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The Space–Time Evolution of the Coupling and Coordinated Development of Public Cultural Services and Cultural Industries: A Case Study of 31 Regions in China

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Abstract: The coordinated development of public cultural services (PCS) and cultural industries (CI) is conducive to sustainable regional development. Few studies focus on the coordinated development of PCS and CI. This study builds an evaluation index system for the coordinated development of PCS and CI and uses the entropy weight method, synchronous development model, coupling coordination model, and exploratory spatial data analysis method on 31 regions in China. It evaluates the synchronous development levels, coupling coordination levels, and spatial evolution characteristics of the coordinated development of PCS and CI from 2011 to 2020. The results are as follows: (1) The coordinated development level of PCS and CI has risen steadily. The leading type is dominant in space, with the leading type > synchronous type > lagging type. (2) The overall coupling degree is high. The high-level coupling in space is dominant. (3) The degree of coupling coordination has improved. Regions with good spatial and high-quality coordination are concentrated in the eastern, central, and coastal areas. (4) The coordinated development of PCS and CI shows positive spatial correlation agglomeration. The degree of agglomeration is increasing, mainly high high, forming an important growth region in the Yangtze River Delta economic region and its surroundings. Finally, we propose policy recommendations for the coordinated development of PCS and CI, and provide new ideas for the collaborative development of PCS and CI in China.

Keywords: public cultural services; cultural industry; entropy weight method; coupling coordination model; spatial autocorrelation

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1. Introduction

The supply of public cultural services (PCS) and the development of cultural industries (CI) are highly valued around the world. Hood pointed out in *New Public Management Theory* that we should enrich the situation of public cultural services and broaden the supply channels of public services [1]. Porte believes that it is necessary to promote the construction of a cultural power based on the actual situation of the country because cultural construction can promote social development and economic growth [2]. In their efforts to promote the development of PCS and CI, countries around the world have adopted different methods. Great Britain, for example, strengthened social participation and the management of public cultural services and implemented the Arm's Length Principle [3]. France formulated a series of tax relief policies, which have promoted the development of a PCS system and CI. The United States supports the construction of public cultural resources through foundations and other mechanisms, actively encouraging social capital and individual forces to participate in CI development and PCS supply [4]. In China, the healthy development of PCS and CI is the core task necessary for cultural prosperity. To promote the integration and development of PCS and CI, the General Office of the CPC Central Committee and the General Office of the State Council issued Opinions on Accelerating the Construction of a Modern Public Cultural Service System in 2015, pointing out that the content and form of PCS should be innovated to promote the coordinated development of cultural undertakings and CI [5]. This is the first time that the Central Committee of the Communist Party of China has made clear the integrated development of public culture and CI in the form of a document [6]. In March 2021, the Fourth Session of the Thirteenth National People's Congress voted to adopt the Fourteenth Five Year Plan for National Economic and Social Development and the Outline of Vision Goals for 2035, which clarifies that the main goals of economic and social development during the Fourteenth Five Year Plan period include making the PCS system and CI system more robust [7]. The concepts of PCS and CI are clearly defined in China's policy documents. In the Law of the People's Republic of China on the Protection of Public Cultural Services, PCS is defined as public cultural facilities, cultural products, cultural activities, and other related services provided by the government with the participation of social forces to meet the basic cultural needs of citizens [8]. CI is defined in the Classification of Culture and Related Industries (2018) as referring to all the production activities that provide cultural products and culturally related products to the public [9]. PCS and CI are one core and two wings of the construction of a socialist cultural power. They must be developed in a coordinated way. Although these policies have been promoted, there are still some problems in the development of PCS and CI in China. Hu's research found that before 2016, there was a phenomenon of the "two skins" of PCS and CI in China's cultural construction. The low degree of integration and insufficient synergy between the two resulted in insufficient internal development momentum of cultural construction [10]. Therefore, to discuss the current situation and characteristics of collaborative development of PCS and CI, this study measures and analyzes the level of their coupling and spatial coordination, and takes 31 regions in China as examples to measure, analyze and identify the weak links of their coupling and collaborative development and provide new ideas for the collaborative development of PCS and CI in the world.

Since the 1990s, international scholars have studied the connotation and significance of industrial integration from the perspective of the integration of cultural CI and other industries. Pine et al. proposed that in the experience era, the tourism industry uses cultural creative processes and means to guide tourists' experiences, creating new economic values [11]. Rogerson took South Africa as an example to study the promotion of creative culture in urban tourism [12]. However, there are few studies on the integration of PCS and CI. Research on PCS and CI mainly focuses on the theoretical discussion of their integration and development relationship. For example, Galloway et al. believed that CI has not only commercial attributes but also public product attributes. Therefore, the government should give full play to its role and attach importance to its public product attributes [13]. Yetano pointed out that the government can effectively promote CI to show their public attributes, provide strategic guidance for CI development, and make the development of CI consistent with market law [14]. Some scholars conducted policy analysis. Hebron, in the book *Economics of Art and Culture*, proposed that one of the important goals of American public cultural policy is to improve the participation rate of all citizens in art and culture. The government determines the supply and management levels of public services and public goods, the cornerstone of citizen participation. Some scholars have discussed PCS from the perspective of public management [15]. Rice discussed the cultural capacity of public service provision and proposed the cultural capacity model of public service provision [16].

PCS and CI are interdependent, and the coordinated development of the two has gradually attracted the attention of Chinese scholars. On the relationship and path of integrated development, Liu, who researched the collaborative development of PCS and CI, took Weinan's "One Yuan Theater" as a case to illustrate that public cultural services can produce cultural industry effects and that there is a "co-prosperity" relationship between the two [17]. Later, Hu used the theory of supply and demand to propose that PCS can promote the demand cultivation and demand release of CI at the demand level, and PCS can optimize human resources and technical resources for the development of CI at the supply level [18]; Hu used theoretical analysis methods to discuss the internal logical relationship between PCS and CI from the aspects of evolutionary origin, realization conditions, functional positioning, and dynamic mechanisms [10]; Li clarified the separation and interactive development space between PCS and CI, and proposed an integration path [19]. Since then, relevant empirical research has focused on two aspects. The first is the analysis of the time–space characteristics of the interaction between public service and economic development. For example, scholars such as Liu et al. used the coupling coordination model to identify the coupling coordination degree characteristics of public service and economic development [20]. Ma et al. studied the spatiotemporal evolution characteristics of the coupling and coordination of basic public services, regional economy, and urbanization by using coupling and coordination models, geographical detectors, and other methods [21]. Zhang et al. used the spatial Dubin model and dynamic spatial convergence model to analyze the space–time distribution, influencing factors, and convergence characteristics of China's public service supply level [22]. The second aspect is measurement research on CI development. For example, Wang et al. analyzed the efficiency and space–time evolution characteristics of China's CI from 1998 to 2018, using the Tobit model to identify factors influencing the efficiency of the cultural industry [23]. Wei et al. used the projection pursuit model to measure and regionally analyze the high-quality development of China's cultural industries and analyze the development obstacles and constraints of different regions [24].

In short, there is a lack of studies using models to conduct quantitative research on the coupling and collaborative development of PCS and CI. Research mainly focuses on qualitative analysis of the collaborative development of PCS and CI. Quantitative research on the coupling and collaborative development of PCS and CI using models is relatively rare. The research objects are mainly single PCS or CI, and there are few spatiotemporal analyses comparing their data horizontally and vertically. The 19th National Congress of the Communist Party of China proposed the idea of CD, which could encourage China's current industrial system to move swiftly toward a modern industrial system [25]. The collaborative development relationship between PCS and CI has been recognized by scholars. For example, Li believes that the interactive development space between PCS and CI should be clarified to better promote their coordinated and interactive development [19]. Huang et al. found that PCS and CI have many commonalities and connections. Collaborative development can foster a creative ecology and promote economic transformation and upgrading [26]. Therefore, this study uses an evaluation index system, a synchronous development model, a coupling coordination degree model, Moran's index, and other methods to quantitatively evaluate the collaborative development level of PCS and CI in 31 regions of China for 10 consecutive years. This study seeks to solve three problems: (1) building the evaluation index system of the collaborative development of PCS and CI in China; (2) analysis of the development trend and types of PCS and CI in China from 2011 to 2020; (3) the coupling and coordination relationship between PCS and CI in China and their spatial characteristics. Through the investigation and analysis of these three issues, the key nodes restricting the coordinated development of PCS and CI coupling will be found, and ways to improve this situation will be explored.

2. Materials and Methods

2.1. Indicator Selection

PCS covers a wide range of fields and contains many elements. Therefore, there is no unified evaluation index system or evaluation method. Most scholars build an indicator system based on the needs of their research. For example, Su et al. found that a PCS performance system includes public cultural services, public cultural facilities, and public cultural activities [27]. Xia et al. believed that the contents of PCS include public cultural institutions, public cultural products, and public cultural activities and services [28]. Zhou et al. proposed that public cultural products, public cultural infrastructure, public cultural funds, and cultural talents are the basic contents of PCS [29]. This study draws on existing research and combines the definitions of PCS to divide the PCS system into three aspects: public cultural facilities, public cultural services, and public cultural activities [30–32]. The secondary indicators are derived from the Law of the People's Republic of China on the Protection of Public Cultural Services, which selects the institutions and PCS facilities closely related to this study. Among them, the basic indicators for measuring public cultural facilities include the number of public libraries, the total book collection, the number of terminals in electronic reading rooms, the number of seats in reading rooms, the number of museums, the number of cultural relics, and the number of cultural relic protection and management institutions. The basic indicators to measure public cultural services include the number of public library readers with certificates, the per capita possession of public library collections, the building area of public libraries per 10,000 people, the proportion of public library practitioners, and the proportion of museum practitioners. The basic indicators for measuring public cultural activities include the total circulation of people, the number of books and periodicals borrowed, the number of national reading activities held, and the number of museum visitors [33,34].

The quantitative evaluation of existing CI focuses on the evaluation of development level and competitiveness. For example, Zhao et al. measured cultural output, market income, cultural strength, cultural consumption, infrastructure, and cultural resources [35]. Wei et al. evaluated four aspects: development environment, development level, development impetus, and development basis [36]. CI is a system composed of multiple elements, and a single economic indicator cannot be comprehensively evaluated. Therefore, based on existing research results [37,38], this study constructs a CI evaluation indicator system from the perspective of CI supply in terms of scale, personnel, and operation. Among them, various indicators refer to the breakdown of CI in the *China Statistical Yearbook* and *Classification of Culture and Related Industries* (2018), and select cultural and related organizations above a designated size, cultural social organizations, art performance organizations, publishing and printing institutions, electronic publications and other institutions, with data that can reflect their number, size, personnel, and operation as evaluation indicators (Table 1).

Table 1. Evaluation Index System for Collaborative Development of public cultural services (PCS) and cultural industries (CI).

Type	Level I Indicators	Secondary Indicators	Weight
PCS	Facilities	Number of public libraries (Nos.)	0.0226
		Total book collection (10,000 copies)	0.0457
		Number of terminals in electronic reading room (set)	0.0235
		Number of seats in the reading room (Nos.)	0.0326
		Number of museums (Nos.)	0.0326
		Number of cultural relics (piece/set)	0.0669
		Number of cultural relics protection and management institutions (Nos.)	0.0966
	Service	Number of readers with certificates in public libraries (10,000)	0.1003
		Per capita possession of public library collections (volumes)	0.0527
		Building area of public library per 10,000 people (m^2)	0.0326
		Proportion of employees in public libraries	0.1124
		Proportion of museum employees	0.0447
	Activities	Total circulation person times (10,000 person times)	0.0712
		Number of books and periodicals borrowed (10,000)	0.0720
		Number of national reading activities held (times/year)	0.0504
		People who participated in national reading activities (10,000 people)	0.0791
		Museum visitors (10,000)	0.0537

Table 1. *Cont.*

Type	Level I Indicators	Secondary Indicators	Weight
CI	Scale	Number of corporate units of culture and related industries above designated size (Nos.)	0.0718
		Number of cultural social organizations (Nos.)	0.0982
		Number of arts performance venues (Nos.)	0.0434
		Number of artistic performance groups (Nos.)	0.0602
		Number of publishing and printing enterprises (Nos.)	0.0387
		Number of book publishing institutions (Nos.)	0.0283
		Annual average types of publications (species)	0.0379
		Number of electronic publications published (volume)	0.0848
		Number of radio and TV programs (sets)	0.0260
	Personnel	Proportion of employees in culture and related industries	0.0610
		Proportion of employees in arts performance groups	0.0392
		Proportion of book publishing employees	0.0595
		Proportion of publishing and printing employees	0.0537
	Operation	Per capita operating income of culture and related industries (CNY/person)	0.0881
		Proportion of culture and related industries in GDP	0.0508
		Visitors to arts performance venues (10,000)	0.0739
		Performance times of arts performance groups (10,000 times)	0.0845

2.2. Data Source

According to the principles of science and data availability, PCS and CI data mainly come from the *China Statistical Yearbook*, *Cultural and Related Industries Statistical Yearbook*, Chinese Cultural Relics Statistical Yearbook, provincial statistical yearbooks, and statistical bulletins. Based on the availability of data, the survey data are taken from 2010 to 2020. The moving average method is adopted to supplement missing data in some years [39]. The spatial scope is selected from 31 provinces (autonomous regions, municipalities directly under the Central Government) in China. Hong Kong, Macao, and Taiwan are not included in the spatial scope of this study due to a lack of data.

2.3. Research Methods

2.3.1. Entropy Weight Method

The entropy weight method is used to calculate the evaluation index weight of the development level of PCS and CI. The weighted sum is used to synthesize the collaborative development level of PCS and CI. The specific implementation steps are as follows [40]:

The first step is to standardize the data.

$$A_{ij} = \frac{X_{ij} - \min(X_{ij})}{\max(X_{ij}) - \min(X_{ij})} \tag{1}$$

$$A_{ij} = \frac{\max(X_{ij}) - X_{ij}}{\max(X_{ij}) - \min(X_{ij})} \tag{2}$$

The original index data in the measurement system are standardized by the extreme value method. In Formulas (1) and (2), $i(i = 1, 2, \ldots, n)$ represents a year; $j(j = 1, 2, \ldots, m)$ represents the region; X_{ij} represents the original index; A_{ij} represents the measurement index value after standardization processing; $\max(X_{ij})$, $\min(X_{ij})$ represent the maximum and the minimum values of X_{ij}, respectively. If the indicator attribute X_{ij} is a positive indicator, Formula (1) applies; if the indicator attribute X_{ij} is a negative indicator, Formula (2) applies.

The second step is to calculate the weight. In Formulas (3) and (4), P_{ij} is the proportion of index j in the ith year, W_j is the entropy value of j indexes, and λ_{ij} is the index weight. The calculation formula is:

$$P_{ij} = \frac{A_{ij}}{\sum\limits_{i=1}^{n} A_{ij}}, W_j = \ln\frac{1}{n}\sum_{i=1}^{n}\left[\left(P_{ij}\right)\ln\left(P_{ij}\right)\right] \tag{3}$$

$$\lambda_{ij} = \frac{\left(1 - W_j\right)}{\sum\limits_{j=1}^{m}\left(1 - W_j\right)} \tag{4}$$

The third step is a comprehensive evaluation index.

$$u_1 = \sum_{i=1}^{m} \lambda_{ij} A_{ij}, u_2 = \sum_{i=1}^{m} \lambda_{ij} B_{ij}, \sum_{i=1}^{m} \lambda_{ij} = 1 \tag{5}$$

In Formula (5), A_{ij} is the result of a PCS index using normalization to eliminate dimension and order of magnitude; B_{ij} is the result of a CI index using normalization to eliminate dimension and order of magnitude; u_1 is the comprehensive evaluation index of PCS development level; and u_2 is the comprehensive evaluation index of CI development level.

2.3.2. Synchronous Development Model

The synchronous development model can analyze the synchronization characteristics of the two systems under the overall coupling coordination degree.

$$E = u_1 - u_2 \tag{6}$$

As Formula (6) shows, E represents the synchronous development index of PCS and CI, $E < -0.1$ represents that PCS lags behind CI, $E \in [-0.1, 0.1]$ represents the synchronous development of PCS and CI, and $E > 0.1$ represents that PCS is ahead of the synchronous development index [41,42].

2.3.3. Coupling Coordination Model

Coupling refers to the phenomenon in which two or more systems interact with each other due to the interaction between key factors in the operation process, leading to mutual influence and combination between systems, and identifying the interdependence and close cooperation of various elements between systems [43]. The degree of coordination refers to the degree of benign coupling in the coupling interaction relationship, potentially reflecting the quality of coordination. The measurement model of coupling coordination degree for the collaborative development of PCS and CI is:

$$C = \frac{\sqrt{(u_1 \times u_2)}}{(u_1 + u_2)}, T(u_1, u_2) = au_1 + bu_2 \tag{7}$$

$$D(u_1, u_2) = \sqrt{C(u_1, u_2)T(u_1, u_2)} \tag{8}$$

In Formulas (7) and (8), C represents the coupling degree of the collaborative development of PCS and CI. The value range of C is [0,1]. When $C = 0$, the coupling degree is at the minimum, and when $C = 1$, the coupling degree is at the maximum. B is the contribution share to the collaborative development of the overall PCS and CI; both values are 0.5. D represents the coupling and coscheduling of the CD of PCS and CI. The value range of D is [0,1]. The closer D is to 1, the better the CD of PCS and CI, and the closer D is to 0, the more serious the imbalance between them. In combination with the existing research [44], the degree of coupling coordination is classified. Based on relevant research [45], the degree of coupling coordination is divided into four grades: low coordination of $D \in [0.0, 0.3]$, medium coordination of $D \in [0.3,0.5]$, good coordination of $D \in [0.5,0.7]$, and high-quality coordination of $D \in [0.7,1]$, as Table 2 shows.

Table 2. Classification of coupling coordination degree.

Coupling Coordination Level	*D* Value Range
Low coordination	$D \in [0.0,0.3]$
Moderate coordination	$D \in [0.3,0.5]$
Good coordination	$D \in [0.5,0.7]$
High-quality coordination	$D \in [0.7,1]$

2.3.4. Exploratory Spatial Data Analysis (ESDA)

ESDA is used to identify the spatial correlation pattern, institutional differences, and other spatial instabilities of various elements through spatial location [46]. The ESDA model includes two types of analysis tools, global spatial autocorrelation and local spatial autocorrelation, as in Formulas (9)–(11).

The formula for calculating the global Moran's I is [47]:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} G_{ij} H_i H_j}{\sum_{i=1}^{n} H_i^2} \tag{9}$$

$$S_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} G_{ij}, H_I = \frac{I - E[I]}{\sqrt{V[I]}} \tag{10}$$

The calculation formula of the local Moran's index is:

$$I_i = \frac{(n-1) H_i \sum_{j=1}^{n} G_{ij} H_j}{\sum_{j=1, j \neq i}^{n} H_i^2} \tag{11}$$

In Formula (11), H_j represents the deviation between the attribute of region i and the average value; G_{ij} represents the spatial weight between region i and j; $n = 31$, that is, 31 regions; S_0 is the aggregation of weights of all regions; I is the overall Moran's index for the CD of PCS and CI; and I_i is the local Moran's index. The value range of Moran's I is -1~1. When Moran's I = 0, it indicates that the space presents randomness. Moran's I > 0 indicates positive spatial correlation, and the larger the value, the more obvious the spatial correlation. Moran's I < 0 indicates negative spatial correlation. The smaller the value, the greater the spatial difference, indicating mutual independence [48].

3. Results

3.1. Comprehensive Development Evaluation

According to the indicator data of PCS and the CI of PCS in 31 regions of China from 2011 to 2020, the comprehensive development level index of PCS and CI in China was calculated, as Figure 1 shows. The composite index of PCS and CI showed a steady growth trend, and the composite index of PCS was significantly higher than that of CI. The comprehensive development level index of PCS rose from 0.288 in 2011 to 0.354 in 2020. CI's comprehensive development level index rose from 0.131 in 2011 to 0.202 in 2020. The concept of PCS was first mentioned in 2005. Since then, the goal of PCS construction in China has been increasingly clear, and the construction of a PCS system has been steadily promoted. Since 2010, relevant PCS have shown explosive growth. The policy release involves 26 administrative departments. The policy content covers macroplanning, system reform, resource allocation, talent training, social participation, funding, and security, actively promoting the all-round development of PCS [49]. In terms of CI, since the promulgation of the Cultural Industry Revitalization Plan in 2009, the CI have become China's national strategic industries, and CI policies have been successively introduced [26]. In 2012, China revised the Classification of Culture and Related Industries to redefine the classification standards and contents. In 2014, the Plan for Deepening Cultural System Reform made new arrangements for cultural reform. In 2016, the 13th Five Year National Strategic Emerging Industry Development Plan included the digital creative industry closely integrated with the cultural industry into the national strategic emerging industry development plan for the first time. In 2017, the Ministry of Culture issued the 13th Five Year Plan for the Development of Cultural Industry, which defined the main tasks, general requirements, and safeguarding measures for the development of CI during the 13th Five Year Plan period. Cultural legislation has also begun to flourish, and has successively implemented cybersecurity law, CI promotion law, and film industry promotion law. This series of policies and measures has steadily promoted CI development.

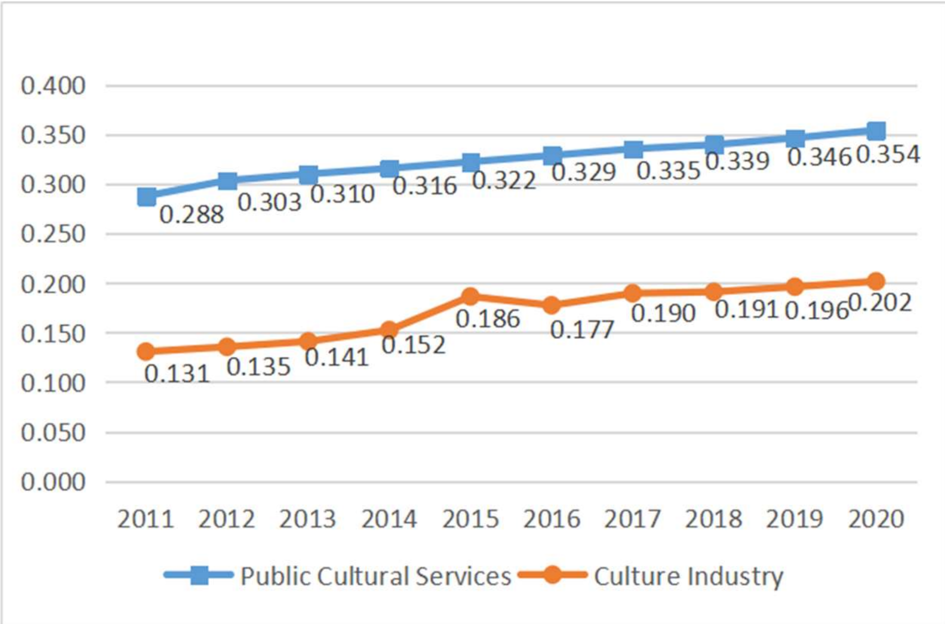

Figure 1. Comprehensive index of the development levels of public cultural services and cultural industries from 2011 to 2020.

3.2. The Space–Time Evolution of Synchronous Development

Based on existing research and the synchronous development index [50], the synchronous development of PCS and CI is divided into three types: lagging, synchronous, and advanced. As Figure 2 shows, the synchronous development of PCS and CI in China is mainly of the leading type, with the number of leading type > synchronous type > lagging type. From the perspective of lagging type change regions, in 2011, PCS lagged behind CI in Beijing and Shanghai. In 2020, lagging regions were expanded further to include Guangdong and Jiangsu. According to the 2020 Chinese Cultural Industry Series Index released by the Cultural Industry Research Institute of the Renmin University of China, Beijing ranked first, Guangdong ranked third, Shanghai ranked fourth, and Jiangsu ranked sixth in the national rankings [51], indicating that CI development in these four regions is strong and significantly higher than the PCS development level, highlighting the need for further improvement of PCS development capacity. Beijing, Guangdong, Shanghai and Jiangsu are active regions in China's economy. CI are closely related to the level of economic development and have become an important growth point of local economic development. Synchronous change regions range from eight regions in 2011 (Guangdong, Jiangsu, Zhejiang, Tibet, Hainan, Tianjin, Chongqing, Ningxia) to six regions in 2020 (Zhejiang, Hainan, Tianjin, Chongqing, Ningxia, Fujian), from which three removed regions are Guangdong and Jiangsu (from synchronous change to lagging type), and Tibet (from synchronous change to leading type). Fujian is newly added (from the advanced type to the synchronous type). The development of PCS and CI in these regions is relatively balanced. They are in a synchronous development state. From the perspective of leading type change regions, there were 21 regions where PCS were ahead of CI in 2011 and 2020, accounting for 68%, indicating that more than half of China's regional PCS development was ahead of its CI development. This shows that, under the promotion of local governments, the construction of PCS in most regions has made remarkable progress surpassing the previous development level.

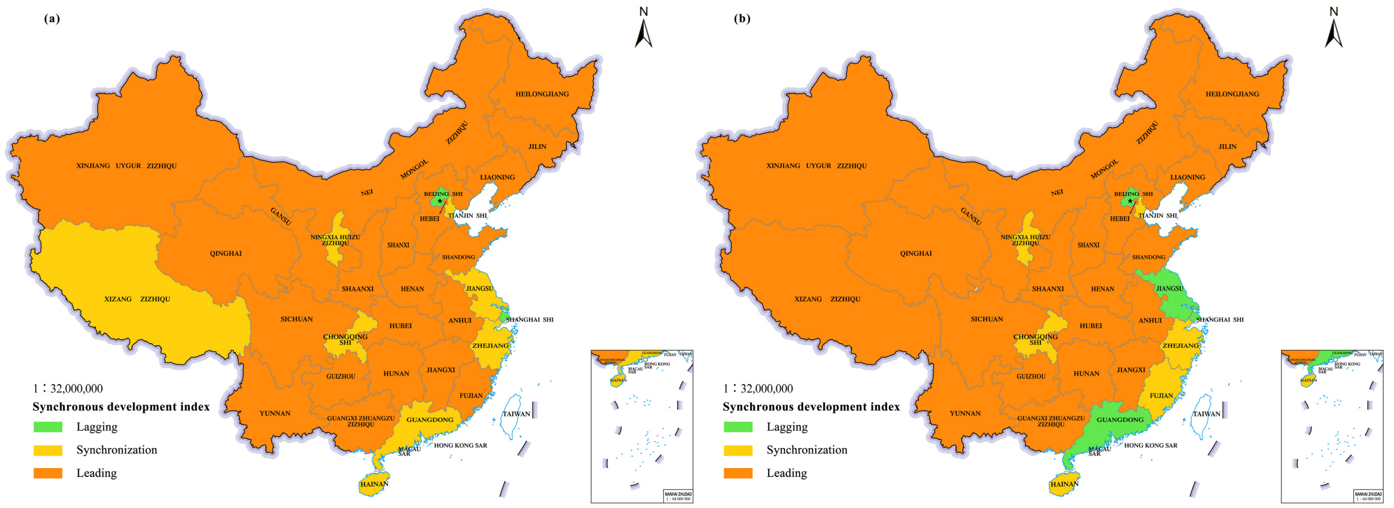

Figure 2. Spatial and temporal evolution of the synchronous development index of PCS and CI: (**a**) 2011; (**b**) 2020.

3.3. Spatiotemporal Evolution of Coupling Degree

Based on relevant research [52], the degree of coupling between PCS and CI is divided into four types according to the value of C (coupling degree), namely, $0 < C \leq 0.3$ low-level coupling, $0.3 < C \leq 0.5$ antagonistic coupling, $0.5 < C \leq 0.8$ running-in coupling, and $0.8 < C \leq 1$ high-level coupling. In general, the average coupling degree between PCS and CI in China has risen slightly from 0.842 in 2011 to 0.875 in 2020, always in a high coupling degree. This shows that from 2011 to 2020, there was a strong interaction between PCS and CI in China, and the mutual influence was steadily strengthened. The space–time evolution diagram of the coupling degree is formed by the C value of PCS and CI in 2011 and 2020 (Figure 3). Figure 3 shows that the coupling degree between PCS and CI in China is characterized by spatial heterogeneity. There are two main types of coupling, namely run-in coupling and advanced coupling; advanced coupling is dominant. Specifically, in 2011 and 2020, there were 21 high-level coupling regions, accounting for 68%, mainly distributed in the east (Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan), the central region (Anhui, Jiangxi, Henan, Hubei, Hunan), some northeastern regions (Liaoning, Jilin), and some western regions (Guangxi, Chongqing, Sichuan, Ningxia, Shaanxi). Running-in coupling was mainly distributed in the western region (Inner Mongolia, Guizhou, Yunnan, Gansu, Qinghai, Xinjiang). Among them, Beijing in the east, Shanxi in the middle, and Heilongjiang in the northeast indicate running-in coupling. These three regions should strengthen the development of PCS and CI, learning from neighboring regions to enhance their interaction. From 2011 to 2020, Jiangxi in the central region also developed well, rising from running-in coupling to advanced coupling. However, Tibet in the western region changed from advanced coupling to low-level coupling, with a significant decline. There is a need to further stimulate the development of PCS and CI. The map shows that the leading high-level coupling regions were mainly distributed in the eastern, central, and coastal regions. These areas have better economic development, thereby proving that the better the development of PCS and CI, the higher the coupling degree. The effective result is a benign cycle model of mutual promotion and CD.

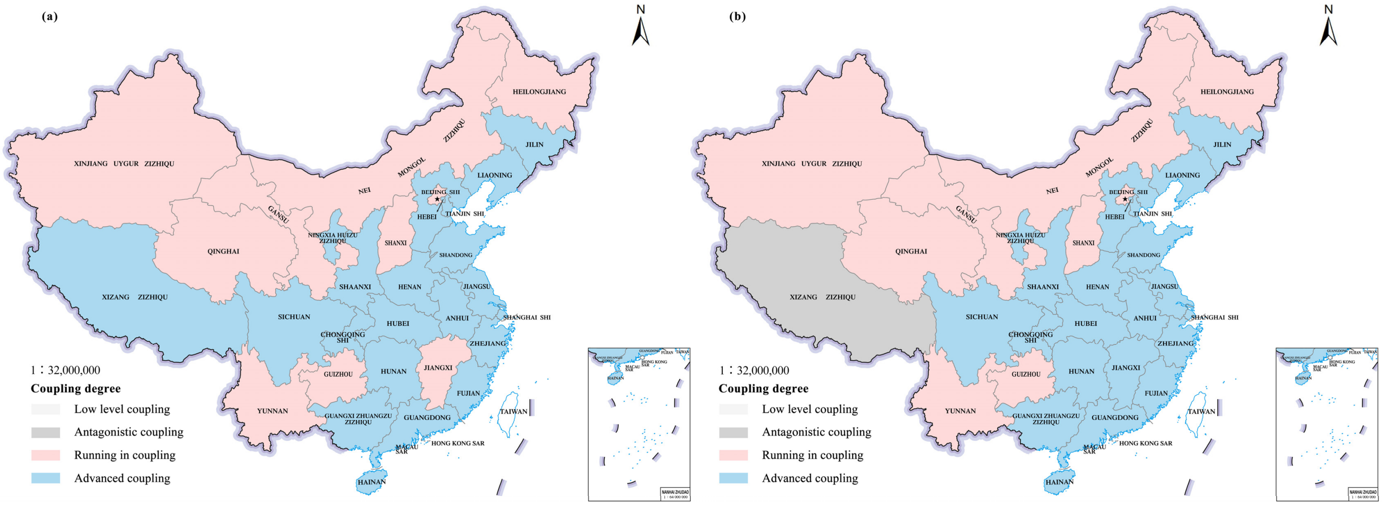

Figure 3. Spatial and temporal evolution of the coupling degree between PCS and CI: (**a**) 2011; (**b**) 2020.

3.4. Spatiotemporal Evolution of Coupling Coordination Degree

On the whole, the mean value of PCS–CI coupling coordination increased from 0.452 in 2011 to 0.541 in 2020, an increase of 19.7%. This shows that PCS and CI have made some progress in this period, and their coupling and coscheduling show a steady upward trend. The spatiotemporal evolution diagram (Figure 4) also clearly shows the overall improvement of PCS and CI coupling scheduling. As Figure 4 shows, from the perspective of the spatiotemporal evolution of the coupling coordination degree, the areas of good coordination and high-quality coordination have increased significantly, mainly concentrated in the eastern and central regions. Specifically, in terms of high-quality coordination level, there was no high-quality coordination level in 2011, but by 2020, there were two high-quality coordination levels, and the coupling coordination level of both, namely Guangdong (0.94) and Jiangsu (0.897), was high. Guangdong and Jiangsu have always been at the forefront of China's PCS system construction and CI development, and have made good achievements in policy support, industrial innovation, social participation, financial security, and other aspects. In terms of good coordination levels, the number increased from 12 in 2011 to 16 in 2020. The medium coordination levels were reduced from 14 in 2011 to 10 in 2020, and the low coordination levels from 5 in 2011 to 3 in 2020. Fujian, Shaanxi, Yunnan, Beijing, Shanxi, and Jiangxi have risen from a medium level to a good level of coordination, while Tianjin and Tibet have risen from a low level of coordination to a medium level. The coupling coordination degree reflects the coordination status of the two systems and is an important indicator of the overall development level. It can be seen from the map that high-quality coordinated areas have emerged, and the number of well-coordinated areas has increased, showing that the overall level of collaborative development of PCS and CI in China has improved significantly.

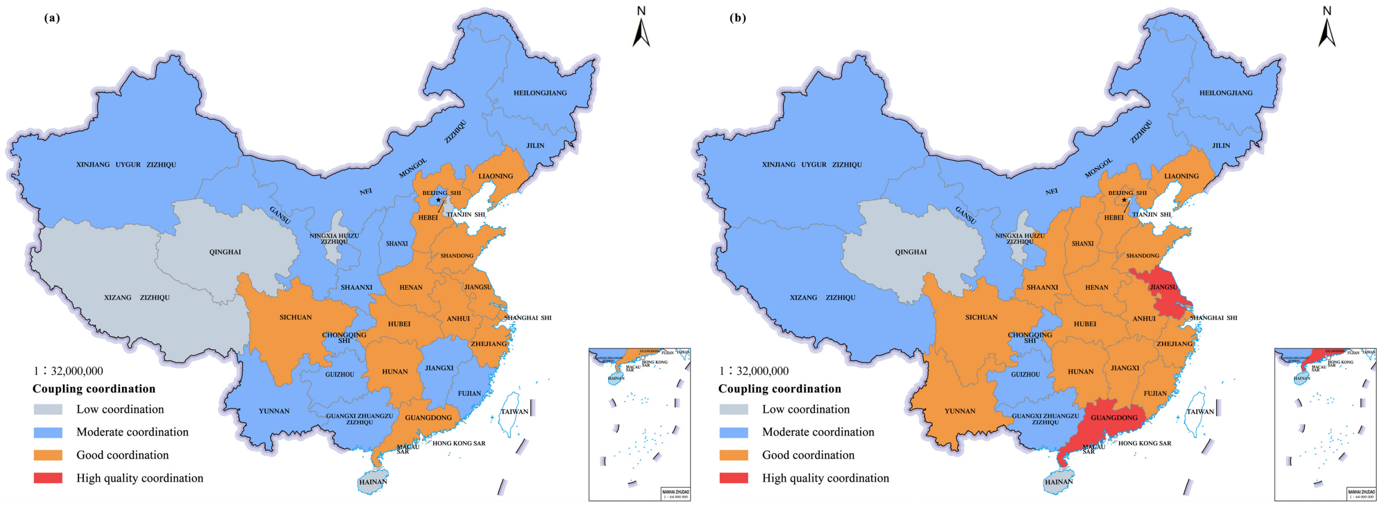

Figure 4. Spatial and temporal evolution of the degree of coupling coordination between PCS and CI: (**a**) 2011; (**b**) 2020.

3.5. Spatial Autocorrelation Analysis

3.5.1. Global Spatial Autocorrelation Analysis

To further analyze the spatial relationship of the collaborative development of PCS and CI, this study uses ESDA [53] to analyze the spatial correlation of the coordination degree of PCS and CI coupling according to the global Moran's index calculation formula. As Table 3 shows, the overall Moran's index of PCS and CI coupling development from 2011 to 2020 is greater than 0 and shows an increasing trend of fluctuation. The coupling and coordination degree of the CD of PCS and CI shows a positive spatial correlation, whereby it has spatial agglomeration, and the degree of agglomeration is generally on the rise, indicating that the coupling development level of PCS and CI in China is gradually improving, forming a spatial agglomeration effect. The emergence of the spatial agglomeration effect can form core cohesion, improve the radiation-driving ability, and promote the coordinated development of the region. The coupling development of PCS and CI can directly promote the use efficiency of PCS and improve the transaction efficiency and innovation level of CI while forming the spatial agglomeration effect.

Table 3. Moran's I index.

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Moran's I	0.166	0.127	0.159	0.161	0.160	0.179	0.188	0.176	0.181	0.183

3.5.2. Local Spatial Autocorrelation Analysis

There are significant differences in the level of economic development, resource endowments, and importance attached to PCS and CI between different regions in China, leading to the unbalanced development level of coupling in different regions. To further reflect the spatial distribution and evolution characteristics of the coordination level of the coupling between PCS and CI in 31 regions, ArcGIS10.2 software was used to draw a LISA cluster diagram (Figure 5a) and a LISA significance diagram (Figure 5b) of China's PCS and CI in 2020. The local Moran's index test can make up for the shortcoming of the global Moran's index test results being too general. The local Moran's index test can reflect four local spatial concentration levels, including high high, low low, high low, and low high. Its significance is tested by LISA significance [54,55]. As Figure 5a shows, the LISA cluster diagram in 2020 indicates that the high high correlation regions include eight regions, namely Beijing, Shandong, Shaanxi, Henan, Anhui, Hubei, Jiangsu, and Shanghai. These regions are mainly concentrated in the Yangtze River Delta and its surrounding areas, forming clusters that are adjacent to and mutually promote each other, indicating that the PCS and CI in these regions are highly developed. Regions with clustering characteristics also include Hainan, Tianjin, and Guangdong. The LISA significance test was conducted on the coupling coordination data in 2020, as Figure 5b shows. The clustering regions passed the significance test as follows: the significance level of high high clustering regions in Beijing, Shaanxi, Shandong, and Anhui was 0.05, and that of Henan, Hubei, and Jiangsu was 0.01. These regions have become important growth poles for the coupling development of PCS and CI. Guangdong has rich PCS and CI resources, with relatively strong development momentum. The per capita level of PCS resources and the level of CI development are in a leading position, well ahead of the surrounding regions. However, Hainan, a low low polymer area, and Tianjin, a low high polymer area, passed the significance test, with a significance level of 0.05. Tianjin is adjacent to Beijing, but its coupling coordination is at a slightly misadjusted level, whereby it becomes a low high concentration area. Due to the low value of self-coupling coordination degree, Hainan is at a level of serious imbalance, so it has become a low low cluster area. The LISA cluster diagram (Figure 5a) shows that the local spatial autocorrelation of the coupling coordination level of PCS and CI is only concentrated in the Yangtze River Delta and its surrounding areas. This is not fully consistent with the high coupling area (Figure 3) and the high coupling coordination area (Figure 4) and does not appear in the coastal areas, indicating that from the perspective of the spatial agglomeration pattern, there is no continuous development belt of coordinated development of PCS and CI across the north and south. It is necessary to consider that the highly coupled and coordinated areas may play a driving role in the development of the surrounding hinterland, and may also play a restraining role. The absorption effect that may occur in the highly coupled and coordinated areas should be prevented.

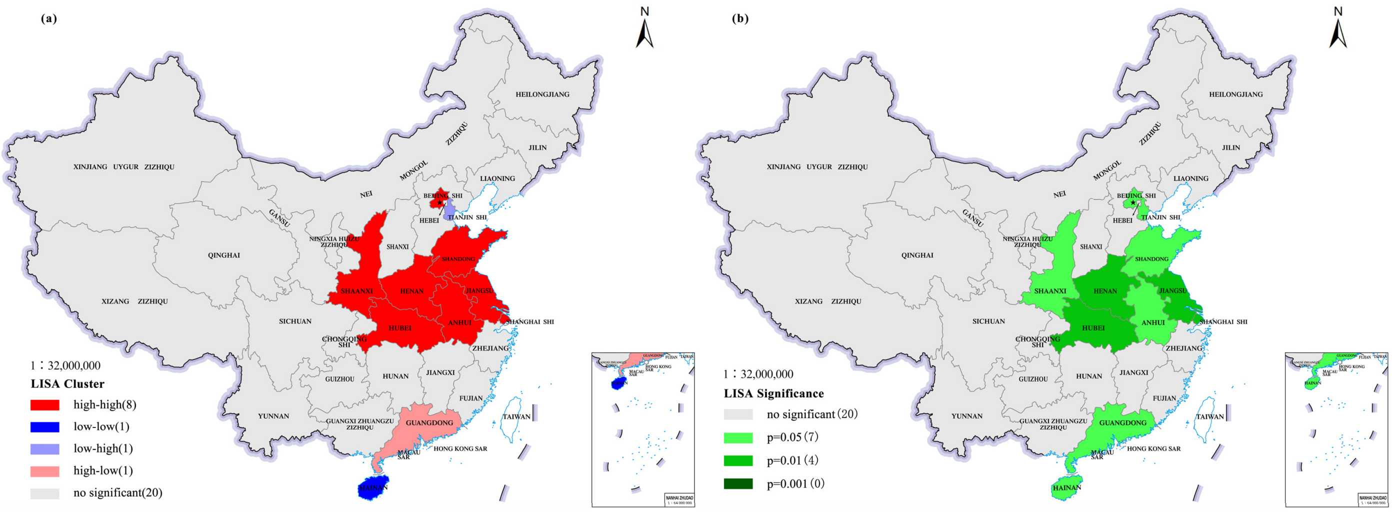

Figure 5. LISA cluster diagram (**a**) and LISA significance diagram (**b**) of PCS and CI in 2020.

4. Discussion and Recommendations

4.1. Discussion

First, the contribution of this study is to build an evaluation index system for the collaborative development of PCS and CI in China, and based on this, analyze the spatiotemporal evolution characteristics and influencing factors of their collaborative development, thereby providing a new approach to the development of PCS and CI. This dimension is based on sustainable collaborative development. Compared with developed countries, there is a gap between the development level of PCS and CI in China. Therefore, it is important to identify how to quickly narrow the gap and coordinate their development. This study found that the spatiotemporal evolution characteristics of the degree of coupling coordination between PCS and CI confirm that the coordinated development situation is improving in the eastern, central, and coastal areas of China. Regarding the coupling scheduling of the spatial distribution of PCS and CI, PCS depends on public welfare investment, directly linking PCS to the level of local economic development.

Second, in the selection of methods, this study draws on other similar research designs and method combinations. Yuan et al. measured and analyzed the integrated development level, spatiotemporal evolution, and spatial correlation of the sports industry and the tourism industry through the construction of an evaluation index system, a coupling coordination model, and exploratory spatial data analysis [48]. Tang et al. used the evaluation index system, coupling coordination model, and geographical detector to reveal the spatiotemporal evolution characteristics of the coupling coordination relationship between the health level and the economic development level of the population of China [56]. Ye et al. analyzed the spatiotemporal evolution characteristics of economic development, social stability, and the ecological environment by building an evaluation index system and then using it as a base for a coupling coordination model [40]. Wei et al. used the entropy weight method, coupling coordination model, and spatial analysis method to discuss the coordination level and spatial evolution pattern of production, life, and ecology in Jilin Province, China [57]. Based on the research design and combinations of methods of these scholars, this study adds a synchronous development model to compare the differences between the PCS development level and CI development level in different regions.

4.2. Recommendations

Figure 1 shows that the continuous support of policies has promoted the continuous growth of China's PCS and CI development levels. Therefore, in the collaborative development of PCS and CI, the government could consider formulating national policy documents and learn from the experience of the United States, the United Kingdom, and France, for example. It could introduce diversified and preferential policies such as cogovernance between the government and society, and the establishment of nonprofit cultural funds and tax incentives. A comparison of Figures 3–5 reveals that the high coupling degree, high coupling coscheduling region, and the high high clustering region in local spatial autocorrelation are not completely consistent. The high clustering regions are mainly concentrated in the Yangtze River Delta and its surrounding areas, while the clustering status of its regions is poor. Therefore, the analysis of the characteristics of spatial distribution shows that the construction of coupling and coordination should strengthen the cooperation between neighboring regions to achieve the complementarity and intercommunication of public cultural service supply and cultural industry resources.

5. Conclusions

This study uses the entropy weight method, synchronous development model, coupling coordination degree model, and spatial autocorrelation analysis to analyze the comprehensive development level, synchronous development level, coupling degree, coupling coordination, and spatial autocorrelation of PCS and CI in 31 regions of China from 2011 to 2020. The main conclusions are as follows:

(1) The comprehensive development level of PCS and CI has shown a steady growth trend. The comprehensive index of PCS is significantly higher than that of CI. In terms of the spatiotemporal evolution of synchronous development, the synchronous development of PCS and CI is dominated by the leading type, accounting for 68%. The leading type > the synchronous type > the lagging type. The areas where PCS lags behind CI are located in the eastern coastal areas.

(2) The development of PCS and CI is in a high coupling degree as a whole, and the coupling degree shows a trend of steadily increasing. In terms of spatiotemporal evolution, there are two main types of coupling: run-in coupling and advanced coupling. Advanced coupling dominates.

(3) The degree of coupling and coordination between PCS and CI has shown a steady upward trend. The regions with good coordination and high-quality coordination account for 58% and are mainly concentrated in the eastern and central regions.

(4) The level of coupling and coordination between PCS and CI presents a spatial positive correlation agglomeration. The degree of agglomeration has gradually increased, with high high agglomeration as the main factor, forming an important growth region in the Yangtze River Delta economic region and its surrounding areas.

Due to the limitations of data and space, this study has the following shortcomings. First, the research data only cover the years up to 2020. Data release practicalities mean that no statistical analysis was carried out on the 2021 data. Second, the connotation of the collaborative development of PCS and CI was not deeply analyzed. The follow-up work will carry out an in-depth analysis of these deficiencies to enhance the applicability of the collaborative development indicator system in a wider range of contexts. Third, the research on the collaborative development plan and policy system construction of PCS and CI is not deep enough. These problems will be addressed in the next stage of this research.

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