36%, whereas it is 62% in sports goods manufacturing industry and only 1% in sports venues and facilities

construction. The added value contributed by the sports service industry accounts for 49%, followed by a contribution of 50% from the sports goods manufacturing industry and merely 1% from sports venues and facilities construction. Per capita spending on sporting activities stands at approximately ¥1003.7626; meanwhile, each individual has access to an average area of about 1.59 square meters dedicated to sporting purposes. Non-state-owned capital represents around half (0.5%) of total investments within the sports industry sector. Expenditure on science and technology research & development (R&D) within public budgets allocated to sport-related initiatives amounts to ¥24.7 million; additionally, enterprises above designated size operating within cultural, educational, and sporting goods manufacturing industries allocate ¥7.3707 million towards R&D efforts as well. Labor productivity within the sports service industry is estimated at approximately one person serving every 1802 individuals; moreover, scientific innovation output value generated by sporting goods manufacturers reaches ¥24,700.

The simulation path driven by sports services is a comprehensive embodiment mode of optimizing resource endowment in the external path. It entails further strengthening the investment tilt towards factor endowment in the sports service industry and enhancing its development, thereby establishing a model that centers around the development of the sports service industry and optimizes its sustainable growth[148]. In terms of mode parameter regulation, it is important to maintain the current accumulation and consumption ratio while promoting the establishment of a modern service system[149]. This will enhance the employment absorption capacity of the sports service industry, facilitate its transformation into a knowledge-intensive sector, and increase its proportion within the overall sports industry development. To encourage investment in sports services, it becomes necessary to reduce investments in other related industries[150]. Therefore, we propose increasing fixed asset investment for culture, sports, and entertainment within the sports service industry by 10%, while reducing new fixed asset investment for culture, education, and sporting goods by 10%. This adjustment aims to provide financial security for the sports service industry. Additionally, there should

be an emphasis on investing in employees within this sector with a 10% increase specifically targeted at them; meanwhile decreasing investments by 10% in manufacturing sporting goods as well as constructing sports venues and facilities industries. Furthermore, efforts should be made to promote intensive development within the sports service industry through a 10% increase in science and technology (research and development) expenditure from public budgets allocated to sport systems; simultaneously reducing research and development expenditures by enterprises above scale within cultural educational sporting goods manufacturing industries by 10%. All other parameters remain unchanged.

The dominant driven simulation path is a typical way of the imbalanced development pattern of the intrinsic path. From the current development of the sports industry, the sports goods and related products manufacturing industry has a leading role in promoting the sustainable development of the sports industry and the economic development of the sports industry and sports. Leading industry driven simulation is to maintain the current proportion of accumulation and consumption, further increase the development of sports products and related products, improve the ability to effectively absorb scientific and technological innovation, accelerate the pace of upgrading the traditional sporting goods manufacturing industry, comprehensively improve the development level of equipment manufacturing industry, consolidate and strengthen the leading role of leading industries, In order to achieve the overall quality of sports industry structure, improve the purpose of industrial competitiveness. Therefore, while adjusting the parameters, the simulation model should maintain the current accumulation and consumption proportion, increase the R&D investment of cultural and educational sporting goods manufacturing enterprises above the scale (10%), further improve the level of sporting goods manufacturing technology innovation, product innovation and other industries, and further rotate the sports product chain. Further improve the labor input of the sporting goods manufacturing industry, increase the investment in fixed assets (10%), and play the driving force and height of sporting goods manufacturing in the sustainable

development of the sports industry through the associated utility of the sports industry. Similarly, to tilt the resource investment of the sporting goods manufacturing industry, it is bound to squeeze the investment of other related industries[151]. Therefore, the investment of other sports industry sectors will be reduced by 10 percentage points.

The simulation of the coordinated and balanced development path serves as the fundamental approach to achieving balanced development within the sports industry. It emphasizes that sustainable growth in this sector relies on innovation through three integration paths: technology, product, and market[152]. By extending the internal value chain of the sports industry, promoting coordinated development among related sectors, and attaining "1+N" sustainable benefits, we can ensure its long-term success. Therefore, when adjusting parameters in the simulation model, it is recommended to allocate equal weight (0.1) to increments in added value for both the sports service industry and sporting goods/related manufacturing industry sectors. This will enable these industries to drive a 10% increment in added value for each other while keeping other parameters unchanged.

The optimization of sports resource allocation is crucial for achieving external optimization, highlighting the pivotal role of government macro-control in guiding the development of the sports industry and market mechanisms in allocating sports resources. This aims to unleash the "multiplier and division effect" of these two mechanisms, enabling them to complement each other's strengths and perform at their best. By adjusting relevant variables, such as maintaining current accumulation and public financial expenditure on sports undertakings, fostering market players through policies related to land use, industry regulations, tax incentives, etc., increasing the number of legal entities within cultural, sports, and entertainment units by 10%, promoting new non-state-owned fixed asset investments in the sports industry by 10% (based on existing levels), we can enhance factor allocation efficiency towards a Pareto optimal state. Ultimately, this will facilitate sustainable industrial development optimization and improve industrial quality to drive economic growth[153].

The model driven by scientific and technological innovation is the fundamental

force behind the optimization of external paths, which emphasizes upgrading and transforming powerful traditional industries through science and technology to achieve sustainable development in overall quality of the sports industry. In the simulation model, parameters are adjusted to increase public budget for sports systems, China's R&D expenditure on science and technology, R&D investment from enterprises above a certain scale in cultural, educational and sporting goods manufacturing industries while keeping current accumulation and number of other participants unchanged.

Demand optimization simulation is the basic guiding path of external optimization path, which determines the evolution process and adjustment direction of the industry. In terms of regulation parameters, while coordinating the production factors of different industrial sectors, the per capita disposable income and sports consumption level (related parameters increased by 10%) are improved to achieve the national economic development goal of "consumption drives the sports industry, uses the sustainable development and upgrading of the sports industry, and optimizes the sustainable development of residents' consumption".

3.1.3 Simulation experiment of Optimizing Path selection for sustainable development of Chinese sports industry

The model's validity needs to be tested. The optimization system dynamics model for the sustainable development of the sports industry undergoes a process of synthesis, decomposition, and iterative adjustment. Therefore, it is essential to verify the accuracy of the established model in order to achieve a high level of simulation fidelity with respect to the real system.

（i）Unit consistency test. The consistency of parameter variables is a prerequisite for the decomposition and cyclical execution of the entire model. The simulation of parametric variable units remains consistent.

（ii）Model structure test. The term "mold structure inspection" refers to the evaluation of the accuracy and deviation between simulation results of the mold structure and the actual performance of the physical structure. The assessment of mold structure

involves determining the precision and error in simulation results as well as comparing them with real-time movement of the physical structure[154]. The simulation was conducted using the software Vensim-PES.9C, and the results were presented in Figure 3.2 displays the discrepancy between simulated output values and actual values. Notably, the error rate for the sports industry (the difference between its added value and the actual value) is found to be -13.89%, indicating a significant deviation. However, overall simulation errors for the entire sample remain within ±5%, suggesting that the simulation consistency test is effective in objectively reflecting China's industrial structure evolution trend.
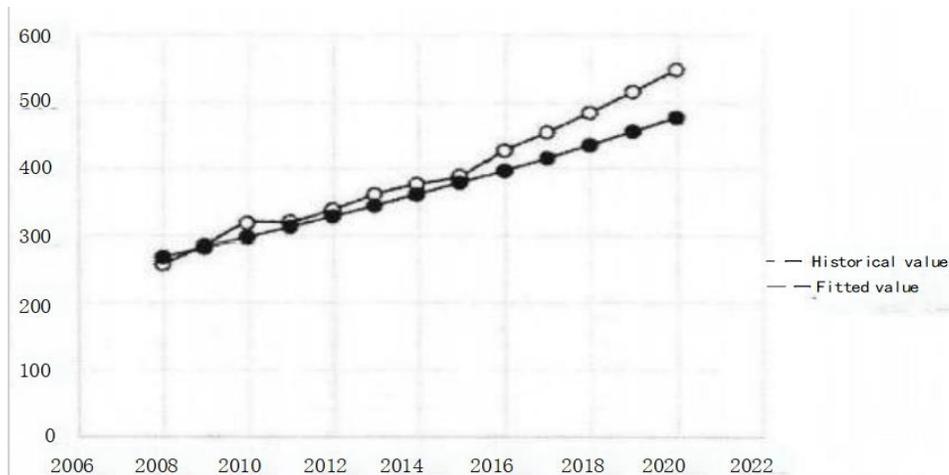
Time(Year)		" Added value of sports industry "	Runs:	Added value of sports industry
2009	Current	9.8289e+006		
2010		1.1969e+007		
2011		1.45107e+007		
2012		1.75222e+007		
2013		2.18829e+007		
2014		2.52856e+007		
2015		3.02387e+007		
2016		3.60686e+007		
2017		4.29235e+007		
2018		5.09768e+007		
2019		6.04317e+007		
2020		7.15268e+007		
2021		8.45426e+007		
2022		9.98092e+007		

Figure 3.2 - Simulation effect of sports industry added value

Source: author's own elaboration

At the same time, in the Announcement on the Total Scale and Value of the National Sports Industry in 2019 issued by the National Bureau of Statistics and the General Administration of Sport of China on December 3 and 20, the added value of China's sports industry in 2019 was 1,124.8 billion yuan. According to the simulation and prediction results of this study (Figure 3.2), in 2019, The added value of China's sports industry will reach 9.98092 billion yuan, the error degree is -1%, the credibility of the research results is high.

Table 3.6 - Degree of error between simulated data and real data

Year	Added value of sports industry (RMB 100 million)			Sports industry employees (10,000)		
	Historical data	Analog data	Degree of error	Historical data	Analog data	Degree of error
2009	982.89	982.89	0.00%	256.3	266.905	4.14%
2010	1265.23	1196.9	-5.37%	283.74	281.195	-0.90%
2011	1554.97	1451.07	-6.60%	317.09	295.903	-6.68%
2012	1835.93	1752.22	-4.38%	319.13	311.051	-2.53%
2013	2220.12	2108.29	-4.72%	336.98	326.664	-3.06%
2014	2689.06	2528.56	-4.72%	336.98	326.664	-3.06%
2015	2689.06	2528.56	-5.50%	360.01	342.77	-4.79%
2016	2689.6	3023.87	13.23%	375.62	359.393	-4.32%
2017	3563	3606.86	2.21%	387.97	376.566	-2.94%
2018	4040.98	4292.35	7.56%	425.77	394.319	-7.39%
2019	5494.4	5097.68	-5.73%	453	412.685	-8.90%

Source: author's own elaboration

The "2019 National Sports Industry Total Scale and Added Value Data Announcement" released by the National Bureau of Statistics and the General Administration of Sport of China on December 31, 2020 revealed that the added value of China's sports industry in 2019 amounted to 124.8 billion yuan. However, based on the simulation prediction results from this study (Figure 3.2), it is projected that the actual added value for China's sports industry in 2019 will reach approximately 998.92 billion yuan, indicating a deviation rate of -11%. These findings demonstrate a high level of reliability.

Table 3.7 - Simulation Results Summary for Optimizing Sustainable Development of China's Sports Industry (2020-2030)

Year	Number of employees in the sports industry (10,000)	Value added of sports service industry (RMB 100 million yuan)	Sporting goods and related manufacturing (RMB 100 million yuan)	Sports facilities are also built (RMB 100 million yuan)	Added value of sports industry (RMB 100 million yuan)
2020	515.044	5965.79	5505.02	442.45	11913.26
2021	537.928	7086.52	6262.34	523.195	13872.06
2022	561.729	8605.61	7113.4	617.718	16336.73
2023	586.509	10432.2	8069.36	728.302	19229.86
2024	612.326	12627.2	9142.78	857.613	22627.59
2025	639.247	15264.1	10347.8	1008.77	26620.67
2026	656.406	16535.9	11700.3	1185.45	29421.65
2027	673.813	17946.5	13152.6	1379.92	32479.02
2028	691.472	19508.9	14710.5	1593.75	35813.15
2029	709.391	21237.6	16380.5	1828.59	39446.69
2030	727.573	23148	18169.2	2086.25	43403.45
Average annual growth rate	3.91%	16.26%	14.19%	18.80%	13.80%

Source: author's own elaboration

The simulation results demonstrate that the sustainable development and optimization path of China's traditional sports industry will lead to a rise in both the added value and employment opportunities. By 2030, the overall added value of China's sports industry is projected to reach 4.340345 billion yuan, with an estimated workforce of 7.2753 million employees. According to statistics from the State General Administration of Sport, between 2006 and 2018, the average annual growth rate of the sports industry's output value was recorded at 13.40%. Based on simulations, it is anticipated that the average annual growth rate for the added value of China's sports industry will be approximately 13.80% from 2020 to 2030. These findings indicate that through vertical promotion of sports industrialization along with supportive policies and substantial investments, significant improvements can be achieved within China's sports industry.

In terms of sector-specific development within the sustainable growth framework

for this industry, it is observed that the sports service sector exhibits a more favorable trend compared to other related industries while also demonstrating a wider scope for development potential. This suggests that as long as a conducive regulatory environment persists, steady growth can be maintained within the sports services sector.

Industrial macro-planning level: Under the traditional development path, the evolution of the sports industry structure can facilitate comprehensive growth of the sports industry system[155]. The accomplishments in the past year serve as clear evidence for this. However, achieving a significant leap in overall sports industry development and establishing it as a pillar industry within the national economy cannot be accomplished solely through this approach. Furthermore, given its reliance on diverse factor inputs and low growth rate, the development of the sports industry does not align with high-quality economic stages characterized by quality change, power change, and efficiency change.

The optimization of sustainable development in the sports industry can be facilitated by the driving force of the sports service industry, which in turn promotes overall growth within the sports industry and facilitates rapid advancement of the sports service sector through resource allocation, policy implementation, and funding support. While prioritizing the sustainable development of the industry around the sports service sector can lead to its expansion, an excessive focus on scaling up this stage may inadvertently squeeze out resources from other related industries and result in an irrational distribution of sporting resources, potentially leading to a loss of target beneficiaries and hollowing out of the sports economy[156]. However, excessively supporting sports services overlooks potential delays in growth within other sectors of the sports industry, hindering its economic scale expansion and making it challenging to achieve developmental goals.

The path to leadership and advancement entails accelerating the pace of upgrading the traditional sporting goods manufacturing industry, enhancing scientific and technological innovation achievements within this sector. This will effectively improve the overall quality of sustainable development in the sports industry, thereby unlocking its

potential for growth[157]. According to Path 3 simulation results, the added value of the sports industry exhibits a growth rate of 16.51%, with average annual growth rates divided as follows: sports service industry (18.84%), sports goods manufacturing industry (14.94%), and sports facilities industry (20.01%). The respective contributions to added value by these three industries are 58.77%, 37.64%, and 3.59%. These findings highlight that optimizing the sports industry through transforming sporting goods manufacturing into high-tech and high-value-added processes can enhance overall scale efficiency within this sector significantly.

Simultaneously, promoting the development of sporting goods manufacturing will accelerate advancements in both the level of development within the sports service industry and improvements in output value scales thereof. However, relying solely on developments within the sporting goods manufacturing sector still falls short in terms of achieving a substantial total amount for our sports economy; by 2030, it is projected that only 2.31% of GDP will be accounted for by added value from this particular domain.

The optimization of the sports industry structure, under the guidance of industry-driven production, can effectively facilitate the overall development of the sports industry and expedite the rapid growth of the sports service sector through resource allocation, policy support, and funding. However, if we solely prioritize or even centralize industrial restructuring around the sports service industry, it may lead to isolated development within this sector while neglecting other related sub-industries' potential for growth and impeding rational resource distribution in sports. This could result in a "hollowing out" phenomenon where loss of target beneficiaries weakens the foundation of the sports economy. Overemphasis on supporting only the sports service industry also disregards lagging benefits from broader expansion within the entire sports industry value chain, hindering its economic scale growth and making it challenging to achieve established developmental goals.

Under the leadership and driving force, enhancing the pace of upgrading the traditional sporting goods manufacturing industry and improving the capacity for

scientific and technological innovation in this sector are sufficient to achieve the objective of enhancing the overall quality of the sports industrial structure, namely its potential growth rate. The added value of the sports industry can increase by 16.51%. The average annual growth rates for the sports service industry, sports goods manufacturing industry, and sports venues and facilities are projected to be 18.84%, 14.94%, and 20.01% respectively. The proportions of these three industries in terms of their contribution to the added value of the sports industry are 58.77% : 37.64% : 3.9%, indicating that optimizing China's sports industry can enhance overall scale efficiency through transforming sporting goods manufacturing into high-tech and high-value-added sectors. Simultaneously, promoting development in this field will accelerate progress in both the level of development within the sports service industry as well as improvements in output value scale; however, relying solely on sporting goods manufacturing still falls short when it comes to achieving a high total amount for China's sports economy which is expected to account for only 2.31% of GDP by 2030.

Through the rational allocation of input-output ratios across various sectors within the sports industry, it promotes effective interaction among industrial departments along the value chain. This positive non-linear effect, in turn, facilitates coordinated development of products, markets, and services within related sub-industries, surpassing the overall scale achieved through other pathways. Simulation results indicate that by 2030, China's sports industry will witness an added value of 61.15 trillion yuan and employ 805,337 individuals respectively. The proportion of the sports industry to GDP is projected to reach 2.81%, with an annual growth rate in added value estimated at 1.65%. Following this trajectory would result in China's sports industry reaching a total added value exceeding 10 trillion yuan by 2030 while accounting for over 0.4% of GDP – thereby accomplishing the objective outlined in "The Outline for Building a Sports Power." Based on these simulation findings, we can promote future optimization within the sports industry to realize rapid enhancement in its added value and employment opportunities while focusing on supporting specific sub-industries or industries to

facilitate upgrading of the entire industrial structure. Achieving optimal structural transformation within the sports industry relies on accelerated development within its service sector as well as support from both sporting goods manufacturing and sports facilities construction industries.

The optimization of economic variables includes resource allocation optimization, path optimization, scientific and technological innovation driving path, and demand optimization driving path, all of which have varying degrees of impact on the upgrading of China's sports industry structure. Among them, the driving path of resource allocation optimization focuses on enhancing factor allocation efficiency to achieve a state close to Pareto optimality for sports resources. Based on simulation data, it is projected that by 2030, the added value and employment in the sports industry will reach 5,800.303 billion yuan and 86,642,900 people respectively. The average annual growth rate of the added value in the sports industry will be 5.63%, with its proportion in GDP reaching 2.67%, second only to the coordinated development path.

Therefore, during future industrial structure optimization processes, it is necessary to address existing shortcomings in market-based sports resource allocation within the current stage of sports industry development. This can be achieved through accelerating institutional reforms and particularly empowering government delegation while allowing market decision-making and independent management to play a role in allocating sports resources effectively – thus achieving a balance between government intervention and market forces.

Furthermore, scientific and technological innovation plays an essential role by further enhancing overall quality and competitiveness within the sports industry sector through increased investment in research & development (R&D), promoting product innovation as well as means innovation (processes), implementing efficiency reforms alongside transforming scientific achievements into practical applications within this field.

Therefore, in the process of optimizing the future industrial structure, it is imperative to address the deficiencies in market-based resource allocation within the

current stage of sports industry development. This can be achieved by expediting institutional reforms, particularly through further delegation of power by the government and empowering market decision-making and independent management. By allowing the market to play a role in allocating sports resources, a harmonious balance between government intervention and market forces can be truly achieved.

Furthermore, enhancing scientific and technological innovation is crucial for improving overall quality and competitiveness within the sports industry. This can be accomplished by increasing investment in sports-related research and development, promoting product innovation, adopting new means of operation, implementing efficiency reforms, as well as facilitating technology transfer within the field. Simulation results indicate that with increased investment in sports science and technology, there will be significant growth in both revenue (reaching 5123.471 billion yuan) and employment opportunities (reaching 76.0238 million people) within this sector.

The optimization path also involves guiding structural improvements within the sports industry through consumer demand considerations. According to simulations conducted on per capita disposable income and per capita expenditure on sports consumption, a 10% increase would result in an additional 43.40345 billion yuan spent on sporting activities annually along with an overall increase of 5.5578 trillion yuan over time. Consequently, this would lead to an average annual growth rate of 5.42% for added value within the sports industry – indicating an optimized consumption structure.

To achieve comprehensive rapid development across all aspects of the sports industry while optimizing its structure effectively requires starting from addressing demand-side factors.

3.2 Justification of the sustainable development management strategy of China's sports industry

The main reason why the sports industry is classified into the economic sector is

because of the positive contribution of the sports industry to the economic development of the country. With the development of social economy, many countries, especially some developed countries in North America and Western Europe, have regarded sports as one of the pillar industries of national economic development. According to relevant statistical survey data, the annual output value of the world sports industry has even reached $600 billion, and the annual growth rate is even close to 20%.Relative to Europe and the United States and other developed countries, of course, some less developed countries and developing countries or because sports as the core industry has not been developed, or because sports products or services, or because the marketization of sports industry is not high the development of sports industry is relatively slow, with developed countries sports industry development has a big gap, such as China's sports industry because started late, so the development scale is relatively small, is still in the initial stage of development.

1. The development advantage of the sports industry. The development of sporting goods industry, as an indispensable part of the development of the Chinese people's life and cause, has always been highly valued by our party and the country. In 2017, the General Administration of Sport of China officially promulgated the 13th Five-Year Plan for the Development of the Sports Industry. The document aims at the new actual situation, new development tasks and new development requirements of the social development of China's children's sports goods industry in China. For the development of China's sports industry into sustainable development power, the macro promotion of the sports industry to maintain rapid growth, for the sustainable development of China's economy has injected a strong power. Sports industry is a sunrise and green industry, with the characteristics of low resources, large elasticity of demand, wide range, high additional price of products, long industrial chain limit, strong driving force. At the same time, with the continuous development of the national economy in recent years, people's living standards, constantly improving the family living standards at the same time, engel coefficient on the basis of continuous improvement, entertainment, health and other pursuit of life also improve to a certain extent, sports industry is also developing to a

certain extent.

2. The development disadvantage of the sports industry. Secondly, the development level of the sports industry, the lack of large enterprises and brands, no external conditions driving the development of the sports industry. Finally, the sports industry structure is deeply affected by other industries, and the sports education is generally backward, and the quality of sports professionals is generally low.

3. Development opportunities for the sports industry. Successfully held the Beijing Olympics in 2022, brought many opportunities for the sustainable development of our country sports industry, our country has more than 50 million modern ice and snow sports, and "drive 300 million people to participate in the ice and snow sports", in 2020 the national modern ice and snow sports industry comprehensive output value has reached 600 billion yuan, our country and the global modern ice and snow sports industry comprehensive output value has reached 1 trillion yuan. At the same time, the "Belt and Road" policy also brings more new cooperation for the development of the sports industry.

4. Development challenges of the sports industry. The scale of China's sports industry is growing slowly and lacks talent and market competitiveness, which is easy to be affected by the development concept of other industries. In the post-epidemic era, the performance of the sporting goods industry has decreased sharply. China has a large population base, is the world's second largest sporting goods consumer market, sporting goods manufacturing industry is the largest part of the sports industry, accelerating China's progress to a sporting goods manufacturing country. However, in order to cooperate with the epidemic prevention and control work, the normal resumption of work and production of sporting goods manufacturers during the epidemic period was affected, which directly caused a sharp decline in China's sporting goods products, signs of sporting goods manufacturing decline, and indirectly caused the failure of sporting goods sales performance. Emphasizing the unresolved parts of the general problem. There are many opportunities for the development of sports industry, but there are also a series of restrictive factors. In the process of cultivating sports industry as a new growth point of

national economy, these constraints must be fully considered.

1. The sports management system is backward and the market system is not perfect. The development of China's sports industry is quite backward, the sports market system is not perfect, the circulation of sports talent market is not smooth, the sports intermediary market is weak, and the brokers are scarce. The scale, operation level, capital, technology, talent and other aspects are very low. At present, the structure of sports products is still relatively single, and the development and utilization of sports intangible assets and the potential of related industries have not been fully played.

2. Talent is scarce. At present, China lacks the senior management talents who are widely familiar with the operation of the sports economy, understand the international sports industry process, and can transform the business opportunities of the sports industry into the industry so as to obtain the sports economic benefits.

Several problems existing in the development of China's sports industry:

1. Insufficient investment of the main body and incomplete market development. Although we have started to operate sports services, sports competition, sports lottery, but from the real sense of sports labor market, sports competition market, sports technology market, sports financial market is far away, our country sports market is still in the start and formation process, development, cultivating sports market task is quite difficult. As the market subject of each association (center), its relationship has not yet been straightened out, the degree of market participation is still shallow. Especially after joining the WTO, the internationalization trend of the sports industry is unstoppable. It is urgent to enhance the competitiveness of China's sports industry market and actively and steadily accelerate the industrialization process of training.

2. Industrial structure is not reasonable, and industrial development is unbalanced. The unreasonable industrial structure is mainly reflected in the lagging of core industry and the absence of intermediary industry. The lag of core industry refers to the development of sports goods industry, the development speed of health entertainment industry and competition performance industry is relatively slow. In the latter, the

competition performance industry overall lags behind the fitness and entertainment industry. Due to the reform of economic and sports management system is not in place, the club system is not pushed in all projects, the competition performance market main body is not clear, competition television rights market price is far lower than the international market price, make the huge investment in economic sports without return, thus affect the social capital to professional sports flow. The core industry is the foundation of the whole sports industry and the driving force for the upgrading of the whole sports industry. If the development of fitness and entertainment industry and competition and performance industry lags behind for a long time, then the sports goods industry, as a peripheral industry, is impossible to have a significant improvement in the scale and efficiency.

The absence of intermediary industry refers to that there is no sports brokerage industry with a certain scale and can provide high-quality professional services in the current structure of China's sports industry. Intermediary industry plays a very important role in connecting the past and the next in the sports industry chain. On the one hand, the absence of intermediary industry will cause insufficient development vitality of core industries and low efficiency. On the other hand, it will also affect the scale expansion of peripheral industries and the upgrading of efficiency. Although there are several companies specializing in sports brokerage business in China, but the scale and business level are low.

The imbalance of industrial development is mainly reflected in the imbalance between regions and projects. Due to the influence of economic, cultural, natural environment and ideology, Chinese society presents an obvious gap between urban and rural areas and east-west gap. Due to the differences in the popularity, economic level, appreciation and advertising value of various sports projects, the degree of entry into the market and the benefits of industrial development are also very different. For example, football, basketball, fitness and bodybuilding have formed; volleyball, table tennis and track, swimming and gymnastics have not been formed.

3. The legalization and standardization of sports market management need to be improved. Standardized and orderly market is the premise and guarantee of the steady development of the industry. China's sports market management is not high mainly reflected in China's sports industry has not covered a national industry management standards. Except for the preliminary attempt in some regions, it has not been started nationwide, and the management in many regions only stays in the simple review and licensing stage, without realizing the active and standardized whole-process industry management.

4. Lack of stable industrial development policies. Sports industry belongs to the tertiary industry, and sports consumption belongs to the final consumption of improving residents' living quality and cultural and physical quality. However, there is no clear policy to follow on how to increase sports expenses and use what policy means to encourage the society to run the sports industry and guide and expand sports consumption. The development status of China's sports industry urgently needs the state to formulate relevant policies to support the development of sports industry and cultivate the sports market.

For example, how to regulate the commercial behavior of athletes from the perspective of sports industrialization. From the development of sports physical assets to intangible assets, we should not only reasonably and legally protect the rights and interests of state-owned and collective, but also legally and reasonably protect individual rights and interests. The "property rights" and other issues involved still need to be issued with relevant policies and regulations.

5. Lack of sports management talents. As the main force of the sports market, each sports management center (association) does not participate in the market. The big reason is the lack of management talents who understand the economy, law, sports and can manage, and the incentive mechanism of talent training is not perfect. In addition, the theoretical research and policy research lag behind, and the industrial direction and industrial policy are not very clear, which is also an important reason for the insufficient

main body investment and the incomplete market development.

China entered the sports industry relatively late, prompting us to formulate a series of policies to encourage and support its development in response to the lagging progress of sports services. Undoubtedly, we have achieved commendable growth. In 2018, the added value of the sports service industry accounted for 64.8% of the total value added in the sports industry, playing a crucial role in China's rapid sporting sector expansion. However, whether it pertains to expanding or optimizing sustainable development within this field, it is important to note that the development of sports services is not dependent on sporting goods manufacturing industries. For an extended period, both academic research and government documents have perceived sustainable optimization within the sports industry as transitioning from manufacturing to service-oriented sectors; considering a high proportion of service industries as transformation and upgrading while regarding a high proportion of manufacturing industries as detrimental flaws in sustainable development. This perspective is evidently inappropriate.

First and foremost, from a macroeconomic perspective, the sporting goods and equipment manufacturing industry serves as the foundation for upgrading the modernization level of both the industrial chain and supply chain. The chapter "Accelerating the Development of Modern Industry" in the "14th Five-Year Plan for National Economic and Social Development" and the vision goal system outlined in the "13th Five-Year Plan" emphasize promoting economic system optimization by building a manufacturing, quality, networked, and digital China. This highlights the crucial role of China's equipment manufacturing industry in achieving economic prosperity, upgrading industrial bases and chains, enhancing sustainable development, optimizing industrial growth, improving economic quality and efficiency, as well as boosting core competitiveness. It is explicitly stated that maintaining a stable proportion of manufacturing is fundamental to consolidating and expanding the real economy while facilitating overall industrial chain optimization.

The integration of sports-related economic activities along with consistent patterns

within sports industry economics has blurred boundaries between various sectors involved in sporting goods manufacturing and sports services. This interconnectedness has resulted in different roles played by diverse industries within sustainable industry development. Without rapid progress in sports service industries, genuine prosperity within sporting goods industries cannot be achieved; conversely, limited possibilities exist for further advancement of sports service industries without swift development within sporting goods sectors.

From the perspective of China's objective to achieve high-quality macroeconomic development, it is imperative to continuously promote sustainable industrial development and upgrading in order to attain more inclusive, sustainable, and high-quality growth. This entails avoiding the "sustainable development trap" associated with industrial system development while successfully overcoming the challenges posed by the "middle-income trap". In general terms, a country's industrial system tends to be dominated by traditional industries experiencing declining growth rates. Conversely, emerging industries face obstacles related to technology, talent acquisition, and innovation.

Currently, the sports goods manufacturing industry is the dominant sector in China's sports industry. However, with the rapid growth of the sports service industry, its contribution to the overall value added of the sports industry has gradually declined while its contribution to the sports service sector has increased. Although there is a growing emphasis on developing the sports service industry for economic advancement, it faces challenges in terms of job creation, knowledge innovation, and other advanced production factors. Based on optimization simulation results mentioned above, an excessive focus on "scale" during the "sports service" stage not only fails to achieve sustainable development goals for the sports industry but also risks hollowing out of the sports economy and weak benefits from its growth potential. This situation reflects a trap in achieving industrial sustainability and may hinder efforts to avoid falling into a "middle income trap".

From the perspective of sports economy operation, the proportion of manufacturing and service industries in the sustainable development of the sports industry is determined

by the stage of economic development, per capita income level, and the degree of sports market development. It cannot be artificially promoted or changed. Currently, with improving living standards and increasing health awareness, there is a gradual diversification in sports service consumption. However, it is evident that common consumption content still revolves around public facilities and "professional" equipment configuration for less economically intensive fitness activities among middle-class individuals and young people. From a microeconomic standpoint, an enterprise's choice of industry depends on its comparative advantage and competitive advantage. Artificially pushing all enterprises into the service sector clearly contradicts basic economic rationality. For instance, Jinling Sports—a leading domestic supplier of sports equipment—has evolved from being solely a basketball equipment manufacturer to becoming a group company centered around developing integrated sports equipment-facilities solutions as well as providing services related to sports health information and events coordination. Nevertheless, for Jinling Sports specifically, their event services segment remains largely unprofitable.

The sports goods manufacturing industry is the industry with comparative advantage in China's sports industry development and serves as the leading sector for optimizing China's sports industry. Within our country's sports industry, only the sporting goods manufacturing industry possesses a competitive international brand. With its extensive domestic market and promising prospects, China stands out globally by independently producing the largest variety of sporting goods. The sporting goods manufacturing industry exhibits strong inward absorption and outward radiation capabilities, making it a key driver for sustainable development in the sports industry through high intermediate investment and demand. Additionally, this sector demonstrates robust resource control abilities, boasts an extensive industry chain spread, and rapidly adopts advanced technology. Consequently, it currently leads the way in advancing China's sports industry. Emphasizing a balanced output value proportion among industries without considering these factors would result in uneven distribution of limited sports

resources and hinder overall growth by perpetuating low-level cycles within the sports economy. As Professor Bao Mingxiao highlighted during an interview, blindly pursuing an "imaginary high" ratio for the sports service sector (which lacks core industrial development) would undermine our advantages and contradict current logic regarding sustainable development and optimization within the sports industry.

3.3 The implementation of a sustainable development management strategy in the Chinese sports industry

3.3.1. Reveal the strategic focus areas for the advancement of China's sports industry.

Generally speaking, the criteria for establishing key industries can be categorized into the following four aspects: firstly, the degree of industry correlation, which refers to the significance and role of economic and technological interdependence in the industrial structure; secondly, technological innovation and transformation, which reflect and represent the pace and novelty of scientific and technological advancement; thirdly, market demand assessment, encompassing stable market demand and substantial market capacity that can sustain long-term development; fourthly, comparative advantage utilization to drive other businesses' growth. Based on these aforementioned criteria combined with empirical analysis conducted in this study, it is argued that future optimization of industrial structure should primarily focus on developing manufacturing sectors related to sports goods production as well as sports leisure services including sports competition performances[158]. Additionally, attention should also be given to enhancing sports venue services along with other sports-related offerings such as sports rehabilitation or sports tourism.

（ⅰ）Pay attention to the development of the dominant industry position in the sporting goods manufacturing sector. The sporting goods manufacturing industry exerts strong influence and control over the sustainable growth of the sports industry,

significantly impacting inter-departmental distribution and transfer of sports-related economic activities. Moreover, it demonstrates a high absorption and conversion rate for sports science and technology. In light of the rapid increase in mass participation in sports, this market possesses leading potential within China's industrial landscape.

However, there are certain limitations associated with sporting goods, including insufficient experiential value, low product added value, and limited scientific and technological content. Consequently, these factors fail to generate a substantial diffusion effect or exert significant pull on other industrial sectors. Looking ahead into both immediate future and long-term perspectives, it is crucial to fully leverage the role played by the dominant sporting goods manufacturing industry in optimizing overall industrial performance.

Attention should be directed towards enhancing product technical upgrades from a perspective that emphasizes improved product technology and functional quality. This will further enhance public engagement through an enhanced sports experience while cultivating a larger population actively participating in sports activities – ultimately fostering better synergy with the sports service industry.

To achieve this objective effectively, focus must be placed on supporting research & development as well as manufacturing efforts related to wearable sports equipment and intelligent sport devices. Additionally, identifying high-tech enterprises specializing in sport-related technologies can serve as an initial starting point for nurturing numerous product-based sport brands boasting advanced technological content alongside independent intellectual property rights.

（ii）The development of sports competition performance activities and sports leisure and fitness services is the key form of development in the new era. Professor Huang Haiyan pointed out in the interview that, "In the future, or even for a prolonged period, the development of sports competition performance and sports leisure and fitness will still be in the stage of 'low output value'. However, for these two industrial sectors, it plays an extremely important role in establishing economic connections within the industry." In

fact, within the internal composition of the sports industry, there exists strong sectoral cooperation and resource control among industry sectors. This enables them to provide essential information from their respective sectors to support service product development. The sports and leisure industry is not solely focused on physical exercise activities aimed at enhancing physical fitness; it also serves as an industry that cultivates sports culture while expanding both sport consumer groups and consumption habits. It can be considered a "composite" industry with a high degree of integration with tourism and leisure industries, real estate industries, manufacturing industries, as well as other related industries. The sports competition performance industry has significant influence throughout this entire sector due to its heavy reliance on media industries, commercial advertising platforms, tourism-related business and other associated fields[159]. It represents an organic integration within this "compound" sports industry where various elements are brought into market circulation while simultaneously enhancing intangible assets' value within this domain. Ultimately this contributes towards further improving overall efficiency along every aspect sporting goods supply chain. Therefore, the optimization of China's sports industry in the new era lies not only in its focus on sports leisure fitness and sports competition performance as key industries, but also in their ability to stimulate the development of other industrial sectors and contribute to the sustainable growth of the overall industry.

At this stage, it is crucial to further enhance the interconnectedness within the sports event industry chain by establishing and improving a robust system for sports property rights and a market-oriented allocation mechanism for resources. This will facilitate professionalization, branding, and integration within the sports competition performance industry while promoting market-driven and industrialized development of sports events that cater to mass participation and meet high market demand. Additionally, efforts should be made to cultivate regional quality events, guide and support amateur sporting activities, develop professional-level competitions, and continuously enrich the variety of available sporting events.

The sports administration department should simultaneously break the industry monopoly, allocate appropriate government resources, enhance financial and tax policies, and expand the development opportunities for the sports performance industry. It should also act as an intermediary bridge in facilitating sustainable growth and optimization of the industry. In terms of fitness and leisure industry development, it is essential to establish a comprehensive system catering to all age groups - youth, young adults, middle-aged individuals, and seniors[160]. This system should be extended to communities while emphasizing market cultivation and fostering players within the leisure market sector to promote organic growth of the sports, leisure, and fitness industry.

（iii）We will prioritize stadium services and other sports-related services. The sector of sports-related services, such as stadium service, is an integrated sector that combines the circulation of sports products with the economy and technology, requiring substantial intermediate investment from other industries and playing a significant role in driving backward linkages. Sports venue services are crucial for transforming sports material carriers into service products. Other sports-related services encompass productive services, particularly in the field of sports rehabilitation, which not only increases public participation but also presents a vast market opportunity[161]. Moving forward, we aim to expand the carrier sector for sustainable development and optimize the sports industry. On one hand, it is necessary to break away from a "one-size-fits-all" development plan for sports venues by gradually strengthening smaller yet diverse and complex facilities while broadening and extending new avenues for industrial sector growth. This approach aims to enrich sports consumption while fully leveraging the role of the stadium service industry in promoting sustainable development and adjustment within the broader realm of the sports industry[162]. On another note, related service platforms such as classified construction and hierarchical city planning should establish characteristic towns focused on sporting activities as well as demonstration areas for sport tourism based on local conditions. Additionally, efforts should be made to cultivate projects related to IoT-enabled health initiatives in relation to sporting activities while

building collaborative innovation projects at three different levels aimed at enhancing overall agglomeration levels and linkage effects within the realm of the sports industry.

3.3.2 The enhancement of the impetus behind innovative factors serves as the driving force for sustainable development and optimization of the sports industry.

From the perspective of optimizing sustainable development and the factor conversion effect of internal resource allocation in the sports industry, it is crucial to fully leverage core elements such as science and technology, capital, talent, and data in driving industrial innovation. This will facilitate a remarkable transformation of the sports industry from relying on extensive material elements to embracing efficient and intensive ones.

(i) The advancement of digital sports and smart sports expedites the sustainable development and optimization process of China's sports industry. Innovation serves as the propelling force behind the sustainable development and optimization of the sports industry. Whether it is addressing the imbalanced growth trajectory of leading sectors, pursuing a path of balanced and coordinated development, or leveraging efficient high-tech solutions to foster sustainability in this field, scientific and technological innovation along with enhanced production techniques are indispensable factors. Currently, China's sports industry as a whole operates at a relatively low level, with limited market share for advanced equipment manufacturing in sporting goods and benchmarking sports service products. To effectively overcome the obstacles hindering sustainable development within China's sports industry, it is imperative to optimize and upgrade both sports goods and services industries through technological advancements. Presently, China finds itself in an important phase dedicated to promoting its strategy as a global leader in sports; consequently, there exists strong governmental support for digital sport-related industries such as smart sports equipment, "Internet + Sports," and intelligent sporting venues.

Digital technology will emerge as a potent tool accelerating high-quality developments within the realm of sports while realizing our aspirations towards becoming a powerhouse. The performance of competitive sports in China is hindered by issues such

as inadequate effective supply, limited overall scale, and low public consumption. It is crucial for us to actively embrace the development trends of new technologies and innovate the provision of products and services in the sports industry. Modern scientific and technological advancements like drones and information technology enhance the quality of sports service offerings. Additionally, we anticipate leveraging big data, 5G sensors, communications, internet financial innovation, production methods, service models, and business models to further drive progress. Simultaneously, enterprises and research institutions are encouraged to integrate innovative resources, consolidate their efforts, and overcome bottlenecks within the sporting goods manufacturing industry. Enhance the innovation capacity of the sports industry to seize a prominent position in the global manufacturing value chain for sporting goods. This can be achieved by promoting innovative collaborations within the sports industry, fostering internal industrial cooperation networks, strengthening connections along the industrial and value chains, and facilitating synergistic growth within the sports sector.

Build a sports science and technology innovation platform. Government departments should strengthen the top-level design, enhance the intelligent development of sports and digital environment, promote the construction of infrastructure related to the digitization of the sports industry, improve the construction of an intelligent public service system, and facilitate smart sports communities (crowd ++ intelligent big data + health monitoring + scientific fitness guidance) by achieving interconnectivity among big health data. Additionally, emphasize on opening up digital application infrastructures for sports enterprises at all levels, establish a comprehensive big data center platform for businesses in the sports industry, and encourage small and medium-sized enterprises to leverage shared business resources available through this platform. Furthermore, focus on implementing tangible initiatives that revolve around establishing open resource platforms between domestic leading enterprises in the sports industry with "industrial chain" as its foundation; examples include constructing smart sports industrial parks, forming digital technology innovation alliances, developing smart factories and digital

workshops.

Strengthen the policy support for scientific and technological innovation in the sports industry, and guide innovative entities to carry out targeted innovation activities based on the actual needs of industrial development. For instance, by shifting from general preferential treatment to addressing specific demands for scientific and technological innovation, notable growth can be observed in sectors receiving preferential treatment, thereby enhancing the enthusiasm of small and medium-sized enterprises or private sports enterprises towards scientific and technological innovation.

Strengthen the development and implementation of national and industry standards for key core technologies in the field of smart sports industry, aiming to enhance China's international influence in intelligent sports. This can be achieved through collaborative design and development of intelligent sports products, fostering cooperation across the entire industrial chain, enabling foreign enterprises to adopt Chinese standards as a reference for product research and development, thereby laying the foundation for China's right to formulate international standards for intelligent sports technology.

3.3.3 The sustainable development of the sports industry can be enhanced through recapitalization and sustainability measures, aiming to restructure and optimize its operations.

The theory and practice have provided evidence for the establishment and optimization of sustainable development in the sports industry. However, it is crucial to consider the following two aspects in order to enhance stock and increment within the sports industry, as well as optimize its sustainable development:

(i) How to ensure that sports industry investments align with expected strategic objectives and optimize structural elements？

Given the unstable financing channels and investment rates in China's sports industry development, targeted approaches include: innovating financing methods. Strengthening the financial industry is a basic condition for enhancing sports industry financing. We believe that current sports bonds and insurance are largely weak links in

sports industry financing, so innovation should start from these areas to develop the sports bond market and insurance market for more significant effects. Improving risk protection. Currently, local governments have introduced financing policies such as credit support, guarantee support, corporate bonds, and low interest rates. However, during implementation processes of listing financing, credit financing and bond issuance policies/regulations are incomplete while banks also maintain strict credit guarantee systems.

We will enhance the legislation and regulations concerning investment and financing in the sports industry. Despite the issuance of financing policies by the government, there still exist numerous deficiencies and gaps in the relevant legislative framework. The Sports Law and Contract Law are currently the only applicable laws; however, they fail to adequately address the financing requirements of the current market. The Sports Law defines the sports industry as a public welfare endeavor, while lacking clarity on state-owned, private, individual, and foreign investments. Moreover, most regulations primarily emphasize "administrative" aspects, significantly limiting market investment efficiency. Therefore, with regards to sports industry development perspective, we should expedite our agenda for sports legislation to resolve issues pertaining to insufficient legislative foundation for sports industry financing and enhance overall funding efficacy.

It is imperative to take the market as a guide, continuously promote innovation in physical education systems and teaching methods at colleges and universities, optimize curricula, and develop innovative talent training models. Currently, there is an urgent need to cultivate high-level professional talents and compound talents in areas such as professional management, snow and ice industry management, outdoor sports and leisure management, comprehensive skills development, intelligent sports hardware and software development and operation talents, innovative IP design and operation. Strengthen the collaboration between educational institutions and sports industry enterprises, leveraging the resources of these enterprises to establish a talent training base for the sports industry.

Innovate the talent development model and create an "Internet +" education and skill enhancement model tailored for professionals in the sports industry. Reinforce the implementation of the National Plan for Sports Talent Development (2020-2030), establish a model training base for cultivating innovative talents, execute programs to train exceptional private entrepreneurs, and foster a cohort of professional, high-caliber sports entrepreneurs. Place significant emphasis on facilitating career development opportunities for retired athletes to venture into the sports industry. Actively seize the prospects offered by central vocational education, leverage the strengths of educational institutions at all levels, and enhance the production of skilled sports professionals.

Conclusions to chapter 3

This chapter presents an alternative path for the sustainable development, optimization, and upgrading of the sports industry. It explores both inward and outward orientations and elaborates on the key paths, directions, and measures associated with different types of paths. To provide a scientific foundation for selecting the optimal path for the sustainable development of the sports industry, this study develops causal diagrams, flow charts, and system dynamics equations to depict system optimization. Furthermore, a dynamic model is established to optimize the sustainable development of the sports industry system. Based on China's internal and external paths towards sustainable development and optimization in its sports industry, simulation parameters are designed to propose seven distinct paths: traditional development; driven by sports services; driven by leading industries; driven by coordinated development; driven by resource optimization; driven by sports technology innovation; and demand-driven optimization.

Firstly. Change ideas and implement institutional reform. Since sports is an industry, it should be established and operated according to the modern enterprise system. While competitive sports are enterprise-oriented, we should also actively cultivate and develop the consumer market of mass sports, and establish the management system of mass sports

and the operation mechanism of self-investment of mass sports. Sports operators should change their operation mode, accelerate the pace of adjustment and reorganization of enterprises, and form a reasonable operation scale. In addition, it is necessary to strengthen the technology and service marketing innovation of sports enterprises, and improve the related sports services.

Secondly. The government has increased its support to vigorously develop the sports industry. Relevant departments should strengthen the development plans for the sports industry, strengthen policy guidance, implement the fiscal, tax, investment and financial support policies determined by the central government, relax the working conditions for sports business activities, and encourage various economic components to invest and operate in the sports industry. We will establish an investment and financing mechanism for sports development with diversified investment subjects and investment channels, expand the scale of the sports industry and raise the market-oriented level.

Thirdly. Improve the quality of all kinds of sports talents, and attach importance to the role of human resources. The development of sports undertakings depends more and more on the degree that sports workers use advanced theories to guide their work. "Science and technology revitalize the body", establish a joint mechanism of scientific research and training, scientific research provides paid services for sports teams, so that sports science and technology from public welfare to business oriented, facing the society, market oriented, demand oriented, participate in competition, and accelerate the commercialization of scientific and technological achievements. It should cooperate with relevant departments in relevant institutions to set up a sports information industry group and a "national network sports information system", and give full play to the advantages of information of text information, electronic information, film and television information and other media information to jointly develop the sports information industry.

Fourthly. The vensim-PLE simulation software is utilized to conduct simulations and comparative analyses of various pathways, aiming to enhance the value added by the sports industry, promote employment development, and optimize the strategic-level

structure of the sports industry. This approach represents the most scientific and sustainable mode of development. The completion of constructing a sports powerhouse has set forth the target task for making the "sports industry a national pillar industry by 2035." Simultaneously, through adjusting external economic variables, optimizing resource allocation, fostering scientific and technological innovation, as well as refining demand optimization pathways can expedite China's sports industry towards sustainable development, optimization, and upgrading.

In finally, the sustainable development of the sports industry extends beyond the implementation of the development strategy. This entails transitioning from a sports material consumption economy to a service-based economy, with an emphasis on not only the proportion but also the level and quality of sports services. Neglecting these aspects will result in being trapped in a self-perpetuating cycle of services, hindering sustainable development. Therefore, adjusting China's approach to sustainable development in its sports industry should involve reasonable planning for its overall growth. Shifting focus from solely improving the proportion of the sports service industry to developing both sports goods manufacturing and sports service industries is crucial for achieving sustainability. This paper systematically elaborates on countermeasures and suggestions for optimizing China's sports industry through six key areas: rational planning of key formats, activating innovation factors, promoting coordinated internal development within the industry, reforming demand-side practices, addressing regional imbalances in development, and implementing comprehensive management.

CONCLUSIONS

The sustainable development of the sports industry is an extension of industrial sustainable development, and it is crucial to define the boundaries of the industrial sustainable development system. However, this study does not focus on the external sustainable development of the sports industry, the sustainable development of the sports economy, or factors influencing its evolution. The structure of the sports industry emerges as society develops to a certain stage, reflecting its composition, spatial distribution, and economic and technological links in resource reproduction processes within this sector. This includes examining how sustainability is achieved within the sports industry itself and how resources are allocated sustainably. There are five fundamental patterns for achieving sustainability in terms of sports industry products, internal output, and spatial layout.

The sustainable development of the internal network in the sports industry is based on the industrial division of labor. The universality of assets, technological innovation, residents' disposable income level, and institutional factors are key determinants for realizing the transmission mechanism of internal correlation changes within the sports industry. Currently, a circular network economy has been established within China's sports industry, with different sectors playing distinct roles in sustainable development. Notably, the sports industry exerts a significant positive driving effect on various departments within its domain, while cross-integration between sports product circulation and economic/technological departments exhibits a more pronounced reverse driving effect on other industries. The sporting goods manufacturing sector holds considerable influence over the sustainable development of the entire sports industry and serves as its leading industry at present. The level, degree, and quality of internal correlations within the sports industry are intrinsic factors contributing to its sustainable development and optimization. Promoting coordinated development among these correlations and ensuring more rational division of labor represents an essential aspect for achieving sustained growth in the sports

industry.

The main external environment and driving force that affects the sustainable development of the sports industry is: the economic development environment is the basic condition of the evolution of the sports industry structure; the Social demand environment is the traction force of sustainable development of the sports industry; Science and technology environment is the fundamental driving force for the sustainable development of sports industry. The resource supply environment is the basic condition of sustainable development. The institutional environment is the fundamental guarantee of sustainable development of the sports industry. The current economic development mode and the development stage of the sports industry, the transformation of social contradictions and low sports consumption, resource constraints and extensive development of the sports industry, the arrival of the fourth industrial revolution, and the emergence of the new form of the sports industry, the modernization of the national management system and management capacity and the transformation of the sports resource allocation mode are the external motivations for the sustainable development and optimization of the sports industry. The sustainable development of sports products and sustainable development needs, the growth effect of the sports economy, the coordinated development of the regional sports industry, the optimization of sports resource allocation and the modern sports industry system, and the stage of "people's growing needs for a better life" are the external directions for the sustainable development and optimization of the sports industry.

The optimization of sustainable development in the sports industry involves a multi-dimensional assessment of its compatibility with economic and social development as well as the external environment, which is characterized by certain stages. Currently, China's goal for sustainable development in the sports industry is to cultivate new growth points for the national economy and promote rationalization and high-level sustainability within the industry; to meet people's needs for a better life, firmly grasp opportunities within domestic circulation, and promote overall balanced and coordinated development between product structure in sports industries and residential consumption. To further

improve quality and efficiency in sports industry development reform, it is necessary to optimize internal resource allocation.

This paper establishes a theoretical optimization model for the sustainable development of the sports industry, and explores the criteria for rationalization, high-level performance, efficiency, advancement, and coordinated spatial layout in regional sports industries, as well as the modern target form of sustainable development in the sports industry. Additionally, it designs evaluation indicators (system) and measurement methods based on these criteria to verify the feasibility of evaluation models and indicators.

The sustainable development of the sports industry itself does not have an absolute benchmark, nor is it solely determined by the proportion of output value contributed by the sports service and goods manufacturing sectors. Currently, the impediments to achieving sustainable development in China's sports industry include: a low level of sustainability within the industry and limited synergies between different industrial sectors, which hinder the integration of technological progress into economic growth: The sustainable development of the sports industry is not high, The low aggregation effect between industrial sectors, Make the technological progress of the industrial sustainable development into the more economic growth has a blocking effect; The sustainable development of sports product supply does not match with the sustainable development of residents' consumption, Not yet formed the interactive utility, There are the problems of relative excess supply of sports products and relative insufficient demand; Unreasonable and sustainable development of internal resource allocation in the sports industry, For the low effectiveness of the utilization of various external economic resources, Low contribution of output conversion; The sustainable development of the sports industry is unreasonable, The coupling and coordination between sustainable development of regional sports industry and regional economic and social resources and environment is low, Regional advantageous industries are not prominent, the division of labor is not clear, the advanced construction, repeated construction phenomenon is

prominent; In the sustainable development of the internal output of the sports industry, Although the output value of sports service industry occupies the absolute main body, However, the intermediate demand for employment, economic operation, and investment in innovation to drive social investment growth are inefficient, Cause the sustainable development of sports industry service quality is low; The development of the core industry sectors within the sports industry lags behind, Low proportion of product consumption, Low output in the core industrial sector, The sustainable development and evolution of the sports industry is still in the low-level development stage; The degree of mutual extension within the sports industry is not enough, and the conversion degree of high and new technology is low, Cause the sustainable development of sports industry integration, high-tech quality underground, In addition, the quality of service-oriented transformation of the sports industry is not high, To a large extent, it restricts the evolution of the sustainable development and modernization of the sports industry.

The optimization path of the sports industry's sustainable development can be categorized into two paths: internal and external. The former relies on the correlation transmission mechanism and effect amplification among the internal components of the sports industry, as well as the enhancement of the coupling level. This includes promoting coordinated development within the industry associations and driving advancements in leading sectors. The latter facilitates a favorable cumulative or dynamic state for the sports industry through adjustments to variables related to its external environment. This encompasses optimizing sports resource allocation modes, fostering scientific and technological innovation, establishing sustainable development plans for unbalanced regional sports industries, and refining resource endowment strategies. Promoting a "coordinated development" path among internal components is a more scientifically sound and healthy model for achieving sustainable development, optimization, and upgrading within today's sports industry.

To promote the sustainable development and optimization of the sports industry, a comprehensive regulatory strategy is required to achieve the desired outcome. In the

context of supply-side sustainable development reform, it is more appropriate for demand-side reform to drive supply-side reform and for supply-side reform to stimulate demand to ensure the sustainable development of the current sports industry and adjust policy orientation. Promoting coordinated regional development within the sports industry involves modifying "unity", content, indicators, batch items, and work mode configuration. This is an essential requirement for China's sports industry spatial strategy. Leveraging science and technology, capital, talent, and data in industrial innovation can further advance efficient and intensive development towards sustainability in the sports industry. Strengthening coordination among various components of the sports industry by promoting horizontal integration with other sectors ("sports +") as well as vertical integration into large-scale project industries and high-quality industrial clusters will enhance sustainable development quality while fostering leading enterprises that serve as chain masters or experts in their respective fields. Promoting a dual-pronged hard resource allocation mechanism along with improving relevant legislation within the sports industry should prioritize cultivating market players through carefully formulated multi-level policies aimed at comprehensive governance coordination. These efforts not only expedite transforming scientific advancements into tangible productivity but also enhance efficiency and transformation capabilities regarding internal resource allocation within the sports industry.

REFERENCES:

1. Huang Haiyan. (2022). Development Trend and Reform Path of Sports Industry in the Process of Chinese Modernization. Journal of Xi'an Physical Education University. 396:526-536.

2. Ren Bo and HuangHai-yan. (2022). Practical Problems and Development Strategies of China's Sports Industry Under the Background of Sporting Powerhouse Construction. Sports Culture Guide. 4:68-74.

3. Wang Jun, Zhang Wenjing and Shen Keyin. (2023). Discussion on the supporting system and strategy of high-quality development of sports industry. Journal of Wuhan Sports University. 5701:58-64.

4. Wu Shaozu. (1995). Accelerate the pace of sports industrialization and promote the development of sports. National Sports Commission directors meeting.

5. Lu Yuanzhen. (2001). Basic theoretic problem of sports industry. Journal of Physical Education. 01:41-44.

6. LI Jianshe. (2006). Study on the Conjunction Effects and Features of Sports Industry. Journal of Tianjin University of Sport. 05:378-380.

7. Fang Chunni. (2012). Research on regional sports industry cluster. Sports Culture Guide. 06:97-101.

8. Su Xiuhua. (2008). Sports industry management and management. Journal of Yunnan University of Finance and Economics. 3903:67-76.

9. Liu Dongfeng and Shi Chenyu. (2009). British and Japanese sports industry concept and development characteristics - Interview with Professor Chris Gratton, Director of the Sports Industry Research Center, Sheffield Hallam University, UK, Chairman of the Asian Sports Management Association, Professor Masahiko Harada of Waseda University, Japan. Global Sport Market. 01:56-57.

10. SHI Hong-jun. (2001). Realization of connotation and extension of the sports industry. Journal of Wuhan Institute of Physical Education. 05:45-46.

11. Cong Huping. (2001). The Analysis on Some Definitions about Sports Industry and Discussion on Some Related Problems. China Sport Science and Technology. 12:3-5.

12. Power D, Kotro T and Repo P. (2012). Consumer contribution to product development in the nordic sports industry : Passionate consumers pose benefits for and challenges to companies. Vaasan Yliopiston Julkaisuja.

13. YANG Ye-hong and FANG Xin-pu. (2011). Talk About Division and Concept of Sports Industry. Journal of Anhui Normal University. 04:394-397.

14. Liu Yanwu. (2007). On urban development and the promotion of sports industry. Journal of Changchun Normal University. 7:74-78.

15. Fu Gangqiang and Liu Dongfeng. (2021). Historical Logic and Experience Enlightenment of Development of Sports Industry in China Under the Leadership of the Party Since Founding of the People's Republic of China. Journal of Shenyang Sport University. 4002:118-123+138.

16. Duan Juanjuan and Li Rongri. (2020). Tracing, viewing and planning: A study on the evolution of sports industry. Journal of Shenyang Sport University. 3906:94-101.

17. Xing Xiqiang. (2017). Try to analyze the development and evolution of China's sports economic thought since the reform and opening up. Economic Research Guide. 17:178-179.

18. (2019). Finance Department, the General Administration of Sport of Chin. Sports Culture Guide. 10:8-18.

19. Huang Haiyan. (2020). Strategic Thinking on Promoting Sports Industry to Become a Pillar Industry of the National Economy. China Sport Science. 12:3-16.

20. Li Rongri. (2020). Theoretical Framework and Logical Path：High-quality Development of Sports Industry in China. Journal of Tianjin University of Sport. 3506:651-657.

21. Fan Songmei and Bai Yunfei. (2022). Research on the Changes and Optimization Path of Sports Industry Structure in China. Journal of Xi'an Physical Education University. 3905:533-540.

22. Lan Di and Fang Chunni. (2022). Current Situation, Realistic Dilemma and Implementation Path on Synergy Development of Sports Industry in the Yangtze River Economic Belt. Journal of Guangzhou Sport University. 4201:59-68.

23. Wang Qian. (2021). The impact of COVID-19 on China's sports industry: an empirical analysis based on event studies. Journal of Wuhan Sports University. 5510:40-48.

24. Xu Tong. (2008). British welfare system and the evolution of mass sports policy. Sports Culture Guide. 04:110-113.

25. Jie Zhang. (2015). Reality and Dilemma: The Development of China's Sports Industry since the Implementation of the Reform and Opening-Up Policy. The International Journal of the History of Sport. 8:

26. Hyysalo S. (2010). User innovation and everyday practices: micro-innovation in sports industry developmen. 2010. 393:245-258.

27. Fredberg T and Piller F T. (2022). The paradox of tie strength in customer relationships for innovation: a longitudinal case study in the sports industry. R & D Management. 5:470-484.

28. Mulligan J G. (2011). Market Size, Service Quality and Competition in the US Downhill Ski Industry. Applied Economics Letters. 18:1487-1500.

29. Ye Lin. (2018). Chinese sports management system: Evolution, present situation and future. Journal of Gansu Administration Institute. 02:41-50.

30. Liu Jiangnan. (2001). A Genaral Picture of American Sports Industry and Analyzing of Its Sociology Factor. Journal of Guangzhou Sport University. 01:1-5.

31. Yang Xiaosheng. (2001). The constraints and countermeasures of sports industry development in our country. Journal of Physical Education. 4:24-25.

32. Xin Li. (2002). The Discussion on the Operation Mechanism of Sports Industrialization Management in China. China Sport Science and Technology. 06:10-12.

33. Liu Yuanxiang. (2004). The Relevant Analysis On The Insufficient Of Effective Demand And The Development Of China's Sports Industry. Journal of Chengdu Sport

University. 05:10-13.

34. C. Liu. (2010). China sports industry development strategy analysis. Sports Culture Guide. 08:65-67.

35. Zhang Shiwei. (2010). Strategy Thinking of China's Sports Industry Development Based on Regional "Growth Pole" Theory. Journal of Beijing Sport University. 3307:12-16.

36. Zhang Ruilin. (2010). Study of the sports industrial management system in China. Journal of Physical Education. 1710:14-21.

37. Luo Jianying and Cong Huping. (2010). The Characteristics and Relationship of Sporting Events Business Network Structure. China Sport Science. 3004:11-20.

38. Jiang Tongren. (2013). The experience and enlightenment of the development mode of sports industry in Europe, America and Japan. 3702:19-24.

39. Jiang Tongren. (2016). Research on the adjustment of China's sports industry policy under the new normal. China Sport Science. 3604:33-41.

40. Guan Zhengliang. (2018). Analysis of the development mode of "Internet +" sports industry. Science & Technology of Stationery & Sporting. 08:33-34.

41. Wang Zipu. (2018). Development Logic of Sports Industry in the Construction of China's Sports Power in the New Era. Journal of Beijing Sport University. 4103:8-13.

42. Pan Wei and Shen Keyin. (2022). Theoretical basis, power mechanism and implementation path of digital economy promoting the high-quality development of sports industry. 2903:59-66.

43. He Xinjia. (2022). Evolution and Prospect of China's Sports Industry Driving Force from the Perspective of High-quality Development. Journal of Shenyang Sport University. 4102:94-101+137.

44. Luan Kaifeng. (2007). Chinese sports industry development present situation and problems should be paid attention to. Sports Culture Guide. 10:3-6.

45. Tian Shichang. (2009). China's eastern region sports industry development analysis. Sports Culture Guide. 11:79-82.

46. Liao Pei. (2005). An analysis of current situation and development prospect of sports industry in China. Journal of Physical Education. 04:28-31.

47. Xie Hongwei. (2009). Research on the upgrading of regional sporting goods manufacturing industrial cluster based on global value chain theory -- A case study of Jinjiang, Fujian Province. Journal of Sports Research. 2305:41-44.

48. Huang Haiyan. (2016). Goal and Path of Chinese Sport Industry during"the 13th Five-year Plan"period. Journal of Shanghai University of Sport. 4002:13-18.

49. Zhu Qiying. (2021). Capital Market Supporting High-Quality Development of Sports Industry： Mechanism，Dilemma and Path Choice. Journal of Shanghai University of Sport. 4512:35-49.

50. Xiao Jun. (2021). Research on Business Performance Evaluation and Influencing Factors of Sports Listed Companies based on DEA － Tobit Mode. Journal of Harbin Sport University. 3906:46-51.

51. Fletcher J E. (1989). Input-output analysis and tourism inpact studies. Annals ofTourism Research. 16:514-519.

52. Mato B. (1997). Evaluation of the economic impact of sport in developed countries and in Croatia. Kinesiology. 29:71-77.

53. Lin Xianpeng. (2006). Research on Present Situation and Trend of Sport Industry in China. China Sport Science. 02:3-9.

54. Zhao Nie. (2009). Study on the relationship between sports and economic and social development in Henan Province. Henan Social Sciences. 1703:210-211.

55. Chen J Q and Yuan J L. (2009). About our country sports industry and economic development relation theory research. Enterprise Economy. 12:137-139.

56. Li Na. (2010). Study on the dialectical relationship between contemporary sports and economy. Journal of the Party School of Leshan Municipal. 1203:90-92.

57. Jie Yunfeng. (2010). Research on the relationship between sports industry development and economic growth. Productivity Research. 08:195-196.

58. Zhang Ruilin. (2011). Study of sport industrial structure optimization in China.

Journal of Physical Education. 1802:21-26.

59. Yu Zhenfeng. (1998). Research on the Relationship Between Mass Sports Consumption and Sports Industry. Journal of Chengdu Sport University. 04:7-11.

60. Ji Jianqiu and Chen Yingchuan. (2001). Research on Sports Consumption of Development Connotation and Relativity of Society Formative in Sports Market. Sichuan Sports Science. 04:9-11.

61. Lian Guihong. (2002). A comparative study of income gap restricting sports consumption demand. Journal of Shandong Sport University. 01:28-29.

62. Wang Wenfeng and Guo Xiting. (2005). Comparative Study of Productive Efficiency between State－owned Commercial Banks and Stock Commercial Banks. Productivity Research. 01:144-146.

63. BI Jin- jie and LIANG Jin. (2005). he Theoretical Study on the Evaluation System of International Competitiveness in Sports Industry. Journal of Tianjin University of Sport. 05:16-18.

64. CAI Bao-jia. (2006). Empirical Research on Regional Sports Industry Aggregation. Journal of Shanghai University of Sport. 01:31-34.

65. CHEN Po. (2007). ARIMA Model in Sporting Goods Exportation Forecast in China. Journal of Tianjin University of Sport. 04:353-357.

66. Qiao Yu. (1998). Capital investment, international trade and economic growth in China: Evidence in the 1980–1990s %J China Economic Review. 91:

67. XU He-lian and AI Ming-yong. (2002). Re-examining Export-led Grow th Hypothesis in China. Journal of Hunan University(Natural Sciences). 03:124-128.

68. Zhang Xiaoxia. (2007). China's sports goods industry development status and development research. Market Modernization. 17:238-239.

69. Feng Guoyou. (2007). Analysis and selection of interests in public sports policies. Journal of Physical Education. 07:15-19.

70. Shi Yan. (2014). Opportunities and challenges faced by sports industry development in China under the background of new policies launched by the State Council

for the sports industry. Journal of Physical Education. 2106:13-18.

71. Xu Zhengdong and Chen Xi. (2018). Discussion on the Hotspot Analysis and Development of Leisure Sports in China since 21 Century. Fujian Sports Science and Technology. 3702:17-18+26.

72. Song Xuguang. (2002). Systematic analysis of comprehensive evaluation methods for sustainable development. Social Science Journal. 06:82-85.

73. Beate Littig and Erich Griessler. (2005). Social sustainability: a catchword between political pragmatism and social theory %J Int. J. of Sustainable Development. 81/2:

74. Liu Jianli. (2008). Interpretation of philosophical thoughts of scientific development view. Scientific Socialism. 05:48-50.

75. Feng Yuemin. (2008). Philosophical interpretation of scientific development view. Journal of China People's Police University. 01:37-39.

76. LIU Yansui. (2018). Research on the urban-rural integration and rural revitalization in the new era in China. Acta Geographica Sinica. 7304:637-650.

77. Whittington J. Lee. (2018). Conscious Capitalism: Liberating the Heroic Spirit of Business, by John Mackey and Raj Sisodia; and Uncontainable: How Passion, Commitment, and Conscious Capitalism Built a Business Where Everyone Thrives, by Kip Tindell %J Academy of Management Learning & Education. 173:

78. Raimund %J International Journal of Sustainable Development Bleischwitz. (2004). Governance of sustainable development: co-evolution of corporate and political strategies. 71:27-43.

79. Chen Chang, M. A. Xiao, Wei Yi and F. U. %J Systems Engineering Xiao. (2004). A Harmony Analysis on System of Economy and Resource Based on Sustainable Development in China.

80. R. Kemp, S. Parto and R. B. Gibson. 'Governance for sustainable development: moving from theory to practice' International Journal of Sustainable Development.

81. Zeng Qingcun. (1996). NaturalCybernetics. Science & Technology Review.

82.Wang Huijiong. (1999). Sustainable development and economic structure. Science Press:Ye Zaisheng.

83. Niu Wenyuan. (2008). 低碳经济的发展模式研究 %J 中国人口·资源与环境. China Population,Resources and Environment. 03:14-19.

84. Liu Peizhe. (2004). Sustainable development and three-dimensional concept of development. Anhui Science & Technology. 10:4-6.

85. Pan Yingxu and Zhong Bingshu. (2004). Theoretical exploration of sustainable development of sports in our country. Sports Culture Guide. 05:9-11.

86. Yu Zhonggan and Liu Zhimin. (2000). The present situation and existing problems of sustainable development of athletics sports in our country. Journal of Shanghai University of Sport. 02:8-11.

87. Song guangchun；and Yan bin. (2006). On raising the marginal propensity to consume and developing the sports industry of our country. Journal of Xi'an Physical Education University. 02:10-13.

88. zhang kun. (2002). On the transmission effect of Olympic economy. China Sport Science and Technology. 08:17-19.

89. kahn R F. (1931). The relation of home investment to unemployment. The Economic Journal. 173-198.

90. Erich %J Studies in Philosophy Baumann and Social Science. (1936). Keynes, J. M., The General Theory of Employment, Interest and Money.

91. Yougui Wang, Yan Xu and Li %J Physics Procedia Liu. (2010). Keynesian multiplier versus velocity of money. 35:1707-1712.

92. LI Jian-she. (2004). Some Theoretical Problems of Sports Industry Development. CHINA SPORT SCIENCE AND T ECHNOLOGY. 05:23-24.

93. Yang Ming and Wang Xinping. (2009). Study on the influence of Beijing Olympic consumption on Chinese economy. Journal of Xi 'an Physical Education Institute. 2602:175-178.

94. Jia zhenjiang. (2002). Economic growth and sports consumption. Business

research. 14138-139.

95. Fang Fuqian. (2004). On the thinking and method of studying the economic influence of Olympic Games. Beijing Social Sciences. 02:3-7.

96. CHEN Wei and XU Jia-peng. (2005). The Analysis of Multiplier Theory and the Application

Study in China᾽s Economic Development. COMMERCIAL RESEARCH. 07:76-78.

97. Stephen Casler, Suzanne %J Resources Wilbur and Energy. (1984). Energy input-output analysis : A simple guide. 62:187-201.

98. Niko Matouschek and Anthony J. %J The Economics of Transition Venables. (2010). Evaluating investment projects in the presence of sectoral linkages1. 134:573-603.

99. LIN Xian-peng, YU Zhong-gan and YANG Yue. (2006). Research on Present Situation and Trend of Sport Industry in China. China Sport Science. 02:3-9.

100. Zhang yan and Wang qing-fang. (2001). Theoretical consideration of sports industrialization in our country. Journal of Chengdu Physical Education Institute. 2:5.

101.

102. Yang Niansong. (2005). Sports industry and sports cause, sports industrialization, sports marketization and their mutual relations. Journal of Chengdu Physical Education Institute. 01:19-21+25.

103. Jin Yinghua. (2006). On the Basic Principles of Policy Adjustment of Sports Industry in China. Journal of Capital Institute of Physical Education. 02:3-4.

104. Cong Ｈｕ－ｐｉｎｇ. (2013). Study on the policy of sport industry in china. China Sport Science. 3309:3-13.

105. Kang Tiexiang. (2008). Research on digital economy and its accounting. Statistics and decision. 5:3.

106. Viorica Turcan, Alexandru Gribincea, Iulita %J ECONOMY Birca, SOCIOLOGY: Theoretical and Scientifical Journal. (2014). Digital Economy – A Premise For Economic Development In The 20th Century.

107. Le Ying, Jin Bo and CHEN Mmeihong. (2020). Connotation of digital economy and the current status of digital entrepreneurship: Based on the analysis of "Zhejiang Good Project". Shanghai Management Science. 4201:25-29.

108. Zhang Tao and Zhang Zhi. (2020). Digital economy, entrepreneurial activity and high-quality development. Manage the world. 3610:65-76.

109. GUO Han and ＲEN Baoping. (2020). High － quality Development of China's Sports Industry in the New Era:Logical Generation and Path Selection. Journal of Xi'an Institute of Physical Education. 3703:291-297.

110. WANG Chenxi and MAN Jianghong. (2020). Construction of the Evaluation Index System for the High-quality Development of China's Sports Industry: Based on Dynamic Change, Efficiency Change and Quality Change. Journal of Capital University of Physical Education and Sports. 323:10.

112. WANG Xianliang and ZHANG Ｒuilin. (2020). From production to Life: On the need for a better life under the high-quality development of sports industry. Journal of Shenyang Sport University. 3904:106-113.

113. REN Bo and HUANG Hai-yan. (2021). Research on the High Quality Development of China's Sports Industry

in the Post Epidemic Era. Sports Culture Guide. 4:7.

114. Shen Keyin. (2021). Macro form and strategy measures of high-quality development of sports industry under the new development pattern of "double cycle". Journal of Sports Research. 3502:11-19.

115. WANG Jian-xun and SHEN Ke-yin. (2020). Dilemma and Realization Path of High-Quality Development of

Sports Industry in the New Era. Sports Culture Guide. 06:7-13.

116. LI Yan-li and DU Zhao. (2020). Research on Digital Transformation of Sports Industry in China. Sports Culture Guide. 10:78-83.

117. XIN Li. (2002). The Discussion on the Operation Mechanism of

Sports Industrialization Management in China. China Sport Science and

Technology. 06:10-12.

118. Ren Bo. (2022). The strategic direction, function mechanism and implementation path of Chinese sports industry to help the construction of sports power. Journal of Nanjing Sports Institute. 2102:1-10+87.

119. Guo Rong-juan and Su Zhiwei. (2017). Mechanism analysis and empirical study on the impact of the upgrading of sports industry structure on the unemployment rate in China. Journal of Ocean University of China(Social Sciences). 04:51-57.

120. Pang Xiao-jie. (2008). Governance model and development mechanism of Chinese sports industry. Hebei Academic Journal. 05:171-173.

121. Cai Wang-Jun. (2020). The influencing mechanism, development trend and coping strategy of China's sports industry in the context of the COVID-19 epidemic: Based on the theoretical perspective of event system. Journal of Physical Education. 3605:20-27+95.

122. ZHANG Lei and XU Mao-wei. (2021). Research on the Internal Mechanism of China's Sports Industry Capacity Growth. Journal of Technical Economics & Management. 06:94-98.

123. Zhang Qing-Song. (2022). Research on the integration mechanism and reconstruction model of sports industry and leisure agriculture in China. Journal of Suihua University. 4208:35-37.

124. Xu Zhi and Ding Renzhong. (2019). Measurement, Prediction and Path Selection of the Quality of Interprovincial Economic Development in China in the New Era. 1:

125. Fu Qun and Hou Xiang. (2021). Realistic bottleneck and promotion strategy of digital transformation of China's sports industry from the perspective of diamond model. Journal of Shanghai University of Sport. 4710:70-87.

126. Liu Ziming and Tetiana Kharchenko. (2023). INNOVATIONS IN THE FIELD OF SPORTS INDUSTRY MANAGEMENT: ASSESSMENT OF THE DIGITAL ECONOMY'S IMPACT ON THE QUALITATIVE DEVELOPMENT OF THE SPORTS

INDUSTRY. Baltic Journal of Economic Studies. 902:10-21.

127. JIANG Tongren, XIA Maosen and LIU Na. (2017). Path Dependence and Countermeasures in Transformation of Sports Industry Development Pattern in China. Journal of Tianjin University of Sport. 325:9.

128. BAI Yang and HUAN Chang － dian. (2018). Ｒelation between government and market in Chinese sports industry: A framework

based on the dispute between Zhang and Lin. Journal of Shandong Sport University. 3404:7-11.

129. Zhang Liang. (2020). Spatial shift and value reconstruction of sports industry development in the post-epidemic era: Based on the analysis of sports industry development in the context of COVID-19. Sports & Science. 4103:25-30.

130. JIA NG Yao. (2006). The Sustainable Development Index Selection Based on Comprehensive Method. Journal of Systems & Management. 5:441-444.

131. Wang Jun. (2019). Discussion on the construction of sustainable development index system of sports industry. Productivity Research. 04:88-92.

132. Luo Zhimin. (2019). The New Space and Motivation Cultivation of China′s Sports Industry under the Perspective of Supply － side Ｒeform. Bulletin of Sport Science & Technology. 2711:139-142.

133. Li Bo. (2016). Enlightenment of "Supply Side" on China□s Sports Industry -- On the Basis of New Supply Side Economics. Journal of Wuhan Sports University. 5002:52-58.

134. Sun Keyi and Qin Chunlin. (1995). On sports management system and reform of Chinese sports management system. 01:6-13.

135. Tang Chunfang. (2006). Research on the Existing Problems and Developmental Strategies of Chinese Sports Industry. Journal of Beijing Sport University. 01:33-35.

136. Tong Ying-juan and Cong Hu-ping. (2002). The Social and Economical Environment of Sports Industry Development in East China and Choice of Development

Mode. China Sport Science and Technology. 11:4-6+10.

137. Zhao Bing-pu, CAI Jun-wu and Li Liyan. (1997). Research on sports industry policy system. China Sport Science. 04:1-7.

138. Liu Fumin. (2019). Implement the Opinions of The General Office of the State Council on Promoting National Fitness and Sports Consumption and Promoting the High-quality Development of the Sports Industry to promote the sports industry to become a pillar industry of the national economy. China Sport Science. 3910:3-10.

139. Wang Qi and Yan Xiaoyan. (2016). Opportunities and Challenges Chinese Sports Development is Facingin the Era of Big Data. 3701:75-80+86.

140. Wang Xueli, Fu Qun and Zheng Chengwen. (2020). On Realistic Challenges and Path Exploration of High-Quality Development of China's Sport Industry. 4301:1-15.

141. Zhou Xiaohong. (1994). A preliminary study on sports industry structure policy. 01:14-18.

142. Gao Xiaoning, Hu Wei and Zang Guoquan. (2022). System Dynamics Simulation Analysis on Factors Affecting Sharing Efficiency of Scientific Research Data. Information Studies:Theory & Application. 4508:146-153+103.

143. Jiao Qiang and Fan Yao. (2022). Problem Domains, Dilemma Attributions and Policy Guarantees of Supply and Demand Balance of China's Sports Industry from the Perspective of Whole Industry Chain. 4201:131-137.

144. Guo Bin, Zhao Wenting and Wu Fei. (2020). Prospect for Compiling the"14th Five Year Plan"of China Sports Industry under the Background of Building A Leading Sports Power. 4307:1-13.

145. Chen Linxiang. (2007). Study on Sports I ndustri al Structure and I ndustri al Distri buti on Poli cy Sel ecti on i n Chi na. China Sport Science. 03:75-82.

146. Yang Yue. (2010). From Big Sports Country to Sports Power —The Demand of China Economic and Social Development on Sports Business in Future Ten Years. China Sport Science. 3003:3-10.

147. Zhang Cheng. (2018). Research on risk measurement and control of SME

Supply chain finance -- based on system dynamics simulation model. Chinese Journal of Systems Science. 2603:76-80.

148. Li Xiaohui and Ma Hongmin. (2009). The influence analysis of sports industry to our country modern economy development. 06:150-152.

149. Wei Xiaolong, Wang Tao, Chen Yang, Lyulyov Oleksii and Pimonenko Tetyana. (2023). The Effects of Population Aging on Sports Industry Development: The Mediating Effect of Technological Innovation %J International Journal of Environmental Research and Public Health. 203:

150. Zhang Wenhao and Mou Chuan. (2023). Analysis and improvement of sports industry development and public health strategy under low-carbon economic structure. . 11

151. Nie Xiaomei, Qu Yongpeng and Yi Feng. (2022). The effect of sports industry economic benefit on economic construction. 2905:48-49+68.

152. Dai Li and Shu Yankai. (2023). Theoretical Logic，Endogenous Dynamics and Practical Path of High － Quality Development of Sports Industry in the New Era. Bulletin of Sport Science & Technology. 3108:203-206+228.

153. YUAN Yuan-yua and HUANG Hai-yan. (2023). Development Process, Key Fields and Development Paths on Sports Industry Investment and Financing in China. 07:65-70+110.

154. FENG De-hon and ZHU Jian-jun. (2006). Simulation Research on Optimization Balance Model of Aggregate Production Planning. Journal of System Simulation. 08:2119-2121.

155. Zhong Ni, Ren Jun-bao, Zhang Chun-yan and Zhong Ming-bao. (2023). Research on the synergy of "quantity" and "quality" in the high-quality development of sports industry. Journal of Sports Research. 3703:95-107+116.

156. XU Mingze and LIN Xiangyang. (2023). The Impact of National Sports Industry Demonstration Base

Establishment on Labor Force Employment in Territorial Cities: An Empirical

Analysis Based on Multi-period DID. Journal of Fujian Normal University(Natural Science Edition). 3904:127-138.

157. CAI Penglong, GAO Fugui and Wang Jiahong. (2023). Research on the Coordination between the Consumption Structure ofUrban Residents and Sports Industry Structure in China. 3503:295-306.

158. ZENG Ziming and WEI Deyang. (2023). A Study on High Quality Industry Convergence of China Sports Service Industry Based on Industry Relevance Perspective. Journal of Wuyi University. 4204:47-53.

159. Geng Tingqin, Zhang Ruilin, Li Ling and Wang Zhiwen. (2023). Evolution of Sports Service Market Regulation in China: Logical Cognition, Realistic Dilemma and Future Development. 3901:20-29+56.

160. REN Bo. (2023). Theoretical Logic and Implementation Path of High － Quality Development of Sports Industry ————Based on the perspective of"People Centered". 4101:29-35+97.

161. HUANG Haiyan. (2022). Development Trend and Ｒeform Path of Sports Industry in the Process of Chinese Modernization. Journal of Xi'an Physical Education University. 3906:526-536.

162. ZHANG Meng and WU JI. (2022). Realistic Foundations, Difficulties and Paths of Sports Consumption Upgrading in China. Sports Culture Guide. 10:1-7.

APPENDICES

Table A.1 - Regional sports industry sustainable development system and regional economic, social, and environmental resources system coupling coordination evaluation of the original data

Evaluation index	Shanghai	Zhejiang	Shandong	Liaoning	Hunan	Henan	Chongqing	Guizhou
Per capita GNP growth rate %	9.32%	6.37%	4.94%	-5.80%	6.13%	8.16%	0.00%	9.95%
Proportion of tertiary industry in regional GDP %	0.705	0.516	0.473	0.515	46.3%	41.9%	48.4%	44.7%
The sports industry accounts for DGP% of the region	0.015	0.0111	0.0104	0.0107	0.0095	0.0079	0.0082	0.0047
Regional per capita disposable income (Yuan)	54305	35537	24685	32876	21115	18443	22034	26742
Urban and rural income per capita disposable income gap	32172	22589	22589	19995	17134	15536.18	8061	18653
Consumption expenditure on entertainment as a proportion of disposable income (%)	0.076	0.1094	0.109	0.1207	0.072	0.1132	0.082	0.089
Engel coefficient	25.5	29.04	29.04	27.6	30.8	30.2	34.3	33.2
Per capita site area (10,000 people /m²)	1.83	1.48	1.8	1.69	1.09	1.02	1.71	0.81
Employment in culture, entertainment and sports as a percentage of labor force (%)	0.0083	0.0043	0.0027	0.0074	0.00033	0.0021	0.004	0.0074
Proportion of bachelor degree or above in culture, Recreation and sports (%)	0.17	0.1433	0.1633	0.121	0.098	0.101	0.101	0.076
New fixed assets investment in cultural, educational and sporting goods Manufacturing industry (billion)	2.53	191.19	393.48	12.46	98.64	236.91	24.9	5.78
New fixed assets of sports service industry (billion)	35.3	101.25	70.6	17.537	73.82	43	19.53	17.5
Proportion of sports expenditure in regional fiscal expenditure (%)	0.001792	0.0042	0.0032	0.0029	0.0027	0.0027	0.0021	0.0029
Cultural, sports and entertainment units Number of legal persons (units)	6000	21071	21732	8745	11450	15552	11688	5829
Proportion of non-state-owned fixed assets investment quota (%)	0.883	0.738	0.761	0.784	0.768	0.734	0.7676	0.729
R&D investment in cultural, educational and sporting goods Manufacturing industry (billion)	0.5	10.2	16.22	7.8	1.87	2.4	0.6754	
Science and technology (R&D) expenditure in the public budget of the sports system (million)	179.45	848.49	97.23	489.1	592.94	0	0	0.42
Added value of sports industry (RMB 100 million)	421.27	525.56	704.08	240.65	298.55	356.25	143.93	54.96
An increase of % over the previous year	16.63%	11.84%	13.83%	12.91%	34.93%	23.40%	1.50%	37.85%
Sports management activities (100 million yuan)	18.02	11.19	23.85	5.45	10.78	7.31	1.86	3.56

Table B.1 - The original data on the assessment of the compatibility between sustainable development of sports industry products and residents' sustainable consumption.

	Sustainable development of resident sports consumption			Sustainable development of sports industry							
	Food	Clothing	Reside	Household goods and services		Transportation and communication education culture and entertainment	Medical care	Other supplies service	Sports service industry	Manufacture and construction of sporting goods and related sports venues	
2009	3111.9	901.8	904.2	904.2	620.5	1147.1	1203.0	309.4	244.6	705.1	33.2
2010	3628.0	1042.0	982.3	601.8	699.1	1357.4	1329.2	357.7	322.5	898.1	44.6
2011	4259.8	1165.9	11454	691.8	786.2	417.1	1358.3	418.3	417.1	1088.3	49.6
2012	4478.5	1284.2	228.9	786.9	856.4	1682.6	1472.8	474.2	534.3	224.2	77.4
2013	4804.7	1444.3	1332.1	908.0	871.8	1983.7	1627.6	499.2	652.7	1472.0	95.4
2014	5506.3	674.7	1405.0	0232	2149.7	851.7	969.0	581.3	892.1	673.0	124.0
2015	4126.7	1027.1	2998.5	806.5	1627.1	1397.7	772.1	318.7	638.8	1920.4	130.4
2016	4126.0	1027.1	2998.5	806.5	6271	1397.7	912.1	324.7	1214.4	2189.6	159.0
2017	4493.9	1099.3	3200.5	889.7	1869.3	1535.9	1044.8	358.0	1339.2	2565.0	136.8
2018	4814.0	1641	3419.2	951.4	2086.9	1723.1	1164.5	389.2	2703.6	2755.5	35.3
2019	5151.0	203.0	3746.0	1044.0	2338.0	1915.0	1307.0	406.0	3560.6	2863.9	50.3
2020	5374.0	1238.0	4107.0	1121.0	2499.0	2086.0	1451.0	447.0	4449.0	3264.6	97.8
2021	3822.8	1025.7	1155.7	801.8	1624.8	1396.5	772.1	318.7	468.1	243.7	10.8

Table C.1 - Raw data of efficient evaluation of sustainable development of sports industry

District	Value added of Sports Industry (Y)	Culture, Sports and Entertainment Professionals (L)	New investment in fixed assets of sports production (K)	Degree of marketization (MAR)	R&D investment in sports industry (T)
Shanghai	351.22	10.77	38.35	86.3	8.1
Tianjin	88.34	6.7	51.37	69.6	3.94
hejiang	463.35	19.57	235.52	82.6	13.1
Shandong	606.74	17.1	373.9	80.5	11.18
Liaoning	209.5	4.9	82.4	81.1	0
Jiangsu	879.81	22.77	347.63	78.47	18.47
Henan	115.24	4	37.1	87.4	23
Guangdong	999.7	28.76	279.62	83.5	10.7
Anhui	118.55	36.5	166.81	83.1	11
Fujian	1061.56	4.31	189.3	68.27	5.7734
Beijing	212	23	7.4426	66.7	0.7366
Hebei	254.25	19.45	290.7	69	0.6021
Neimenggu	138.84	3.4	33.93	53.9	2.3
Jixi	87.54	14.47	148	92.8	0.2
Hubei	325.67	8.84	149.84	79.9	3.27
Hunan	194.28	53.45	143.4	50	1.124
Hunan	185.05	12.87	283.5	83.7	2.403
Shanxi	58.52	9.27	31.93	37	0.0862

Table D.1 - The original data of system dynamics model parameter determination for sustainable development optimization of sports industry in China

Indicators/Years	2009	2010	20111	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Added value of sports industry (ten thousand yuan)	9828900	2652300	15549700	18359300	22201200	26890600	26896000	35630000	40409800	54944000	64748000	78114000	100790000
GDP(million)	2194389000	2700923000	3192446000	3485178000	4121193000	4879402000	5385800000	5929632000	6412806000	6859929000	7400608000	8207543000	9003095000
Per capita disposable (10,000 yuan)	0.7673	0.8963	1.0271	1.1164	.2514	1.43935	1.6241	1.831	2.0167	2.1966	2.3821	2.5973	2.8228
Per capita sports consumption (ten thousand yuan)	0.0583	0.0593	0.06427983	0.069677862	0.0755292	0.081871914	0.088747271	0.0962	0.0926	0.100376269	0.108805566	0.11794273	0.127847205
Fiscal expenditure (million	404227300	479813500	625926600	762999300	898741600	1092477900	259529700	1402121000	1517855600	1758777700	1877552100	2030854900	2209040000
Educational financial expenditure	69402300	71223200	90102100	104375400	125500000	164970000	164970000	212420000	230417100	262718800	262718800	301531800	321694700
Funds for sports undertakings (ten thousand)	2472000	2601000	2898000	2982000	3201000	4219000	4302000	4600000	4718500	4808400	6557110	7444600	3023400
Per capita sports area (square meters)	1.03	1.09	1.157	.226	1.299	1.377	1.4	.46	1.52	1.59	1.626	1.66	1.81
The non-state capital of the sports industry is more than (%)	0.207748184	0.2862249	0.319315068	0.322702278	0.3443446	0.442909658	0.561139451	0.581506235	0.64012413	0.659890777	0.664951762	0.675769919	0.676096793
Sport service technology investment (10,000)	6700	9300	11600	13200	15300	16200	18600	19000	20200	24700	25400	45400	51200
Sporting goods manufacturing	20106	39106	57532	84309	73566	36993	341220	495880	655441	737070	918855	004695	1113715

ndustrial andtechnological input (tenthousand)													
Sporting goods manufacturing New fixed capital Production (million)	506000	1000000	2155000	568000	1884000	3249000	8346000	10380000	14318000	18735000	1903000	21450000	23180000

New investment in fixed assets in sports services (10 million)	629000	978000	1424000	1765000	3564000	2729000	5030000	7559000	7389000	7537000	8085000	11078000	13271400
Number of cultural and sports corporate enterprises (10,000)	6.949	7.2873	7.643	8.1878	9.0891	9.5633	10.2275	12.1126	23.05544	26.338	29.7274	34.1182	41.4973
New sports workforce (10,000)	61.15	61.2	62.5	63	64.75	65.7	67.5	68.85	73.5	74.55	75.4	76.1	83.3
Culture and Entertainment Labor (10,000)	122.3	122.4	125	126	129.5	131.4	135	137.7	147	149.1	50.8	52.2	66.6
Revenue generated by Sporting goods Manufacturing (million)	303300	324400	364400	545300	582600	1286400	2224000	3227700	5516400	3719100	4368900	5518700	5708600
Labor productivity in sports services (10,000 / person	4.019060138	5.913091309	5.03805267	5.637438008	6.222804843	7.45184195	5.019014693	8.949373618	9.784247826	18.024	21.65222415	2451239669	32.9145507
Number of employees in the	256.3	283.74	317.09	319.13	336.98	360.01	375.62	387.97	425.77	453	482.445	514.5	547.9425

sports industry (10,000)													
Sports service industry (10,000)	60.86	74.54	82.78	94.77	04.89	119.71	27.27	135.7	136.87	150	64.445	81.5	198.3925
Sporting goods Manufacturing (10,000)	95.44	229.2	234.31	224.36	232.09	240.3	248.35	252.27	288.9	303	318	333	349.55
Sports Construction (10,000)	2.77	3.29	3.35	4.6	5.14	5.49	5.03	5.6	5.38	5.84	6.35	7	7.605
Value added of sports service industry (10,000)	2446000	3225000	4170500	5342600	5527100	8920600	10851200	12144300	13391700	27036000	35606000	44490000	65300000
Added value of Sporting goods and Related manufacturing (million)	7051200	8981000	10883100	22423000	14720300	16730300	19204200	21895700	25649900	27555000	28639000	32646000	33990000
Added value of sports facilities construction (ten thousand)	131700	146300	196100	244000	253800	277000	280410	290000	300000	353000	503000	978000	500000