

## Article

# Prediction Analysis of the Coordinated Development of the Sports and Pension Industries: Taking 11 Provinces and Cities in the Yangtze River Economic Belt of China as an Example

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**Abstract:** In order to promote the coordinated development of the sports and pension industries, it is of great significance to apply the theory of industrial integration to the study of the interaction mechanism of the sports and pension industries, but there is a lack of research in this area at present. This paper firstly constructs the evaluation system of the coupling and coordination development of the sports and pension industries. Secondly, based on the panel data of 11 provinces and cities in the Yangtze River Economic Belt in 2013–2017, this paper analyzes the coupling and coordination relationship between the sports and pension industries by using the entropy method and the coupling coordination model. Finally, the coupling coordination relationship between the two industries in the region in the next five years is predicted using the grey model (1.1), i.e. GM (1.1) model. The results show the following: (1) The development level of the two major industries in 11 provinces and cities of the Yangtze River Economic Belt is generally on the rise, and they have a high correlation. (2) The sports industry is more volatile than the pension industry, and the sports industry has become an effective path dependence to narrow the regional development differences. The sports industry has a weak driving role in the pension industry, while the pension industry has a greater role in promoting the sports industry. (3) There is a large spatial difference in the coupling coordination degree of the sports and pension industries in 11 provinces and cities of the Yangtze River Economic Belt, which will remain in the next five years, though the evolution and upgrading speed of the coupling coordination level will be significantly accelerated.

**Keywords:** Yangtze River Economic Belt; sports industry; pension industry; coupling coordination; prediction analysis

## 1. Introduction

With the intensification of the aging process of the Chinese population, the nineteen major reports of the Communist Party of China proposed that the strategy of a healthy China should be implemented to speed up the development of industry [1]. At present, China is also constantly promoting the rapid development of the pension industry in the economic restructuring, making the pension industry a new growth point of the people's livelihood economy. As a sunrise industry in the tertiary industry, the sports industry itself covers many fields and has a strong pulling effect on the regional economy. In October 2014, China's State Council issued several opinions on accelerating the development of the sports industry and promoting sports consumption, which proposed to actively expand business types, promote the integration of sports and pension services, enrich the content of the sports industry, and promote the integration of industry development [2]. In November 2015, the State Council issued

the guiding opinions on accelerating the development of the life service industry and promoting the upgrading of the consumption structure, which proposed to encourage the integration and innovative development of pension services and related industries [3]. In March 2017, China's State Council issued the 13th five-year plan for the development of national aging undertakings and the construction of a pension system, which proposed to enrich new models and new formats of the pension service industry, and support the integrated development of the pension service industry and the health, fitness and leisure industries [4]. Under the background of the accelerated aging of the population and the transformation of the economic structure, the integration development of the sports and pension industries will become the inevitable trend of the development of the two industries.

Industrial integration is one of the trends of global economic development in the 21st century. In the early 1960s, Rosenberg [5,6] investigated the evolution of the American mechanical equipment industry. He found that the widespread application of general production technology in different industries led to the emergence of an independent and specialized mechanical equipment industry, and then proposed the concept of "Technology Integration". In 1978, Nicholas made a model description of the technological integration among the computer, printing and radio film industries, which has since opened the door for the academic research on industrial integration [7]. Ono [8] analyzed and explained the connotation of the integration development of Japan's Telecom, radio and television and publishing industries by building empirical models. They propose that the key to the real integration of the three industries lies in the transformation of the special information platform to the general information platform. In 2005, Lind [9,10] used the theory of industrial life cycle to analyze the phenomenon of industrial integration, and pointed out that the essence of this phenomenon is the redefinition of the industrial boundary brought by technological innovation. The research on industrial integration in China started at the end of the 1990s. Yu [11] pointed out that the phenomenon of industrial integration appeared in the first, second and third industries. Since then, Ma et al. [12], Li et al. [13], Zhou [14] and Shan et al. [15] have begun to study the theory of industrial integration and industrial innovation. Ma Jian [16] claimed that with the progress of technology and deregulation, the industrial integration at the industrial boundary and intersection has changed the characteristics and demands of the original industry and changed the cooperation and competition relationship between enterprises, which makes the industry gradually blurred, and finally leads to the redefinition of the boundary between industries. Western scholars have been discussing the integration of the sports industry and related industries since the 1990s, and have aroused heated discussion on the integration of the sports industry, tourism industry and cultural industry. Cheng [17] first put forward the concept of sports industry integration in an article on the phenomenon of sports industry integration published in China. Subsequently, research results on the integration of the sports industry with tourism, culture, real estate, media and other related industries have emerged. Especially in recent years, the guiding opinions on accelerating the development of the fitness and leisure industries issued by the general office of the State Council in 2016 promoted the integration of the fitness, leisure and pension industries. Therefore, how to integrate the development of the sports and pension industries has become a hot topic in China. Zha et al. [18] studied the integrated development of China's sports industry and health service industry, and proposed that government support and enterprise optimization were the main paths of industrial integration. Ye et al. [19] discussed the interaction mechanism and integration process of the sports and pension industries, and proposed that the government-led system concept integration should guide the market integration. Shen [20] believes that as a new carrier of cross-border integration of the sports industry, the characteristic town of "sports + pension" type, embodies the concept of "great health" and is an important part of building a "healthy China". Most of these researches have been focused on the phenomenon, reason, mode and countermeasures of the integration of the sports and pension industries from the perspective of technology and concept integration. For example, Tian [21] analyzed the bottleneck of the development of the sports industry by using a documentary method and a logical reasoning method, taking the coupling of the sports industry and the tourism industry as an example. He et al. [22] used the coupling coordination degree model to analyze the

pension industry, the regional economy and their coupling coordination spatiotemporal evolution law in Jiangsu Province in 2005, 2010 and 2015. Although much progress has been made, these researches on the sports and pension industries are mostly in the stage of parallel research, and there is little research on the interaction mechanism between them and a lack of future prediction. Therefore, it is essential to analyze the coupling and coordination, regional differences and future prediction of the sports and pension industries.

In this paper, to explore the current situation and future trend of the sports and pension industries, the evaluation system of the coupling and coordination development of the sports and pension industries is established by applying the theory of industrial integration. The entropy method and coupling coordination model are used to analyze the coupling and coordination relationship between the sports and pension industries, based on the panel data of 11 provinces and cities in the Yangtze River Economic Belt in 2013–2017. Furthermore, the coupling coordination relationship between the two industries in the region in the next five years is predicted using the grey model (1.1), i.e., GM (1.1) model. This paper intends to apply the theory of industrial integration to the research on the coordinated development of the sports and pension industries and measure and study the relationship between the coupling degree and coordination degree, so as to provide new methods and path choices for the research and design of the coupling development of the sports and pension industries, and to provide reference for the development of the sports and pension industries. The comparison of this work with previous works [21,22] is shown in Figure 1.

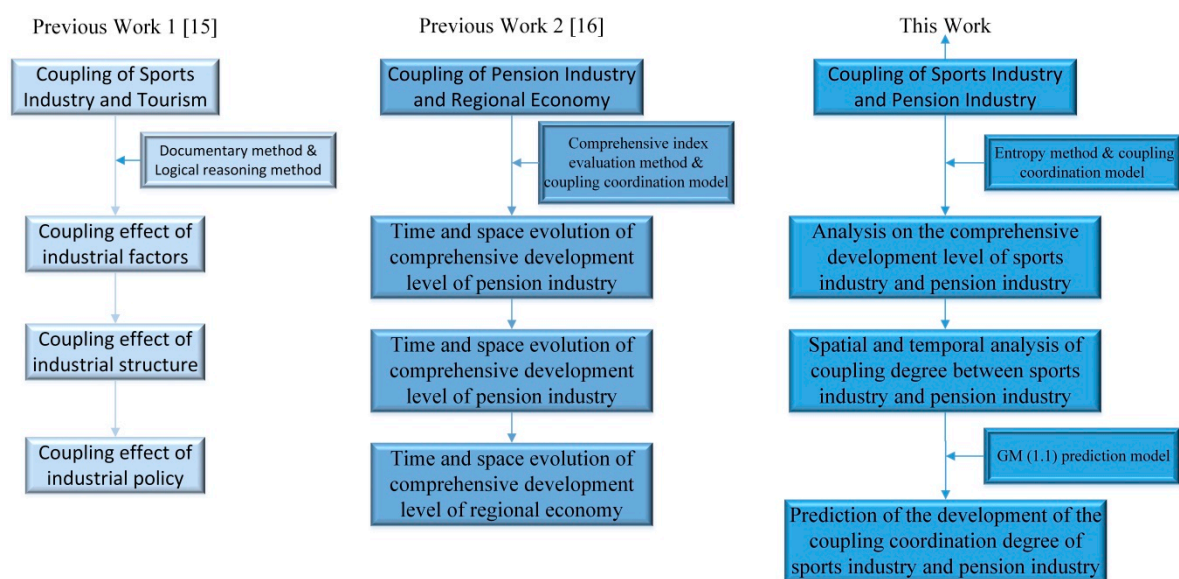


Figure 1. Comparison between this work and previous works.

## 2. Methods and Data

### 2.1. Index System

Although the sports and pension industries belong to two different systems, due to the fuzziness of the industrial boundary and the diversity and complexity of economic activities, there is a network coupling relationship between the sports and pension industries. This paper intends to measure and evaluate the coupling and coordination between the sports and pension industries, which requires the construction of a scientific evaluation index system. The methods of constructing a comprehensive evaluation index system include frequentness analysis [23,24], fuzzy comprehensive evaluation [25,26], principal component analysis [27,28] and the Delphi method [29,30]. Based on the analysis of the characteristics of the sports and pension industries, and referring to the relevant industry classification documents of the National Bureau of statistics, this paper mainly uses frequency

analysis and theoretical analysis to build the evaluation index system. The principles of constructing the evaluation index system are as follows: (1) The evaluation index can reflect the connotation of the sports and pension industries, and fully reflect the development level and evolution law of the two industries; (2) The evaluation index can reflect the coupling relationship between the sports and pension industries; (3) The establishment of evaluation indexes should be able to reflect rich information with a simplified index system, eliminate redundancy and highlight key points; (4) The establishment of evaluation indicators should consider the availability of data, make the best use of existing statistical data, and consider the feasibility of accounting. Based on the above methods and principles, this paper selects 12 specific indicators from two levels of economic contributions and a basic scale to evaluate the comprehensive development level of the sports and pension industries, forming a summary of indicators of the sports and pension industries system (see Table 1 for details). The values of entropy, difference coefficient and weight are calculated by Equations (5), (6) and (7), respectively, according to the entropy method shown in Section 3.1.

**Table 1.** Summary of sports and pension industries system indicators.

Coupling System	First Level Index	Second Level Index	Entropy	Difference Coefficient	Weight
Sports Industry System	Economic contribution	Added value of the sports industry (100 million yuan)	0.995578	0.004422	0.158941
		Sports expenses (100 million yuan)	0.995055	0.004945	0.177757
		Sales of sports lottery (10,000 yuan)	0.995843	0.004157	0.149415
	Foundation scale	Number of sports system institutions	0.997136	0.002864	0.102963
		Number of sports venues	0.993695	0.006305	0.226653
		Employees (10,000 persons)	0.994874	0.005126	0.18427
Pension Industry System	Economic contribution	Unit income of pension service industry (100 million yuan)	0.995302	0.004698	0.184252
		Unit assets of pension service industry (100 million yuan)	0.997065	0.002935	0.115118
		Sales of welfare lottery (100 million yuan)	0.995293	0.004707	0.184616
	Foundation scale	Number of pension service institutions	0.995404	0.004596	0.180276
		Number of beds for the aged	0.997518	0.002482	0.097345
		Employees (10,000 persons)	0.993922	0.006078	0.238393

## 2.2. Data Source

In view of the fact that the statistical data of China's sports industry were relatively unified after the promulgation of the classification of sports and related industries (trial) in 2008, and following the availability, systematization and accuracy required by the sample data, the panel data of 11 provinces and cities in the Yangtze River Economic Belt in 2013–2017 were adopted. The region of the Yangtze River Economic Belt is shown in Figure 2. In the lower reaches of the Yangtze River are Shanghai City and the Jiangsu and Zhejiang provinces. In the middle reaches are Anhui and Jiangxi cities and the Hubei and Hunan provinces. In the upper reaches are Chongqing City and the Guizhou, Yunnan and Sichuan provinces. The data of each index mainly come from the website of the China Statistics Bureau, the website of the China Ministry of Civil Affairs, the website of the China Ministry of Finance, the website of the China General Administration of Sport, the China Statistical Yearbook, the China Tertiary Industry Statistical Yearbook, etc.

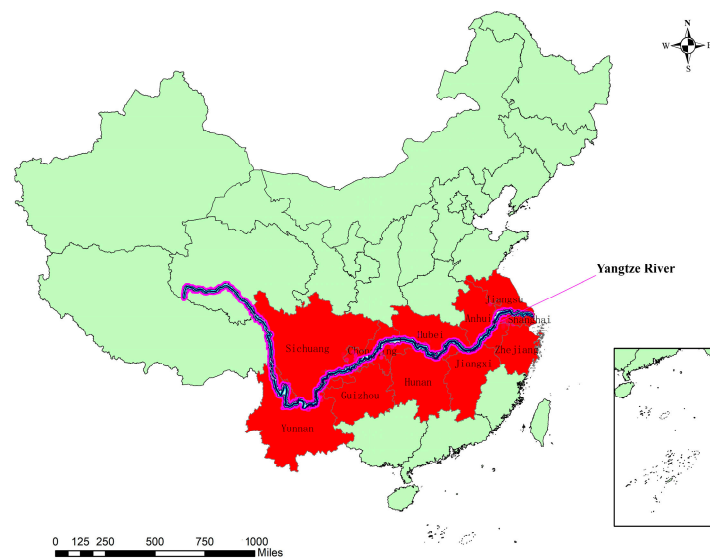


Figure 2. The region of 11 provinces and cities in the Yangtze River Economic Belt (in red).

### 3. Research Procedure

#### 3.1. The Calculation Principle of the Entropy Weighting Method

At present, the entropy method is often used to determine the weight, which mainly includes a subjective method and an objective method. The subjective weighting method is widely used, but it has an obvious subjective tendency, so the weight result determined by this method lacks a practical reference value [31]. In order to ensure the objectivity, correctness and scientificity of the evaluation results, the entropy weighting method—one of the objective weighting methods—was used in this paper. The weighting process of the entropy weighting method is reproducible and transparent, which can avoid the interference of human factors, and will not be affected by the linear correlation of the evaluation data. The weight is determined according to the significance of the value itself and the variation size of the index. Therefore, the weight has a high reliability [32]. The calculation principle of the entropy weighting method is as follows:

Firstly, considering that the units and dimensions of indicators are different and cannot be calculated and compared directly, each indicator is standardized before calculating the weight of each indicator. Equation (1) is the standardized calculation formula when selecting indicators as positive indicators, and Equation (2) is the standardized calculation formula when selecting indicators as negative indicators [33].

$$x'_{ij} = \frac{X_{ij} - x_j^{\min}}{x_j^{\max} - x_j^{\min}} \quad (1)$$

$$x'_{ij} = \frac{x_j^{\max} - x_{ij}}{x_j^{\max} - x_j^{\min}} \quad (2)$$

where  $x'_{ij}$  represents the dimensionless index value ( $i = 1, 2, \dots, n; j = 1, 2, \dots, m$ );  $x_j^{\min}$  is the minimum value of the  $j$ -th index;  $x_j^{\max}$  is the maximum value of the  $j$ -th index; and  $x_{ij}$  is the standardized value of the  $i$ -th sample of the  $j$ -th index.

Secondly, considering that some index values may have negative or smaller values after standardization, Equation (3) is used to translate the standardized value  $x'_{ij}$ , where  $H$  is the range of index translation, generally taken as 1. After translation processing, a specific gravity method, i.e., Equation (4), is used for the dimensionless processing of data, where  $y_{ij}$  is the dimensionless index value ( $i = 1, 2, \dots, n; j = 1, 2, \dots, m$ ).

$$x''_{ij} = H + x'_{ij} \quad (3)$$

$$y_{ij} = \frac{x''_{ij}}{\sum_{i=1}^n x''_{ij}} \quad (4)$$

Finally, the entropy value of the  $j$ -th index ( $e_j$ ), the difference coefficient of the  $j$ -th index ( $g_j$ ) and the weight of the  $j$ -th index ( $w_j$ ) are calculated by Equations (5), (6) and (7), respectively. The comprehensive scores of the sports and pension industries ( $Z_i$ ) are obtained by Equation (8), in which the standardized data and the weight are multiplied.

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n y_{ij} \ln y_{ij} \quad (5)$$

$$g_j = 1 - e_j \quad (6)$$

$$w_j = \frac{g_j}{\sum_{j=1}^p g_j} \quad (7)$$

$$Z_i = \sum_{j=1}^p w_j x'_{ij} \quad (8)$$

### 3.2. The Calculation of the Coupling Coordination Degree

The coupling coordination model can reflect the function and structure of the system, which is used to describe the degree of interaction between different elements and systems. In the analysis of complex systems, the coupling coordination model has obvious advantages, mainly including coupling degree and coupling coordination [34,35]. The coupling degree is used to describe the influence degree of interaction between systems or elements, and the coupling coordination degree is used to measure the benign cycle and coordination relationship between systems or between internal elements of the system [36,37]. When the coordinated development and cooperation between the systems or between the internal elements of the system are good, it is a benign coupling; otherwise it is a malignant coupling [38]. In this paper, the coupling degree (C) and coupling coordination degree (D) of the sports and pension industries are calculated by Equations (9) and (10) [39,40], respectively.

$$C = 2 \left[ \frac{U \times G}{(U + G)^2} \right]^{\frac{1}{2}} \quad (9)$$

$$D = \sqrt{C \times T} \quad (10)$$

where  $U$  and  $G$  represent the score of the sports and pension industries, respectively; the value range of  $D$  is between 0 and 1; and  $T$  is a comprehensive evaluation index reflecting the overall synergy effect of the two industries, which can be calculated by Equation (11) [41]:

$$T = \alpha U + \beta G \quad (\alpha + \beta = 1) \quad (11)$$

where  $\alpha$  and  $\beta$  represent the weight of the sports and pension industries, respectively;  $\alpha$  and  $\beta$  are set as 0.5 to the equal importance of the sports and pension industries. In order to more intuitively reflect the coupling relationship between the two industries, this paper sets the coupling coordination degree level and division interval according to the literature [42], as shown in Table 2.



**Table 2.** Classification standard of the coupling coordination degree.

Serial Number	Range of D Value	Coupling Coordination Degree Level
1	0.00–0.09	Extreme imbalance
2	0.10–0.19	Severe imbalance
3	0.20–0.29	Moderate imbalance
4	0.30–0.39	Mild imbalance
5	0.40–0.49	Little imbalance
6	0.50–0.59	Bare coordination
7	0.60–0.69	Primary coordination
8	0.70–0.79	Intermediate coordination
9	0.80–0.89	Good coordination
10	0.90–1.00	Excellent coordination

### 3.3. The Quantitative Prediction Using the GM (1.1) Model

The Grey prediction method is based on the theory of grey systems, which is widely used in the fields of social systems, economic management and engineering control [43]. According to the characteristics of prediction objects, it can be divided into system comprehensive prediction, topological prediction, sequence prediction, seasonal disaster prediction and disaster prediction [44]. In this paper, the development and change of a certain index is quantitatively predicted by the type of series prediction, and the specific value of the index in the future is its prediction result. The GM (1.1) model differential equation [45] is listed as Equation (12):

$$\frac{dX_1}{dt} + aX_1 = \mu \quad (12)$$

where  $\mu$  is the endogenous control grey number and  $a$  is the development grey number; the  $n$  observation values of original time series are set as  $X = \{\chi(1), \chi(2) \dots \chi(n)\}$  and a new series  $X_1 = \{\chi_1(1), \chi_1(2) \dots \chi_1(n)\}$  can be obtained by accumulating the original series. The prediction model [46] is represented by Equation (13), which is obtained by solving differential equations:

$$x_1^T \overline{X}_1(k+1) = \left[ x_n(1) - \frac{u}{a} \right] e^{-ak} + \frac{u}{a} \quad k = 1, 2, 3 \dots, n \quad (13)$$

where  $u$  is gray action. The parameter vector to be estimated is set as  $\beta (\beta = [a/u])$  and the least squares method is used to get  $\beta = (B^T B - 1) B^T Y_n$ . The accuracy of the gray prediction formula is tested according to the gray prediction accuracy test grade standard in Table 3.

**Table 3.** Evaluation standard of model accuracy grade.

Accuracy Grade	Small Error Probability (P)	Mean Square Deviation Ratio (C)
Good	>0.95	<0.35
Qualified	>0.80	<0.50
Barely qualified	>0.70	<0.65
Unqualified	≥0.70	≤0.65

## 4. Results and Discussions

### 4.1. Results

#### 4.1.1. Evaluation Value of the Sports and Pension Industries in 11 Provinces of the Yangtze River Economic Belt

In this paper, the comprehensive scores of the sports and pension industries in 11 provinces and cities of the Yangtze River Economic Belt were obtained by multiplying the standardized data and the weights of each index. The results are shown in Figures 3 and 4, which show that the development

of the sports and pension industries in 11 provinces and cities of the Yangtze River Economic Belt in China have strong similarities. Obviously, the development level of the sports and pension industries is generally on the rise. It is noted that some provinces and cities have fluctuated by different degrees in 2015. It is found that the development of the sports and pension industries is the best in Jiangsu, while Guizhou is the last. There is a large spatial difference between the sports and pension industries in the Yangtze River Economic Belt of China. Figures 3 and 4 also show that there are differences in the dynamic characteristics of the sports and pension industries.

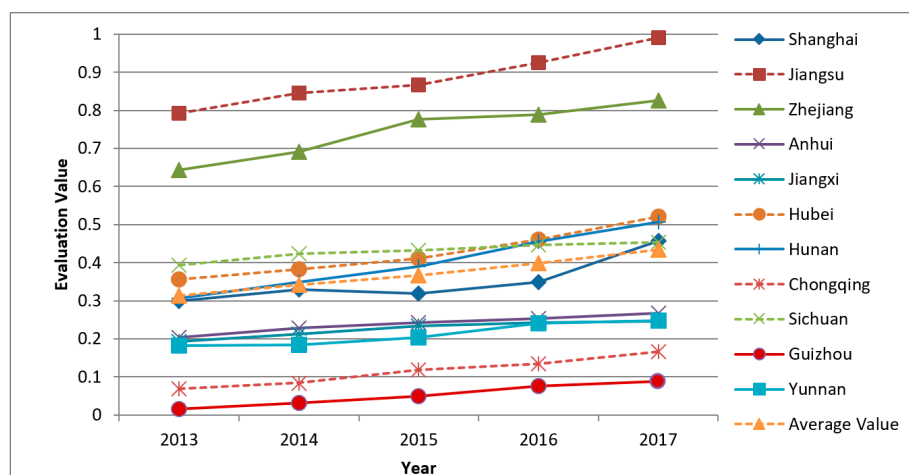


Figure 3. Evaluation values of the sports industry in 11 provinces of the Yangtze River Economic Belt.

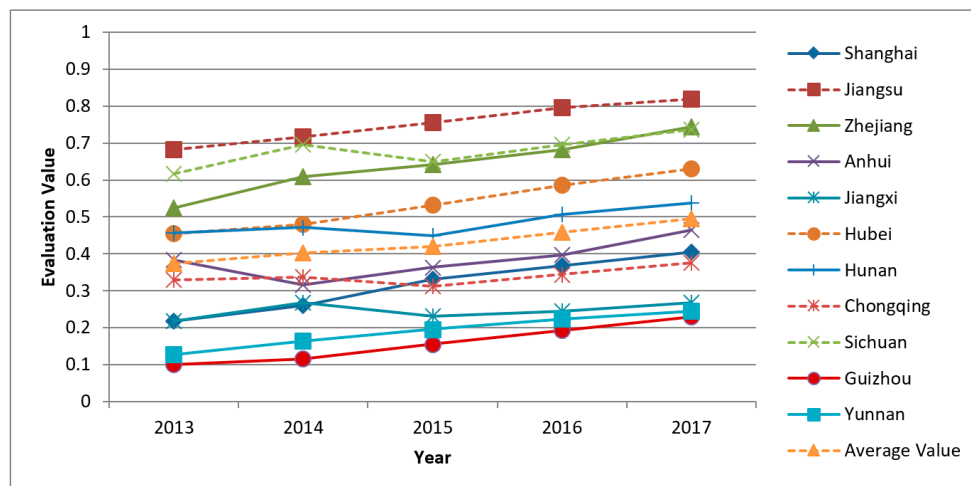
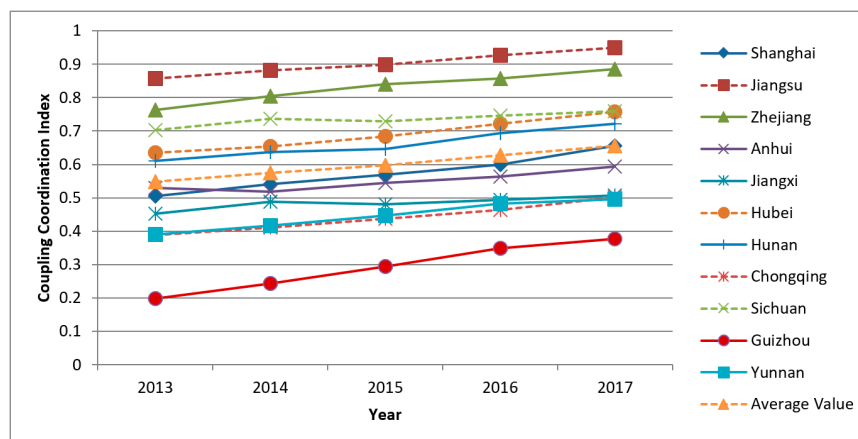


Figure 4. Evaluation values of the pension industry in 11 provinces of the Yangtze River Economic Belt.

#### 4.1.2. The Coupling Coordination Degree of the Sports and Pension Industries in the Yangtze River Economic Belt of China

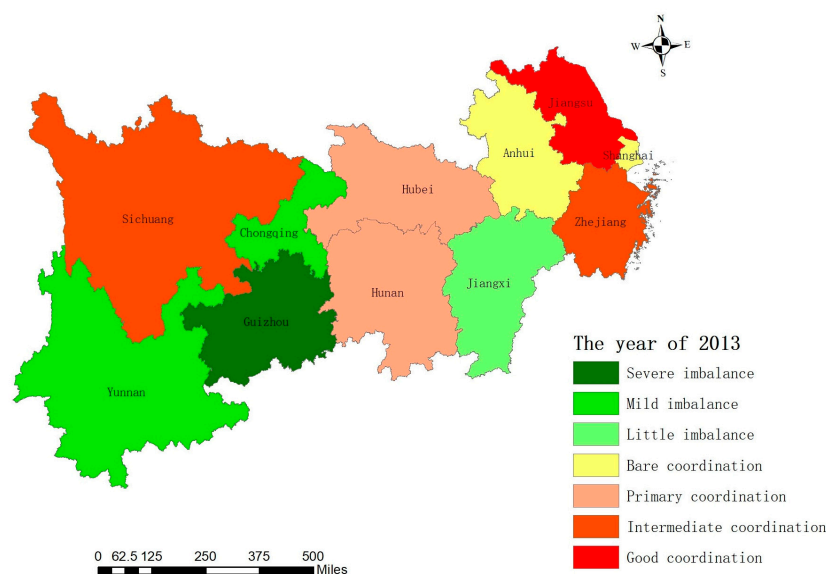
In this paper, the coupling coordination index formula was used to calculate the coupling coordination index of the sports and pension industries of 11 provinces and cities in the Yangtze River Economic Belt of China (Figure 5) based on the obtained coupling degree and comprehensive evaluation value. The coupling coordination stage of each province and city in the Yangtze River Economic Belt was obtained according to the classification standard of the coupling coordination degree. Figure 5 shows that the coupling coordination degree of the sports and pension industries in the Yangtze River Economic Belt has increased from 0.548132 in 2013 to 0.65486 in 2017. The coupling coordination of the two industries increased steadily year by year, but the evolution and promotion speed was relatively slow. The coordination relationship was between bare coordination and primary coordination.



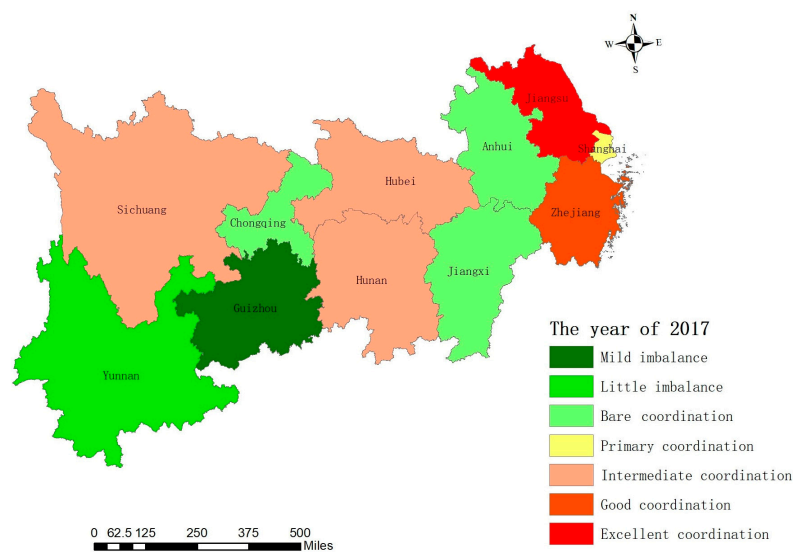


**Figure 5.** Coupling coordination index of the sports and pension industries in 11 provinces of the Yangtze River Economic Belt.

Figures 6 and 7 show the coupling and coordinated dispatching of the sports and pension industries in 11 provinces and cities of the Yangtze River Economic Belt in 2013 and 2017, respectively. As can be seen from Figure 6, there is a large spatial difference in the coupling coordination degree of the sports and pension industries in the 11 provinces and cities of the Yangtze River Economic Belt in 2013. It can be seen from Figure 7 that the coupling coordination degree of the sports and pension industries in all provinces and cities of the Yangtze River Economic Belt in 2017 increased significantly, while the distribution pattern was basically the same as that in 2013, and the spatial difference was still significant.



**Figure 6.** Spatial differences of industrial coupling coordination between 11 provinces and cities in the Yangtze River Economic Belt in 2013.



**Figure 7.** Spatial differences of industrial coupling coordination between 11 provinces and cities in the Yangtze River Economic Belt in 2017.

#### 4.1.3. The Prediction Value of the Development of the Coupling Coordination Degree of the Sports and Pension Industries in the Yangtze River Economic Belt of China

Based on the grey GM (1.1) prediction model, the coupling coordination degree of the sports and pension industries of 11 provinces and cities in the Yangtze River Economic Belt in 2013–2017 were used as the analysis data, and the prediction parameters were preset, in which the number of residual repeated modeling is 7 and the prediction time length is 1. Thus the prediction value of the coupling coordination prediction value of the sports and pension industries in 2018 was obtained. A new data series was generated from the prediction value in 2018 and the 2013–2017 original value, and then the coupling and coordination forecast values of the sports and pension industries in 2019 were calculated according to the number of previous residual repeated modeling and the length of the forecast time. Finally, the prediction value of the coupling coordination degree of the two major industries in 11 provinces and cities in the eastern region in the next five years from 2018 to 2022 can be similarly obtained, and they are listed in Table 4.

**Table 4.** Prediction of coupling and coordinated development of two systems in 11 provinces and cities along the Yangtze River Economic Belt in China.

	Year				
	2018	2019	2020	2021	2022
Shanghai	0.691882	0.737715	0.786583	0.838689	0.894246
Jiangsu	0.973239	0.99798	1.023351	1.049366	1.076042
Zhejiang	0.913162	0.941379	0.970468	1.000456	1.031371
Anhui	0.619365	0.647507	0.676928	0.707686	0.739841
Jiangxi	0.509469	0.516396	0.523418	0.530536	0.53775
Hubei	0.79457	0.834589	0.876623	0.920775	0.967151
Hunan	0.754088	0.788909	0.825339	0.863451	0.903322
Chongqin	0.532521	0.568787	0.607523	0.648897	0.693088
Sichuan	0.765563	0.774904	0.784358	0.793928	0.803615
Guizhou	0.442367	0.509028	0.585736	0.674003	0.775571
Yunnan	0.532122	0.564603	0.599067	0.635635	0.674435
Average value	0.684395	0.716527	0.750854	0.787584	0.826948

## 4.2. Discussion

### 4.2.1. Analysis on the Comprehensive Development Level of the Sports and Pension Industries in the Yangtze River Economic Belt of China

From the results of the comprehensive scores of the sports and pension industries in 11 provinces and cities of the Yangtze River Economic Belt, it is found that the development level of the sports and pension industries is generally on the rise. This result is consistent with the results of other literature reports [47,48], which found that the growth effect of China's sports industry gradually appeared and the comprehensive benefit value of the pension industry continued to rise, and the increasing range gradually increased. The fluctuation of some provinces and cities in 2015 may be due to the external environment of the slowdown of world economic growth in 2015 and the internal factors of the decline of China's consumer confidence index, the decline of sales of sports lottery and welfare lottery, as well as the decrease in the number of employees in the sports industry and the pension service industry. All of these slowed down the development of the sports and pension industries, and made some provinces fluctuate downward. The phenomenon in which the development of the sports and pension industries is the best in Jiangsu, while Guizhou is the last, is the same as the previous literature report by Wang [49]. He holds that the development of the sports industry in Jiangsu, Zhejiang and Shanghai has obvious advantages, while the comprehensive scores of the pension industry in Jiangsu, Guangdong and Beijing are relatively high. This means that the sports and pension industries have a high correlation, that is to say, a high level of the pension industry can promote the development of the sports industry, while the long-term development of the regional sports industry will be restricted by the weak level of the pension industry. It indicates a large spatial difference between the sports and pension industries in the Yangtze River Economic Belt of China.

The differences in the dynamic characteristics of the sports and pension industries is consistent with the results reported by Han [50], that the overall development of the sports and pension industries in the region is not consistent, and that the spatial difference is large and there is an increasing trend. The differences observed from Figures 3 and 4 are summarized in the following three aspects: (1) From the dynamic change curve of the two industries it can be deduced that the pension industry is relatively moderate and the fluctuation range of the development level of the pension industry among provinces and cities in the Yangtze River Economic Belt is relatively small, while the fluctuation of the development level of the sports industry is relatively strong. This shows that it is difficult to change the development level difference of the pension industry among 11 provinces in the Yangtze River Economic Belt in a short time. The sports industry, which has a wide range of radiation, a strong foundation, a long industrial chain and a high degree of relevance, has become an effective way to narrow the regional development differences. (2) From the average development level of the two industries, the development level of the sports industry in the Yangtze River Economic Belt has been lower than that of the pension industry in 2013–2017, which belongs to the lagged development type of the sports industry. That is to say, the driving effect of the sports industry on the pension industry is relatively weak, while the pension industry plays a greater role in promoting the development of the sports industry. (3) From the provincial perspective of the Yangtze River Economic Belt, the comprehensive evaluation level of the sports and pension industries in 11 provinces and cities can be divided into two types, which are a leading development type of the sports industry (i.e., the sports industry driving the pension industry) and a lagging development type of the sports industry (i.e., the driving role of the sports industry on the pension industry is not obvious). Jiangsu, Zhejiang, Shanghai and Yunnan are in the leading development type of the sports industry. Provinces Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan and Guizhou belong to the lagging development type of the sports industry.

#### 4.2.2. Time and Space Analysis of the Coupling Coordination Degree of the Sports and Pension Industries in the Yangtze River Economic Belt of China

From the result of the coupling coordination degree of the sports and pension industries shown in Figure 5, the development of coupling and coordination can be divided into two stages: the bare coordination stage in 2013–2015 and the primary coordination stage in 2016–2017. This shows that the internal relationship between the sports industry and the pension industry in the Yangtze River Economic Belt is gradually strengthening, the internal interaction and coordination are gradually improving, and the coupling and coordination relationship is evolving to a higher level. From the provincial perspective of the Yangtze River Economic Belt, Jiangsu and Zhejiang have the highest coupling coordination, in which Jiangsu has entered the stage of excellent coordination and Zhejiang has entered the stage of good coordination. The coupling and coordination between the sports and pension industries in Jiangsu and Zhejiang provinces can enter a high-level stage, mainly because the two provinces have a mature sports industry development, complete types of the sports industry, rich sports resources and a high level of development of the pension industry. After years of development, Sichuan, Hubei and Hunan provinces have entered the intermediate coordination stage; Shanghai's coupling coordination degree has also entered the primary coordination stage; Anhui, Jiangxi and Chongqing are in the bare coordination stage, which is far from a good coordination. The coordination in Yunnan and Guizhou is located in the low value area, with little imbalance and mild imbalance, respectively. However, it can be seen that the coordination between the two major industries in Guizhou has been greatly improved, which indicates that Guizhou has begun to take comprehensive measures to improve the coordination between the development of the sports and pension industries, so as to prevent the two industries from falling into imbalance.

In 2013, the spatial pattern from the lower reaches of the Yangtze River to the upper reaches of the Yangtze River generally presents as “medium-high-medium-low-high-high-high-high”. In the lower reaches, the coupling coordination degrees of the sports industry are bare coordination, good coordination and intermediate coordination for Shanghai, Jiangsu and Zhejiang, respectively. In the middle reaches, the coupling coordination degrees of the sports industry are bare coordination, little imbalance, primary coordination and primary coordination for Anhui, Jiangxi, Hubei and Hunan, respectively. In the upper reaches, the coupling coordination degrees of the sports industry are little imbalance, mild imbalance, severe imbalance and intermediate coordination for Chongqing, Guizhou, Yunnan and Sichuan, respectively. In 2017, the spatial distribution pattern was basically the same as that in 2013, and the spatial difference was still significant. In the lower reaches, the coupling coordination degrees of the sports industry are primary coordination, excellent coordination and good coordination for Shanghai, Jiangsu and Zhejiang, respectively. In the middle reaches, the coupling coordination degrees of the sports industry are bare coordination, bare coordination, intermediate coordination and intermediate coordination for Anhui, Jiangxi, Hubei and Hunan, respectively. In the upper reaches, the coupling coordination degrees of the sports industry are bare coordination, mild imbalance, little imbalance and intermediate coordination for Chongqing, Guizhou, Yunnan and Sichuan, respectively. The main reason for this spatial pattern is that the development level of the sports industry in Jiangsu, Zhejiang, Sichuan, Hubei, Hunan, Shanghai, Anhui and other provinces has obvious advantages over that in Jiangxi, Chongqing, Yunnan and Guizhou, which leads to the increase of unbalanced coefficients to a certain extent.

#### 4.2.3. Prediction of the Development of the Coupling Coordination Degree of the Sports and Pension Industries in the Yangtze River Economic Belt of China

As can be seen in Table 4, the coupling coordination degree of the sports and pension industries in the Yangtze River Economic Belt in 2018–2022 has entered into a good coordination stage from the primary coordination stage, and the two major industries in the whole region continue to develop in a more comprehensive, coordinated and orderly direction. The evolution and promotion of the coupling and coordination level of the two industries are fast, but there are still significant spatial

differences between regions. From the provincial perspective, the level of coupling coordination is still higher in Jiangsu and Zhejiang. The coupling coordination in Shanghai, Hubei and Hunan has been greatly improved; especially that in Shanghai is close to high-quality coordination, and the coupling coordination in Hubei and Hunan have entered the stage of high-quality coordination. The coupling coordination degrees of Anhui, Chongqing, Guizhou and Yunnan have also been greatly improved, especially the optimization of Guizhou from near maladjustment to intermediate coordination; Anhui has also reached intermediate coordination, and Chongqing and Yunnan have reached primary coordination. The promotion range of coupling coordination between Jiangxi and Sichuan is not ideal, especially the coupling coordination between Jiangxi and Sichuan has been hovering in the reluctant coordination stage, and the promotion range of coupling coordination between Sichuan and Jiangxi is relatively small, which is worthy of further consideration.

#### 4.2.4. Limitations and Future Work

The integration of the sports and pension industries is a new research topic, so the relevant theoretical system is not perfect and needs to be tested in practice. The purpose of this paper is to establish a scientific evaluation system for the coupling and coordinated development of the sports and pension industries, so as to promote the healthy development of the sports and pension industries. However, due to various limitations, the research on the coupling and coordination between the sports and pension industries is still preliminary. In future research, efforts can be made from the following two perspectives: The first is the index system. When constructing the evaluation index system of the coupling and coordinated development of the sports and pension industries, this paper tries to select indicators that can comprehensively and systematically reflect the development status of the two industries. However, due to the limitations of the relevant statistical data, some indicators with incomplete and discontinuous data have to be eliminated. The second is the research methods. In the research process of this paper, due to the simultaneous evaluation of the coupling and coordinated development of the sports and pension industries from the two dimensions of time and space, it is difficult to choose a scientific evaluation method that can not only meet the evaluation of time series, but also meet the evaluation of the space scale. This is also a place to further improve the scientific nature of the work in the future.

## 5. Conclusions and Suggestions

### 5.1. Conclusions

In this paper, the evaluation system of the coupling and coordination development of the sports and pension industries was established and the coupling and coordination model was used to measure the coupling and coordination between the sports and pension industries in 11 provinces of the Yangtze River Economic Belt in 2013–2017. Furthermore, the coupling coordination relationship between the two industries in the region in the next five years was predicted using the GM (1,1) model. This study could build a new academic starting point for the research on the development of the sports and pension industries, and provide a new method and path choice for the research and design of the coordinated development of the sports and pension industries. The main conclusions are as follows:

- (1) There is an obvious interaction between the sports and pension industries, with remarkable characteristics of coupling and coordinated development. Through the evolution and organization of internal factors, the two industries promote the coordinated development of the sports and pension industries. The coupling and coordinated development of the sports and pension industries not only plays an important role in the pension industry, but also greatly promotes the development of the sports industry itself. Coordinating the coupling relationship between the sports and pension industries is of great significance to the sports and pension industries.
- (2) The development level of the sports and pension industries in 11 provinces and cities along the Yangtze River Economic Belt in China is on the rise, and the relationship between the sports and

pension industries is relatively high. A higher level of development of the pension industry can promote the sports industry, while the long-term development of the regional sports industry will be restricted by the weak level of the pension industry. Areas with a high level of pension industry are also areas with good development of the sports industry. For example, the development level of two major industries in Jiangsu is the highest in the whole Yangtze River Economic Belt, and the development level of two major industries in Guizhou is in the low value area. The fluctuation range of the whole regional pension industry level is relatively small, while the fluctuation of the sports industry development level is relatively strong. The sports industry has become an effective path to reduce the regional development differences. The development of the pension industry in the Yangtze River Economic Belt plays a greater role in promoting the sports industry, while the development of the sports industry plays a weaker role in promoting the pension industry.

- (3) The coupling coordination of the sports and pension industries in 11 provinces of the Yangtze River Economic Belt is steadily increasing year by year, but the pace of evolution and promotion is relatively slow, and the coordination relationship is between the reluctant coordination and primary coordination levels. However, the prediction results show that the evolution and upgrading speed of the coupling coordination level will significantly accelerate in 2018–2022, and the two major industries in the whole region will continue to develop in a more comprehensive, coordinated and orderly direction. The evolution and upgrading speed of the coupling coordination level is faster. In addition, there is a large spatial difference in the coupling coordination between the sports and pension industries in 11 provinces of the Yangtze River Economic Belt. The spatial pattern from the lower reaches of the Yangtze River to the upper reaches of the Yangtze River generally presents a pattern of “medium-high-medium-low-high-low-high-high-high”, and there is still a significant spatial difference in the predicted next five years.

## 5.2. Suggestions

(1) The sports industry of the Yangtze River Economic Belt in China is still weak in driving capacity for the pension industry, which provided a favorable market for the development of the sports industry. Therefore, the Yangtze River Economic Belt should strengthen the driving role of the sports industry in the pension industry, give full play to the driving and promoting role of the sports industry in related industries, strengthen the understanding of the sports industry as a national strategic pillar industry, promote the process of “sports + pension” with unified efficiency and quality, and realize the upgrading and optimization of the industrial structure. This paper puts forward suggestions from three aspects:

- (i) As a province with significant driving role of the sports industry, Jiangsu should make full use of the regional advantages of sports competition platforms and the Yangtze River Delta, pay attention to the innovation strategy of the sports industry, start with the development and operation mechanism and management system of the sports industry, promote the development of the sports industry and the liberation of productivity, and further reform and innovation of the sports industry System, so as to form a new experience and model of the sports industry driving the pension industry and create a new type of “sports + pension” industry.
- (ii) Zhejiang, Shanghai and Yunnan, as provinces and cities with a more prominent driving role of the sports industry, should use the integration strategy of the sports industry to promote the transformation of the development mode of the sports industry from a quantitative model to a quality and efficiency model through the integration of the sports industry and the culture, pension, education, health, agriculture, forestry, water conservancy, general aviation, transportation and other industries. Considering that the education industry has been upgraded, these provinces and cities can develop as characteristic towns of the sports industry, promote the development of



the “sports + pension” industry and realize the unity of sports industry benefits and pension industry benefits.

- (iii) Anhui, Jiangxi, Hubei, Hunan, Chongqing, Sichuan and Guizhou, as provinces and cities with no obvious driving role of the sports industry, should cultivate the sports industry as an important engine of the pension industry and continue to optimize the environment for the development of the sports industry. They should give full play to the advantages of the regional ecological environment, develop ecological sports and low-carbon sports, accelerate the release of the potential value of sports, and constantly enlarge the comparative advantages of sports. Thus, the sports industry could become an important force in the development of the pension industry. In addition, they should provide a service guarantee and necessary facilities for the development of the sports industry, and further promote the development of the “sports + pension” industry.

The above suggestions are summarized in Table 5.

**Table 5.** Suggestions to strengthen the weak driving role of the sports industry in the pension industry.

Area	Suggestion
Jiangsu Province	<ul style="list-style-type: none"> <li>• Make full use of the regional advantages of sports competition platforms</li> <li>• Pay attention to the innovation strategy of the sports industry</li> <li>• Promote the development of the sports industry and the liberation of productivity</li> </ul>
Shanghai City, Zhejiang and Yunnan Provinces	<ul style="list-style-type: none"> <li>➤ Use the integration strategy of the sports industry to promote the transformation of the development mode of the sports industry</li> <li>➤ Develop characteristic towns of the sports industry</li> <li>➤ Promote the development of the “sports + pension” industry</li> </ul>
Chongqing City, Anhui, Jiangxi, Hubei, Hunan, Sichuan and Guizhou Provinces	<ul style="list-style-type: none"> <li>✧ Optimize the regional ecological environment, develop ecological sports and low-carbon sports</li> <li>✧ Accelerate the release of the potential value of sports and constantly enlarge the comparative advantages of sports</li> <li>✧ Provide a service guarantee and necessary facilities for the development of the sports industry</li> </ul>

(2) Attention should be paid to the spatial differences in the coordinated development of the sports and pension industries in the Yangtze River Economic Belt. The effective way to solve the unbalanced regional development problem is to further strengthen the radiation-driving role of regional growth pole, standardize the regional development order, curb regional differentiation and promote regional integration. Therefore, the Yangtze River Economic Belt should promote the development of the sports and pension industries in the whole region by means of local driving the whole, point to area, multi-level and all-round cooperation, so as to realize the evolution of the coupling coordination degree of the sports and pension industries to a good coordination stage. This paper puts forward suggestions from two aspects:

- (i) The Yangtze River Economic Belt should enhance the spatial spillover effect of the growth pole of the Jiangsu sports industry in the Yangtze River Delta. With the help of the high-speed railway along the Yangtze River and the golden waterway and other axes, through government cooperation, the flow of production factors and industrial transfer and other forms, the development of the sports and pension industries in the Yangtze River Economic Belt will be driven, radiated and led.

Through the development of central cities such as Wuhan and Chengdu in Hubei, and Sichuan and other provinces in the central and western regions of the Yangtze River Economic Belt, the development of other urban agglomerations will be driven, leading the regional development of the “sports + pension” industry and specialized production. In this way, it can promote the reasonable flow of regional elements and resources, so as to achieve the improvement of the overall development level of the sports and pension industries in the Yangtze River Economic Belt and the reduction of the development differences between provinces and cities.

- (ii) The Yangtze River Economic Belt should establish an all-round cooperation mechanism and industrial linkage mechanism based on sports industry cooperation and driven by the sports industry, and comprehensively deepen the cooperation of relevant departments, so as to lead the construction of regional integration. On the one hand, a Joint Working Committee of the sports industry of 11 provinces and cities in the Yangtze River Economic Belt should be established, and a multi-level consultation system should be established. Under the joint working committee, sports industry cooperation organizations of different management levels and administrative levels should be established to jointly promote the integrated development of the sports industry in the Yangtze River Economic Belt. On the other hand, they should expand the field of sports cooperation, guide the main body of the sports market to break the restrictions of the original administrative divisions, and expand the content of cooperation from sports brands and sports products to intelligent sports and sports management. The above measures can realize the coordinated development of the sports industry, the sports market and sports resources in the Yangtze River Economic Belt, and form a coordinated development mode of “the sports industry provides sports fitness elements for the pension industry, and the pension industry provides a pension service market for the sports industry”.

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