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# Characterizing Spatial-Temporal Variation of Cultural Tourism Internet Attention in Western Triangle Economic Zone, China

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**Abstract:** More and more tourists tend to seek cultural enjoyment while taking trips based on their satisfied socio-economic needs. The spatiality of cultural tourism determines the feasibility and convenience of the access to cultural tourism resources. Given that spatial research on cultural tourism rarely involves the underdeveloped regions in China, especially via Baidu Index data, this study aims to explore the dynamic spatial pattern of cultural tourism Internet attention based on Baidu Index through social network analysis (i.e., network density, centrality analysis, core-periphery model, etc.) in the Western Triangle Economic Zone (WTEZ), China. Research findings are as follows. (1) Temporally, the centrality is increasingly enhanced in terms of the core cities with high cultural tourism Internet attention, as well as their radiation effect. (2) Spatially, the distribution pattern of cultural tourism Internet attention is shifting from polarization to equilibrium. However, the overall network density still presents a mode of loose connection and fails to extend from the core triangle structure in the planar dimension. (3) The cultural tourism Internet attention in WTEZ presents an obvious core-periphery pattern. Xi'an-Chengdu-Chongqing is in a dominant position, and the core area spreads from south to north. (4) The spatial-temporal pattern of cultural tourism Internet attention in WTEZ is influenced by transportation, reception facilities, consumption ability, and political environment, and the main driving factors are the number of hotels, per capita income, total highway mileage, and cultural tourism policy indicators. This study is conducive to sustainable spatial planning of cultural tourism through smart data governance.

**Keywords:** culture tourism; web visibility; dynamic spatial pattern; social network analysis; WTEZ



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## 1. Introduction

Cultural tourism is an important part of the global tourism market, accounting for approximately 40% of international tourism arrivals [1]. As culture has become one of the main content providers of the tourism experience, tourism has also become one of the most significant income sources for cultural institutions. Tourism and culture have been more and more closely related with each other over the years [2–4]. In the immediate aftermath of World War II, cultural tourism was not a topic widely studied by scholars. However, the first Edinburgh International Festival in 1947 sought to bridge the divisions of the war through culture, advocating the recovery of post-war tourism development. Tourism has become a crucial path to cultural communication among people and countries [5]. By the 1990s, cultural tourism was integrated into culture-led revitalization projects in Europe and North America. The museum became a new symbol for the city in presenting its image, and the Bilbao Guggenheim, opened in 1997, stimulated many other cities to use its iconic route to urban identity [6]. Currently, culture is subdivided into a series of niche areas, such as creative tourism, gastronomic tourism, or literary tourism. This raises the question whether cultural tourists still exist and challenges the status of traditional cultural institutions like museums [7]. Therefore, cultural tourism is being transformed by the development of new technologies [8].

Effective cultural management makes it possible to develop characteristic tourism in culturally sensitive areas [9]. This encourages a mode of locally beneficial tourism, reshapes the relationship between visitors and local residents, highlights the special nature of the locality, and assists local community institutions in designing inclusive and participatory governance frameworks and mechanisms to better tackle issues of tourism, local cultural vitality, and social well-being dynamics [10,11]. In addition, it promotes interaction between tourism and culture, improves residents' quality of life, enhances cultural vitality and visitors' experience, and thus facilitates sustainable development of urban cultural tourism [12–14]. China's economic development has shifted from pursuing high speed to high quality. In terms of the tourism industry, it is being transformed from single-resource development at the early stage to coordinated, integrated, and sustainable development, namely, from quantity-oriented to quality-oriented growth [15,16]. With urban economic development changing from production-driven to consumption-led, cities create spaces, activities, and landscapes for residents and tourists to consume. That is, visitors and local residents can do the same activities and enjoy the same culture of the city [17]. In this context, cities should rethink scenic spots that bring a good experience for tourists and accordingly create unique and new spaces [18]. This greatly influences the cultural tourism industry. Cultural tourism products are no longer created and marketed just for tourists, but for a broader context (including quality of life improvements, cultural regeneration, and creative industries) [19–21]. These aim to satisfy urbanites' cultural leisure needs and upgrade the competitiveness of urban cultural tourism.

In the domain of cultural tourism, scholars mainly focus on the classification of cultural tourism concepts and theoretical discussions [22,23], motivation, experience, behavior and market research of cultural tourists [24–26], cultural tourism resource development [27], and cultural tourism environmental protection and management [23,28]. Research has rarely shed light on cultural tourism from a spatial perspective. Exploring the spatiality of cultural tourism facilitates understanding of the integrated development trend of related products and industries of tourism and culture on a regional scale [29]. Cultural and tourism industries have coordinated in developing and spatially forming a trend of positive agglomeration from 2010 to 2018 in Shaanxi Province, China [30]. Moreover, the characteristics of this spatial-temporal evolution and its driving factors have been explored in terms of the collaborative development of the culture–tourism industry in China from 2013 to 2017 by the geographical detector [31]. Cultural tourism development quality (CTDQ) is found to show a Z-shaped spatial upward trend, with significant spatial agglomeration characteristics in China's Yangtze River Delta [32]. For characterizing the spatiality of the cultural tourism industry in China, most studies focus on the integration of the development of spatial evolution of culture and tourism [33–35]. Additionally, the literature mainly focuses on the top three of China's Economic Growth Poles (i.e., the Guangdong–Hong Kong–Macao Greater Bay Area, the Yangtze River Delta, and Beijing–Tianjin–Hebei) and other administrative regions in China [36–38]. However, there is a severe lack of in-depth research on the spatiality of tourism in the underdeveloped regions in China.

The Baidu Index is a newly emerging source of big data employed in the domain of tourism research based on the largest Chinese searching engine, Baidu ([www.baidu.com](http://www.baidu.com) (accessed on 30 March 2022)) [39]. As a free mass data analysis service, it reflects the user awareness and media attention of different keywords over a period of time. Through the Baidu Index, information can be discovered, shared, and mined to reflect recent social hot spots and users' interests and needs [40,41]. The Baidu Index has been adopted to spatialize the tourism network attention of 337 prefectural cities in China from 2018 to 2021 by seasonal concentration index, Zipf model, and Dagum Gini coefficient [39] in order to explore the spatial-temporal variation of sports tourism internet attention and the factors that affect consumers' choice of sports tourism, providing theoretical reference for China's sports tourism marketing and layout planning for the consumer market [42] to systematically analyze Internet attention and its spatial pattern of tourist destination

cities in Hunan Province. It has been concluded that tourist destination cities' attention to the Internet shows a synchronous fluctuation trend periodically each year, with strong "co-occurrence" [43]. However, combining Baidu Index data in the domain of cultural tourism is still a research gap.

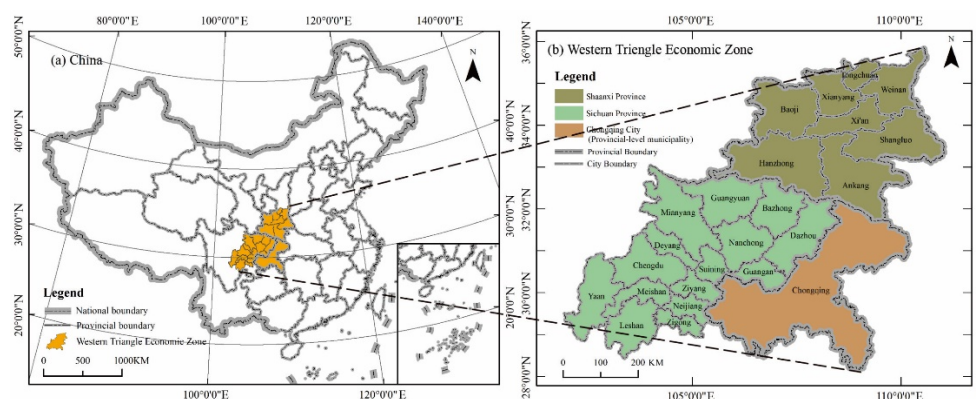
The Western Triangle Economic Zone (WTEZ) is promising to turn into the fourth of China's Economic Growth Poles, consisting of three core cities (i.e., Chongqing, Chengdu, and Xi'an) and their peripheral regions [44]. As the economic core of the western region, WTEZ has abundant cultural tourism resources and effectively promotes the development of cultural tourism in the western region [45,46]. Due to the Xi'an–Chengdu high-speed railway and the Chengdu–Chongqing inter-city railway being in operation, the interaction of the cities in WTEZ has been greatly strengthened, with the interaction of cultural tourism strengthened as well [47]. Given increasingly frequent cultural tourism exchanges, it becomes imperative to explore the spatial and temporal characteristics of cities in WTEZ [48]. Therefore, this study aims to illustrate the dynamic evolution of cultural tourism in WTEZ.

This article is structured as follows: Section 2 introduces the research area and the research methods. Section 3 analyzes the cultural tourism Internet attention of each city in the Western Triangle Economic Zone and their influential factors. Section 4 further discusses research findings and their political implications. Section 5 draws the research conclusions.

## 2. Methodology

### 2.1. Study Site

The Western Triangle Economic Zone (WTEZ) plays an important strategic role in advancing the inter-city and intra-city development of China's western region. WTEZ is potentially the fourth of China's Economic Growth Poles and acts as the engine for large-scale Development in China's western region. As shown in Figure 1, WTEZ stretches across four provinces or provincial-level municipalities (i.e., Shaanxi Province, Sichuan Province, and Chongqing Municipality) and mainly covers the Sichuan–Chongqing urban agglomeration and Guanzhong urban agglomeration, with Xi'an City as the center. "Xi'an–Chengdu–Chongqing" is defined as the hinterland cities of WTEZ. The three cities radiate into their peripheral area within WTEZ to form a powerful urban agglomeration, realizing the integration and promotion of a regional economy [49,50].



**Figure 1.** Study Site: (a) China; (b) Western Triangle Economic Zone in China.

As an economic zone with developed cultural tourism resources and the most potential for future economic development, WTEZ is selected as the case study in this research. Specifically, 24 representative cities are selected, considering the comparability and accessibility of nodal cities as well as their economic development strength, with a total area of 388,990 square kilometers. That is, eight cities in central and southern Shaanxi, the selection of Shaanxi Guanzhong and the area of Chongqing Municipality, 15 other cities in Sichuan province in addition to the Abo, Ganzi, Liangshan, Panzhihua, Yibin, and

Luzhou prefectures. The geographical location of these 24 cities ranges from east longitude ( $101^{\circ}56'41.97''$ – $111^{\circ}2'41.86''$ ) to north latitude ( $28^{\circ}10'22.74''$ – $32^{\circ}50'41.99''$ ). Most of these cities are in plain areas (Chengdu Plain and Weihe Valley) with flat terrain and humid climate, which is conducive to economic development and talent attraction.

In the development of cultural tourism, the eight cities in Shaanxi Province contain the time-honored ancient capital culture and the ecological culture with picturesque scenery. They have built famous cultural tourism destinations, such as the Great Tang All Day Mall, the Terracotta Warriors and Horses in Emperor Qin Shi Huang's Mausoleum, The Xi'an Circumvallation, the Shaanxi History Museum, the Xinghan Scenic Spot, and the Jinsi Gorge. Fifteen cities in Sichuan Province have launched ten cultural tourism brands, including Great Jiuzhai, Great Emei, Giant Panda, Grand Shangri-La, Great Gongga, Great Bamboo Sea, Great Irrigate Area, Great Shu Road, Great Ruins, and Great Grassland, to create a strong Intellectual Property (IP) of cultural tourism in Sichuan Province, with Bashu culture, culture of Three Kingdoms, food culture, ethnic culture, and leisure slow-life experience as the core. As the youngest municipality directly under the central government in China, Chongqing has integrated Bayu culture, Anti-Japanese War culture, Three Gorges culture and urban culture, developed the famous Three Gorges of the Yangtze River and the world's largest mountain-water city, and jointly established the Chengdu–Chongqing city agglomeration along with the Sichuan area to exert a cluster effect.

Therefore, the selected 24 cities possess rich cultural tourism resources with their own characteristics, highly attractive to tourists from other cities. According to the statistical annual reports of each region by 2020 shown in Table A1 in the Appendix A, the economic aggregate of these 24 cities has reached CNY 8.52 trillion, with urban per capita disposable income of CNY 37,198.50, a total resident population of 133 million, and a total number of tourist arrivals of 1.74 billion. This shows that this district has strong cultural tourism attractions and great development potential.

## 2.2. Data Sources

This research involves the following data sources: (1) The base map from the National Basic Geographic Database of the National Basic Geographic Information Center of the Ministry of Natural Resources and the longitude and latitude coordinates of the 24 nodal cities, obtained through the Baidu map pickup coordinate system; (2) Cultural tourism Internet attention in 2016, 2018, and 2020 searched from the Baidu Index. Based on the Baidu Index tool platform, “cultural tourism” and “name of prefecture-level city” are used as search keywords, and the average daily search index in 2016, 2018, and 2020 is obtained; (3) Statistical data. Taking into account the comprehensiveness, accuracy and availability of the data, the China Statistical Yearbook, the China Urban Statistical Yearbook, and local statistical bulletins were selected.

## 2.3. Methods

Social network analysis is a method to explore the network relationships and spatial structure of nodes through relational data. It takes the bond relationship between nodes as the basic unit of analysis, describes the complex attributes of the relationship pattern between nodes, and shows the diversity of these nodes compared with other nodes, which is normally adopted for spatial network analysis [51–53]. This study established a basic database of users' mutual search for cultural tourism in 24 cities of the Western Triangle Economic Zone in 2016, 2018, and 2020, based on user search data (i.e., the Baidu Index). After binarizing the Baidu Index data with the UCINET software in terms of the social network analysis method, we selected the most representative network density analysis and centrality analysis to analyze the individual network and the core–periphery model and cohesive subgroup to study the whole network structure. This not only reflects the connectivity between the research area in general, but also analyzes the subordination relationship of spatial units and the flow direction of tourists' attention. The specific descriptions are as follows.

### 2.3.1. Network Density Analysis

Network density refers to the closeness of connections among members of a network, which can be obtained by comparing the number of actual relations with the number of theoretically possible relations, and its value range is from 0 to 1 [54]. The more connections between members, the denser the network. This method is normally used to measure the intensity and evolutionary trend of social relationships.

$$d(G) = \frac{2L}{N(N-1)}, \quad (1)$$

In Formula (1),  $N$  represents the number of nodes, and  $L$  is the number of actual connected edges. When the network is fully connected,  $d(G) = 1$ . When there is no link relationship in the network,  $d(G) = 0$ . However, networks with a density of 1 almost never exist, and the maximum density found in actual networks is 0.5.

### 2.3.2. Centrality Analysis

Centrality analysis is an important index to measure the centralization level of the whole network. In the urban agglomeration network, the core city with a high level of centralization has easier access to resources and information and more powerfully influences other cities. Network centrality can be divided into three indexes: degree centrality, betweenness centrality, and closeness centrality [55]. In fact, degree centrality and closeness centrality have some similarities. That is, both are indexes to measure the closeness between one certain individual and other individuals, and they reflect the individual's core subordinate status. Compared with closeness centrality, degree centrality's in-degree and out-degree can better reflect the direction of individuals' closeness. Hence, this study selects degree centrality and betweenness centrality to reflect the dominant ability and radiation effect of node cities.

#### 1. Degree centrality analysis

Degree centrality is used to measure the centralization level of nodes. The higher the centralization level is, the closer the node is connected with other nodes. That is, the node more powerfully influences other nodes [56]. In the directed graph, degree centrality is divided into "point in-degree" and "point out-degree". "Point in-degree" shows the number of other nodal cities pointing to the node core city and describes the concerned degree of the core city by other nodal cities. "Point out-degree" refers to the number of other nodal cities the core city points to. It indicates to what degree the core city pays attention to cultural tourism of other nodal cities. The formula for degree centrality is:

$$C_{RD}(i) = \frac{C_{AD}(i)}{n-1}, \quad (2)$$

#### 2. Betweenness centrality analysis

Betweenness centrality refers to the number of times that a node city, as an intermediary, helps its two other node cities connect each other. The greater the number of times, the greater the betweenness centrality of the city, indicating the intermediary function of the city [57]. Formula (3) is as follows:

$$C_{RB}(i) = \frac{2C_{AB}(i)}{(n-1)(n-2)} = \frac{2 \sum_i^n \sum_k^n b_{jk}(i)}{(n^2 - 3n + 2)} = \frac{2 \sum_i^n \sum_k^n g_{ik}(i) / g_{jk}}{(n^2 - 3n + 2)}, \quad (3)$$

In Formula (3),  $C_{RB}(i)$  is the relative point centrality of node cities.  $C_{AB}(i)$  is the absolute point centrality of a node city.  $b_{jk}(i)$  indicates the connectivity level of Point<sub>*i*</sub> to Control Point<sub>*j*</sub> and Control Point<sub>*k*</sub>.  $g_{ik}(i)$  represents the number of cities that pass through Control Point<sub>*j*</sub> and Control Point<sub>*k*</sub>.



### 2.3.3. Core–Periphery Model

Core–periphery structure is an index to measure the density of connections among node cities in the Western Triangle Economic Zone. The “core” is a cluster, and the members of the core area, the actors, are often “co-occurring” with each event in the event partition. A “periphery” is a partition of a series of actors that do not “co-occur” in the same event [58,59].

This study adopts the Network/Core & Periphery/Categorical/Continuous module function of the UCINET software, takes the Baidu search term “cultural tourism” as an index, categorizes the node cities of WTEZ into core areas and periphery areas, and constructs the density matrices of core areas and periphery areas. Cities in the core areas have a stronger ability to attract cultural tourism consumption in the periphery areas, with the inter-city cultural tourism activities closely connected. They are the highland of regional cultural tourism development and in an active position. However, the cities in the periphery areas are heavily dependent on the cities in the core areas, and the cultural tourism activities between cities are weak and passive. They are in a passive position, with their inter-city cultural tourism activities weakly connected.

### 2.3.4. Cohesive Subgroup Analysis

A cohesive subgroup is a set of actors with stable, direct, strong, frequent, or positive connections, which is used to describe the overall spatial structure and status of cultural tourism network attention of cities in the Western Triangle Economic Zone and can be used to divide the interconnected small groups [60,61]. This article selects the Baidu index “cultural tourism”, using the Network/Role & Positions/Structural/CONCOR function of UCINET software to get the cohesion index of cultural tourism internet attention in WTEZ. The greater the cohesion index, the stronger the cohesion of the network and the closer the cultural tourism activities between the cities in the network. The cohesive subgroup analysis can reflect the number of cohesive subgroups, the cities involved in each cohesive subgroup, and show the spatial pattern of the inner sub-structure of urban agglomeration tourism network structure.

### 2.3.5. Quadratic Assignment Procedure

The relationship data constitute the spatial correlation matrix and its driving factor matrix of the cultural tourism network attention of each city in the Western Triangle Economic Zone. The quadratic assignment program (QAP), based on the non-parametric estimation method, can effectively avoid the multicollinearity problem, which is beneficial for analyzing the driving mechanism [62,63]. When the significance level is within the range of (0.01, 0.05 or 0.10), it indicates that the two matrices have a strong correlation statistically. This method has been widely used in tourism research [27].

The influencing factor evaluation model of the spatial structure of cultural tourism Internet attention in WTEZ is constructed:

$$R = f(AGS, TRE, EDL, RSC, STT), \quad (4)$$

In Formula (4), R represents the spatial network relationship matrix of cultural tourism Internet attention of cities in WTEZ, AGS stands for the spatial proximity matrix, TRE represents the tourism resource endowment difference matrix, EDL represents the matrix of difference in economic development level, RSC represents the matrix of difference in reception service capacity, and STT stands for transportation convenience degree matrix.

## 3. Results

### 3.1. Network Density Analysis

By using the Netdraw/Cohesion–Density module of UCINET software, the network density of the mutual concern in cultural tourism per city in the Western Triangle Economic Zone was calculated. The network densities of mutual attention in cultural tourism in 2016, 2018, and 2020 were 0.313, 0.324, and 0.337, respectively, indicating that the connection effect

of cultural tourism Internet attention among cities in the Western Triangle Economic Zone was weak. Although the network density increased year by year, it was still loosely connected.

### 3.2. Centrality Analysis

The Transform/Dichotomize function of UCINET software was used to binarize the Baidu Index for mutual concern in cultural tourism in 24 cities. Further calculation about point centrality and betweenness centrality between cities in 2016, 2018, and 2020 were necessary, for which the degree and betweenness functions of Network/Centrality was used, and the inverse distance weight method of the ArcGIS10.6 software was used to analyze the spatial difference. Thus, the distribution map of degree centrality and betweenness centrality of each node city in WTEZ from 2016 to 2020 were obtained.

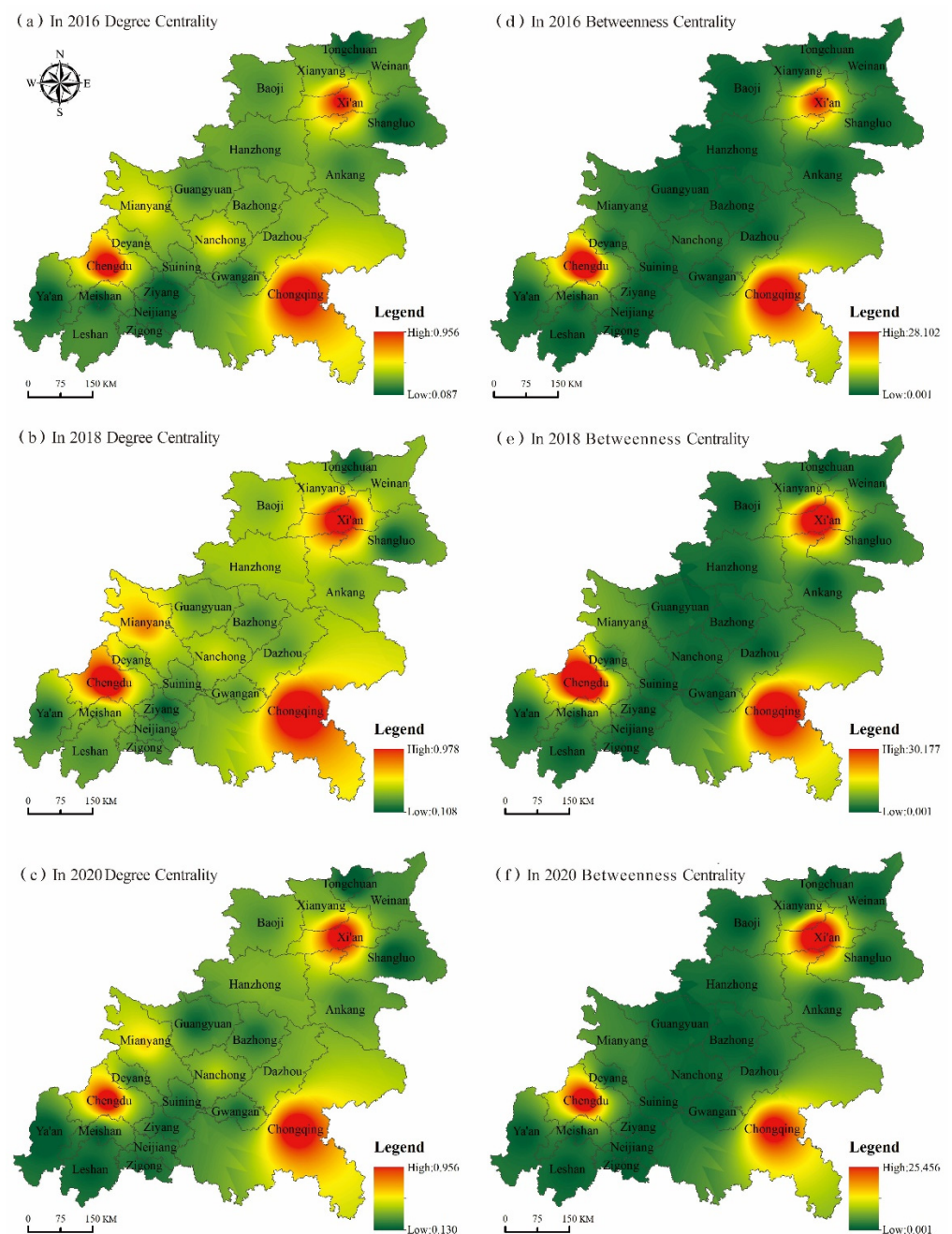
#### 3.2.1. Degree Centrality Analysis

As shown in Figure 2, the degree centrality of 24 cities in the Western Triangle Economic Zone in 2016 is generally low and had significant spatial differences. The areas with high value include Chengdu, Xi'an, and the southeast of Chongqing, with the highest value of 21.9915. The areas with a medium value include Mianyang and Nanchong, with the degree centrality about 12.002. The other cities have low centrality. It shows that although the cultural tourism network of core cities in the Western Triangle Economic Zone gets high attention, its radiation effect is limited due to traffic conditions, and its driving effect on other cities is not significant. The centrality of the whole region shows a trend of polarization.

The degree centrality of 24 node cities in 2018 were steadily improved since 2016. This means that the cultural tourism Internet attention of cities in the Western Triangle Economic zone is on the rise. Chengdu, Xi'an, and the southeast of Chongqing are still high-value areas, with the highest value of 22.9863. Mianyang also rose to the high-value range, and the degree centrality value of Nanchong increased. This shows that in 2018, the cultural tourism Internet attention of core cities in the Western Triangle Economic Zone was steadily increasing, and the radiation effect and driving effect are enhanced as a result. However, the number of cities covered by the low value area were up to six compared with 2016, which indicates that the polarization and spatial difference within the region have further increased.

In 2020, both the gross value and mean value of degree centrality in the Western Triangle Economic Zone showed an upward trend. The centrality of the three core cities (i.e., Chengdu, Xi'an, and Chongqing) and the two secondary core cities (i.e., Mianyang and Nanchong) has been further increased to the high value area, with the value ranging from 18.4987 to 22.9981. The linkage effect of the core cities has been strengthened, while the degree centrality of the lowest value city has increased by more than two times, and the following ability has been improved. This indicates that in 2020, the attention network of cultural tourism in the Western Triangle Economic Zone entered the stage of comprehensive improvement, and the spatial difference of node cities narrowed. The development trend in these cities is balanced.

Overall, in 2016, the degree centrality per city in WTEZ as a whole was low and had a significant spatial difference. In 2018, the degree centrality value rose steadily, while the polarization and spatial difference increased. By 2020, the total value and mean value of degree centrality increased, and the spatial development difference decreased, tending toward equilibrium. This indicates that from 2016 to 2020, the degree centrality of the cultural tourism Internet attention in the Western Triangle Economic Zone to focus on core cities was continuously enhanced, the radiation effect and driving ability were significantly improved, and the polarization trend eased. The overall Internet attention developed in a balanced direction.



**Figure 2.** Centrality of cultural tourism network attention in WTEZ: (a) degree centrality in 2016; (b) degree centrality in 2018; (c) degree centrality in 2020; (d) betweenness centrality in 2016; (e) betweenness centrality in 2018; (f) betweenness centrality in 2020.

The interaction relationship between node cities can be seen from out-degree and in-degree centrality. As can be seen from Table 1, the mean values of out-degree and in-degree in 2016, 2018, and 2020 show a downward trend, indicating that the cultural tourism Internet attention of cities in the Western Triangle Economic Zone was generally strengthened and showed periodic fluctuations. Specifically, the out-degree of Xi'an, Baoji, Xi'anyang, Weinan, Chengdu, Mianyang, Nanchong, and Chongqing in the three years are all higher than the in-degree, which indicates that the cultural tourism development of these cities is located in the power center, and their own capacity and radiation ability are strong. The impact on cultural tourism in other cities is even stronger. However, other cities with higher in-degree than out-degree, such as Shangluo, Tongchuan, Zigong, Neijiang, Guangyuan, and other cities, indicate that these cities are more controlled by other cities,



and their cultural tourism development is restricted by others. There is also a situation of trend changes in the out-degree and in-degree of Leshan, Meishan, Deyang, and Dazhou which are not consistent over the three years. In a particular year, the out-degree is higher than the in-degree, indicating that the city has a certain influence on other regions, but the utility is erratic.

**Table 1.** In- and out-degrees of cultural tourism Internet attention of WTEZ in 2016, 2018, and 2020.

Time	2016		2018		2020	
Node Cities	n Out-Degree	n In-Degree	n Out-Degree	n In-Degree	n Out-Degree	n In-Degree
Xi'an	0.957	0.609	0.913	0.826	1.000	0.913
Baoji	0.304	0.217	0.301	0.254	0.304	0.261
Shangluo	0.043	0.217	0.087	0.130	0.087	0.217
Hanzhong	0.174	0.348	0.261	0.348	0.261	0.435
Tongchuan	0.043	0.174	0.043	0.174	0.043	0.217
Xi'anyang	0.391	0.217	0.391	0.217	0.391	0.261
Weinan	0.391	0.174	0.348	0.174	0.348	0.174
Ankang	0.174	0.304	0.174	0.304	0.174	0.348
Ya'an	0.130	0.174	0.043	0.217	0.043	0.217
Leshan	0.391	0.130	0.174	0.217	0.174	0.179
Zigong	0.174	0.261	0.174	0.217	0.174	0.217
Neijiang	0.130	0.217	0.130	0.217	0.217	0.261
Meishan	0.087	0.174	0.261	0.174	0.130	0.217
Chengdu	1.000	0.913	1.000	0.957	1.000	0.913
Deyang	0.391	0.217	0.261	0.217	0.217	0.261
Ziyang	0.087	0.087	0.087	0.130	0.130	0.261
Mianyang	0.478	0.435	0.739	0.348	0.739	0.348
Suining	0.174	0.348	0.174	0.217	0.174	0.261
Guangan	0.130	0.261	0.174	0.261	0.174	0.261
Nanchong	0.478	0.278	0.435	0.261	0.565	0.261
Guangyuan	0.217	0.261	0.174	0.261	0.174	0.217
Bazhong	0.174	0.391	0.130	0.261	0.174	0.261
Dazhou	0.348	0.261	0.174	0.261	0.391	0.261
Chongqing	0.913	0.871	0.913	0.870	1.000	0.870
AVG	0.324	0.324	0.313	0.313	0.337	0.337

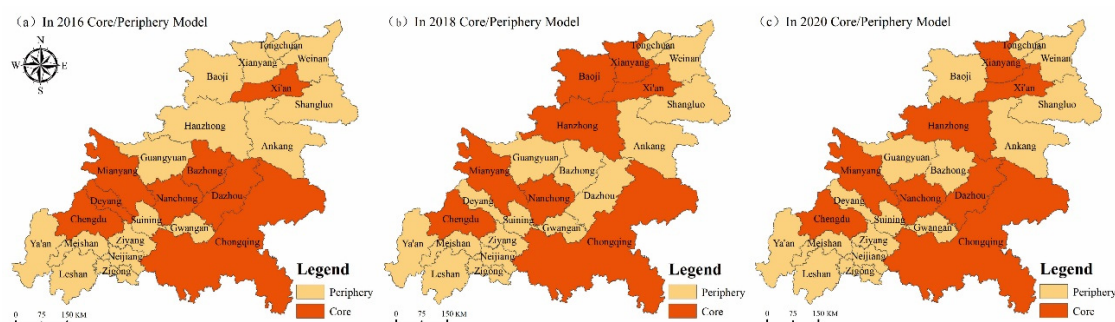
### 3.2.2. Betweenness Centrality Analysis

As can be seen from Figure 2, the intermediate centrality index of each node city in the Western Triangle Economic Zone is significantly different on the whole, forming a stable radiation pattern of “three pillars”. From 2016 to 2020, the intermediate centrality index of Xi'an, Chengdu, and Chongqing is much higher than that of other cities, indicating that in the attention structure of the cultural tourism network in the Western Triangle Economic Zone, these cities are in a dominant position, playing a powerful communication and connection function, and have a high ability to exert control over other cities. Regional cultural tourism development heavily depends on the intermediary role of these cities. The second gradient changes from Nanchong and Mianyang to the Mianyang betweenness centrality index, which shows that Mianyang is in the secondary hub position in the network attention structure and has certain control and influential ability. The third gradient cities changed from Dazhou and Xi'anyang in 2016 to Nanchong, Xi'anyang, and Hanzhong in 2018, and finally included four cities: Hanzhong, Nanchong, Dazhou, and Ankang. The fourth gradient cities changed from Zigong, Suining, Bazhong, Weinan, Hanzhong, Baoji, Neijiang, and Ya'an in 2016 to Leshan, Meishan, Dazhou, Zigong, Weinan, Baoji, Guangyuan, and Deyang in 2018, and finally five cities were retained: Neijiang, Baoji, Deyang, Xi'anyang, and Bazhong, which indicate that the communication function of node cities in southern Shaanxi increased more than that of other cities in the region, but they are all subordinate to the network focus structure of the Western Triangle Economic Zone.

From the changes of high-value areas in betweenness centrality, the highest value in 2016, 2018, and 2020 respectively rose from 28 to 30 and then fell to 25. The coverage of the high value of Xi'an and Chongqing gradually expanded, while the area of high value area of Chengdu in 2020 contracted. The reason for the current situation is that cultural tourism was in the initial development period in 2016, so its value increases rapidly. In 2018, from the national strategy level to the field implementation level, the integration of culture and tourism has been comprehensively promoted, and people's attention to cultural tourism has been enhanced. Therefore, people's network attention to cultural tourism in the Western Triangle Economic Zone has increased to the highest value and the coverage has been expanded. However, from January to March 2020, affected by COVID-19, people all over the country stayed at home and were quarantined for the epidemic, paying less attention to cultural tourism. With the improvement of epidemic control and the gradual resumption of work, the online attention to cultural tourism has gradually recovered. Therefore, according to the annual data, the peak value of online attention on cultural tourism in 2020 was lower than that in 2018 and 2016. Due to the rebound of a small number of cases in December, the high-value areas in Chengdu shrank in 2020, resulting in a sharp decrease in people's attention to Chengdu's cultural tourism network at this stage, which further affected all of the annual high-value areas.

### 3.3. Core–Periphery Model Analysis

The core–periphery analysis results of the cultural tourism network attention of each node city in the Western Triangle Economic Zone are shown in Figure 3. According to Figure 3, from 2016 to 2020, Xi'an, Chengdu, Mianyang, Nanchong, and Chongqing have been core areas under the impact of the level of economic development. In addition to shared cities, the core area also includes Deyang, Bazhong, and Dazhou in 2016. This indicates that the core region of cultural tourism network attention in the Western Triangle Economic Zone is more inclined toward the key cities of the southern Chengdu–Chongqing urban agglomeration. In 2018, the core area contained Baoji, Hanzhong, and Xi'an, which indicates that the core area was transferred to the north. This part of the core area is mainly composed of three parts: Xi'an extending to the west, Chengdu developing to the north, and Chongqing City. In 2020, Hanzhong, Xi'an, and Dazhou were also included, which means the core area runs from south to north. In general, from 2016 to 2020, the core area of cultural tourism network attention in the Western Triangle Economic Zone spread from the south to the north.

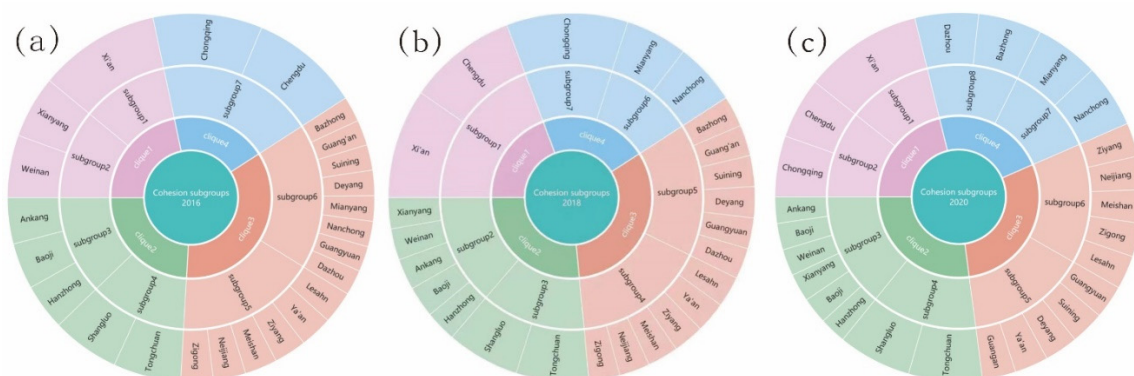


**Figure 3.** The core/periphery pattern of cultural tourism Internet attention in WTEZ: (a) 2016; (b) 2018; (c) 2020.

### 3.4. Cohesive Subgroup Analysis

Cohesive subgroup analysis is one method for overall network analysis and can identify the small group agglomeration phenomenon existing in the cultural tourism Internet attention of cities in the Western Triangle Economic Zone, so as to scientifically and deeply demonstrate its internal spatial structure. Figure 4 shows the agglomerated subgroup plots in 2016, 2018, and 2020. The core faction of cultural tourism Internet attention in the Western

Triangle Economic Zone changed from “Chengdu–Chongqing” to “Xi’an–Chengdu” and finally tended toward the combination of “Xi’an–Chengdu–Chongqing”.



**Figure 4.** Cohesive subgroup structure of cultural tourism Internet attention in WTEZ: (a) 2016; (b) 2018; (c) 2020.

As can be seen from Figure 4, the cohesive subgroup of the Western Triangle Economic Zone in 2016 can be divided into four factions and six subgroups. The most critical factors affecting the formation of subgroups are administrative divisions, provincial boundaries, geographical locations, and urban regional connections. Among them, Xi’an was formed independently and did not form a subgroup with other node cities, indicating that it has less connections with other cities and has certain differences in internal spatial structure with other cities. This is because in 2016, Xi’an was the leading city in Shaanxi Province, and other cities acted as followers, with different development modes and states among each other. More often, other cities in the province took the initiative to seek contact with Xi’an. However, for cities outside Shaanxi Province, the transportation conditions for mutual communication were not perfect. Three subgroups were formed in Shaanxi Province: Xianyang–Weinan, Baoji–Ankang–Hanzhong, and Shangluo–Tongchuan. Xianyang–Weinan–Xi’an formed the core faction in the northeast, and the other two subgroups formed the sub-core faction in the northeast. Within Sichuan Province, there are two subgroups: Ya’an–Leshan–Zigong–Neijiang–Meishan–Ziyang and Nanchong–Deyang–Mianyang–Suining–Guang’an–Dazhou–GuangYuan–Bazhong, which constitute the auxiliary faction of Chengdu–Chongqing urban agglomeration in southwest China. Chengdu–Chongqing not only formed a sub-group, but also formed the core faction of cultural tourism Internet attention in the Western Triangle Economic Zone due to the drive of Chengdu–Chongqing urban agglomeration.

According to Figure 4, the cohesive subgroup of the Western Triangle Economic Zone in 2018 was still divided into four factions and six subgroups. Weekday traffic accessibility, geographical spatial proximity, Internet celebrity economy, and resource sharing are important factors affecting the subgroup division at this stage. The opening of the Xi’an–Chengdu high-speed railway makes it more convenient to commute between Xi’an and Chengdu in a day. Furthermore, short video platforms such as TikTok promote tourists to check on Internet celebrities in places such as Xi’an and Chengdu. In comparison, the leading role of Chengdu–Chongqing urban agglomeration is slightly weak, thus Xi’an–Chengdu formed a sub-group and became the core faction of cultural tourism Internet attention in the Western Triangle Economic Zone, while Chongqing took shape separately. Compared with 2016, the node cities within the subgroup changed, but the cliques did not change. The Xianyang–Hanzhong–Ankang–Weinan–Baoji and Shangluo–Tongchuan subgroups formed the northeastern cliques. Two subgroups, Ya’an–Leshan–Neijiang–Meishan–Zigong–Ziyang and Deyang–Dazhou–Suining–Guang’an–GuangYuan–Bazhong, formed the southwest faction. Different from this, Nanchong and Mianyang, as strong competitors of the second largest tourism city in Sichuan, were influenced by the development of regional tourism. They formed a rich area of cultural tourism resources through regional combination and grew

into the second growth pole of cultural tourism development in Sichuan. They separated from the previous sub-group structure and formed an independent sub-group, forming the second core faction of the Western Triangle Economic Zone with Chongqing.

As can be seen from Figure 4, the cohesive subgroup of the Western Triangle Economic Zone in 2020 was divided into four cliques and seven subgroups, with no change in cliques and one additional subgroup. At the regional economic development level, resource sharing and industrial correlation are the key factors affecting the construction of subgroups. Xi'an–Chengdu–Chongqing, as the region with the strongest level of economic development among all the node cities, organized sub-groups and form the core faction of the Western Triangle Economic Zone. Compared with 2018, Hanzhong–Ankang–Xianyang–Weinan–Baoji and Shangluo–Tongchuan subgroups are still the northeast clique, while Guang'an–Ya'an–Deyang–Suining–Guangyuan and Leshan–Zigong–Ziyang–Meishan–Neijiang constitute the southwest clique. In addition to Mianyang–Nanchong, Bazhong–Dazhou, as the newly added subgroups, constitute the secondary core faction of cultural tourism network attention in the Western Triangle Economic Zone together.

According to the density matrix of cohesive subgroups (Tables 2–4), it can be observed that except for subgroups 4 and 6, the density values of cities in other subgroups in 2016 were high, showing a state of mutual close attention. The closely related subgroups are subgroup 1 with the other 6 subgroups, subgroup 2 with subgroups 3, 4, and 6, subgroup 3 with subgroup 6, and subgroup 5 with subgroups 6 and 7. In 2018, the density values of inner cities in subgroups 1, 2, and 6 were high, while the density values of subgroups 3, 4, 5, and 7 were low. The closely connected subgroups are: subgroup 1 with the other 6 subgroups, subgroups 2, 3, 4, 5, and 6 with subgroup 7, and subgroup 6 with subgroup 4, 5, and 6. In 2020, the density values of inner cities in subgroups 1, 2, 3, 7, and 8 were high, while the density values of subgroups 4, 5, and 6 were low. The closely connected subgroups are: subgroups 1 and 2 with other subgroups, subgroup 7 with subgroups 5, 6, and 8, and subgroup 8 with subgroup 7. According to the density distribution among the three subgroups, the density of cohesive subgroups is positively correlated with the spatial distance and the development level of the cultural and tourism industry, and the density value within the core city and between other subgroups is higher, and the attention is closer.

**Table 2.** Cohesive subgroup density matrix in 2016.

The Number of Subgroups	1	2	3	4	5	6	7
1	1.000	1.000	1.000	1.000	0.833	1.000	1.000
2	1.000	1.000	1.000	1.000	0.000	1.000	0.000
3	1.000	0.167	0.667	0.167	0.000	1.000	0.000
4	1.000	0.000	0.000	0.000	0.000	0.000	0.000
5	1.000	1.000	1.000	0.405	1.000	1.000	1.000
6	0.671	0.000	0.000	0.000	1.000	0.167	0.104
7	0.500	0.000	0.042	0.000	1.000	0.042	0.571

**Table 3.** Cohesive subgroup density matrix in 2018.

The Number of Subgroups	1	2	3	4	5	6	7
1	1.000	1.000	1.000	0.833	1.000	1.000	1.000
2	1.000	0.700	0.300	0.000	0.033	0.000	1.000
3	0.750	0.000	0.000	0.000	0.000	0.000	0.000
4	0.750	0.000	0.000	0.167	0.000	0.083	0.833
5	0.917	0.000	0.000	0.000	0.100	0.417	1.000
6	1.000	0.100	0.000	0.500	1.000	1.000	1.000
7	1.000	1.000	0.000	1.000	1.000	1.000	0.267



**Table 4.** Cohesive subgroup density matrix in 2020.

The Number of Subgroups	1	2	3	4	5	6	7	8
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3	1.000	1.000	0.750	0.400	0.000	0.000	0.000	0.000
4	1.000	0.000	0.100	0.000	0.000	0.000	0.000	0.000
5	0.800	0.900	0.000	0.000	0.000	0.040	0.400	0.000
6	1.000	1.000	0.000	0.000	0.000	0.200	0.000	0.000
7	1.000	1.000	0.200	0.000	1.000	0.600	1.000	1.000
8	0.500	1.000	0.100	0.000	0.300	0.000	0.500	1.000

### 3.5. QAP Regression Analysis

In this study, 13 influencing factors from four aspects of regional economic level, tourism development level, tourism service facilities, and accessibility of the cities in the Western Triangle region were included in the QAP regression model as the dependent variable matrix. In order to exclude the influence of different dimensions on the regression analysis, UCINET software was used to standardize the index matrix before the analysis. The standardized matrix of network mutual attention of 24 cities in the Western Triangle region was taken as the dependent variable, and the matrix of nine selected indicators was taken as the independent variable for QAP regression analysis.

According to the QAP regression coefficient and test, the results were analyzed from the perspectives of significance, influencing factors, and influencing degree. Based on the relevant data of cities in the Western Triangle region, the corresponding results could be calculated by the QAP regression analysis module in the social network software UCINET, shown in Table 5.

**Table 5.** QAP regression coefficients and test results.

Affecting Factors	Variables	Unstandardized Coefficients	Standardized Coefficients	Significance
Regional economic level	GDP	−0.00597	−0.00631	0.42329
	Average per capita income	−0.04138	−0.04378	0.17246
	Human occupancy	−0.02178	−0.02304	0.23838
Level of tourism development	Number of cultural enterprises	0.00127	0.00134	0.47526
	Number of tourists	−0.02596	−0.02747	0.31534
	Tourist income	0.01706	0.01805	0.38731
	Cultural tourism policy indicators	0.04055	0.04989	0.11894
Tourism service facilities	Number of hotels	−0.09494	−0.10043	0.22250
	Star-rating of hotel	0.01319	0.01395	0.32334
	Number of cultural sites	−0.00789	−0.00834	0.40130
Accessibility	Airport visitor throughput	0.02530	0.02676	0.21189
	Total highway mileage	−0.05376	−0.05687	0.04598
	Railway network density	0.02423	0.02563	0.17741

#### 3.5.1. Significance Analysis

Among the 13 influencing variables, the standardized regression coefficients of regional GDP difference, the difference in the number of cultural enterprises in regulation, and the difference in the number of cultural sites are −0.00631, 0.00134, and −0.00834, respectively, and the absolute value is low among all variables. It shows that regional economy and regional cultural attraction have no significant effect on the network attention of cultural tourism brands in the Western Triangle when other variables are unchanged. The standardized regression coefficients of the difference in the number of hotels, the difference in the total highway mileage, and the difference in cultural tourism policy indicators

were  $-0.10043$ ,  $-0.05687$ , and  $0.04989$ , respectively, with the highest absolute value among the 13 variables. The results show that residential service facilities, road accessibility, and open tourism policies have significant effects on the network attention of cultural tourism brands in the Western Triangle.

### 3.5.2. Influence Direction Analysis

The three matrices of per capita income difference, the difference in the number of hotels, and the difference in total highway mileage have a significant negative impact on the network attention of cultural tourism brands in the Western Triangle, indicating that the smaller the difference of per capita income, hotel number, and total highway mileage among cities, the stronger the network correlation. The cause of these results is firstly, that per capita income is a reflection of the developmental ability of regional cultural tourism. The closer the per capita income is, the residents will show similar emotional fluctuations in their attention to cultural tourism brands, so it is more likely to be associated with other cities improving the strength of network association. Secondly, the tourism transportation links between cities in the Western Triangle are mainly highways. With the development of highways and high-speed rail, tourism activities between cities are less by air and rail, which has a significant negative impact due to the loosely connection.

### 3.5.3. Influence Degree Analysis

The absolute value of the standardized regression coefficient of the number of hotels is the largest among the 13 variables, which is  $-0.10043$ . This means that the regional tourism accommodation and reception ability has a strong positive linkage effect on the network attention of cultural tourism brands, which is mainly due to the pursuit of high-quality tourism and comfortable tourism. The other reason is the difference in per capita income. The standardized coefficient is  $-0.04138$ , indicating that the higher regional per capita income, the more help to improve the network attention intensity of cultural tourism brands in the Western Triangle. The standardized regression coefficient of the difference in the number of cultural enterprises is the smallest among the 13 variables, which is  $0.00134$ . The reason for this phenomenon is that it is affected by the double impact of tourism and COVID-19 that micro-vacations, health tourism, and short-distance self-driving tourism have become the mainstream, and the attention to regional culture has decreased. The difference in the number of cultural enterprises has little influence on the network attention of cultural tourism brands.

## 4. Discussion

### 4.1. Research Findings

The main conclusions are as follows. (1) Inter-urban cultural tourism Internet attention in the Western Triangle Economic Zone increases year by year, yet is still loosely connected. (2) From 2016 to 2020, the core city centrality in cultural tourism network was enhanced, and the radiation effect and driving forces have been significantly improved, forming a stable radiation pattern in Xi'an, Chengdu, and Chongqing. Since the outbreak of COVID-19 in 2019, the high value of mutual attention on cultural and tourism has weakened, making public Internet attention deviate to the epidemic situation. In other words, the severe shock of sudden social public health events in the short term leads to a sharp decrease in the Internet attention of the regional cultural tourism industry. (3) The core area of cultural tourism Internet attention from 2016 to 2020 diffused from south to north. (4) From 2016 to 2020, the influencing factors of cohesive subgroups changed from administrative division, geographical location, and urban regional connection to weekday traffic accessibility, economic strength, resource sharing, and industrial correlation. The core clique of cultural tourism Internet attention in the Western Triangle Economic Zone changed from "Chengdu–Chongqing" to "Xi'an–Chengdu" and finally tended toward the combination of "Xi'an–Chengdu–Chongqing". This enhanced the connectivity of core cities, and the influencing effect was transformed from being oriented to urban agglomeration

and transport connectivity to higher-level coordinated development of regional cultural tourism integration.

#### *4.2. Research Strengths and Limitations*

This research possesses both strengths and limitations. For research strengths, this paper theoretically explores the relationship between Internet attention and tourism flow structure from a spatial perspective, filling the research gap of only combining a temporal perspective. Empirically, this paper summarizes the typical characteristics, key problems, and development mode of cultural tourism and provides countermeasures and suggestions for the development of cultural tourism in WTEZ. The limitations are as follows. (1) The data used are secondary data, lacking timeliness. (2) The research objects are only 24 cities in WTEZ, and a larger spatial scale remains to be explored to better reflect the spatial distribution rules. (3) This study involves the Internet attention data in 2016, 2018, and 2020, which reflects the potential tendency of the public towards cultural tourism in the Western Triangle, without considering the actual impact and future impact of the COVID-19 outbreak in 2020. Based on the Baidu Index, this research established a model to explore the relationship between cultural tourism Internet attention and tourism flow structure in WTEZ from the spatial perspective, which can be generalized to future related research.

#### *4.3. Political Implications*

The results show that the cultural tourism Internet attention of cities in the Western Triangle Economic Zone is unbalanced. Therefore, it is necessary to develop competitive strategies for different cities from different spatial dimensions so as to build a hierarchical cultural tourism city cluster system with reasonable layout and perfect functions and maximize the competitive advantages of urban clusters.

Firstly, for the core node cities concerning the cultural tourism Internet attention in WTEZ, the advantages of core cities should be brought into play, cultural tourism resources of related cities should be integrated, cultural tourism product forms should be innovated, cultural tourism brand IP of sub-groups should be formed to form regional punch products with core competitiveness. At the same time, new media, new means, and new technologies, especially short video platforms, Internet celebrities, big V, and other hot spots should be fully utilized to shape the differentiated identification of core and marginal cities, effectively improve their popularity, and form a new pattern of three-dimensional publicity.

Secondly, major public health events can have a deadly impact on transnational and remote tourism, and 2020 Western Triangle network attention changes between cities also reflect this trend. However, in the post-epidemic period, short-distance travel around the country will become increasingly popular, which provides excellent development opportunities for other cities besides the core cities in the Western Triangle Economic Zone. At the same time, it is imperative to emphasize regional linkage and epidemic prevention and control. For cities with weak competitiveness, it is necessary to have clearer development goals, form a differentiated competition pattern, and make breakthroughs. For instance, they could make more use of artificial intelligence, big data, and other methods to develop online tourism accordingly and cultivate a leading new form of cultural and tourism business.

Lastly, for the spatial association of all nodal cities in WTEZ, a comprehensive transportation network should be built, so as to improve the accessibility level of the whole area, using traffic connectivity to break the shackles of administrative region management and effective linkage of Chengdu–Chongqing urban agglomeration and Guanzhong Plain urban agglomerations to promote the coordinated development of regional tourism development and regional integration.

China's overall epidemic prevention tends to be accurate and efficient. This is very beneficial to the cultural tourism industry development in WTEZ. At the same time, the study on the temporal and spatial evolution of public attention based on Internet searches can also better reflect the change of people's cognitive demands during the period of

epidemic normalization, which plays an important role in the layout of the cultural tourism industry in WTEZ.

## 5. Conclusions

In the context that tourists have begun to seek cultural enjoyment, cultural tourism has become widely popularized, and scholars pay increasing attention to this field. Despite the significance of exploring cultural tourism from the spatial perspective, the spatiality of cultural tourism is still insufficiently studied, especially with a specific focus on undeveloped areas via Baidu Index data in China. This study aims to explore the spatial-temporal pattern of cultural tourism Internet attention of 24 major node cities in China's Western Triangle Economic Zone (WTEZ) via the social network analysis method (i.e., network density, centrality analysis, core–periphery model, cohesive subgroup, etc.). Research findings are as follows. (1) Cultural tourism Internet attention of WTEZ cities is increasing year by year, yet is still loosely connected. (2) The core city centrality of the cultural tourism network from 2016 to 2020 was constantly enhanced, and the radiation effect and driving forces were significantly improved, forming a stable radiation pattern in Xi'an, Chengdu, and Chongqing. Affected by the COVID-19 epidemic in 2020, the high value of cultural tourism Internet attention weakened. (3) The core area of cultural tourism Internet attention in WTEZ from 2016 to 2020 diffused from south to north. (4) From 2016 to 2020, the key influencing factors of cohesive subgroups changed from administrative division, geographical location, and urban regional connection to weekday traffic accessibility, economic strength, resource sharing, and industrial correlation. The core clique of cultural tourism network attention in WTEZ has changed from “Chengdu–Chongqing” to “Xi'an–Chengdu” and finally tended toward the combination of “Xi'an–Chengdu–Chongqing”. This research is conducive to the coordinated development of interregional cultural tourism from the Internet attention perspective.

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## Appendix A

**Table A1.** Statistics of WTEZ Cities.

City	GDP (100 million)	Population (/1000)	Area (km <sup>2</sup> )	Urban Per Capita Disposable Income (CNY)	Annual Tourist Arrivals (/1000)
Xi'an	10,020	13,163	10,752	43,713	301,104
Baoji	2277	3761	18,100	36,209	106,412
Shangluo	740	2379	19,292	26,616	37,302
Hanzhong	1593	3211	27,200	34,417	61,700
Tongchuan	382	698	3882	34,143	9475



Table A1. Cont.

City	GDP (100 million)	Population (/1000)	Area (km <sup>2</sup> )	Urban Per Capita Disposable Income (CNY)	Annual Tourist Arrivals (/1000)
Xianyang	2205	3960	10,196	37,975	43,840
Weinan	1866	4631	13,030	35,304	53,900
Ankang	1089	2493	23,391	28,247	20,334
Ya'an	755	1435	15,062	37,191	38,342
Leshan	2003	3160	12,739	38,931	70,713
Zigong	1458	2489	4375	38,781	27,321
Neijiang	1466	3141	5365	38,337	38,957
Meishan	1424	2955	7133	38,892	39,948
Chengdu	17,717	20,938	14,337	48,593	203,953
Deyang	2404	3456	5907	39,360	35,460
Ziyang	808	2309	5752	37,562	18,768
Mianyang	3010	4868	20,252	39,680	62,715
Suining	1403	2814	5326	37,117	55,889
Guang'an	1302	3255	6360	38,071	27,775
Nanchong	2401	5608	12,475	36,057	83,165
Guangyuan	1008	2306	16,342	35,740	45,845
Bazhong	767	2713	12,306	35,821	29,206
Dazhou	2118	5385	16,596	36,001	37,949
Chongqing	25,003	32,124	82,400	40,006	290,303

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