Cover Letter

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The Spatial and Temporal Evolution and Spatial Correlation Pattern of the Integration and Development of the Digital Economy and Sports Industry in China

Dear Editor:

Thank you very much for your and the reviewers' comments on our manuscript (sustainability-2031066). The comments have provided excellent suggestions and helped us to improve the manuscript. We have revised this manuscript and update the abstract, introduction, literature, conclusion, added the contribution, structure of the work, limitations and future research. Because the above changes, the former title "The Spatial and Temporal Evolution and Spatial Correlation Pattern of the Integration and Development of the Digital Economy and Sports Industry in China" has been changed into "The Coupling Coordination Degree and Spatial Correlation Analysis of the Digital Economy and Sports Industry in China" in the revised manuscript. The changes in the manuscript have been highlighted in red font.

Please find attached a revised version of our manuscript. Our point-by-point responses to your comments are listed below. If you have any questions about this paper, please let me know.

We are looking forward to receiving your final decision.
Best wishes
Ya-wei Wang

Response to Reviewer 3 Comments

Point 1.: The article submitted to Sustainability>journal, but it not reflected sustainability.

Response 1: We are extremely grateful that the reviewer pointed out this problem. The interactive and integrated development of digital economy and sports industry is the objective demand of current economic development. This paper explores the coupling and coordination relationship between the digital economy and sports industry in 30 provinces in China from 2015 to 2019, and understands the trend and spatial characteristics of the integrated development of digital economy and sports industry in China. Through the research results, we can understand the trend and spatial characteristics of the integrated development of digital economy and sports industry in China, and provide theoretical and practical experience for the sustainable and high-quality development of digital economy and sports industry.

Point 2: The abstract is weak.Kindly enhance it by including novelty and need of the study.

Response 2: We are extremely grateful that the reviewer pointed out this problem. We have rearranged the abstract, adding novelty and need of the study.

As following:

Driven by a new round of scientific and technological revolution and industrial transformation, the interactive and integrated development of the digital economy and sports industry is the objective demand of current economic development. In order to explore the coupling coordination relationship between the digital economy and the sports industry, this paper used the coupling coordination degree model and exploratory spatial data analysis method to analyze the coupling coordination degree and spatial correlation of the integrated development of China's digital economy and sports industry by taking the statistical data of 30 provinces, autonomous regions and municipalities in China from 2015 to 2019 as observation samples. The results show that the coupling coordination degree of China's digital economy and sports industry is low, showing an unbalanced development trend of "low in the west, high in the east, low in the north and high in the south". There is a significant positive clustering in the spatial integration of the two industries, and the degree of clustering increases year by year. It is necessary to establish a regional coordinated development mechanism, define the stage of regional integration, optimize the spatial pattern of coupled development, and promote the balanced development of the digital economy and sports industry.(see absearct，page 1, line 12 -26)

Point 3: Please, show why your topic will be interesting not only to Chinese readers,but also to readers ofother countries.

Response 3: We are extremely grateful that the reviewer pointed out this problem. Through the literature search of Web of Science database, it is found that the international research results on the coupling development of digital economy and sports industry have the following three characteristics: First, the existing research results mainly focus on the power, process, path and effect of the coupling of "digital economy and sports industry" from the qualitative level; Second, the research focuses on the one-way impact of digital economy on the high-quality development of sports industry, and the two systems interact with each other, so it is necessary to analyze the two-way relationship between them from the perspective of coupling and coordinated development. Third, the index system of the development of digital economy and sports industry exists independently, and the coupling development system between digital economy and sports industry has not been built, and there are few results of systematic quantitative research on the degree of coupling coordination between the two and the spatial distribution characteristics of this relationship. Based on this, this study uses the coupled coordination theory to construct the evaluation index system of the coupled development of the integrated development of digital economy and sports industry, and analyzes the correlation and spatial agglomeration effect of the integrated development of digital economy and sports industry from the perspective of space. It is expected to provide theoretical and practical references for the construction of the index system of the complex coupling relationship between digital economy and sports industry in other countries (regions), the correlation measurement method, and the evaluation of spatial agglomeration effect, so as to gain the interest of readers in other countries.

Point 4: The relevance of the topic is weak in the introduction, the connection with previous studies onthis and related topics is poorly shown.

Response 4: We are extremely grateful that the reviewer pointed out this problem.We have added a literature review to the introduction to review the 2018-2022 results related to the topic, identify the contributions of other authors to the research and the literature gaps, and give a detailed description of the novelty of this paper.(see introduction, page 2, line 30-52, page 3, line 1-5, page 4., line 1-18)

As following:

In recent years, scholars have shown great interest in the relationship between the digital economy and the sports industry. On the theoretical level, a large number of scholars have carried out relevant research, based on the connotation of digital economy and combined with the "push-pull theory", YE et al studied and elaborated the driving mechanism of the development of sports industry driven by digital economy [7]. Ren et al. believes that the sports industry gives play to economies of scale, economies of scope and the long tail effect through factor digitalization, process digitalization and product digitalization, forming the internal mechanism of the integration of digital economy and sports industry [8].Dong et al constructed the mechanism of the big data digital economy driving the high-quality development of the sports industry from the micro, meso and

macro levels, and showed through simulation experiments that the digital economy could endow the sports industry with high-quality development power, improve the industrial production efficiency, and contribute to the quality reform, efficiency reform and power reform of the sports industry [9].At the same time, the digital economy is gradually being applied and infiltrated into different aspects of the sports industry,unmeng Chen, Li Haijie, CAI Jianhui, Luo Yuxin and Liu Chao respectively analyzed the dynamic mechanism, value dimension and strategic measures of digital economy in creative sports industry, sports leisure characteristic town, sports goods manufacturing industry, sports competition performance industry, ice and snow sports industry and other fields [10-14]. Shen Keyin et al. further refined the research content and program, and took the 5G technology-enabled live ice hockey game of Beijing Sports Media, the block chain-enabled "Sports Time Bank" of Bluebird Sports, and the Internet-enabled Zhejiang Huanglong Sports Center as examples to analyze the scene samples of the digitalization of sports service industry and make a study and decision on the development trend [15]. Pan Wei, Wei Yuan and Chai Wangjun respectively analyzed the current development predicament and optimization path from the perspectives of digital economy enabling high-quality sports industry, driving the upgrading of sports industry structure and boosting the digitalization of sports industry [16-18].(see page 2, line 30-52, page3, line1-6)

Existing literature has proved that digital economy can significantly improve the development of sports industry, but digital economy and sports industry are complex systems, without accurate objects and appropriate indicators, it is difficult to quantitatively analyze the relationship between them. In order to solve this problem, a large number of scholars have carried out relevant research. Considering the potential relationship between digital economy and energy transition, Muhammad Shahbaz et al. studied the impact of digital economy on renewable energy consumption and power generation structure, as well as the heterogeneity between digital economy and energy transition [19]. Li Linhan et al. estimated the level of China's digital economy from the perspectives of grey correlation, coupled coordination and spatial correlation network [20]. Li Xiangyang and Han Zhaoan constructed the index system between digital economy and high-quality development from different dimensions [21-22]. Liu Jun et al. analyzed the driving factors of digital economy based on SAR model [23]. Yang Song et al. used the coupling coordination degree model to measure the coupling coordination degree of Chinese sports industry and electronic information industry [24]. Wang Yuzhen et al. conducted an empirical analysis of the coupling coordination relationship between the development of China's sports industry and tourism industry, and sorted the explanatory power of influencing factors of coordinated development from the greatest to the smallest through OLS regression model [25]. Yao Songbo et al. made an empirical analysis of the influence of sports industry agglomeration on regional economic growth by using static and dynamic panel models, and measured the level of sports industry agglomeration in various provinces and cities with the industrial proportion index [26]. Xu Jinfu et al. studied the development of sports industry and tourism industry from the perspective of industrial integration [27].(see page 3, line 7-30)

The above research results provide good experience for further deepening the research on the coupling development of digital economy and sports industry, but there is still room for further expansion. First, the existing research results mainly focus on the power, process, path and effect of the coupling of "digital economy and sports industry" from a qualitative level. Most of the literature

analyzes specific cases. Describe the case phenomenon and analyze the existing problems, and put forward the countermeasures and suggestions to promote the coupling development of the two; Second, the research focuses on the one-way impact of digital economy on the high-quality development of sports industry, and the two systems interact with each other, so it is necessary to analyze the two-way relationship between them from the perspective of coupling and coordinated development. Third, the index system of the development of digital economy and sports industry exists independently, and the coupling development system between digital economy and sports industry has not been built, and there are few results of systematic quantitative research on the degree of coupling coordination between the two and the spatial distribution characteristics of this relationship.(see page 3 line31-45)

Based on this, the main contribution of this study is reflected in the following two aspects: First, it constructs the evaluation index system of the coupling development of the integrated development of digital economy and sports industry by using the coupling coordination theory, and empirically tests the coupling development level and dynamic evolution of the two in China based on the statistical data from 2015 to 2019, expanding the quantitative research on the integration development of the two. Second, the spatial correlation analysis method is adopted to analyze the spatio-temporal evolution characteristics of the integrated development of China's digital economy and sports industry, and the correlation and spatial agglomeration effect of the integrated development of digital economy and sports industry in 30 provinces, autonomous regions and municipalities in China (except Xizang and Hong Kong, Macao and Taiwan, hereinafter referred to as the provinces) are analyzed from the spatial perspective. In order to provide theoretical and practical reference for other countries (regions) in the world to quantitatively evaluate the complex coupling relationship between digital economy and sports industry. It provides quantitative decision-making reference for relevant departments in China and provinces to clearly position the integration stage, identify the two-way force between digital economy and sports industry, optimize the digital transformation strategy of sports industry, and improve the driving force of digital economy.(see page 3 line46-51, page 4 line1-13)

The rest of this article is organized as follows. The second part introduces the data source, index system structure and research methods. In section 3, the dynamic coupling relationship with time is studied. The fourth section further discusses the spatial correlation pattern of integrated development. Finally, Section V draws conclusions and recommendations.(see page 4 line14-18)

Point 5: What does a quantitative guideline for decision-making mean?

Response 5: We are extremely grateful that the reviewer pointed out this problem. According to a series of policies proposed by the Chinese government, such as "accelerate the deep integration of Internet, big data, artificial intelligence and sports real economy" and "vigorously develop digital economy and promote the deep integration of artificial intelligence, Internet, big data and real

economy", the paper constructs the integrated development index system of China's digital economy and sports industry. By calculating the comprehensive development index, coupling degree and coupling coordination degree of the two, we can understand the current situation and level of the integrated development of China's digital economy and sports industry, as well as the correlation and spatial agglomeration effect of the digital economy and sports industry in various provinces of China. According to the research results, in order to provide theoretical and practical reference for other countries (regions) in the world to quantitatively evaluate the complex coupling relationship between digital economy and sports industry. For the relevant departments of China and provinces to clearly position the integration stage, identify the two-way force of digital economy and sports industry, and provide decision-making reference for the next step to enhance the driving force of digital economy, optimize the digital transformation of sports industry and other policies.(see page 4 line 6-13)

Point 6: The purpose of the study is far from the title of the article, Include research questions and hypotheses

Response 6: We are extremely grateful that the reviewer pointed out this problem. In order to explore the coupling coordination relationship between digital economy and sports industry, this paper analyzes the coupling coordination level and spatial distribution characteristics of 30 provinces, autonomous regions and municipalities in China from 2015 to 2019. In order to express the research purpose and research question more succinct and appropriate, the title is modified as"The Coupling Coordination Degree and Spatial Correlation Analysis of the Digital Economy and Sports Industry in China".

Point 7: The paper does not mention any theoretical or anecdotal evidences which actually justify theselection of the variables in the context of used economy.

Response 7: We are extremely grateful that the reviewer pointed out this problem. In terms of the construction of the model, the paper follows the principles of scientific, systematic and available selection of indicators. Firstly, the frequency statistics method is adopted to screen the relevant literature of the digital economy index system and the sports industry index system. Through the frequency statistics, the indicators with high frequency are selected to form the first round of indicators. Secondly, the theoretical analysis method is used to explain the connotation and elements of digital economy and sports industry, and the primary indicators are checked and filled with gaps, and finally the empirical model of this paper is obtained. (see page 4 line21-41)

Point 8: The authors applied the Entropy Weight Method,but did not explain what other methods could beused and why they chose this method.Entropy Weight Method is often criticized(https://www.hindawi.com/journals/mpe/2020/3564835/)

Response 8: We are extremely grateful that the reviewer pointed out this problem. Considering that the entropy weigh method is not affected by whether the evaluation data is linear or not, the weight is determined according to the variability of the evaluation data and the significance of the index value, which effectively avoids the interference of human factors. Due to the transparency and reproducibility of the evaluation process, this method is chosen to determine the weight. Meanwhile, it is explained in 5.3 that this is the limitation of this study. Future studies will adopt the combination of subjective and objective weighting to determine the weight of indicators in a more scientific and reasonable way.

Point 9: Three years is too short a time to draw conclusions about evolution.We can only talk aboutchanges.Perhaps the authors will choose another term?

Response 9: We are extremely grateful that the reviewer pointed out this problem. The research period is 2015-2019. Through 5 years of research, the change and spatial distribution characteristics of the coupling relationship between China's digital economy and sports industry are empirically analyzed.

Point 10: Add links p.3,p.6,p.8,p.10,p.14,p.18,p.19

Response 10: We are extremely grateful that the reviewer pointed out this problem. After a careful review of the article, We have added the above link.

Point 11: The connection between the digital economy and the sports industry is poorly disclosed Inparagraph 1.3.2.

Response 11: Thanks for your advice. We examined the article carefully, there is no paragraph 1.3.2 in this article.

Point 12: Check the brackets in Table 2, Coupling Coordination Degree Value.

Response 12: We are extremely grateful that the reviewer pointed out this problem. In this paper, the square brackets are indicated to contain the boundary numbers and the Parentheses represent theses that do not contain the boundary numbers, ensuring that the coupled value includes all of the digits from 0 to 1.

Point 13: The Figure 3 repeated twice, on page 13 and on page 14.

Response 13: Thanks for your advice. We check Figures 3 again. Figure 3 is figure of comparison of the digital economy and the comprehensive level of the sports industry, It's on page 13. on page 14 is Table 5 (Table of coupling coordination scores by province). With the previous modifications, Figure 3 now on page 15.(see page 15 line1).

Point 14: The result and discussion section are very much disorganized.The authors should clearly statewhich studies are in line with their findings and which contradicts.

Response 14: We are extremely grateful that the reviewer pointed out this problem. It has become an academic consensus that digital economy can drive the high-quality development of sports industry. By using web of science and CNKI to search the research results in this field, we found that the author Bo Dong's (Mob.Inf.Syst. 2022, 9131081) research results are similar to those in this paper through the reading of a large number of literatures. Both of them explore the relationship between digital economy and sports industry by means of quantitative research. Firstly, an evaluation index system for the high-quality development of digital economy and sports industry is constructed, and then entropy method is adopted to determine the index weight. However, there are also differences. Bo Dong focuses on the dynamic relationship between the digital economy and the sports industry. With the data of the sports industry in a certain region as the experimental sample, he conducts a simulation test on the high-quality development evaluation system of the sports industry driven by the digital economy. (see page 20 line21-31, page 21 line1-5)

Point 15: In paragraph 4.1, expand in more detail what the combined development of the digital economy and the sports industry means

Response 15: We are extremely grateful that the reviewer pointed out this problem. In paragraph 4.1, the coupling coordination degree of digital economy and sports industry is taken as the observation index and ESDA analysis method is adopted to analyze the coupling coordination degree of their integrated development. Moran I value is a positive number, indicating that the coupling coordination degree of digital economy and sports industry presents a significant positive correlation on the whole, that is, there is an obvious spatial agglomeration. And the degree of agglomeration has an increasing trend year by year, indicating that the integration of China's digital economy and sports industry presents a good development trend.

Point 16: What new results were obtained.

Response 16: We are extremely grateful that the reviewer pointed out this problem. By calculating China's 2015-2019 digital economy Development Index, sports industry development index and their coupling coordination degree, We have learned that the development of China's sports industry lags behind the digital economy, and the coupling coordination degree between China's digital economy and sports industry is low, showing an unbalanced development trend of "low west, high east, high north, low south". There is a significant positive clustering in spatial integration, and the degree of clustering increases year by year.

Point 17: Include more limitations and future research directions.

Response 17: We are extremely grateful that the reviewer pointed out this problem. According to your suggestions, we have revised the introduction extensively, added the literature review part, reviewed the achievements related to the topic from 2018 to 2022, identified the contributions of other authors to the research and the existing literature gaps, described the contributions of this paper in detail. During the revision process, it was found that the paper lacked the content of limitations and future research direction. Therefore, add this section in 5.3.

As following:

This paper only selects indexes from the aspects of informatization development, Internet development, digital transaction development, industrial economy and market size to construct the coupling evaluation index system of digital economy and sports industry. However, the coupling development of digital economy and sports industry is the result of multiple factors. The optimization of evaluation index and consideration of other related factors are important issues that need to be solved in further research. At the same time, this paper mainly uses the method of objective weighting (entropy value method) to determine the weight of indicators. In the future, the method of combining subjective weighting and objective weighting can be used to determine the weight of indicators more scientifically and reasonably. In addition, spatial Markov chain, Dagun Gini

coefficient and other methods can be used to deeply analyze the spatial and regional differences of the integration development of digital economy and sports industry.(see page 23, line1-14).