

Research on the Coupling and Coordination of China's Tourism Economy and Internet Development

Jiao Mi^{1,*}

¹School of Tourism, Sichuan Agricultural University, Chengdu, Sichuan 611830, China

*Corresponding author. Email: mijiao136@126.com

ABSTRACT

Taking China's 30 provincial units as the research target and constructing an evaluation index system of tourism economy and Internet development, we use the coupling coordination model to measure the degree of coupling and coordination between China's tourism economy and Internet development from 2007 to 2017, and to explore its temporal and spatial evolution features and laws. The results show: First, the development level of the national tourism economy is far ahead of the development level of Internet; Second, for a long time, except for Jilin and Ningxia, there has been a high level of coupling between the tourism economy and the development of Internet in other provinces in China; Third, the level of coupling coordination between China's tourism economy and the development of Internet is mainly in the barely coordinated or primary coordinated stage, and over time, the proportion of provinces that transition from imbalance to the coordinated stage has increased, but the degree of coordinated development between the two is still relatively low.

Keywords: *tourism economy, Internet, coupling degree, coupling coordination degree*

I. INTRODUCTION

Internet and the tourism industry have a natural adaptability [1][2], from "parents are here, do not travel far" to "the world is so big, I want to see", travel behavior in different periods deeply reflects the development of the ages and technology [3]. Internet has given more and more people access to tourism and has become a driving force for the booming tourism industry. In September 2015, the National Tourism Administration pointed out that the new round of technological and scientific revolution represented by Internet has become the driving force of the tourism reform, and the integrated development of the two has turned to be an unstoppable trend of the times [4]. In June of the same year, "Oriental Hawaii" Hainan Province clarified the core position of Internet tourism in promoting the innovation of Hainan's tourism business model [5]; In September, Heilongjiang Province officially advocated the comprehensive development of the level of tourism informatization to improve the integration of Heilongjiang Province's tourism industry and Internet [6]; In April 2020, Jiangsu Province with South China Charms, proposed to accelerate the "Internet + tourism" and strengthen the construction of smart scenic spots [7]. The systemic changes triggered by Internet have urged provinces to gradually use Internet tourism as a breakthrough in the deep integration of tourism resources, which has

become a new opportunity for reform and growth of the tourism field.

Under the advancement of the integration and improvement of tourism and Internet, related Chinese and international research is gradually refined and mature. There are abundant research achievements on the Internal relationship between Internet and tourism. Buhalis mentioned that Internet can improve the competitiveness of tourist destinations and increase the visibility of tourist destinations[8]; Buhalis and Law pointed out that the unique way of publishing tourism information on Internet has promoted the transformation of the tourism industry[9]; Gössling and Toader et al. proved that Internet can support the sustainable development of the tourism industry [10][11]; Qian Jianwei believes that the subversive changes brought by Internet to the traditional tourism industry cover almost every link in the tourism value chain [3]; Lin and Liu Yifeng pointed out that accelerating the development of integration with Internet is not only the core power for the upgrading and of further transformation the tourism industry, but also the only way to integrate the elements of the tourism industry [12]; Yang Yong used provincial panel data and related measurement methods to empirically test Internet's impact on the tourism development quality and efficiency in China [2]. The improvement of modern information and communication techniques represented by Internet has profoundly affected the growth and pattern evolution of the tourism industry,

including the tourism economy [13][14][15]. With the continuous deepening of research, some researchers have conducted study on the relationship between tourism economic growth and Internet. For example, Wu Yuanyuan and Song Yuxiang found that China's tourism information service has a important influence on tourism financial mismatch [13]; Zhang Buhong believe that the tourism information industry has the power of improving the evolution of China's new tourism economy [16]; Yang Yan also pointed out that a higher level of tourism informatization has the power of improving the evolution of regional tourism economy [14]. In addition, scholars have gradually paid attention to the mechanism and evaluation of Internet and the coordinated development of tourism/tourism economy. Fan Jigang studied the coupling and coordinated growth of tourism industry and information industry in Sichuan Province from 2002 to 2011 [17]; Wang Guanxiao evaluated the coupling and coordination level of tourism and informatization of 31 provinces in China in 2014 [18]. Yang Yan found that there is a positive coupling relationship between the informatization of the four-star rural tourism area in Jiangsu Province and the development level of tourism economy [14].

To sum up, the current domestic and foreign related research mainly focuses on the relationship between Internet and tourism, and the relationship between Internet and tourism economy, especially the mechanism of the coordinated development mechanism between the two, is rarely involved, and in the only researches, the research object tends to be a single province or year, ignoring the extensive research based on a broader time and space perspective, and cannot

fully and objectively reflect the relationship, characteristics and laws of the tourism economy of China's provinces and the development of Internet; In terms of methods, the relationship between tourism or tourism economy and the development of Internet is mostly based on qualitative analysis, while quantitative analysis is relatively rare. In terms of indicator selection, limited by the availability and authenticity of data, most scholars have limited indicators to measure the tourism economy, so it is hard to objectively and comprehensively show the growth of the national tourism economy [13][19][20]. Based on these, this article constructs an evaluation index system for the coordination and coupling of regional tourism economy and Internet development, taking China's provincial units as the research object, using SPSS23.0 and ArcGIS 10.2, and using the coupling coordination model to study China's tourism economy's spatial and temporal evolution features and Internet growth from 2007 to 2017. And putting forward policy suggestions according to the results is helpful for all provinces to actively seek a new path for Internet and tourism economy's coordinated development and continuously promote the coordinated improvement of the two.

II. CONSTRUCTION OF INDICATOR SYSTEM AND DATA SOURCES

A. Construction of indicator system

According to the prior study results, this article construct the tourism economy [19][21][22] and Internet development [23] evaluation index system ("Table I").

TABLE I. EVALUATION INDEX SYSTEM FOR COUPLING TOURISM ECONOMY AND INTERNET DEVELOPMENT

System	Secondary indicators
<i>Tourism economy</i>	The total number of annual tourists (10,000 people); the total number of inbound tourists (10,000 people); the total number of domestic tourists (10,000 people)
	International tourism revenue (million US dollars); domestic tourism revenue (100 million yuan); total tourism revenue (100 million yuan); total tourism revenue as a percentage of GDP (%)
	Number of travel agencies (a); number of star hotels (a); number of higher tourism institutions (a)
	Railway mileage (km); highway mileage (km); GDP per capita (yuan); total post and telecommunications business (100 million yuan)
<i>Internet development</i>	Internet penetration rate (%); number of people surfing Internet (10,000 people); telecommunication business volume (100 million yuan);
	Total length of long-distance optical fiber (ten thousand kilometers); number of IPV4 addresses (ten thousand); number of CN domain names (ten thousand)
	Total page bytes (KB); percentage of web pages updated within a week (%); number of web pages (10,000)
	Number of World Wide Web Sites (10,000); Number of Express Delivery Services (10,000); Number of Mobile Phones (10,000)

B. Data sources

In this paper, the applied data mainly cite from the National Economic and Social Development Statistical Bulletins, Statistical Yearbooks and China Internet Information Center of the corresponding years in each

province. In addition, due to the imperfect data of relevant social and economic indicators in Tianjin and the update of some important indicators of Internet in 2018, this study finally took 30 provinces from 2007 to 2017 except Tianjin as the research object.

III. RESEARCH METHODS AND RESEARCH PROCESS

A. Research methods

1) *Data standardization processing*: The formula is as follows:

$$u_{ij} = \begin{cases} (x_{ij} - x_{ijmin}) / (x_{ijmax} - x_{ijmin}), & x_{ij} \text{ is a positive index} \\ (x_{ijmin} - x_{ij}) / (x_{ijmax} - x_{ijmin}), & x_{ij} \text{ is a negative index} \end{cases} \quad (1)$$

Among them, u_{ij} is the dimensionless value of x_{ij} standardized.

2) *Comprehensive evaluation of development level*: The formula is in the below:

$$U_1 = \sum_{j=1}^n w_{1j} u_{1j} \quad U_2 = \sum_{j=1}^n w_{2j} u_{2j} \quad (2)$$

Among them, U_1 and U_2 are respectively the comprehensive development level of the tourism economic system and Internet development level system; w_{ij} is the index weight, which is obtained by principal component analysis. According to related research [24][25], U_1 and U_2 can be divided into three types of relationships: when $U_1 < U_2$, the tourism economy is lagging; when $U_1 > U_2$, Internet development is lagging; when $U_1 \approx U_2$ ($|U_1 - U_2| \leq 0.2$), the tourism economy and the development of Internet are synchronized.

3) *Coupling function*: Coupling degree refers to the phenomenon in which two or more elements or systems influence and interact with each other [26]. The formula is as follows:

$$C = \sqrt{U_1 U_2} / [(U_1 + U_2) / 2]^2 \quad (3)$$

Where C is the degree of coupling, and $C \in [0, 1]$. According to related research [21], C is divided into 4 stages: 0~0.3 is a low-level coupling stage; 0.3-0.5 is an antagonistic stage; 0.5-0.8 is a running-in stage; 0.8-1.0 is a high-level coupling stage.

4) *Coupling degree*: Coupling coordination degree describes the degree of coordination and mutual influence among various elements or systems. It not only reflects the strength of the correlation between the systems, but also reflects the quality of the coordination between the systems [19]. The formula is as follows:

$$T = \alpha U_1 + \beta U_2 \quad D = \sqrt{C \times T} \quad (4)$$

Among them, T is a comprehensive evaluation index, reflecting the overall benefits or levels of the two systems. α and β are undetermined coefficients, which indicate the importance of the two systems. Since the two are equally important, $\alpha = \beta = 0.5$; D is the degree of coupling coordination, $D \in [0, 1]$. With reference to Liu Anle [24], Liu Danli [25] and other related studies, the degree of coupling coordination is divided into 7 levels: 0-0.2 is extreme maladjustment; 0.2-0.4 is moderate maladjustment; 0.4-0.5 is near maladjustment; 0.5-0.6 is Reluctant coordination; 0.6-0.7 is primary

coordination; 0.7-0.8 is intermediate coordination; 0.8-1 is high-quality coordination.

B. Research process

Using SPSS23.0 to perform KMO value and Bartlett sphere test on the data standardized by formula (1), the results show that the KMO values of the two systems are both greater than 0.6 (70% of the years greater than 0.7), and Sig.=0.000, reaching significant level, suitable for principal component analysis. The cumulative variance contribution rate of the principal components extracted from all years in each system in the principal component analysis results are all greater than 80%, which shows that the data is representative. Divide the factor loading number obtained by the principal component analysis result by the square root of the corresponding component eigenvalue to obtain the linear combination coefficient, and then divide the sum of the product of the linear combination coefficient and the variance contribution rate of the corresponding component by the sum of the variance contribution rate to obtain the synthesis of each index Score model coefficients, and normalize the coefficients to obtain the weights of various indicators over the years. In the calculation process, due to the negative values of the weights obtained in some years, the study used the formula $Y_{ti} = H + Y_i$ to translate the results according to the 3σ principle in statistics [27][28][29]. ("Table II")

TABLE II. COMPREHENSIVE EVALUATION INDEX, COUPLING DEGREE AND COUPLING COORDINATION DEGREE OF EACH PROVINCE

Province	2007				2017			
	U_1	U_2	C	D	U_1	U_2	C	D
Beijing	0.454	0.616	0.989	0.727	0.316	0.510	0.972	0.633
Hebei	0.345	0.187	0.955	0.504	0.473	0.286	0.969	0.607
Shanxi	0.261	0.187	0.986	0.470	0.376	0.163	0.918	0.497
Inner Mongolia	0.212	0.101	0.936	0.383	0.294	0.136	0.930	0.447
Liaoning	0.435	0.211	0.938	0.551	0.385	0.210	0.956	0.533
Jilin	0.404	0.104	0.808	0.453	0.473	0.124	0.811	0.492
Heilongjiang	0.254	0.131	0.948	0.428	0.212	0.145	0.982	0.419
Shanghai	0.361	0.486	0.989	0.647	0.256	0.285	0.999	0.520
Jiangsu	0.711	0.370	0.949	0.716	0.681	0.409	0.968	0.726
Zhejiang	0.579	0.443	0.991	0.712	0.575	0.477	0.996	0.724
Anhui	0.265	0.125	0.933	0.426	0.466	0.190	0.908	0.546
Fujian	0.299	0.257	0.997	0.526	0.343	0.287	0.996	0.560
Jiangxi	0.233	0.118	0.945	0.407	0.426	0.144	0.869	0.498
Shandong	0.614	0.317	0.948	0.664	0.681	0.379	0.959	0.713
Henan	0.495	0.214	0.918	0.570	0.546	0.307	0.960	0.640
Hubei	0.354	0.169	0.936	0.495	0.503	0.217	0.918	0.575
Hunan	0.351	0.185	0.951	0.505	0.507	0.212	0.912	0.573
Guangdong	0.732	0.790	0.999	0.872	0.789	0.814	1.000	0.895
Guangxi	0.224	0.142	0.974	0.422	0.406	0.171	0.914	0.514
Hainan	0.058	0.045	0.993	0.227	0.046	0.063	0.988	0.232
Chongqing	0.243	0.119	0.940	0.412	0.333	0.133	0.904	0.459
Sichuan	0.437	0.243	0.958	0.571	0.535	0.298	0.959	0.632
Guizhou	0.164	0.071	0.918	0.328	0.460	0.129	0.828	0.494
Yunnan	0.315	0.117	0.888	0.438	0.509	0.158	0.850	0.532
Tibet	0.026	0.040	0.976	0.180	0.036	0.051	0.987	0.207
Shaanxi	0.229	0.140	0.971	0.423	0.386	0.172	0.924	0.508
Gansu	0.118	0.091	0.991	0.322	0.205	0.093	0.927	0.372
Qinghai	0.039	0.050	0.993	0.211	0.049	0.079	0.972	0.250
Ningxia	0.011	0.027	0.904	0.131	0.003	0.038	0.499	0.100
Xinjiang	0.164	0.104	0.975	0.361	0.198	0.116	0.965	0.389

IV. COORDINATION AND TIME-SPACE EVOLUTION OF THE COUPLING AND DEVELOPMENT OF THE NATIONAL TOURISM ECONOMY AND INTERNET

A. Comprehensive development level of national tourism economy and Internet development

1) *Time series evolution characteristics of comprehensive development level:* "Fig. 1" shows that the comprehensive level of the two from 2007 to 2017 is very weak, and their changes are relatively stable. After 2011, the comprehensive development level of the tourism economy tends to grow slowly; In addition, the tourism economy's comprehensive development level has always been higher than Internet. Calculating the standard deviation and coefficient of variation of the two, it is found that the standard deviation of tourism economy and Internet development is between 0.1 and 0.2, accounting for 90.91%, which is low and stable; the coefficient of variation of tourism economy only fluctuates from 0.593 in 2007. The coefficient of variation of tourism economy only decreased from 0.593 fluctuation in 2007 to 0.506 in 2017, and the

coefficient of variation of Internet development only decreased from 0.841 fluctuation in 2007 to 0.711 in 2017. However, the volatility of Internet was greater than that of tourism economy, and the overall coefficient of variation was also greater than that of tourism economy. This shows that although the development level of the two is not high, they have shown a relatively positive development trend in the evolution of time. The overall development level of Internet is lower than the overall development level of the tourism economy, and the former has much room for improvement.

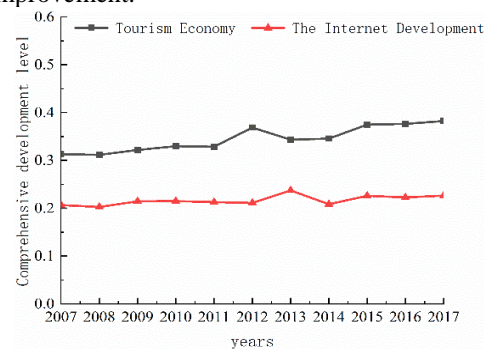


Fig. 1. The comprehensive development level of the national tourism economy and Internet development level from 2007 to 2017.

2) *Characteristics of spatial pattern of comprehensive development level:* "Fig. 2" shows that, with the exception of Beijing and Guangdong, the development level of tourism economy in most provinces in my country is far ahead of the development level of Internet. As far as the level of tourism economic development is concerned, as time goes by, the differences between regions, especially between the east and the west, have been shrinking, and the western region has shown a positive growth trend overall. In terms of Internet development level, the combined scores of the last three Ningxia, Tibet, and Hainan in 2007 were 0.037, and the combined scores of

the top three Guangdong, Beijing, and Shanghai were 0.631, which was 17.05 times that of the last three; By 2017 the combined scores of the last three Ningxia, Tibet, and Hainan are 0.051, and the combined scores of the top three Guangdong, Beijing, and Zhejiang are 0.600, which is 11.76 times that of the last three. From this perspective, the gap between regions in China's Internet development is gradually narrowing. Combining the results of scholar Wang Zimin's measurement of China's regional Internet development level, it can be predicted that after 2014 will be the main period of narrowing the regional gap in Internet development.

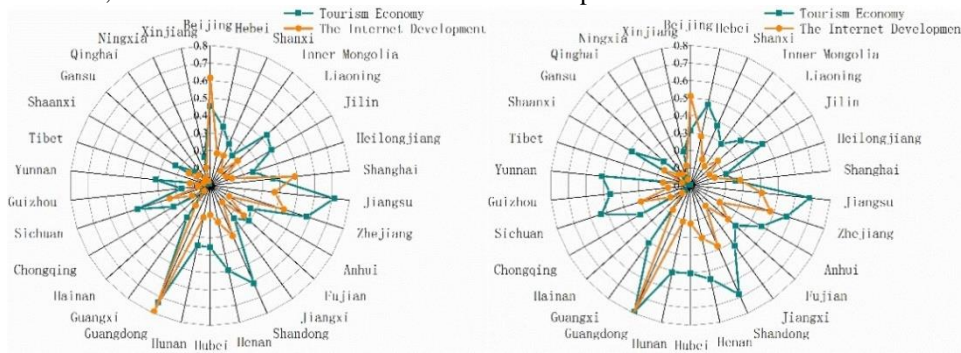


Fig. 2. The comprehensive development level of my country's tourism economy and Internet development in 2007 and 2017.

B. The timing coupling of national tourism economy and Internet development

1) *Time series evolution analysis of coupling degree:* From "Table II", the coupling degree of China's tourism economy and the development of Internet in the past 11 years is mainly at a high-level coupling stage of (0.8, 1). "Fig. 3" shows that the average coupling degree of the two from 2007 to 2017 during the whole sample period is 0.935. In comparison, the average coupling degrees of 2007-2008 and 2010-2013 were higher than the average coupling degrees of the entire sample period, while the average coupling degrees of 2009 and 2014-2017 were lower than the average coupling degrees of the entire sample period, indicating that the coupling degree of 2014-2017 has slightly decreased compared with previous years. From the perspective of the degree of fluctuation, the average coupling degree of the two major systems has not fluctuated much since 2007, and the pattern has a certain degree of stability. Generally speaking, the coupling between tourism economy and Internet development is very optimistic. The long-term high level coupling indicates that there is a high degree of interaction and mutual influence between them.

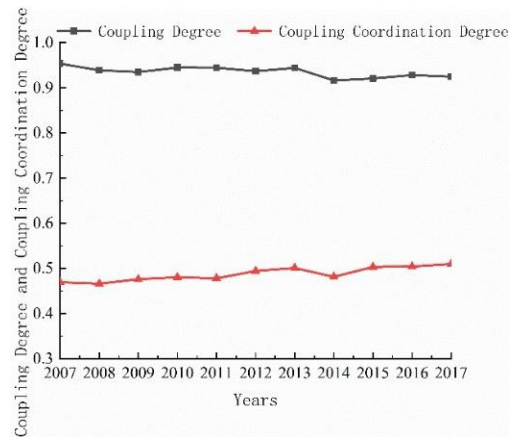


Fig. 3. 2007-2017 China's tourism economy and Internet development coupling degree and coupling coordination degree average.

2) *Time series evolution analysis of coupling coordination degree:* According to "Fig. 3", the coupling coordination degree of China's tourism economy and the development of Internet in the past few years is mainly in the (0.4, 0.5) stage of imbalance. In 2013 and 2015-2017, the average coupling coordination degree was slightly greater than 0.5, which turned into barely coordination phase. Compared with the average value of 0.488 for the coupling and coordination of tourism economy and Internet

development in the full sample period from 2007 to 2017, the average value of coupling and coordination for 2007-2011 and 2014 is lower than that of the full sample, while the mean value of coupling coordination degree in 2012-2013 and 2015-2017 was higher than the mean value of full-sample coupling coordination degree. On the whole, this shows that since 2007, the two systems have had a low degree of benign interaction and coordinated development. From the perspective of the subtle evolution trend of the mean value of the coupling coordination degree, the coupling coordination degree shows a relatively positive trend to a certain extent. In terms of the degree of fluctuation, the evolution characteristics of the average coupling coordination degree of the two are similar to those of the mean coupling degree. That is, the degree of

volatility is not large and the stability is high. In addition, the mean value of coordination degree is generally far lower than the mean value of coupling degree, indicating that although the tourism economy and Internet development are interdependent and have a high degree of mutual influence from 2007 to 2017, the degree of synergetic development of the two is not optimistic.

C. The spatial coupling of national tourism economy and Internet development

The research uses ArcGIS10.2 to visualize the data, and draws the spatial differentiation chart of the degree of coupling and coordination between tourism economy and Internet development in 30 provinces and cities ("Fig. 4").

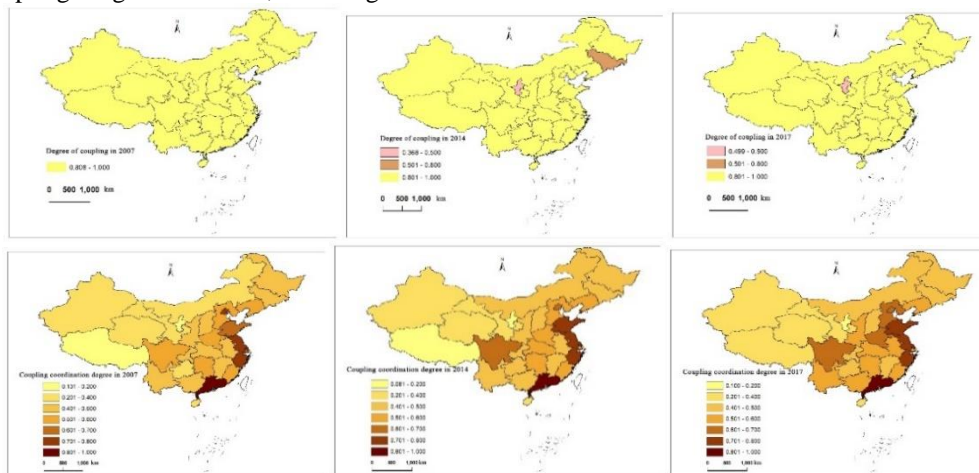


Fig. 4. The spatial differentiation diagram of the coupling degree and coupling coordination degree of China's tourism economy and Internet development from 2007 to 2017.

1) *Coupling degree spatial differentiation analysis:* According to "Fig. 4", from 2007 to 2017, the growth of tourism economy and Internet in China's 30 provinces was mainly in the high-level coupling stage, and only parts of the northwest and northeast have turned into a running-in and straitened stage in some years. In terms of specific provinces and cities, except for the changes in the degree of coupling between Jilin and Ningxia in some years, the remaining provinces and cities are in a high level of coupling from 2007 to 2017.

2) *Coupling coordination degree spatial differentiation analysis:* According to "Fig. 4" and combined with the time series evolution analysis results of tourism economy and Internet development coupling degree, the coupling coordination degree of 30 provinces and cities in China is generally not high. The eastern coastal provinces have the highest coupling coordination degree, followed by the central provinces,

and the northwest and southwest parts (Ningxia and Tibet) have a long-term "low valley" in the degree of coupling and coordination, presenting a stepwise decline in the east, middle, and west, and its spatial evolution is significantly greater than the degree of coupling. In terms of stages, according to the above-mentioned time-series evolution law of the coupling coordination degree, it can be roughly divided into two phases: Phase I (2007-2014) and Phase II (2015-2017). Observing "Fig. 4" and "Table III", in 2007, 33.33% of China's provinces and cities were in the stage of imbalance, and the provinces that were barely coordinated accounted for 20% and they were Hebei, Liaoning, Fujian, Henan, Hunan, and Sichuan. Tibet and Ningxia are in a stage of extreme imbalance, Shanghai and Shandong are in the primary coordination stage, Beijing, Jiangsu, and Zhejiang are in the intermediate coordination stage, and Guangdong is in the high-quality coordination stage; in 2014, the

provinces that were barely coordinated increased to 23.33%, except for Sichuan which was transferred to the primary stage. Outside of the coordination (including Beijing) phase, the additional provinces are Shanghai and Hubei, Jiangsu, Zhejiang, and Shandong are middle-level coordination, and Guangdong, Tibet and Ningxia remain unchanged. It can be seen that in the first stage, the number of provinces and cities with moderate dysfunction decreased, and the number of provinces and cities on the verge of dysfunction and barely coordinated increased, while the status quo was maintained in other stages. Entering the second stage,

the number of high-quality coordination and intermediate coordination provinces remains unchanged, but the number of provinces in the reluctant coordination and primary coordination stages has increased, and the extremely imbalanced provinces have decreased, showing a good overall situation. In 2017, Hebei and Henan moved from reluctant coordination to the primary coordination stage, Anhui, Hubei, Guangxi, Yunnan, and Shaanxi entered the reluctant coordination stage, and Tibet shifted from extreme imbalance to moderate imbalance.

TABLE III. THE PROPORTION OF COUPLING AND COORDINATION LEVELS OF TOURISM ECONOMY AND INTERNET DEVELOPMENT FROM 2007 TO 2017

Grade	2007	2014	2017
Extreme imbalance	6.67%	6.67%	3.33%
Moderate Disorder	20.00%	10.00%	16.67%
On the verge of maladjustment	33.33%	40.00%	23.33%
Barely coordinated	20.00%	23.33%	30.00%
Primary coordination	6.67%	6.67%	13.33%
Intermediate coordination	10.00%	10.00%	10.00%
Quality coordination	3.33%	3.33%	3.33%

For the purpose of studying the spatial difference characteristics of the coupling and coordination degree of tourism economy and Internet development in various provinces, 30 provinces across the country are divided into tourism economy lagging type, tourism economy and Internet development synchronization type, and Internet development lagging ("Table IV"). Among them, there is no tourism economy lagging type, and the two synchronization type and Internet development lagging type change in the opposite direction. The number of synchronous provinces has decreased from 26 in 2007 to 16 in 2017, but their proportions are still the highest in each year, with greater than 50%; the number of provinces with lagging Internet development increased from 4 in 2007 to 14 in

2017, showing an overall trend of growth. The above results reflect that the development of Internet and the tourism economy in China during the period from 2007 to 2017 have basically synchronized development, but compared with the tourism economy, the development of Internet is not optimistic.

TABLE IV. BASIC TYPES OF COUPLING AND COORDINATION OF NATIONAL TOURISM ECONOMY AND INTERNET DEVELOPMENT

Basic type	2007	2017
<i>Tourism Economy—Synchronous Development of Internet</i>	Beijing, Hebei, Shanxi, Mongolia, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	Beijing, Hebei, Mongolia, Liaoning, Heilongjiang, Shanghai, Zhejiang, Fujian, Guangdong, Hainan, Chongqing, Tibet, Gansu, Qinghai, Ningxia, Xinjiang
<i>Lagging Internet development</i>	Liaoning, Jilin, Shandong and Henan	Shanxi, Jilin, Jiangsu, Anhui, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangxi, Sichuan, Guizhou, Yunnan, Shaanxi

V. CONCLUSION

First, from the perspective of the temporal and spatial evolution characteristics of the comprehensive development level: (1) In terms of temporal evolution, the overall level of national tourism economy and Internet development is relatively stable, and the former has always been ahead of the latter and has a more positive trend of growth. (2) In terms of spatial differentiation, with the exception of Guangdong and Beijing, Internet development level of most provinces is obviously lagging behind the tourism economy, but the regional differences between the two have a trend of shrinking development. The huge gap between this result and the development of Internet has made Internet development of more and more provinces gradually lag behind the growth of tourism economy, which has an adverse effect on the sustainable development of tourism to a certain extent. Therefore, it is urgent to improve Internet infrastructure and promote the balanced development of Internet and tourism. All parts of the country, especially the provinces that have shown the lagging state of Internet development, can make Guangdong and Beijing as benchmarks to strengthen and update the construction of Internet infrastructure and support intelligence. Internet era characterized by precision, convenience, and comprehensiveness is an opportunity to provide more efficient information services to meet the needs of various stakeholders in the tourism industry, and provide differentiated services for tourist groups with different needs with more convenient management[12].

Second, from the perspective of the spatio-temporal evolution of the coupling degree: (1) In terms of time series evolution, the development of the national tourism economy and Internet is relatively stable at a high level of coupling, and there is a strong correlation between the two. (2) In terms of spatial differentiation, with the exception of Jilin and Ningxia, the tourism economy and Internet development in other provinces in China are at a high level of coupling. It can be seen that not only Internet has an important contribution to improving the quality and efficiency of the tourism industry and economic growth by providing technical support for the development of the tourism industry [1][2][30], but the improvement of the tourism industry will in turn promote Internet technology continues to upgrade, and the integration and development of the two are of great benefit. Therefore, both the government and tourism enterprises should accelerate the application of information technology, increase the intensity of "Internet + tourism" transformation, change the original tourism marketing method, accelerate the integrated development of Internet and the tourism industry, and further promote the growth of tourism economy.

Third, from the perspective of the spatio-temporal evolution law of the coupling coordination degree: (1) In terms of time series evolution, the coupling coordination degree of the national tourism economy and Internet development is not high and the fluctuation range is not large, and it is mainly in the two stages of imbalance and barely coordination. (2) In terms of spatial differentiation, the level status of the national coupling coordination has not changed much, but its distribution location generally shows the law of "East-Middle-West" decreasing. (3) The number of provinces where the development of the national tourism economy and Internet is synchronized and the number of provinces with the lagging Internet development are changing in the opposite direction. The vast majority of provinces are developing at the same time. Most provinces with lagging Internet development are located in the northeast coast and central and western regions. The above shows that although China's tourism economy and the development of Internet have a high degree of interdependence and influence, and the proportion of provinces that have shifted from imbalance to the coordination stage has increased, the degree of coordinated development between the two is low and there is no significant improvement. And its distribution location law is roughly consistent with the characteristics of China's regional economic development level. Therefore, cross-regional cooperation between Internet construction and tourism industry development should be strengthened to promote the rationalization of the spatial allocation of Internet resources. And considering Guangdong, Jiangsu, Zhejiang and Shandong as the core, gradually radiate the cross-regional cooperation model of the development of the tourism industry and Internet construction in the central and western regions, and drive the "disharmony" with "coordination"; at the same time, actively cultivate and transport compound talents in the tourism and information industries for the central and western regions. The integrated development of the two provides strong talent support, and gradually promotes the rationalization of the spatial allocation of resources through the input of talents, funds, and technology.

Finally, although this study has enriched the mechanism of the coupling and coordination of China's tourism economy and the development of Internet based on multi-temporal and spatial perspectives, there are still some shortcomings. In the future, the relevant research can be improved based on the following points: 1) Although the selection of indicators about the tourism economic system is relatively comprehensive, but limited by the availability of data, the traditional Internet measurement indicators are mainly selected in Internet development system. In recent years, the mobile Internet has developed rapidly. In the future, it can be considered based on mobile Internet

development indicators to measure the coupling and coordination mechanism of tourism economy; 2) This article only analyzes the degree of coupling and coordination between the national tourism economy and the development of Internet from a macro perspective, but fails to conduct a more systematic and in-depth analysis of the coupling and coordination of specific regions. In the future, a more systematic and in-depth analysis of coupling coordination in specific regions such as northeast China and southwest China can be carried out.

References

- [1] Yang Yong. Has Internet promoted the dynamic optimization of the tourism industry? [J]. *Economic Management*, 2019, 41(05): 156-170.
- [2] Yang Yong. Has Internet improved the quality and efficiency of the tourism industry? — An Empirical Analysis Based on my country's Provincial Panel Data[J]. *Journal of Tourism*, 2020, 35(01): 32-46.
- [3] Qian Jianwei, Rob Law. The great changes in the tourism industry in the "Internet +" era[J]. *Tourism Tribune*, 2016, 31(06): 2-4.
- [4] National Tourism Administration. Notice of the National Tourism Administration on the Implementation of the "Tourism + Internet" Action Plan [EB/OL]. http://www.gov.cn/zhengce/2016-05/23/content_t_5075923.htm, 2015-09-18.
- [5] Hainan Provincial People's Government. Several Opinions of Hainan Provincial People's Government on Accelerating the Development of Internet Industry [EB/OL]. http://www.gov.cn/zhengce/2015-06/06/content_5046093.htm, 2015-06-06.
- [6] Heilongjiang People's Government. Heilongjiang Province "Tourism + Internet" Action Plan [EB/OL]. <http://www.hlj.gov.cn/ztl/system/2015/11/26/010749935.shtml>, 2015-11-26.
- [7] General Office of the People's Government of Jiangsu Province. Notice of the General Office of the Provincial Government on Several Measures to Promote Culture and Tourism Consumption [EB/OL]. http://www.jiangsu.gov.cn/art/2020/4/1/art_46144_9030068.html?gqnahi=affiy2, 2020-03-19.
- [8] Buhalis D. Marketing the competitive destination of the future [J]. *Tourism Management*, 2000, 21(1): 97-116.
- [9] Buhalis D, Law R. Progress in information technology and tourism management: 20 years on and 10 years after Internet—The state of eTourism research[J]. *Tourism Management*, 2008, 29(4).
- [10] Toader, Cosmina-Simona. Tourism information centers-proof of tourism management[J]. *Agricultural Management*, 2011, 17 (2): 7-10.
- [11] Gössling, Stefan. Tourism, information technologies and sustainability: an exploratory review[J]. *Journal of Sustainable Tourism*, 2017, 25(7): 1024-1041.
- [12] Zhou Lin, Liu Yifeng. Research on the Integrated Development of Tourism Industry and Internet [J]. *Theoretical Discussion*, 2019(06): 114-117.
- [13] Wu Yuanyuan, Song Yuxiang. The characteristics of the evolution of the spatial pattern of China's tourism economy and analysis of its influencing factors[J]. *Geographical Sciences*, 2018, 38(09): 1491-1498.
- [14] Yang Yan, Ding Zhengshan, Ge Junlian, Wu Yaoyu, Wang Yi. Coupling and coordination between rural tourism informatization and regional tourism economy in Jiangsu Province[J]. *Economic Geography*, 2018, 38(11): 220-225.
- [15] Xie Shouhong, He Jiafeng. Analysis on the Spatial Differences of Tourism Economy in the Yangtze River Delta[J]. *East China Economic Management*, 2008(10): 4-8.
- [16] Zhang Buhong, Liang Fangfang. Analysis of the new tourism economy-the formation, development and promotion of the tourism information industry [J]. *Geography and Geo-Information Science*, 2011, 27(01): 90-94.
- [17] Fan Jigang, Wang Zhaofeng, Yang Weishu. Research on the Coupling and Coordination of Tourism Industry and Information Industry in Sichuan Province[J]. *Resource Development and Market*, 2014, 30(01): 110-113.
- [18] Wang Guanxiao, Liang Liuke, Li Feng, et al. Empirical research on the coupling and coordination relationship between regional tourism and informatization[J]. *Journal of Natural Resources*, 2016, 31(08): 1339-1350.
- [19] Fang Yelin, Huang Zhenfang, Wang Kun, Tu Wei. Analysis of the time and space differences of China's provincial tourism economy based on PCA-ESDA[J]. *Economic Geography*, 2012, 32(08): 149-154+35.
- [20] Li Shujuan, Li Manxia. Research on the coupling relationship between tourism economy and ecological environment of coastal cities in my country [J]. *Commercial Research*, 2016(02): 185-192.
- [21] Fang Yelin, Huang Zhenfang, Duan Zhongxian, Wang Kun. Research on the Coupling and Coordination of China's Tourism Development and Ecological Environment[J]. *Economic Geography*, 2013, 33(12): 195-201.
- [22] Wu Han, Liu Dongjin. Research on the Coupling and Coordination Degree of my country's Transportation and Tourism Development[J]. *Statistics and Decision*, 2019, 35(17): 143-146.
- [23] Wang Zimin, Pan Dandan. Measurement and Convergence Analysis of China's Regional Internet Development[J]. *Statistics and Decision*, 2018, 34(08): 86-89.
- [24] Liu Anle, Yang Chengyue, Lu Fen, Ming Qingzhong. Research on the Coupling Development of Transportation Network and Tourism Industry in Central Yunnan Urban Agglomeration[J]. *World Geographical Research*, 2017, 26(01): 65-76.
- [25] Liu Danli, Wang Xia, Wu Xiaogen, He Jing, Duan Zhiyong. Time and space changes in the degree of coupling and coordination between tourism competitiveness and economic development in poor countries around the world[J]. *Advances in Geographical Sciences*, 2018, 37(10): 1381-1391.
- [26] VEFIE L. *The Penguin Dictionary of Physics* [M]. Beijing: Foreign Language Press, 1996: 92-93.
- [27] Zhang Yuyang, Yang Changming. Research on the location characteristics and optimization strategies of Shichahai hot commercial streets and lanes—Based on the road centrality perspective[J]. *Tourism Tribune*, 2019, 34(07): 110-123.
- [28] Lai Yifei, Qin Bingjie, Lei Hui, Li Keyang. Research on the relationship between the agglomeration of innovative elements and economic growth in the provinces of the "Middle Triangle"[J]. *Science and Technology Progress and Policy*, 2016, 33(23): 32-39.
- [29] HAGERSTRAND T. Innovation diffusion as a spatial process[J]. *Journal of Farm Economics*, 1967, 19(2): 1213-1227.
- [30] Wang Ruyi, Liang Qi, Li Guangqian. Virtual agglomeration: a new form of spatial organization with the deep integration of a new generation of information technology and real economy [J]. *Management World*, 2018, 34(02): 13-21.
- [31] Cheng Hui, Xu Qiong, Guo Yaoqi. The spatiotemporal evolution of the coordinated development of my country's

tourism resource development and ecological environment[J].
Economic Geography, 2019, 39(07): 233-240.

- [32] Wang Longjie, Zeng Guojun, Bi Doudou. Spatial spillover effects of informatization on the development of tourism industry[J]. *Acta Geographica Sinica*, 2019, 74(02): 366-378.
- [33] Dong Wenjing, Wang Changsen, Zhang Zhen. Research on the spatio-temporal coupling of rural revitalization and rural tourism in Shandong Province[J]. *Geographical Sciences*, 2020, 40(04): 628-636.