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Modeling the Driving Factors of the Value Added in the Chinese Sports Industry: A Ridge Regression

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Abstract: The development of a high-quality sports industry is crucial to China's economic growth. This research quantitatively analyzed factors influencing the development of the sports industry for the period 2010–2019. The study selected variables pertaining to the gross national income per capita (X_1), household final consumption expenditure per capita (X_2), sports population (X_3), number of fitness venues and facilities (X_4), number of sporting events (X_5), and number of sports-related business registrations (X_6) and analyzed their relationship with the value added to the sports industry. By developing a ridge regression model, it can be determined that correlations (Pearson's r) between six factors and the value added to the sports industry were all greater than 0.90, and that each factor had a positive impact on the industry ($p < 0.05$). After standardizing the ridge regression model with the z-score method, it was determined that the degree of influence of the six factors varied: X_2 (β_{ridge} = 0.156), X_3 (β_{ridge} = 0.153) and X_5 (β_{ridge} = 0.153), X_1 (β_{ridge} = 0.151), X_4 (β_{ridge} = 0.136), and X_6 (β_{ridge} = 0.121). The ridge regression model can give a reference model for predicting and optimizing the sustainable development of the sports industry in China.

Keywords: GDP; consumer consumption; physical activity; income; sports venues

1. Introduction

In 2010, the General Office of the State Council of the People's Republic of China (hereafter referred to as the State Council) issued the "Guiding Opinions of the General Office of the State Council on Accelerating the Development of the Sports Industry" [1], which proposed to vigorously develop the fitness and leisure market and to coordinate and promote the interactive development of the sports industry and related industries. In 2011, the General Administration of Sports of China announced the "Sports Industry 12th Five-Year Plan" [2], designating the expansion of the sports consumer market as one of the plan's primary objectives in order to foster the growth of sports industry. In 2014, the State Council issued "Several Opinions of the State Council on Accelerating the Development of the Sports Industry and Promoting Sports Consumption", which elevated national fitness to a national strategy, so elevating the prestige of the sports industry and setting its clear goals for development, including five trillion yuan (CNY) to the overall scale of sports industry by 2025 [3]. In 2016, the General Administration of Sports of China released the "13th Five-Year Plan for Sports Industry Development", with the goal of achieving three trillion yuan (CNY) in revenue for the Chinese sports industry by the end of 2020 [4]. In 2019, the State Council issued "Opinions of the General Office of the State Council on Promoting National Fitness and Sport Consumption and Facilitating High-quality Development of Sport Industry" [5] and the "Circular of the General Office of the State Council on Printing and Issuing the Outlines for Building a Sports Power" [6], which explicitly outlined that the strategic objective of the sports industry is to become a pillar of the Chinese economy by 2035. It is clear that the national policy framework for the growth of the sports industry

has persisted throughout the past decade. As a result of policy tailwinds, the value added to the sports industry has climbed from 222 to 1,124.8 billion yuan (CNY) between 2010 and 2019 [7].

The strategic importance of the high-quality development of the sports industry to the growth of the Chinese economy has prompted a number of studies on the factors driving the industry's expansion. Tong and Cong [8] evaluated the socioeconomic development level of the eastern provinces of China in four categories: social structure, economic efficiency, population quality, and quality of life. They concluded that the growth of the sports industry is contingent on socioeconomic growth. Zhu [9] suggested that the main issues inhibiting the growth of China's sports industry are the imbalanced structure of the sports market, the polarization of consumer subjects, the imbalanced regional social development, and excessive government intervention. Chen and Jiang [10] regarded the developed economic aspect, the sound policy aspect, the management system aspect, and the sports industry talent aspect as the most important features of the growth of sports industry in Shaanxi Province. Zhang [11] suggested that the upgrading of sports consumption demand is an essential driving force for the transformation and development of sports industry; however, the unreasonable structure and the low degree of association of China's sports industry hinder the development efficiency of sports industry. Dai [12] argued that investment is a catalyst for the growth of the sports industry and that there should be an increase in investment in the sports industry. Xu et al. [13] recommended that promoting sports projects as the cornerstone of the event industry, key regional sports, new space for the sports industry, and accelerating the innovation of sports industry content and operation improvement are the keys to the sports industry's high-quality development. Liu [14] concluded that the sports competition and performance industry, the leisure and fitness industry, and the sporting goods manufacturing industry provide the inherent strength for China's sports industry development.

In addition to qualitative research, quantitative research has explored the factors that influence the growth of China's sports industry. From the standpoint of regional economics, Yu [15] proposed that the environment for the development of sports industry consists of economic basis, sports population, resident income, sports infrastructure, and daily leisure time. Using the cointegration test, the error correction model, and the Granger causality test, Ren and Dai [16] concluded that there is a long-term beneficial interaction between urban and rural residents' consumption expenditures and the development of the sports industry. Zhang et al. [17] chose the annual regional gross domestic product (GDP) per capita, the fiscal expenditure on sports, and the consumer consumption level of Jilin residents to study the factors influencing the sports industry in Jilin Province. They concluded that the level of economic development had the greatest impact on the development of sports industry in Jilin Province, while consumer consumption level had the least impact. Recently, using the input–output method, He and Pan [18] proposed that on the supply side, the main driving force for the development of sports industry is the increase in the productivity of labor and capital; on the demand side, consumer consumption is the main driving force for the development of sports industry, and urban residents' consumption contributes significantly to the development of sports industry.

In the aforementioned literature review on the factors that can influence the sports industry, the following characteristics were noticed in the existing studies. First, the majority of relevant studies employed qualitative research methods, and these studies generally revealed associations between sports industry development and government policies, management and market system, sports consumption demand, and population relationship. In recent years, sports industry studies have increasingly emphasized quantitative analysis. Second, most studies on the factors influencing the sports industry were undertaken for specific regions, such as Shanghai, eastern cities, and the Yangtze River Economic Belt. In contrast, the development of the national sports industry as a whole serves as the focus of this study. Third, the majority of the literature used quantitative research methods wherein the relationship between indicators and the sports industry is indirect, failing to extract the

factors directly influencing the sports industry or compare the degree of influence amongst the variables.

China adopted and implemented the United Nations' concept of sustainable development early on, publishing its own national Agenda 21 in 1994 [19]. "Better quality, more efficient, fairer, and more sustainable development" [20] is President Xi Jinping's guiding principle for China's economy, society, and environment in the twenty-first century. Traditionally, the sports industry can propel the growth of textile, construction, electronic, food, and health industries. In a modern economic system, the sports service industry has become an important industry for social and economic development, which promotes the expansion of employment possibilities and the growth of the service sector [21]. Meanwhile, the expansion of China's sports industry has the potential to attract international human resources, management expertise, and capital, thereby increasing China's regional collaboration and long-term economic growth [22]. Furthermore, the increasingly aging Chinese population may jeopardize China's long-term economic viability, and a healthy population is of strategic importance to China's economic stability [23]. In short, the sustainable development of China's economy can be influenced directly or indirectly by the expansion of China's sports industry, including the service sector, manufacturing, infrastructure construction, the quality of the population, and economic cooperation and exchange. Thus, the key to establishing a high-quality and sustainable development of sports industry lies in identifying and improving the essential variables that drive its growth.

Under the governmental guidance, China's sports industry is through a period of rapid development, and there are defined task indicators for the years 2025 and 2035: By 2025, the overall size of the sports industry will approach 5 trillion yuan (CNY) [24]; by 2035, the sports industry will have become a pillar of the Chinese economy [6]. The impact of the COVID-19 has hampered the global sports industry [25], and China's sports industry is currently at a critical juncture for achieving multiple national objectives. Therefore, this study systematically analyzed the factors influencing the growth of sports industry between 2010 and 2019. By synthesizing existing experience, this study aimed to create the theoretical groundwork for the high-quality development of China's sports industry between 2025 and 2035.

2. Materials and Methods

2.1. Theoretical Modeling

Multiple regression is a statistical technique that predicts the outcome of a response variable using several explanatory variables. Multiple regression is used to model the linear relationship between explanatory variables and response variable. The model assumes the absence of multicollinearity, which means that the explanatory variables are not highly correlated. A multiple regression model is written as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon \tag{1}$$

where Y is the response variable, X represents the explanatory variables, β is the regression coefficients to be estimated, and ε represents the errors are residuals.

This is a quantitative study of the national sports industry as a whole, thus there are a number of challenges in the modelling process, such as complex indicators and unequal geographical development in China. To minimize the impact on the results, we selected the indicators according to the following four principles: the systemic principle denotes that the dimensions of the selected indicators are comprehensive, and there is a specific logical relationship between the indicators, allowing them to comprehensively reflect the variables driving the development of sports industry; the representativeness principle donates that the selected indicators can more accurately reflect the characteristics of the sports industry; the accessibility principle denotes the availability and validity of essential data; and, the operability principle denotes that the selected data are suitable of being quantitatively analyzed. Based on the existing literature, this study identified significant socioeconomic factors and modeled the degree to which each factor influenced the development of the

Chinese sports industry between 2010 and 2019. The variables used in this study are listed in Table 1.

Table 1. Variables definitions.

Variable	Definition
Y	Value added of sports industry (CNY 100 million)
X_1	Gross national income per capita (CNY)
X_2	Household final consumption expenditure per capita (CNY)
X_3	Sports population (10 thousand)
X_4	Number of fitness venues and facilities (10 thousand)
X_5	Number of sporting events
X_6	Number of sports-related business registrations (10 thousand)

2.2. Response Variable

The significance of the total output value of an industry is how much production value the industry contributes to society as a whole. In terms of the high-quality development potential of the Chinese economy [26], particularly in the context of the Industry 4.0 era [27], the value added to an industry reflects the development trend of the industry, and its analytical relevance is stronger than the total output value of the industry. Therefore, the value added to the sports industry (Y) was selected as the response variable. The value added to the sports industry from 2010 to 2019 was derived from the China Statistical Yearbook [7].

2.3. Explanatory Variables

Gross national income per capita (X_1) and household final consumption expenditure per capita (X_2) are prerequisites for the development of the sports industry, and only when the income reaches a specific stable level can we successfully promote residents' spending and industrial development. Data from 2010 to 2019 were derived from the China Statistical Yearbook [7].

Sports population (X_3) tends to purchase more sports goods, compete in more sports events, use more sports services, and engage in additional sports industry consumption, and is the driving force behind the expansion of sports industry. The National Fitness Program [28] includes as sports population those who exercise at least three times per week, for at least 30 min per session, and at a moderate level. Sports population from 2010 to 2019 were derived from the Intelligence Research Group [29].

The number of fitness venues and facilities (X_4) assures the economic and ecological viability of the sports industry. The concept applied in this study is the number of fitness venues and facilities, which is the indication chosen in the sixth national sports venue census [30] and should be separated from the concept of sports stadiums. Fitness venues and facilities include stadiums that host professional sporting events as well as urban fitness trails and national fitness tracks that satisfy the necessities of Chinese people's daily lifestyles. Data from 2010 were derived from the 2010 National Sports Directors Conference [31]. Data from 2011 were derived from the interview of the Director of Mass Sports Department of the General Administration of Sports of China [32]. Data from 2012 were imputed based on the average of 2011 and 2013 data. Data from 2013–2017 were derived from the Intelligence Research Group [29]. Data from 2018 and 2019 were derived from the official release [33,34].

The number of sporting events (X_5) is a significant factor in the growth of sports industry. There are numerous and diverse sporting events in China that are impossible to list. Since marathoning is a rapidly growing sport, using marathon events can indicate the development trend in the sports industry. The number of marathon events from 2010 to 2019 was derived from the Chinese Athletic Association [35].

With the ongoing expansion of the overall industry, the number of sports-related business registrations (X_6) rose, which is also a theoretical indicator of the status quo of

sports industry. The number of sports-related business registrations from 2010 to 2019 was derived from the *Insight and Info* [36].

2.4. Statistics

Multiple regression analysis was conducted using SPSS Statistics 25.0 (IBM, USA). Ridge regression analysis was conducted using SPSSAU (QingSi Technology Ltd., China). Significance was set at $p < 0.05$.

3. Results

3.1. Determination of Correlation

The initial step of modeling was to assess whether a linear relationship exists between each factor and the value added to the sports industry. The Pearson correlation coefficient can be used to measure the strength of linear correlation between multiple variables, and the correlation coefficient analysis is shown in Table 2. All correlation coefficients are greater than 0.9, demonstrating that the value added to the sports industry is statistically related to all variables.

Table 2. Pearson correlation coefficient for variables.

Y	X_1	X_2	X_3	X_4	X_5	X_6
r	0.979	0.981	0.987	0.951	0.957	0.921
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

3.2. Linear Modeling by Multiple Regression

A multiple regression (Table 3) was used to predict the value added to the sports industry from the six factors. The model explained a significant amount of variance in the value added to the sports industry, $F_{(6, 3)} = 456.687$, $p < 0.001$, $R^2 = 99.9\%$, indicating that at least one of the six factors affects Y. Analyzing the parameter estimates generated from the multiple regression model, only the parameter result for X_5 was significant ($p = 0.022$), whereas the results of X_1, X_2, X_3, X_4, X_6 were not significant ($p > 0.05$), with X_1 and X_3 even having negative β. Common sense suggests that there should not be a negative correlation between the growth of X_1 and X_3 and Y. Taking into account the Pearson correlation coefficient test and the real-life circumstances, it could be determined that the multiple regression model is flawed, which might be attributed to the presence of collinearity among the explanatory variables.

Table 3. Results of multiple regression.

	B	*SE B*	β	*t*	*p*	VIF
$X1$	−0.522	0.18	−2.103	−2.893	0.063	1449.347
$X2$	1.467	0.494	2.604	2.969	0.059	2110.778
$X3$	−1.365	5.095	−0.093	−0.268	0.806	329.754
$X4$	7.875	2.979	0.205	2.644	0.077	16.495
$X5$	1.144	0.262	0.258	4.366	0.022	9.543
$X6$	11.647	11.843	0.166	0.983	0.398	78.034

Note. *B*, unstandardized beta; *SE B*, the standard error for the unstandardized beta, β, standardized beta; *t*, *t* test; VIF, variance inflation factor.

Multicollinearity is the occurrence of correlations between two or more explanatory variables in a linear regression model that skew the parameter estimation or make it challenging to estimate them accurately [37]. The shared trend associated with economic variables is one of the primary causes for multicollinearity [38], such as the multicollinearity between X_1 and X_2 chosen for this research, thereby segregating the analytical model from the actual situation. There are different methods for diagnosing multicollinearity, one of which is the variance inflation factor (VIF). Typically, a VIF > 10 indicates multicollinearity

among the explanatory variables [39]. Reviewing Table 3, only X_5 has a VIF value of 9.543, while all other values are greater than 10, and X_2 has a VIF value of 2110.778, indicating that there is severe multicollinearity among the explanatory variables.

3.3. Linear Modeling by Ridge Regression

Ridge regression is considered to be the most effective method for resolving multi-collinearity in financial and economic data [40]. Thus, ridge regression was employed to solve the case of multicollinearity in this research. The first step in modeling a ridge regression is to determine the ridge biasing parameter k [41]. Using the ridge trace plot method (Figure 1) and the variation of different ridge regression coefficients (Table 4), we found that data follow a smooth pattern between k values of 0.9 and 0.99, therefore indicating that $k = 0.99$ is the most suitable ridge parameter.
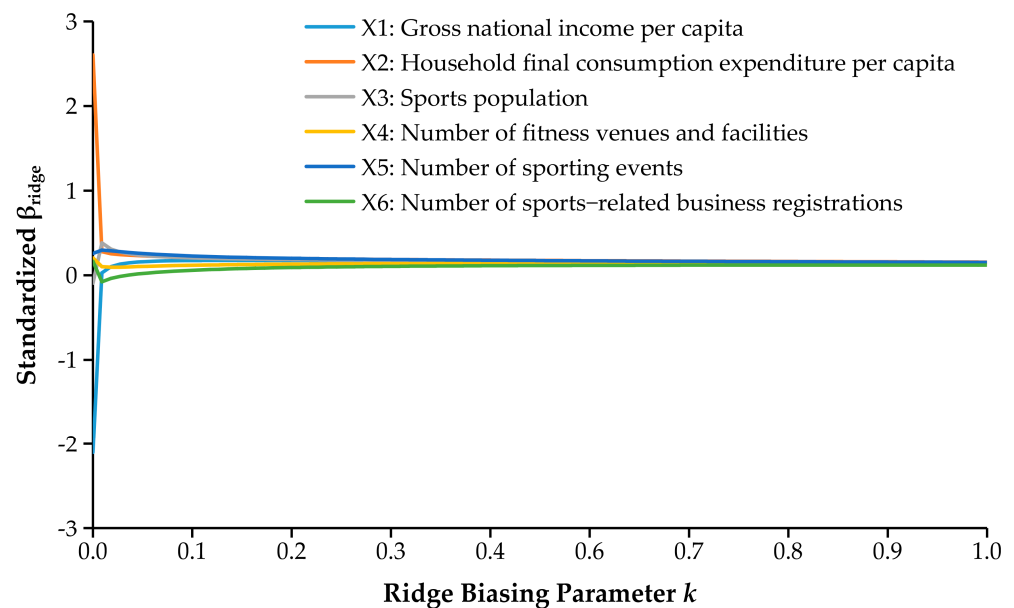

Figure 1. Ridge trace plot.

Table 4. Matrix of ridge constants and standardized coefficients.

k Value	X_1	X_2	X_3	X_4	X_5	X_6
0	−2.103	2.604	−0.093	0.205	0.258	0.166
0.1	0.174	0.216	0.209	0.117	0.232	0.054
0.2	0.175	0.199	0.188	0.131	0.204	0.088
0.3	0.172	0.189	0.179	0.137	0.19	0.103
0.4	0.169	0.181	0.173	0.139	0.18	0.111
0.5	0.165	0.176	0.168	0.14	0.173	0.116
0.6	0.162	0.171	0.165	0.14	0.168	0.119
0.7	0.159	0.166	0.161	0.139	0.163	0.12
0.8	0.156	0.163	0.158	0.138	0.159	0.121
0.9	0.153	0.159	0.155	0.137	0.156	0.121
0.99	0.151	0.156	0.153	0.136	0.153	0.121

After determining the optimal k value, ridge regression results were calculated (Table 5). The model explained a significant amount of variance in the value added to the sports industry, $F(6, 3) = 13.403$, $p = 0.029$, $R^2 = 96.4\%$, indicating that at least one of the six factors affects Y. All parameter estimates generated from the ridge regression model are significant ($p < 0.05$), indicating that all six factors had a positive influence on the value added to the sports industry. The ridge regression model is designed as follows:

$$Y = -8472.4 + 0.038 \times X_1 + 0.088 \times X_2 + 2.242 \times X_3 + 5.211 \times X_4 + 0.678 \times X_5 + 8.506 \times X_6 \quad (2)$$

Table 5. Results of ridge regression.

	B	SE B	β	t	p	VIF
X1	0.038	0.006	0.151	6.122	0.009	1449.347
X2	0.088	0.015	0.156	6.043	0.009	2110.778
X3	2.242	0.318	0.153	7.051	0.006	329.754
X4	5.211	1.150	0.136	4.53	0.020	16.495
X5	0.678	0.149	0.153	4.551	0.020	9.543
X6	8.506	2.355	0.121	3.612	0.036	78.034

Note. *B*, unstandardized beta; *SE B*, the standard error for the unstandardized beta, β, standardized beta; *t*, *t* test; VIF, variance inflation factor.

3.4. Model Verification

Results of the prediction performance are shown in Table 6. The ridge regression model gives similar results to the actual value added to the sports industry. A Pearson correlation coefficient test showed that the two were strongly and significantly related, $r = 0.995$, $p < 0.001$. There was no statistical difference between predicted and actual values, $t(9) = -0.134$, $p = 0.896$. These results demonstrate good agreement between predicted and actual value added to the sports industry.

Table 6. Performance comparisons in the ridge regression model.

Pearson Correlation Coefficient			Paired-Samples *t*-test				
N	r	p	M	95% CI	t	df	p
10	0.995	<0.001	−23.9	[−426.324, 378.524]	−0.134	9	0.896

Note. *N*, sample size; *M*, mean difference between the groups; 95% CI, 95% confidence interval of the difference; *t*, *t* test; *df*, degrees of freedom.

3.5. Model Standardization

Due to the non-uniformity of the data units employed, variances in nature, magnitude, and other features among different variables may result in the heteroskedasticity effect. To eliminate this effect, we transformed all variables to *z*-scores and then performed the analytic methods using variables that had been standardized. The ridge regression model with standardized coefficients is designed as follows:

$$Y = 0.151 \times X_1 + 0.156 \times X_2 + 0.153 \times X_3 + 0.136 \times X_4 + 0.153 \times X_5 + 0.121 \times X_6 \quad (3)$$

Compared to the unstandardized model, the standardized model explained the same significant amount of variance in the value added to the sports industry: $F(6, 3) = 13.403$, $p = 0.029$, $R^2 = 96.4\%$. However, the magnitude of standardized coefficients can now be directly compared to determine the degree of effect of the driving factors. According to the standardized equation, the magnitude of the six factors' influence on the value added to the sports industry is as follows, in descending order: the household final consumption expenditure per capita (X_2), the sports population (X_3) and the number of sporting events (X_5), the gross national income per capita (X_1), the number of fitness venues and facilities (X_4), and the number of sports-related business registrations (X_6).

4. Discussion

This is the first study in China to systematically model the contributing factors to the growth of sports industry from 2010 to 2019. The ridge regression model can be used to study the factors influencing the value added to the sports industry and to forecast the future value added to the industry.

The primary factor influencing the growth of sports industry is the household final consumption expenditure per capita. Consumption's contribution to China's GDP has been declining steadily around 2010, and insufficient domestic demand had become a major impediment to the economic growth and sustainability of China. At the Central Economic

Work Conference held at the end of 2011, it was highlighted to increase domestic demand and promote the consumption of services, such as culture, tourism, fitness, and senior care [42]. From 2010 to 2019, the per capita consumption expenditure of urban residents climbed from 13,471 to 28,063 yuan, whilst the Engel's coefficient declined from 35.7% to 27.6%; the per capita consumption expenditure of rural residents increased from 4382 to 13,328 yuan, whilst the Engel's coefficient decreased from 41% to 30% [7]. By 2020, China's consumption has accounted for 54.3% of GDP, and consumption is be the primary driver of economic growth [43]. The relationship between consumer expenditure and the growth of sports industry is mostly driven by sports consumption [16], and the formation and growth of sports industry are highly contingent on residents' sports consumption demand. China's sports consumption per capita increased from 926 yuan in 2014 to 2264 yuan in 2018 [7]. During 2015–2020, the total sports market consumption in China was 476.01 billion yuan (CNY), 593.68 billion yuan (CNY), 711.35 billion yuan (CNY), 910.53 billion yuan (CNY), 1.16 trillion yuan (CNY), and 1.5 trillion yuan (CNY), respectively [44]. China's sports consumption market is developing steadily, sports consumption per capita is progressively increasing, and the consumption model driven by greater sports consumption has resulted in the rapid growth of sports industry.

The "Opinions of the General Office of the State Council on Promoting National Fitness and Sport Consumption and Facilitating High-quality Development of Sport Industry" makes it abundantly evident that by 2025, the overall size of the Chinese sports industry would surpass 5 trillion yuan (CNY) [5]. According to our analysis, the household final consumption expenditure per capita is the most critical determinant; therefore, boosting sports consumption per capita is the most effective way to attain national policy objectives. Compared to developed nations such as the United Kingdom, the United States, and Japan, China's sports consumption per capita is still relatively low, and material consumption (e.g., purchasing sports clothing) is still the primary way that Chinese consumers engage in sports consumption [45]. In addition, Chinese consumers' sports consumption is characterized by a singular sports consumption structure, a lack of sports consumption knowledge and consumption ideas, and an uneven regional development of sports consumption [46]. Improving the household final consumption expenditure per capita necessitates establishing a conducive environment for sports consumption, enhancing sports consumption policies, and providing inhabitants with additional guidance on sports consumption.

The sports population is the foundation for the growth of sports industry. In 2009, the State Council published the "Regulations on National Fitness" [47], the first law in China pertaining particularly to the national fitness area, and designated August 8 as "National Fitness Day" annually. In 2011 and 2016, the State Council published the National Fitness Program (2011–2015) [48] and the National Fitness Program (2016–2020) [49], respectively, which described the aims and tasks, working measures, safeguards, and organization and implementation of the National Fitness Program for a 10-year period. Especially after national fitness became a national strategy in 2014 [3], the concept of fitness and health has taken root in Chinese people's minds and encouraged more individuals to engage in sports. In 2010, 340 million Chinese engaged in regular physical activity, or 28.2% of the total population. In 2020, the proportion of Chinese who engage in regular physical activity has increased to 37.2% [28]. The rise in the number of sports population could spur a series of increases in sports consumption demand, sports financial expenditures, the number of national fitness activity centers, the number of stadium facilities, and the number of sporting events and competitions [50], thereby fostering the growth of sports industry.

Since the National Fitness Program was adopted as a national strategy in 2014 [3], increasing the sports population has always been a major priority for the policymakers. China's sports population reached 37.2% in 2020, although compared to other sports-developed nations, there is still considerable capacity for growth. In 2020, there were 229.7 million sports population in the United States, with a participation rate of 75.6% [51]. In the United Kingdom, 15.5 million adults aged 16 or older exercised at least once per week for 30 min between 2011 and 2012, representing 36% of the population [45]. To

achieve the goal of 38.5% of the population participating in sports by 2025 [28], the industry should support the implementation of the National Fitness Program in special populations, such as the elderly, women, and people living in remote and rural areas [52], and should encourage more inactive individuals to engage in regular physical activity. The larger sports population could further have a ripple effect on other factors that speed up the development of sports industry.

According to the model, the number of sporting events is also an important factor contributing to the rapid expansion of sports industry. Since it is impossible to count the data of national sporting events, this study utilized mass-popularity marathons as a proxy. The number of marathons in China increased 140-fold in just ten years, from 13 in 2010 to 1828 in 2019 [35]. The commercialization of sporting events is the key to promoting the sports economy, and boosting the commercialization of sporting events can accelerate the growth of the entire sector [53]. With the advancement of modern society and technology, sporting activities have a greater economic impact. From a demand perspective, the concept of national fitness encourages people to frequently and actively participate in sports, hence increasing the demand for sports consumption, such as the boom of marathon events. In terms of communication channels, the broadcasting of modern sporting events, the advent of e-sports, and the development of 5G-based live games are all essential to the growth of sports industry [54,55]. In terms of industrial structure, sporting events are closely related to other industries. For instance, the "integrating fitness with education, health, and tourism" promoted in the latest National Fitness Program [28] can fuel the development of sports and cultural industries and give new economic growth nodes for the urbanization of cities [56,57]. With their unique functional role, sporting events have not only effectively fostered the swift development of local sports [56] but also generated significant economic and social advantages by driving the development of other connected sectors during the boom of the sports economy [58].

For the sports industry, the driving force of sporting events, particularly mass sports events and e-sports participated by average people, is enormous. The digital level of sporting events will have an impact on the investment and sponsorship behavior of events, create space for the sale of peripheral products of events, and thus cause changes in the revenue structure, while the popularity of 5G, VR, and other technologies has laid a solid foundation for the further development of digital sporting events [59]. Digital sporting events have the potential to contribute significantly to the growth of the sports industry [60]. In addition, the sports industry should expedite the integration of sporting events with other industries so that the economic benefits of sporting events can be fully realized. The value added to China's sports competition and performance industry has increased from 5.26 billion yuan (CNY) in 2015 to 10.3 billion yuan (CNY) in 2018 at a compound annual growth rate of 25.11% [61]. However, China's sports competition and performance industry is still in its early stages of development, and the commercial operation mode of sporting events is not yet sufficiently developed. Therefore, it is necessary to investigate the in-depth cooperation between the sports industry and other industries, as well as the commercial operation mode of sporting events that integrates online and offline retail experiences.

As the income growth of urban and rural residents exceeds the rate of economic growth, China's consumption structure has begun to shift from "subsistence" to "well-off," and the country has entered a stage of high-quality development. During the period 2008–2020, China's national income accelerated [62], with urban residents' per capita disposable income increasing from 15,781 yuan (CNY) to 43,834 yuan (CNY) and rural residents' per capita disposable income increasing from 4765 yuan (CNY) to 17,131 yuan (CNY). In 2021, China's GDP per capita surpassed the global GDP per capita threshold, reaching 80,976 yuan [7]. Household consumption rises in tandem with household income and spending directly stimulates the growth of sports economy. Thus, the increase in gross national income per capita is a precondition for the growth of sports industry. Meanwhile, the policymakers should construct a range of social security mechanisms in order to

optimize the supply structure of main commodities and services, stabilize and reduce their selling prices, and encourage greater sports participation and consumption.

In two primary ways, fitness venues and facilities contribute to the promotion of sports industry. On the one hand, sporting facilities can foster the growth of sports industry, including the sports competition and performance industry [63]. Have a greater proportion of venues with the hardware conditions required to enable the growth of the key components of sports industry, such as the competitive performance industry, and boost regional economic integration [64]. On the other hand, sports venues can expedite the National Fitness Program in order to foster the growth of sports industry. According to the 2019 national data [33], 823,500 urban fitness trails operate nationwide, and the leading sports venues by type are basketball courts, soccer fields, and volleyball courts, which account for 52.05% of the total number of sports venues. The widespread use of these fitness venues and facilities provides the required infrastructure for the growth of fitness and recreation. The economic potential of fitness venues and facilities should be explored to its fullest extent. In 2021, China's sports venue area per capita was 2.41 square meters [65], which is considerably less than that of industrialized nations, such as the United States and Japan, where the sports venue area per capita exceeded 10 square meters years ago [61]. Together, policymakers and relevant stakeholders should improve the reasonable layout of sports venues, construct a network of multi-level fitness facilities and a 15-min fitness circle in urban communities, thereby fostering the expansion of the entire sports industry.

The expansion of the sports industry is supported by a rise in the number of sports enterprises, which can provide employment. From 2010 to 2019, the number of sports-related business registrations in China climbed from 100,000 to 1,566,000 [36]. Supposedly, the growth of sports enterprises is closely related to the overall value of sports industry; however, the number of sports-related business registrations is the least relevant factor, maybe due to the organizational structure of sports enterprises. In recent years, the number of sports, exercise rehabilitation, health care, and early childhood sports facilities in Beijing, Shanghai, and other metropolitan areas has expanded considerably, but very few are profitable and the vast majority are operating at a loss [66]. The development of sports enterprises in China is hindered by insufficient investment in research and development, a lack of corporate culture, and a dearth of management talent. Therefore, an increase in the number of sports-related business registrations cannot promote the sports industry effectively. Accordingly, the development of sports enterprises should not be centered on quantitative growth, but rather on the internal quality of sports enterprises and organizational innovation model in order to increase the competitiveness of China's sports enterprises.

It should again be highlighted that the indicators included in this model are selected based on the status of China's sports industry, and individual indicators (e.g., X_5) have been selected using only representative data, which could have an impact on the model's accuracy and its application. In addition, the model must undergo extra research to improve its accuracy and stability, and it must be compared with the actual scenario of China's sports industry in all aspects to improve the model's fit.

In conclusion, this research proposed a ridge regression model of the value added to the sports industry in order to predict the development of the sports industry, which could help to encourage the positive effects of driving factors, realize the effective management and control of sports industry resources, and promote the sustainable development of the sports industry.

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