Research Article

Spatiotemporal Evolution Patterns and Driving Factors of Synergistic Development of Culture, Sports, and Tourism Industries: The Case Study of China

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Synergistic development of the culture, sports, and tourism industries is an emerging trend in China, providing new formats for industrial evolution and fresh momentum for industrial upgrading. Therefore, building a robust framework to evaluate the synergistic development is relevant to China's economic and social development. This study used a coupling coordination model to calculate the coupling coordination degree of the three industries, for 31 provinces in China from 2013 to 2017. Subsequently, it employed spatial autocorrelation techniques and GeoDetector to identify factors affecting the synergistic development from global and local perspectives before discussing the driving mechanisms. The results showed that (1) the synergistic development of the three industries was generally stable with a slight imbalance. (2) The development level varied across regions. The general spatial pattern was low in northeastern and western China, stable and average in the central region, and high in the eastern region. (3) The synergistic development has a prominent "proximity dependence" effect reflected by a notable spatial agglomeration feature and positive spatial autocorrelation trend and (4) twenty-one indicators of six driving factors (industrial pulling force, population supporting force, consumer purchasing power, transportation pushing force, resource attraction force, and economic driving force) affected the synergistic development.

1. Introduction

In recent years, pursuing synergistic development across industries has become an emerging global trend. Various industries have been reshaped or integrated for optimising industrial structures and business models. Owing to considerable social and technological progress and an increasingly well-educated population in China, the culture, sports, and tourism (CST) industries have developed rapidly. Blurring boundaries among the three industries highlights the need for innovation and integration in reforming industrial structures. The synergistic development of CST industries could also expand the scope of the broader tertiary sector with new business formats, models, and products. The Chinese central government explicitly required a more coordinated development of the CST industries, for example, building more sports culture

brands and developing boutique sports tourism events and routes. Numerous local governments have proposed policies to promote the development of CST industries. These supportive measures cover multiple dimensions, such as land allocation, fiscal assistance, financing accessibility, tax and levy incentives, and brand building. As they could considerably promote the development of other industries with their long industrial chains, CST industries are a critical driver of the Chinese economy. Therefore, insights into enhancing the coordinated development of the three essential industries are relevant to China's economic and social development. Moreover, they could also inform other countries' efforts to optimise the spatial layout of their industries and promote the sustainable and moderate development of the three industries.

The synergistic development across industries requires further extension and interpenetration of industrial chains

and networks, involving structural adjustment and upgrading of the industries. In turn, it has also become an important path for industrial upgrading; numerous studies have examined how the synergistic development has promoted industrial upgrading [1]. In recent years, scholars have investigated the synergistic development in different industries. For instance, using evolutionary game analysis, Pingkuo et al. [2] explored the energy transition problem in the power generation industry from the perspective of the synergistic development, which can be regarded as the game of interest balance of the thermal power and energy power generation enterprises. Qiu et al. [3] investigated whether the tourism industry can promote rural economy and explored the synergistic development problem between agriculture and tourism based on a corresponding index system and a coupling coordination model. The study demonstrated the integrated development of the agricultural and tourism industries. Considering the sustainable and coordinated development in the logistics industry and the manufacturing industry, Gong et al. [4] adopted a three-stage superefficiency slack-based model (SBM) to analyse the Yangtze River Economic Belt of China. The results indicated that the logistics industry is relatively lagging in promoting the development of the manufacturing industry, and the overall levels of coordination between the two industries were limited. Similar studies have investigated other industries. Nevertheless, most scholars focus on the synergistic development between the two industries; only a few have integrated three different industries into the same system to explore their interaction and coupling mechanisms. Moreover, most studies have focused on time-series evolution comparisons, when the driving factors of the synergistic development of the industry lack attention.

The synergistic development across CST industries is a dynamic process. Driven by numerous factors, businesses in the industries with common interests remove industrial barriers and interpenetrate, extend, or restructure industrial chains and networks, leading to new business formats that follow the multidimensional integration of technologies, businesses, and markets [5]. The literature on synergistic development across CST industries has mainly focused on three combinations. The first is the synergistic development between the sports and tourism industries: concepts and definitions, intrinsic characteristics, and developmental challenges and strategies. Liang defined the synergistic development between the sports and tourism industries in terms of economics, stressing that tourism services should be offered on the basis of sports resources [6]. To create a tourism-oriented regional development strategy, Fugao and Li proposed and defined all-for-one sports tourism. They also classified the development models into the dominant, subordinate, symmetric, and derivative types, depending on how relevant industries coexist [7]. Zuo et al. adopted the Wuli-Shili-Renli system approach, a holistic analytical process that considers the physical world, social interactions, and human factors, to analyse the spatial distribution pattern of China's sports tourism resources. By adopting a geographic detector probe model as an analysis method, they found that government support and guidance, market

cultivation and development, and economic benefits are drivers behind the development of sports tourism [8].

The second is the synergistic development between the sports and culture industries: mainly classification and definition of the two industries, achieving the synergistic development, and related constraints or bottlenecks. Zhang argued that sports and culture are interdependent. The culture industry could provide a better platform for developing the sports industry, which, in turn, would positively promote its own development [9]. Deli et al. suggested that the synergistic development between the sports and culture industries is preferred for sports development. To achieve this, the sports industry should customise its development on the basis of local geographic environment and cultural resources [10]. The third is the synergistic development between the culture and tourism industries. Compared with the other two combinations, studies on the interaction and synergistic development between the two industries had started earlier, although these are generally qualitative and on the sustainable development of the two industries. Bachleitner and Zins discussed the growing demand for cultural tourism and its social context. They also warned that while using cultural tourism as a development tool in rural areas, policymakers must carefully consider that key attraction factors, such as cultural identity and authenticity, may be destroyed by tourism development [11]. In the field of cultural heritage tourism, Rudokas et al. adopted a cost-benefit analysis of tourism statistics to investigate the cost-effectiveness of public investments in cultural heritage conservation and their capabilities in attracting tourism businesses [12]. Lestari et al. regarded culture as capital and urged local stakeholders to evaluate the cultural tourism industry from a capitalist perspective using a case study [13].

In summary, the three combinations have been investigated extensively. Although some studies have addressed relevant indicators for the three industries, others have focused on the synergistic development across the three industries. However, further studies are still needed in several directions. (1) The dynamics and evolutionary characteristics of the synergistic development across the CST industries. As discussed, the relevant studies have primarily explored the combinations of any two of the three industries and offered only theories about synergistic development. Therefore, in practice, the dynamics of the synergistic development of CST industries and the spatial and temporal characteristics of the development need to be investigated first. (2) The driving factors for the synergistic development of the CST industries: the driving factors identified could predict the dynamics of the synergistic development, thereby informing measures to promote the synergistic development of the CST industries. The CST industries are naturally coupled in three dimensions. They are successive in time, overlapping and mutually enhancing in space, and push each other's growth. The strength of the coupling relationship of the CST industries can be measured by a coupling degree. A higher coupling degree implies more spillover effects from increased efficiency in leveraging resources from the other two industries, thus making it more competitive than when depending on the resources of a single industry. In contrast,

a lower coupling degree implies more independence or less interrelated industrial factors and structures, leading to a weak synergy among the industries. Therefore, using the coupling coordination model, this study measured the coupling coordination degree of the CST industries of 31 provinces (including provincial-level municipalities and autonomous regions, but excluding Hong Kong, Macao, and Taiwan) in China from 2013 to 2017 and followed the research framework of "spatial pattern-spatial effect" to reveal the synergistic development trend and related spatiotemporal evolution patterns of the cultural, sports, and tourism industries. GeoDetector was used to explore the driving factors of the synergistic development quantitatively. This study provides a more reasonable explanation of the mechanisms behind the observed patterns and expands theoretical and empirical research of CST industries, thereby informing the measures to enhance their synergistic development.

2. Materials and Methods

2.1. Methods

2.1.1. Entropy Method.
To measure the development level of CST industries comprehensively, the weight of each indicator needs to be determined appropriately to ensure the evaluation results are robust, objective, and accurate. The entropy weighting method used in the study is more objective than the analytic hierarchy process. It assigns a weight mainly on the basis of information contained in the indicator, regardless of data linearity. By avoiding the interference of subjective factors effectively, it is also more reliable [14]. Owing to data availability, China's data were used in this study to calculate the weight.

2.1.2. Coupling Coordination Model.
The coupling degree model maps the systematic coupling degree of the CST industries, reflecting its strength among the three systems. It was calculated as follows. Variable q_i denotes the order parameter of each system of CST industry, q_{ij} represents the indicator j of the order parameter i, and the value is x_{ij} ($i = 1, 2; j = 1, 2, \ldots, n$). Max ($x_{ij}$) and min ($x_{ij}$) are, respectively, the maximum and minimum values of the corresponding indicator of the order parameter at the critical point of system stability [15]. The function q_{ij} for the efficacy of the CST industries on systematic order is as follows:

$$q_{ij} = \begin{cases} \dfrac{x_{ij} - \min\left(x_{ij}\right)}{\max\left(x_{ij}\right) - \min\left(x_{ij}\right)}, & q_{ij} \text{ is positive,} \\[3mm] \dfrac{\max\left(x_{ij}\right) - x_{ij}}{\max\left(x_{ij}\right) - \min\left(x_{ij}\right)}, & q_{ij} \text{ is negative.} \end{cases} \tag{1}$$

For the three subsystems of CST industries, the contribution of each indicator to the entire system was calculated by a linear weighting method with the following formula:

$$q_i = \sum_{j=1}^{n} \lambda_{ij} q_{ij}, \sum_{j=1}^{n} \lambda_{ij} = 1, \tag{2}$$

where q_i is the comprehensive evaluation efficacy of the three subsystems of culture, sports, and tourism industries in year j and λ_{ij} denotes the weight determined by the entropy weighting method [16].

According to the coupling theory in physics and relevant study results [17, 18], the efficacy contribution of each order parameter is calculated for building the coupling degree model to describe the interaction of the three subsystems of culture q_1, sports q_2, and tourism q_3 industries as follows:

$$C(q_1, q_2, q_3) = 3\left[\frac{q_1 q_2 q_3}{q_1 + q_2 + q_3}\right]^{1/3}, \tag{3}$$

where the value of the coupling degree C is in the range of [0, 1]. The C value approaching 1 implies that the three subsystems are reaching orderly development and desirable resonance coupling. On the contrary, the value edging nearer to 0 suggests that the three subsystems are slipping into a disordered state with poor coupling. Well aware of the possibility of disparity between lower efficacy of the three subsystems and higher coupling degree, we decided to build the coupling coordination model of the CST industries as follows:

$$D = \sqrt{CT},$$

$$T = \frac{1}{3} q_1 + \frac{1}{3} q_2 + \frac{1}{3} q_3, \tag{4}$$

where D is the coupling coordination degree and T is the comprehensive evaluation index. Given the three subsystems' importance to the coupling relationship and drawing upon the results of prior studies [17, 18], we allocated the weight of 1/3 for each of the three subsystems. A higher coupling coordination degree implies a higher matching degree between them, indicating that the subsystems are more likely to develop in an orderly manner. Furthermore, referring to relevant studies, we graded the coupling and coupling coordination degree as shown in Table 1.

2.1.3. Spatial Autocorrelation.
Spatial autocorrelation measures the correlation between a geographic attribute and its value of a location with those of neighbouring localities [19, 20]. To test for spatial autocorrelation, we used Moran's I index as follows:

$$I = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} \omega_{ij} (X_i - \overline{X})(X_j - \overline{X})}{S^2 \sum_{i=1}^{n} \sum_{j=1}^{n} \omega_{ij}}, \tag{5}$$

where ω is the spatial weight between locations i and j; n denotes the number of locations; X_i is the observed value for location i, and X_j is that for location j. The value range of Moran's I is −1 to 1. Moran's $I > 0$ indicates a positive spatial correlation, whereas Moran's $I < 0$ indicates a negative spatial correlation. Moran's $I = 0$ indicates an independent random distribution [21].

TABLE 1: Classification criteria and grades of coupling and coupling coordination degree.

Coupling degree C		Coupling coordination degree D	
Interval	Coupling stages	Interval	Coordination stages
$0 \le C < 0.3$	Low-level coupling	$0 \le D < 0.1$	Extreme imbalance
		$0.1 \le D < 0.2$	Severe imbalance
$0.3 \le C < 0.5$	Partly engaged	$0.2 \le D < 0.3$	Moderate imbalance
		$0.3 \le D < 0.4$	Slight imbalance
$0.5 \le C < 0.6$	Initial break-in stage	$0.4 \le D < 0.5$	Bordering imbalance
		$0.5 \le D < 0.6$	Barely coordinated
$0.6 \le C < 0.8$	Deep break-in stage	$0.6 \le D < 0.7$	Slightly coordinated
		$0.7 \le D < 0.8$	Moderately coordinated
$0.8 \le C \le 1$	High-level coupling	$0.8 \le D < 0.9$	Satisfactorily coordinated
		$0.9 \le D \le 1$	Excellently coordinated

2.1.4. GeoDetector. GeoDetector is used to analyse and detect spatial variation, and in particular, to measure the extent to which a factor can explain a variation in the result variable, thereby identifying the source of the variation [22]. It is described by the following equation:

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N \sigma^2}, \qquad (6)$$

where L is the variable stratification, namely classification or partition; N_h and N are the number of units in layer h and the whole area, respectively; σ_h^2 and σ^2 are the variances of the result variable in layer h and the whole area, respectively; and q represents the influence of an antecedent variable on the result variable. With the value range of [0, 1], q closer to 1 indicates that the antecedent variable has higher explanatory power on the result variable; conversely, when it approaches 0, the explanatory power is lower. In this study, GeoDetector was used to identify the key factors that affect the coupled and coordinated development of the CST industries.

2.2. System of Indicators. Coupling is a concept in physics, referring to a phenomenon where two or more systems or modes of motion interact to achieve mutual influence and then synchronisation [23]. By nature, CST industries are substantially coupled and correlated. Given the complex relationship between these three industries, coupling theories have been used to analyse the interactions between their subsystems. Furthermore, the coupling degree and the coupling coordination degree have been used to describe how the three subsystems are interrelated, how they affect each other, and how they develop in a coordinated way, thereby revealing the dynamics behind the systematic coupling among China's CST industries (see Figure 1).

The conceptual model provides the basis for composing an industrial development index for CST industries with a carefully designed indicator evaluation system. Indicators were selected by referring to prior studies [20, 24–26] and in compliance with principles such as robustness, representativeness, feasibility, reliability, and availability. The resultant indicators for the three industries were grouped into the categories of production factors and industrial economy (see Table 2). Compared with previous studies, more of the culture industry indicators selected for this study are related
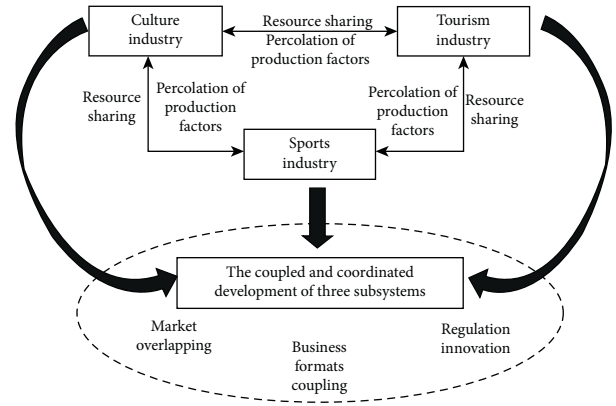

FIGURE 1: Conceptual model depicting the coupling mechanism of CST industries.

to cultural entertainment and recreational services that are ready to interact with sports and tourism industries. Therefore, the results shown later are inconsistent with those from previous studies [27].

2.3. Data Sources. Given the statistical definitions for indicators related to the CST industries, 2013–2017 data of 31 provinces in China (excluding Hong Kong, Macao, and Taiwan) were used in this study. The data were mainly from the China Statistical Yearbook, China Tourism Statistical Yearbook, and Annual Report of Mass Sports Development in China from 2013 to 2017. For some indicators, the data were supplemented by those from local statistical yearbooks, statistical communiques of local sports bureaus, and official websites of the Ministry of Finance of the People's Republic of China and China Marathon (https://www.runchina.org. cn). Moreover, the map of China used in this study was taken from the Data Centre for Resources and Environmental Sciences of the Chinese Academy of Sciences (https://www. resdc.cn/Default.aspx).

3. Results

3.1. Overview of Coupling and Coordination among the Culture, Sports, and Tourism Industries. This study measured the coupling coordination degree of China's CST industries from 2013 to 2017. The results are shown in Table 3. In the

TABLE 2: System of developmental indicators for the culture, sports, and tourism industries.

Subsystems	Tier 1 indicators	Tier 2 indicators	Unit	Weight
Culture industry	Production factors	Number of performing arts organisations	Number	0.1544
		Number of performing arts venues	Number	0.1149
		Number of performing arts performances	10,000 performances	0.2388
		Attendance to domestic performances	10,000 viewers	0.2319
		Number of visits to performing arts venues	10,000 visits	0.1802
	Industrial economy	The consumer price index for culture and entertainment (last year = 100)	%	0.0434
		The consumer price index for culture and entertainment products (last year = 100)	%	0.0364
Sports industry	Production factors	Number of sports venues	Number	0.1588
		Sports lottery amount	10,000 yuan	0.1900
		Number of marathon races	Number	0.2006
	Industrial economy	The consumer price index for sports products (last year = 100)	%	0.0696
		The average salary of employed persons in urban sports organisations	Yuan	0.2302
		The average salary of employed persons in urban sports private organisations	Yuan	0.1508
Tourism industry	Production factors	Number of accommodation businesses	Number	0.1414
		Number of food and beverage businesses	Number	0.1834
		Total number of travel agencies	Number	0.1192
		Number of A-level tourist attractions	Number	0.1240
		Passenger kilometres	10,000	0.1253
	Industrial economy	Total tourism revenue	10,000 yuan	0.1180
		Per capita tourism income	10,000 yuan/person	0.1086
		Total tourism revenue as a percentage of GDP	%	0.0802

TABLE 3: Coupling and coordination of China's sports, tourism, and culture industries.

Year	Cq_1 (culture industry)	Cq_2 (sports industry)	Cq_3 (tourism industry)	D (coupling coordination degree)	Industrial interaction	Coordination grade
2013	0.2112	0.2661	0.3195	0.3568	Lagged culture and sports industries	Slight imbalance
2014	0.2178	0.3197	0.3200	0.3707	Lagged culture industry	Slight imbalance
2015	0.1928	0.2852	0.3264	0.3536	Lagged culture industry	Slight imbalance
2016	0.1811	0.3180	0.3231	0.3564	Lagged culture industry	Slight imbalance
2017	0.1983	0.3049	0.3165	0.3591	Lagged culture industry	Slight imbalance

2013–2017 period, the coupling coordination degree of China's CST industries generally changed little, fluctuating within a range of 0.3536 to 0.3707. The comprehensive development level of the three industries was generally stable over the years with notable growth in the sports industry, a steady tourism industry, and a slightly declining culture industry. The coordination grade for CST industries had not changed notably in these five years. Persistent imbalance is not conducive to the synergistic development of the three industries, and thus, adjustment is urgently needed to optimise the industrial structure. In terms of the comprehensive development level, tourism industry Cq_3 > sports industry Cq_2 > culture industry Cq_1. Moreover, the coordination and interaction can be characterised as lagged culture and sports industries in 2013 and a lagged culture industry after 2013. Before 2013, the tourism industry was far ahead of the sports and culture industries. After 2013, the gap between the sports and tourism industries narrowed significantly, especially in 2014 and 2016, to as low as 0.003

and 0.051, respectively. The policies *Several Opinions on Accelerating the Development of Sports Industry and Promoting Sports Consumption* and *National Fitness Plan (2016–2020)* issued by the Chinese government in 2014 and 2016, respectively, can explain the developments as they might have motivated the sports industry's development. In contrast, compared with the sports and tourism industries, the consistently straggling culture industry encountered problems related to investments, ownership, technologies, and scale [25].

3.2. Characteristics of Spatiotemporal Evolution of the Coupling and Coordination among the Culture, Sports, and Tourism Industries. Using the coupling coordination degree model, this study measured the degree of the CST industries' coupling coordination in 31 provinces in China from 2013 to 2017, as shown in Figure 2. The changes in the grades of the provinces from 2013 to 2017
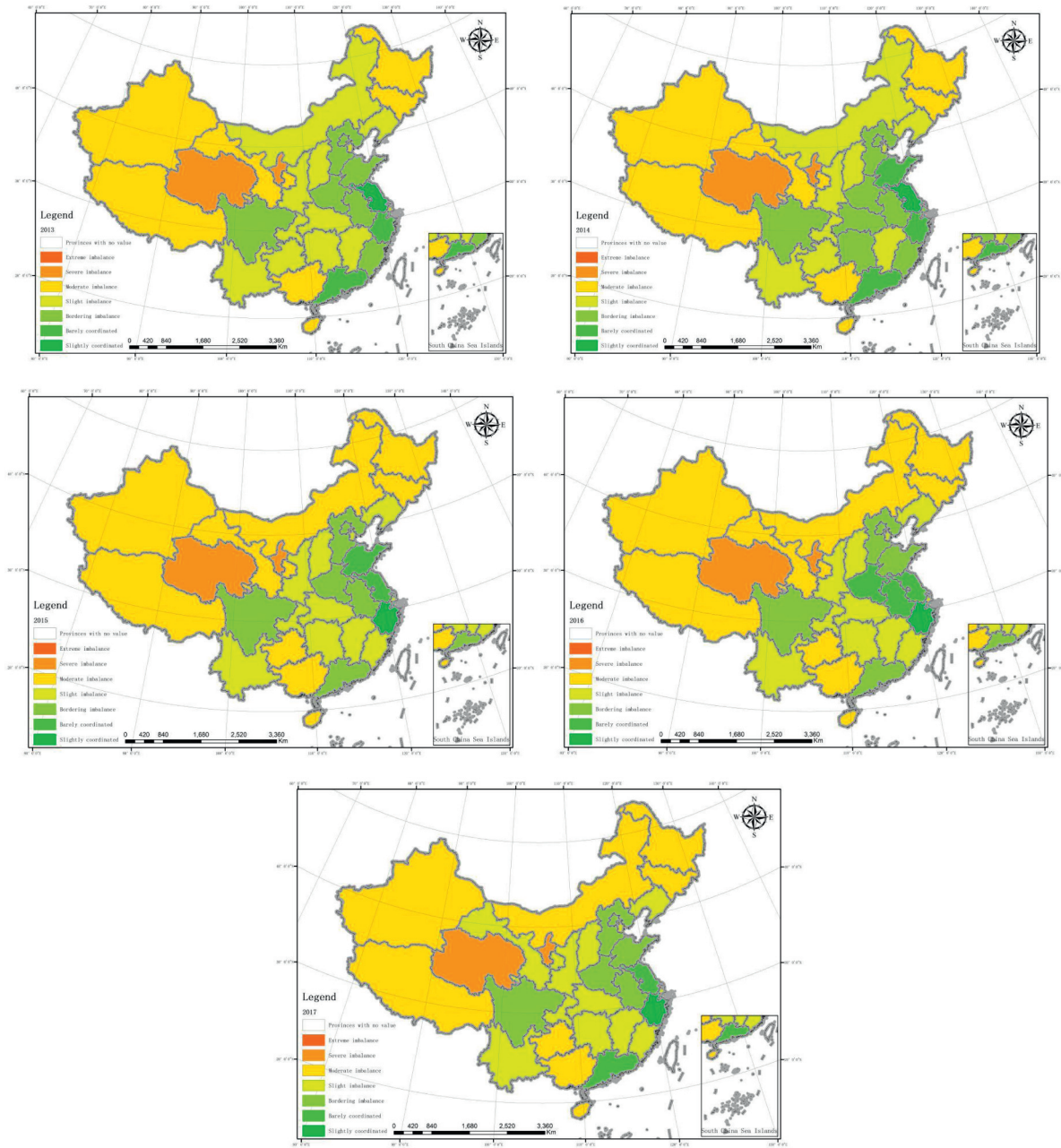
Figure 2: Coupling coordination grade of the CST industries in China's provinces from 2013 to 2017.

were minor and were distributed normally for the provinces. With the exception of a few provinces graded as severe imbalance and moderately coordinated, most were in the range of bordering imbalance to barely coordinated. Specifically, Inner Mongolia dropped from a state of bordering to moderate imbalance, and eastern China briefly upgraded from bordering imbalance to barely coordinated in 2016, before returning to the former grade the next year, whereas for the other provinces, the changes were minimal. Although the synergistic development across the CST industries has been widely debated, the lack of practical experience implies lagged effects of related economic policies.

Nevertheless, the coupling coordination degree in eastern China was much higher than the national average level with small but steady growth over the years. For example, in Zhejiang, Guangdong, Jiangsu, and Shandong, the degree increased moderately from 2013 to 2016 to the "coordinated" grade. Owing to stable growth, the degree was slightly higher than the national average in central China and was converging to the coordinated grade. In northeastern and western China, the degree improved too slowly to prevent imbalance, implying a considerable space for improvement.

This study employed the global spatial autocorrelation technique to explore the spatial characteristics and

aggregation effects of the coupling coordination degree of the CST industries in China's provinces. ArcGIS 10.2 (Esri, Inc., Redlands, CA, USA) was used to calculate the global Moran's I index, which reflects the global autocorrelation of the coupling coordination degree, as shown in Table 4. The values of global Moran's I for the coupling coordination degree of CST industries from 2013 to 2017 were all positive with $Z(I) > 3.5508$ and $P(I) < 0.001$, indicating that the coupling coordination degree had a significant spatial aggregation potential. Over the years, global Moran's I from 2013 to 2017 showed a wave-like movement. It was up from 2013 to 2014, down from 2014 to 2015, up from 2015 to 2016, and down again from 2016 to 2017, with a general upward trend. Notably, the peaks in 2014 and 2016 suggest that government policies had a positive role in increasing spatial autocorrelation. Moreover, the consistently positive values of $Z(I)$ from 2013 to 2017 indicate that the coupling coordination degree of China's CST industries had positive spatial autocorrelation. Given the spatial agglomeration and positive correlation, geographically neighbouring provinces had notable "proximity dependence" effects. More precisely, hot spots and cold spots are used to describe the distinctive spatial agglomeration forms.

The global spatial autocorrelation analysis revealed a general spatial agglomeration characteristic for the synergistic development of China's CST industries. To better analyse the evolution of local hot spots, based on the natural break classification in ArcGIS 10.2 (Esri, Inc., Redlands, CA, USA), we classified the provinces into the categories of cold spots, sub-cold spots, average spots, sub-hot spots, and hot spots. Figure 3 presents the results.

In general, the evolution of the spots can be characterised as follows. The number of hot spots, most in eastern China, increased moderately, particularly in inland areas. In the case of Anhui, surrounded by hot spots, the province was upgraded from a sub-hot spot to an emerging hot spot. The area of some cold spots decreased to a certain extent, notably in provinces along the national border and in western China. However, Tibet, Qinghai, Ningxia, and Heilongjiang remained consistent cold spots.

Moreover, the hot spots and sub-hot spots gradually expanded from eastern China to central and southwestern China, and from coastal provinces bordering the Yellow Sea and the East China Sea to those along the Yangtze River. Specifically, the hot spots in 2013 were Shandong, Jiangsu, Zhejiang, Henan, and Guangdong, whereas the sub-hot spots were Beijing, Hebei, Anhui, Hubei, Fujian, and Sichuan. In 2017, the hot spots were Anhui, Shandong, Jiangsu, Zhejiang, Henan, and Guangdong, and the sub-hot spots were Beijing, Shanghai, Chongqing, Hebei, Anhui, Hubei, Hunan, Fujian, and Sichuan. The results are encouraging signs of continuous, albeit moderate, improvement. In these spots, the synergistic development across CST industries was relatively satisfactory with mutual promoting effects among the provinces.

In contrast, the area of cold spots shrank, mostly in provinces along the border and in western China. More precisely, in 2013, the cold spots were Tibet, Qinghai, Ningxia, Heilongjiang, and Jilin, whereas the sub-cold spots

were Tianjin, Inner Mongolia, Gansu, Xinjiang, Guizhou, Guangxi, and Hainan. By 2017, although the total number of cold and sub-cold spots did not change notably, the cold spots covered only Tibet, Qinghai, Ningxia, and Heilongjiang, whereas the sub-cold spots were Inner Mongolia, Gansu, Xinjiang, Guizhou, Guangxi, Hainan, and Jilin. How the synergistic development of CST industries in these provinces can be promoted by fully leveraging ethnic sports, culture, border trade, and border tourism along the border and in western China is a direction for future research. The key to the question may be the building of cultural, creative, and sports events, and exhibiting intellectual property (IP).

3.3. Factors Driving the Coupling and Coordination among the Culture, Sports, and Tourism Industries. As three complex systems, the CST industries are influenced by numerous factors during the synergistic development, such as their industrial development levels, population, transportation, resources, and the economy. In this study, GeoDetector was used to determine the influences of 21 indicators of six driving factors (industrial pulling force, population supporting force, consumer purchasing power, transportation pushing force, resource attraction force, and economic driving force) on the synergistic development of the CST industries. The previously obtained comprehensive development index of these industries was used to measure the industrial pulling force. The regional population supporting force was calculated using the data of the total population, the natural rate of growth, and employment. The number of people aged 15–64 years, per capita disposable income of residents, and per capita consumption expenditure of residents were used to measure the consumer purchasing power. Highway and railway mileage, public finance expenditure on transportation, and the total fixed asset investment (transportation, storage, and postal industry) were employed to gauge the transportation pushing force. To calculate the resource attraction force, the indicators were public finance expenditure on culture, sports, and media, business services, and others; and fixed asset investment in water conservation, environment, and the public facility management industry, and the catering and accommodation industry; and the culture, sports, and entertainment industry. We also used GDP per capita, tertiary sector GDP, and the latter as a percentage of total GDP to gauge the economic driving force.

The quick cluster analysis method in SPSS 24.0 (SPSS Inc., Chicago, IL, USA, 2019) was used to divide the driving factors of industrial pulling force, population supporting force, consumer purchasing power, transportation pushing force, resource attraction force, and economic driving force into five categories. Subsequently, the GeoDetector analysis program was used to calculate the effects of each driving factor on the synergistic development of the CST industries. The results are shown in Table 5.

In Table 5, the value of q reflects the extent to which the determining factor explains and affects the synergistic development of the CST industries. The higher the value of q, the higher the influence of the factor on the

TABLE 4: Global autocorrelation analysis of coupling coordination degree of China's CST industries.

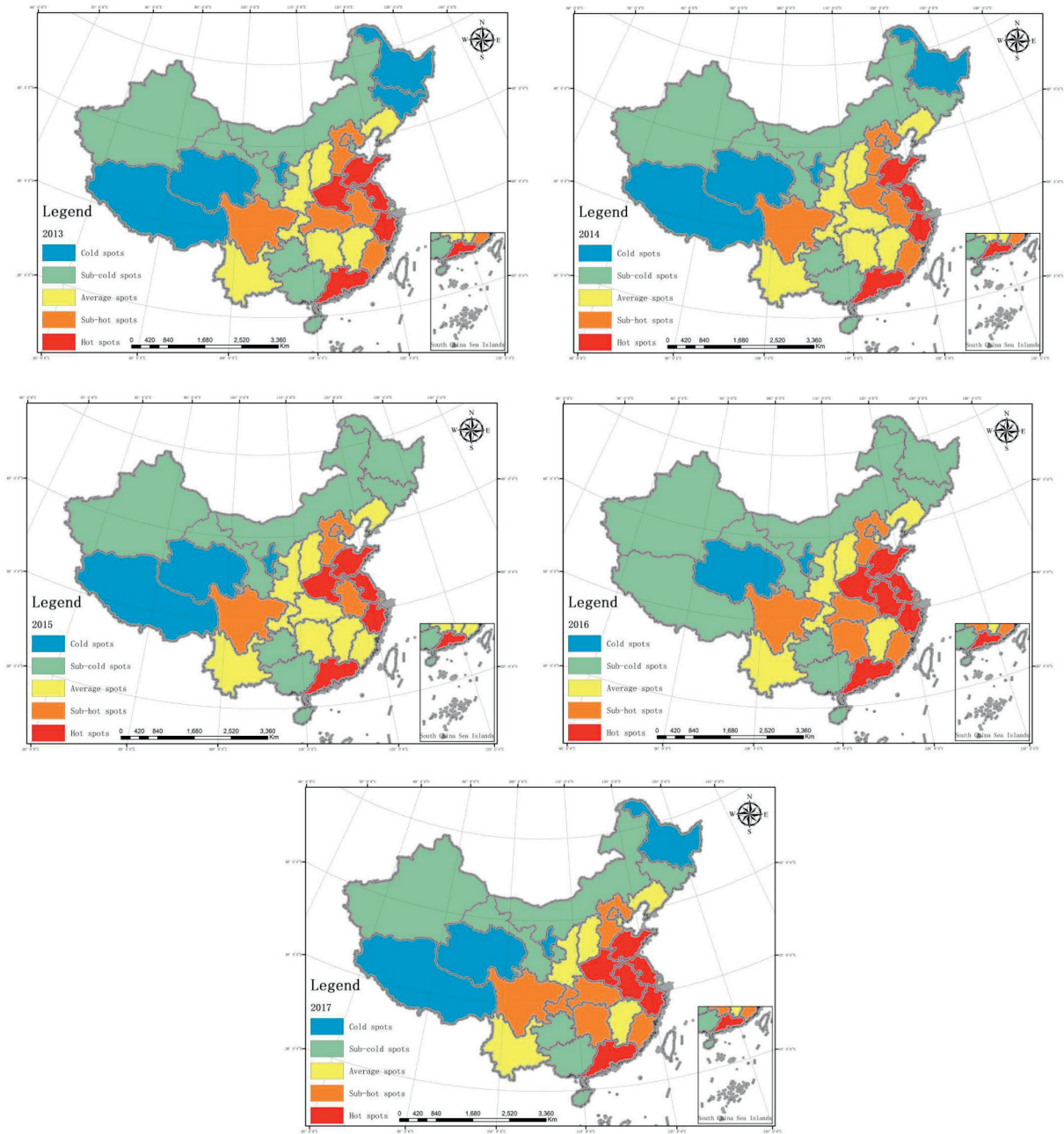| Year	Global Moran's I	$Z(I)$	$P(I)$	Spatial distribution
2013	0.3968	3.5508	0.001	Highly concentrated
2014	0.4469	3.9462	0.001	Highly concentrated
2015	0.4278	3.7766	0.001	Highly concentrated
2016	0.4546	4.0531	0.001	Highly concentrated
2017	0.4346	3.8660	0.001	Highly concentrated

FIGURE 3: Cold to hot spots of synergistic development of CST industries in China's provinces from 2013 to 2017.

synergistic development. In contrast, when the value is lower, so is the impact. In general, among the six driving forces detected, the factors with the highest to lowest influence on the synergistic development of the CST industries were industrial pulling force (0.736>); resource attraction force (0.551>); population supporting force (0.540>); consumer purchasing power (0.395 > economic driving force (0.380>)); and

TABLE 5: Driving factors affecting the synergistic development of CST industries (q value).

Driving factors	Detecting indicators	2013	2014	2015	2016	2017	Mean
Industrial pulling force	Sports industry development	0.639	0.648	0.621	0.669	0.637	0.643
	Tourism industry development	0.792	0.766	0.836	0.840	0.815	0.810
	Culture industry development	0.763	0.712	0.777	0.792	0.734	0.756
Population supporting force	Total population (year-end)	0.593	0.586	0.555	0.530	0.573	0.568
	Natural rate of growth	0.494	0.184	0.394	0.168	0.153	0.278
	Employment	0.822	0.771	0.787	0.751	0.735	0.773
Consumer purchasing power	Number of people aged 15–64 years	0.672	0.604	0.558	0.553	0.569	0.591
	Per capita disposable income of residents	0.362	0.355	0.404	0.372	0.397	0.378
	Per capita consumption expenditure of residents	0.234	0.191	0.218	0.220	0.221	0.217
Transportation pushing force	Highway mileage	0.131	0.120	0.102	0.115	0.131	0.120
	Railway mileage	0.182	0.172	0.148	0.148	0.136	0.157
	Public finance expenditure (on transportation)	0.474	0.417	0.500	0.606	0.422	0.484
	Total fixed asset investment (transportation, storage, and postal industry)	0.628	0.546	0.647	0.443	0.479	0.549
Resource attraction force	Public finance expenditure (on culture, sports, and media)	0.657	0.670	0.695	0.502	0.471	0.599
	Public finance expenditure (on business services and others)	0.791	0.685	0.742	0.578	0.585	0.676
	Fixed asset investment (water conservation, environment, and public facility management industry)	0.524	0.523	0.432	0.418	0.479	0.475
	Fixed asset investment (catering and accommodation industry)	0.525	0.427	0.516	0.392	0.447	0.461
	Fixed asset investment (culture, sports, and entertainment industry)	0.623	0.582	0.507	0.497	0.498	0.542
Economic driving force	GDP per capita	0.334	0.382	0.374	0.317	0.406	0.363
	Tertiary sector GDP	0.808	0.712	0.719	0.664	0.749	0.730
	Tertiary sector GDP as a percentage of total GDP	0.063	0.030	0.041	0.045	0.061	0.048

Note: data of the selected indicators are from the China Statistical Yearbook.

transportation pushing force (0.328>). The details are provided as follows:

(1) Industrial pulling force: the GeoDetector analysis results showed that the means of q values for the development of the culture, sports, and tourism industries were 0.756, 0.643, and 0.810, respectively. Overall, industrial development was the most important factor affecting the synergistic development of CST industries. Specifically, owing to the recent development, the rapid expansion of individual industries is a prerequisite to achieving the results of $1 + 1 > 2$ and $1 + 1 + 1 > 3$. Among them, the q value of tourism industrial development was the highest. In terms of the current path for the synergistic development of the CST industries, characteristic streets and towns, scenic parks, and sports events are dominant product forms. For any of the forms, the pulling force of the tourism industry is more prominent than the sports and culture industries [28]. Furthermore, the culture industry helps the above characteristic business forms to remove the restriction of natural resources and reduce their dependence on the environment, thereby enabling integrated products to surge ahead [29].

(2) Resource attraction force: Iin terms of their effects on the synergistic development of the CST industries in descending order, the five indicators are public finance expenditure on business services and others (0.791>); public financial expenditure on culture, sports, and media (0.657>); fixed asset investment in culture, sports, and entertainment industries

(0.623>); fixed asset investment in catering and accommodation industries (0.525>); and fixed asset investment in water conservation, environment, and public facility management industry (0.524). The values of q were all higher than 0.5, indicating that the resource attraction force is also a critical factor affecting the synergistic development of the CST industries. Resource factors play a decisive role in the development of the CST industries as, to a certain extent, the purpose of the synergistic development is to use stock resources efficiently, innovate resource allocation, and realise the maximum utility of limited resources [30].

(3) Population supporting force: the mean of q values for employment was 0.773 and that for the total population was 0.568. In contrast, that for the natural rate of growth was only 0.278. The results indicate that population supporting force has an important impact on the synergistic development of the CST industries, where employment and the total population are even more critical. Generally, the size of the population is the most critical factor for a market, directly determining the conceivable capacity of the potential target market. Furthermore, the expansion of population size could accelerate the accumulation of local human capital, which is a necessary condition for the rapid development of CST industries [31]. The population age structure and employment structure are also determinants of economic growth and industrial transformation, and employment is the soft condition of industrial development [32].

(4) Consumer purchasing power: the mean of q values of the number of people aged 15–64 years was 0.591, that of per capita disposable income of residents was 0.378, and that of per capita consumption expenditure of residents was 0.217. The results imply that consumer purchasing power has an important impact on the synergistic development of the CST industries; however, the number of people aged 15–64 years is more important. This development caters for the higher-level consumption demands and implies expanding consumption space. Therefore, monotonous consumer demand and the weak consumption power of residents affect the synergistic development process [33].

(5) Economic driving force: the mean of q values for per capita GDP was 0.363 and that for tertiary sector GDP was 0.730, whereas that for the tertiary sector GDP as a percentage of total GDP was only 0.048. Although the economic driving force can drive the synergistic development of the CST industries to a certain extent, the effect from the tertiary sector's GDP as a percentage of total GDP was minimal. The synergistic development of CST industries is necessary for improving the quality of economic development. Therefore, the economic development level and economic comprehensive contribution are the major factors affecting the synergistic development [28]. Capital input is conducive to improving local infrastructure. The tertiary sector GDP reflects the development level of the service industry, whereas enhanced living and tourism services are beneficial to the development of the CST industries.

(6) Transportation pushing force: the four indicators with the highest to lowest influence on the synergistic development of the CST industries were total fixed asset investment (transportation, storage, and postal industry) 0.549> public finance expenditure (on transportation) 0.484> railway mileage 0.157> highway mileage 0.120. The lower values for railway mileage and highway mileage imply that, although the two factors affect the synergistic development of the CST industries, the impact is limited. Transportation infrastructure is a prerequisite for the rapid development of the tourism industry [34]. It had a considerable impact on sports tourism and cultural tourism; however, its effect on the sports culture industry (e.g., sports and arts performances) may not be so prominent.

4. Discussion and Conclusion

4.1. Conclusions. The synergistic development of CST industries is crucial to boosting consumer demand for all three industries, improving the quality of the national economy, and promoting cultural innovation. This provincial-level study used data related to the CST industries of provinces in China from 2013 to 2017. With a coupling coordination model, we calculated the development level index, coupling degree, and coupling coordination degree of CST industries. Subsequently, we explored the spatial characteristics of the synergistic development using the global autocorrelation technique and identified the hot spots, sub-hot spots, sub-cold spots, and cold spots by leveraging the hot and cold spots analysis technique. Finally, GeoDetector was employed to identify the key driving factors affecting the synergistic development of the CST industries. The findings can be summarised as follows:

(1) The synergistic development of China's CST industries was generally stable in a state of a slight imbalance. In terms of the development level of the three industries, the growth of the sports industry was notable, the tourism industry remained stable, whereas the culture industry decreased slightly. In 2013, both the culture and sports industries lagged behind. However, after 2013, only the culture industry was straggling. In general, the synergistic development of the CST industries in China is still in the nascent stage, and accordingly, improving the development level of the three industries further could enhance the synergistic development.

(2) Notable spatial characteristics in the synergistic development of the CST industries were determined. The differences among these industries across provinces in China were substantial. The general spatial characteristics were at a low development level in northeastern and western China, at a stable and average level in central China, and at a high level in eastern China. The global spatial autocorrelation results showed that the synergistic development of the CST industries had a distinctive "proximity dependence" effect reflected by a notable spatial agglomeration feature and a positive spatial autocorrelation trend. Anhui, Shandong, Jiangsu, Zhejiang, Henan, and Guangdong were hot spots for the synergistic development of CST industries. In contrast, Tibet, Qinghai, Ningxia, and Heilongjiang were cold spots.

(3) The GeoDetector results showed that 21 indicators of six driving factors affect the CST industries' synergistic development. The six factors in the descending order of their influence are industrial pulling force > resource attraction force > population supporting force > consumer purchasing power > economic driving force > transportation pushing force. Among the indicators, the q values for the development of the CST industries, the total population (year-end)

employment, number of people aged 15–64 years, total fixed asset investment (transportation, storage, and postal industry), public finance expenditure on culture, sports, and media, and business services and others, fixed asset investment (cultural, sports, and entertainment industry), and tertiary sector GDP were higher than 0.5, whereas that for tertiary sector GDP as a percentage of total GDP was less than 0.1.

4.2. Discussion. The synergistic development of the CST industries would not be possible without the following three prerequisites: (1) the spatial and temporal coupling of production factors of the CST industries; (2) the business formats generated through integration that can cater to a high level of demand; and (3) common interests and market convergence points for CST industries. The synergistic development of the CST industries offers both explicit and implicit benefits. Explicit benefits include diversifying the tourism product system, expanding tourism consumption space, and promoting the transformation of the tourism industry. The implicit benefits comprise enhanced supply quality of CST industries and optimised supply structure. Culture provides content products and creative thinking for tourism, whereas tourism offers the channel to communicate culture and convert it into saleable goods. Culture brings spiritual connotations and functions as a communication platform for sports, whereas sport builds a consumption market and offers themes and elements for culture. Sports provide content resources and a customer base for tourism, whereas tourism supports sports and utilises sports resources.

Based on the trends and spatiotemporal patterns of the synergistic development of China's CST industries, we propose the following:

(1) Accelerating the development of the cultural, entertainment, and recreational service industry: due to existing structural defects in the investment, ownership, technology, and scale, the development of the cultural, entertainment, and recreational service industry was restricted, leaving it in a state of imbalance for a long time and lagging behind the sports and tourism industries [25]. This would highlight the roles of culture by providing sports with spiritual content, style characteristics, and a communication platform as well as the role of sport in creating consumption demands, endowments, and content for culture. Furthermore, it would emphasise culture's capacity to offer content, ideas, cultural resources, and strong competitiveness to tourism, as well as the latter's contributions to culture as media of information and a path for influencing consumption demands.

(2) Strengthening regional linkage: given the strong spatial dependence of the three industries, a variety of infrastructures could be leveraged to form geographic clusters to maximise the efficacy of limited resources. The measures could be classified as adjacent region and cross-region linkage. This linkage, as suggested, requires leveraging complementary advantages of the CST industries among adjacent regions to promote large-scale development and capture the spillover effects. For example, Anhui Province has successfully turned into a hot spot in the process of building a city cluster in the Yangtze River Delta. The goal of cross-regional linkage is to narrow the gap between well-developed and less-developed regions, ultimately building and improving a synchronised development mechanism across the eastern and western regions.

(3) Devising a holistic plan that accounts for resource allocation and demographic features: industrial upgrading, synergistic development, and optimisation of resource allocation complement each other. The synergistic development of CST industries should be approached from the perspective of resource allocation to expand understanding of the definition, pattern, driving forces, and mechanisms of the synergistic development across industries. Demographic features are essential for an industry, including its sustainable development and industrial structure. Factoring in demographic features into plans will better maintain the sustainable development of the CST industries in China. Previous studies have proposed that the integration of the CST industries is driven by multiple factors to break down industry barriers and experience the dynamic development process of new business forms after the multidimensional integration of technology, business, and market [5]. Hence, the industrial pulling force and resource attraction force corresponding to technology, business, and market should be the top priorities in promoting the synergistic development of the cultural, sports, and tourism industry.

(4) Launching distinctive and high-quality products by merging CST factors to meet the growing needs for "a better life": differentiated cultural experiences, healthy and high-quality lifestyles, and quality services are all conducive to improving public consumption. By establishing a fusion model with sports and cultural resources as the centre and tourism service as the carrier [6], the integration of culture can increase the essence of sports and tourism, whereas sports and tourism can better promote the development of culture [9]. For example, meeting consumers' needs in pursuit of events, tourism, and emotional experiences in sports and fitness activities could provide them with an unforgettable experience of physical and mental pleasure.

Data Availability

The raw data supporting the conclusions of this article can be made available by the authors to qualified researchers.

Conflicts of Interest

The authors declare no conflict of interest.

Authors' Contributions

Ji Li and Yifan Zuo conceptualised the study; Ji Li, Jiabao Cui, and Qihang Qiu designed methodology; Xuan Liu provided software; Ji Li and Jiangtao Xia validated the data; Jiabao Cui investigated the study; Ji Li and Yifan Zuo curated the data; Ji Li, Jiangtao Xia, and Yifan Zuo wrote the original manuscript and prepared the draft; Ji Li, Yifan Zuo, Qihang Qiu, and Hongfa Zeng wrote, reviewed, and edited the manuscript; Ji Li visualised the data; and all authors have read and agreed to the published version of the manuscript.

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