

## ORIGINAL RESEARCH ARTICLE

# A case study on tourism spatial pattern and its influencing factors from the perspective of real and virtual tourism economic at county scale in Yellow River Economic Belt

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## ABSTRACT

Based on the index of tourism Baidu search volume and total tourism income of 667 research units at county scale in Yellow River Economic Belt, this paper uses spatial classification, exploratory analysis of spatial data, nuclear density estimation and other methods to compare and analyze the spatial pattern of county tourism economy in the Yellow River Economic Belt, and then uses the geographical detector model to analyze the influencing factors. The results are drawn as follows. Firstly, from the perspective of spatial distribution pattern, the imbalance of the overall tourism economy is obvious, and the spatial pattern shows a “one big, three small” four core agglomeration pattern. Secondly, from the perspective of spatial correlation pattern, significant HH and LL areas are dominant whether virtual economy or a real economy, and spatial agglomeration effect is obvious. Real economic significant HH areas mainly distribute in the tourism economic developed areas of Shaanxi and Shandong, while real economic significant LL areas are mainly concentrated in the middle and east of Inner Mongolia, the south of Shanxi, most of Qinghai and the north of Ningxia, and scattered in Henan, Gansu and other places. Compared with the entity level, the HH areas of the virtual economy are significantly expanded, mainly distributing in Shandong, Shaanxi and the eastern part of Inner Mongolia. The number of significant LL areas is significantly increased and the distribution range has changed, and the distribution scope of low-value cluster areas mainly distributes in most areas of Qinghai, south and north of Shanxi, and sporadically distributes in Gansu. From the perspective of nuclear density, the spatial structure of virtual and real economy is similar, and the high-value counties mainly distribute in Shandong, Henan and Shanxi forming a high-value gathering area expanding into a core development area. It is worth noting that the virtual economy scope in the north of Shaanxi and the northeast of Inner Mongolia has formed many sub-cores, which indicates that the level of virtual economy in the region is rapidly rising. Finally, according to the results of the Geo-detector model and the coupling matching analysis model, we found the real economy is mainly affected by the resources support level. We also found virtual economy is mainly affected by the level of information technology.

**Keywords:** real tourism economy; virtual tourism; spatial pattern at county scale; Yellow River Economic Belt

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## 1. Introduction

At present, tourism industry, as a sunrise industry, has strong pulling force and wide coverage. The high-quality development of tourism industry can not only promote the promotion of other related industries, but also promote the optimization and upgrading of regional industrial structure; moreover, it can further stimulate the endogenous driving force of regional economic development and enhance the comprehensive competitiveness of the region. However, due to the limitations of tourism resource endowment, economic development level, number and quality of tourism related employees, tourism infrastructure and other factors in underdeveloped areas, the imbalance and insufficiency of China's tourism industry is further exacerbated. Therefore, optimizing the balanced development of tourism industry and improving the input-output benefit level of tourism industry are important ways to promote the high-quality development of tourism industry.

Looking at the existing research results, the research content of tourism economy mainly involves the development efficiency of tourism industry<sup>[1-3]</sup>, competitiveness evaluation<sup>[4-6]</sup>, spatial difference of tourism economy<sup>[7-10]</sup>, spatial distribution of tourism resources and endowment degree<sup>[11-13]</sup>. Some scholars also conduct in-depth research on the relationship between informatization and tourism economy<sup>[14-16]</sup>, but the research content mainly focuses on the real tourism economy and lacks the research on virtual tourism economy. With the proposal of ecological civilization construction, academia has gradually paid attention to the research on the coupling and coordination evaluation of tourism economy and ecological environment<sup>[17,18]</sup>. In terms of index selection, some scholars build a comprehensive evaluation index system<sup>[19,20]</sup> around the specific contents of the tourism industry, mainly based on the aspects of economy, labor force, infrastructure, tourism resources and ecological environment<sup>[21,22]</sup>, and generally choose from the aspects of tourism revenue and tourism reception<sup>[23-25]</sup> in terms of single index. Then, the comprehensive

evaluation is carried out by DEA model<sup>[26]</sup>, principal component analysis<sup>[27,28]</sup>, exploratory spatial data analysis method<sup>[29]</sup> and entropy weight method<sup>[30,31]</sup>. In recent years, the trend of using multiple methods for research is obvious. In terms of spatial scale, most scholars conduct macro pattern analysis on the scale of national level<sup>[32]</sup> and provincial level<sup>[33-35]</sup>, while some scholars conduct research on provincial areas, urban agglomeration and economic zone on the scale of city<sup>[36,37]</sup>, but few conduct large-scale regional research on the scale of county<sup>[38]</sup>. Generally speaking, most studies focus on the analysis of spatial characteristics and causes, the explanation of phenomena and the prediction of future development, lacking the quantitative analysis of the influencing factors of tourism economy. Most of the research methods and contents focus on the traditional geographical research field, on the analysis of the real tourism economy, and less on the virtual tourism economy.

As China's "artery" of the "Belt and Road", the construction of the Yellow River Economic Belt not only helps to promote the rapid rise of the economy of underdeveloped regions and coordinate the balanced development of regional economy, but also further connects with the maritime Silk Road and forms an economic corridor complementary to sea and land<sup>[39]</sup>. The proposal of the Yellow River Ecological Economic Belt is an important supporting force to promote the transformation of the advantages of ecological resources and economic late development in the Yellow River basin into the advantages of economic transformation. It is an important economic belt to support the economic revitalization of northern China. Therefore, many scholars have demonstrated it. Different scholars have different definitions of the scope of the Yellow River Economic Belt. In the early stage, some scholars designated it as 12 provinces and cities<sup>[40]</sup>, and in recent years, some scholars designated it as 11 provinces and cities<sup>[41-43]</sup>. Based on the above research, taking the natural scope of the Yellow River basin as the basis and considering the integrity of the administrative region, this paper defines the scope of the Yellow River Economic Zone as 8

provinces and cities except Sichuan, including Shandong, Henan, Shanxi, Shaanxi, Ningxia, Gansu, Qinghai and Inner Mongolia. As the mother river of China and the birthplace of Chinese civilization, the Yellow River not only gave birth to the diverse mountains and rivers and beautiful natural scenery, but also gave birth to the Hehuang culture, Heluo culture, Guanzhong culture and Qilu culture etc. Therefore, the Yellow River basin is a triple combination of natural, cultural and ecological resources becoming a “golden” tourism economic zone. With the continuous transformation and upgrading of information network technology and the diversification of residents’ tourism concerns, networking, digitization and refinement have become an important attraction for urban and rural residents to choose tourism destinations. So, in the end urban and rural residents choose their destinations through which channels, and what netizens’ concerns can be reflected by search engines? Based on this, this study starts from the county perspective, takes 667 county research units in the Yellow River Economic Belt as the research object, adopting the perspective of comparative analysis of the real tourism economy (tourism actual income) and the virtual tourism economy (tourism Baidu retrieval volume). The space classification, spatial data analysis, kernel density estimation and other methods are used to analyze the spatial differences and spatial distribution characteristics of the tourism economy in the Yellow River Economic Belt, and the geographic detector model are used to explore its influencing factors, in order to provide support for high-quality development and spatial optimization of the tourism economy in the Yellow River basin.

## 2. Data sources and methods

### 2.1. Data sources

Considering the difficulty of obtaining data at the county scale, the representative total tourism income is selected as the research index at the level of real tourism economy to reflect the regional

differences of tourism economic level. With the support of big data platform and mobile Internet technology, people’s attention to tourism in this region and the development of tourism economy can be reflected through people’s page views and searches. Based on this, this study selects Baidu, China’s largest Chinese search engine, and takes the tourism Baidu retrieval volume of specific counties and cities as the measurement index to reflect the tourism economic development level at the virtual level and measure the tourism publicity and network economic expression of a region.

The data of entity indicators and their influencing factors are mainly from the statistical yearbook of provinces, cities and counties in the study area in 2018, and some are from the official statistical data such as the statistical bulletin of national economic and social development of counties (cities) and government work report in 2017. A small amount of data is calculated and supplemented by using the data of adjacent years and growth rate. The tourism Baidu search volume of the virtual index comes from Baidu search engine. The cumulative search volume of each research unit in the study area before 2017 (including 2017) is obtained by searching one by one.

### 2.2. Research methods

#### *Spatial classification*

The common spatial classification methods include Jenks natural breakpoint classification method, geometric interval classification method, equivalent division method and so on. Each method has its own characteristics. When studying the development level of county tourism economy, referring to the classification standards in the existing research<sup>[44]</sup>, we take the average value of county data as the reference, and grade according to the multiple of the average value on the basis of determining the average value, in order to better reflect the grade difference of tourism economic development and study its spatial pattern more clearly. Therefore, according to the above classification criteria, the physical indicators and

virtual indicators are divided into five levels: 0.25 times less than the average value, 0.25 times greater than the average value, less than 0.5 times greater than the average value, less than 1 time greater than the average value, less than 1.5 times greater than the average value, and 1.5 times greater than the average value. They are spatially visualized to compare the spatial pattern evolution characteristics of county real tourism economy and virtual tourism economy.

### **Exploratory spatial data analysis method**

In terms of spatial law exploration, in addition to the general methods of spatial classification, spatial visualization and difference analysis etc., exploratory spatial data analysis methods can also be used to establish the statistical relationship among data through spatial location, which can better explain the spatial correlation characteristics of variables and further explain the spatial agglomeration state of variables than traditional methods. Therefore, using the exploratory spatial data analysis method, the commonly used measurement indicators are Moran's  $I$  index, Moran's  $I$  scatter diagram and Lisa agglomeration distribution diagram. The global spatial autocorrelation index Moran's  $I$  explores the similarity of spatial correlation and the trend of enhancement or weakening in the study area. Its calculation formula is as follows:

$$I_i = \frac{(x_i - \bar{x})}{s^2} \sum_j w_{ij} (x_j - \bar{x}) \quad (1)$$

Among them,  $I$  is Moran index;  $s^2 = \frac{1}{n} \sum_{i=1}^n x_i$ ;  $w_{ij}$  is the spatial weight between elements  $i$  and  $j$ ;  $x_i$  and  $x_j$  are the observed values of element  $i$  and element  $j$ ;  $\bar{x}$  is the average value. The value of  $I$  is generally between  $[-1, 1]$ . When Moran's  $I$  index is greater than 0, it indicates positive correlation, and when it is less than 0, it indicates negative correlation.

At the same time, Moran's  $I$  scatter map and Lisa agglomeration distribution map are drawn by Geo-Da to further explain the specific agglomeration types and spatial correlation characteristics from the

spatial location<sup>[45]</sup>.

### **Kernel density estimation method**

Kernel density estimation is a spatial analysis method based on the distribution characteristics of the research object itself, which can intuitively reflect the spatial dispersion and agglomeration degree of the development level of tourism economy. It is an effective means to reveal the distribution law of tourism economy. Therefore, the kernel density analysis method is used to compare the density changes of physical indicators and virtual indicators of counties in the Yellow River Economic Belt in 2017, and analyze the difference of spatial agglomeration degree between them. The main formula is as follows:

$$f_k(x) = \frac{1}{nh} \sum_{i=1}^n K\left(\frac{x_i - x}{h}\right), x \in R. \quad (2)$$

Among them,  $F_n(x)$  represents the kernel density estimation of the kernel density function;  $n$  represents the number of points in the neighborhood;  $h$  represents bandwidth;  $(x - x_i)$  represents the distance from the estimated point  $x$  to  $x_i$ .

### **Geo detector model**

Geographic detector is a method to detect spatial differentiation and reveal the driving factors behind it<sup>[46]</sup>, and its  $q$  value is to measure the size of spatial differentiation, detect the interactive relationship between explanatory factors and analysis variables. The geographic detector is divided into four parts: Risk detector, factor detector, ecological detector and interaction detector. In this study, the factor detector is mainly used to detect the explanatory power of each influencing factor on the dependent variable and analyze its main factors. The formula is as follows:

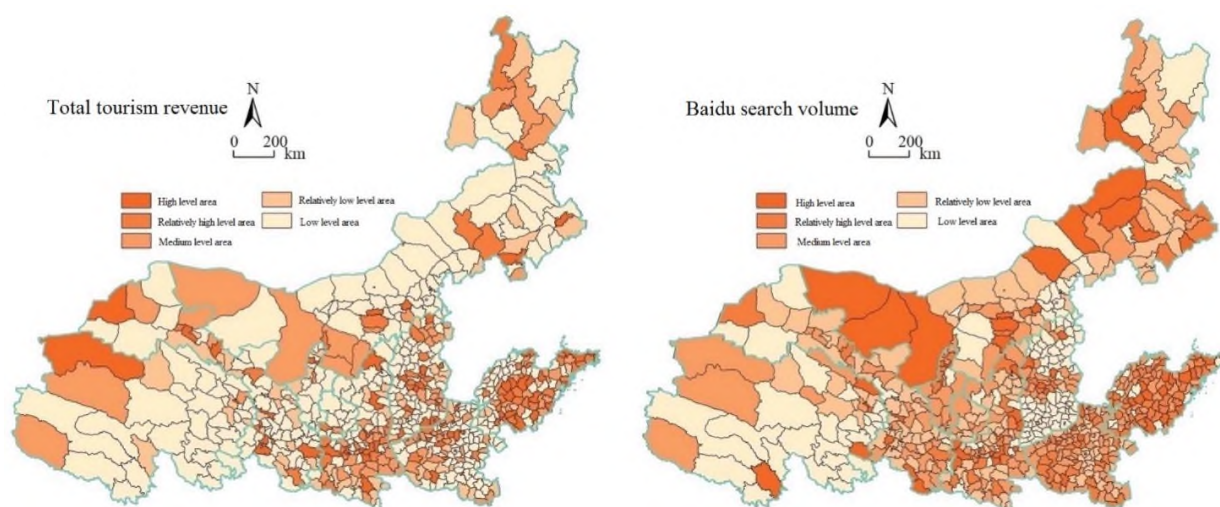
$$q = 1 - \frac{\sum_{h=1}^L N_h \delta_h^2}{N \delta^2} = 1 - \frac{SSW}{SST}, \quad (3)$$

$$SSW = \sum_{h=1}^L N_h \delta_h^2, SST = N \delta^2.$$

Among them,  $q$  is the determinant of

influencing factors on tourism economy, and the value of  $q$  is between 0 and 1, and the greater the value of  $q$ , the greater the explanatory power of influencing factors on independent variables;  $h$  is the number of samples in the whole study area,  $h = 511$ ;  $\delta^2$  is the discrete variance of regional tourism economy; SSW is the sum of intra layer variances; SST is the total variance of the study area.

### 3. Spatial pattern characteristics of



**Figure 1.** Spatial distribution map of total tourism income and Baidu retrieval at county scale.

From the perspective of the entity, the overall pattern is “high in the southeast, low in the northwest”, and the spatial pattern of high-level areas agglomeration is obvious. From the perspective of the spatial distribution of high-level areas, the core agglomeration characteristics of “one big and three small” are obvious, and a large-scale high-value agglomeration “large core area” is mainly formed in the central and eastern Shandong. The “small core area” is the Weihe plain in Guanzhong, Shaanxi, and high-value agglomeration areas in the Qinling Mountains in southern Shaanxi, northwestern Henan, and central Shanxi. Luanchuan county in the northwest of Henan province has beautiful natural scenery and ranks among the top 100 counties in China’s county-level tourism competitiveness, which can effectively promote the development of tourism in the surrounding areas. Moreover, Xi’an in Shaanxi and Pingyao and

## county tourism economy in the Yellow River Economic Belt

### 3.1. Change of spatial classification pattern

Based on the reference division standard of average value, the spatial distribution state of real and virtual tourism economy is divided into five categories. The results are shown in **Figure 1**.

Yangcheng counties in central Shanxi are rich in historical and cultural relics and other human resources, so the central region forms a prominent “small core area”. In addition, high-level areas are scattered around areas with abundant tourism resources or central cities in Gansu, Qinghai, and northern Inner Mongolia. The distribution characteristics of the higher development level area adjacent to the high development level area are obvious, mainly distributing in the northern half of Shaanxi and most of Shandong, showing a core-periphery pattern. From the perspective of the combination of lower and higher development level areas, the two dominate absolutely, mainly in the western part of the Yellow River Economic Belt and in the less developed northern provinces. Compared with the development level of tourism economy in the eastern and western regions, there is a large gap between the two, and the overall spatial distribution

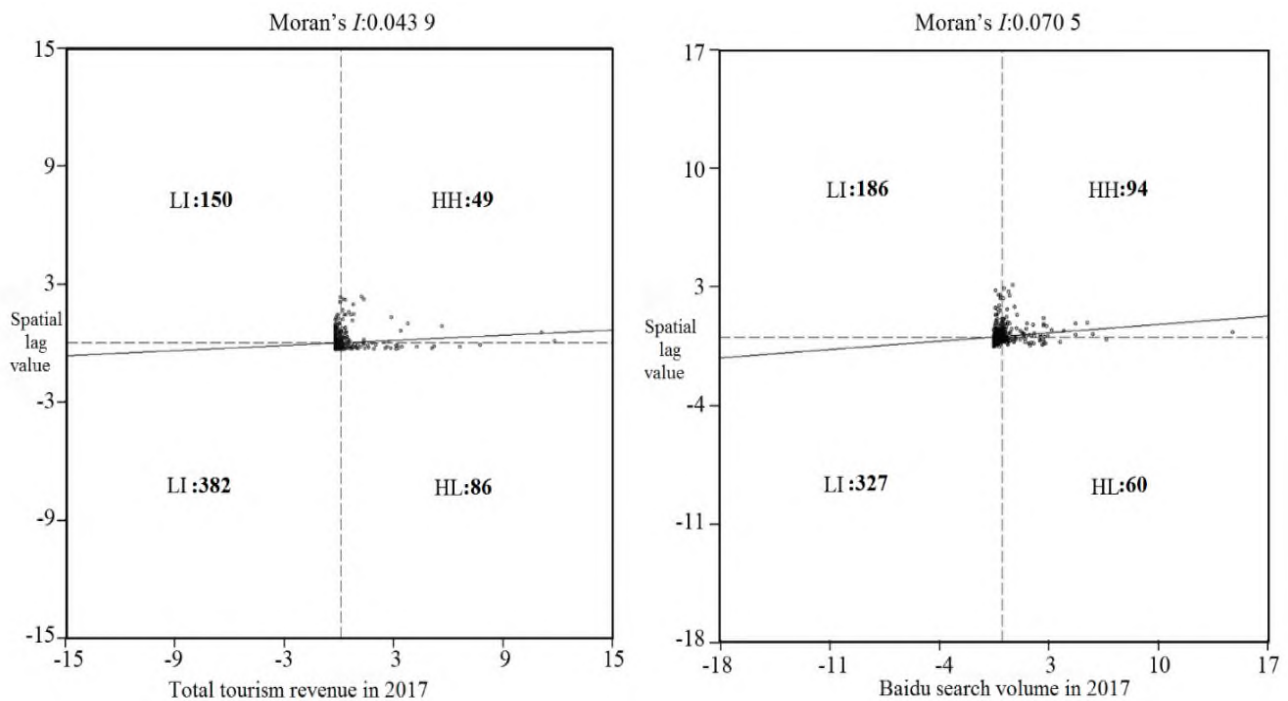
pattern is unbalanced.

From the virtual level, the overall spatial pattern is basically consistent with the real tourism economy, but the distribution range of high-level and relatively high-level areas is significantly expanded, and the low-level areas is significantly improved. Driven by Shandong region and combined with the surrounding “four cores” linkage effect, the higher development level areas gradually spread outward, and many county units in the middle and lower reaches of the Yellow River jumped into higher development level areas, forming a large-scale continuous area. It is worth mentioning that compared with the real tourism economy, the virtual tourism economy has fewer restrictive factors and relatively small impact. Therefore, two new high-value clusters in the west and northeast of Inner Mongolia have been added, and the level of the whole provincial unit has risen sharply. Affected by the “four cores” linkage radiation of high-level areas, the number of medium

development level areas in the central part of the whole economic belt has increased rapidly and occupied a dominant position. Due to the influence of the network embodiment of tourism publicity and other aspects, although the low development level areas are also concentrated in the northwest, their scope has been significantly narrowed compared with the real tourism economy. In short, the development level of virtual tourism economy is higher than that of real tourism economy.

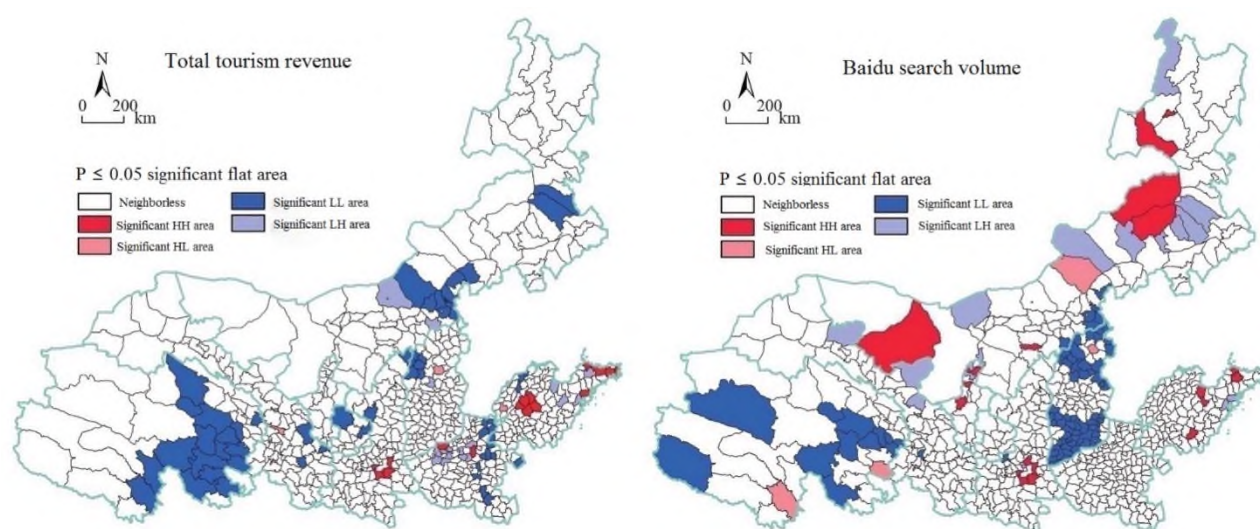
### 3.2. Spatial correlation characteristics

In order to further explore the spatial correlation characteristics of the development of county tourism economy, the spatial autocorrelation characteristics of county tourism economy are analyzed by using the spatial autocorrelation and local autocorrelation analysis tools in Geo-Da software. The results are shown in **Figure 2~Figure 3**.



**Figure 2.** Moran's *I* scatter plot of total tourism revenue and Baidu search volume at county scale.





**Figure 3.** Distribution map of spatial association types of total tourism income and Baidu retrieval volume at county scale.

It can be seen from **Figure 3** that the Moran's  $I$  value of the real tourism economy is 0.0439, with obvious agglomeration characteristics. From the distribution number of four quadrants of Moran's  $I$  scatter diagram, there are 150 in LH area, 49 in HH area, 382 in LL area and 86 in HL area, indicating that HH area and LL area occupy the absolute dominance, and agglomeration, especially low value agglomeration, has obvious benefits. The Moran's  $I$  value of virtual tourism economy is 0.0705, which is higher than the agglomeration LH effect of real tourism economy, but the degree of agglomeration is still low. From the number of quadrants, there are 94 in HH district, 186 in LH district, 327 in LL district and 60 in HL district. More than 2/3 of the areas are located in LL district and HH district, which is similar to the characteristics of real tourism economy.

From the local spatial LISA agglomeration distribution map (**Figure 4**), the significant HH area and significant LL area of the real tourism economy are similar to the quadrant diagram and occupy the leading position, followed by the significant LH area and the significant HL area. Specifically, significant HH areas mainly distribute in Shaanxi, Henan and Shandong. Significantly, HH area is basically consistent with the characteristics of the classification pattern of real tourism economy, forming a "rapid development area" with its surrounding areas, reflecting the positive role of

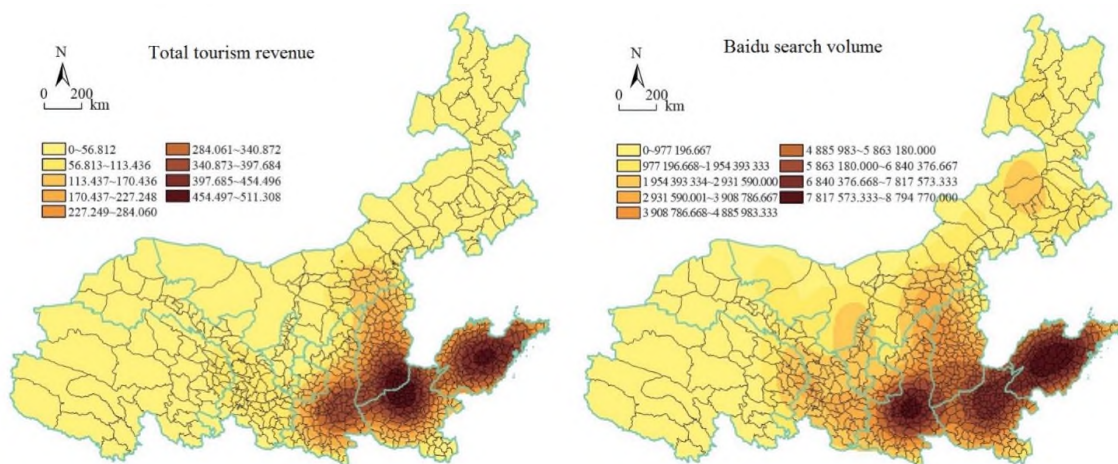
economic development and tourism publicity in the core area of southeast China. The significant LL area mainly forms a large-scale continuous area in the east of Qinghai, a "V-shaped" small area and two groups in the northeast of the central area of Inner Mongolia, and a small part sporadically distribute in Ningxia, Gansu and northern Shanxi, forming a "development lag area". The significant LH area has obvious distribution characteristics near significant HH area, which is mainly concentrated in high-value areas in Henan and Shandong, forming a "depression area" around the high-level area in the southeast; in addition, a small number of significant LH areas are scattered in Inner Mongolia, forming a "subsidence area" surrounded by low-value areas and high-value areas. The number of significant HL areas is small, mainly scattered in Gansu and Shanxi, forming a "polarization area" surrounded by high-value areas and low-value areas. In contrast, the spatial pattern characteristics of each significant area of virtual tourism economy have changed, the scope of significant HH area has been significantly expanded, Inner Mongolia has highlighted two significant core areas, and Ningxia has added sporadic significant HH areas. Meanwhile, the number of significant HH areas in Shandong has significantly decreased and the spatial pattern tends to be scattered; the number of significant LH areas increased significantly, mainly distributing near the significant HH area, forming a "settlement area" surrounded by low-

value areas and high-value areas. The number of significant HL areas is basically stable, but the distribution range changes greatly. They are mainly scattered in Qinghai, Inner Mongolia and Shaanxi, forming a “polarization area” surrounded by high-value areas and low-value areas. The distribution range of significant LL areas is significantly reduced, showing two characteristics: (1) The spatial pattern of low-value areas in Qinghai tends to be scattered, from large-scale continuous areas to small-scale group and sporadic distribution; (2) The southern

and northern regions of Shaanxi have formed low value agglomeration areas in the south and north.

### 3.3. Spatial agglomeration characteristics

In order to further explore the spatial agglomeration heterogeneity of county tourism economic level, the kernel density analysis tool in the spatial analysis of ArcGIS 10.3 software was used. The results are shown in **Figure 4**.



**Figure 4.** Kernel density of total tourism income and Baidu retrieval distribution at county scale.

As can be seen from **Figure 4**, both the real tourism economy and the virtual tourism economy form high-density agglomeration centers with the central and northern part of Henan, the central part of Shandong and the central and southern part of Shaanxi as the core, and the agglomeration degree of the virtual tourism economy is higher. Taking Henan and Shandong as the core, the real tourism economy radiates to the west and north, extends outward to Guanzhong area of Shaanxi, forms a secondary core area, and the concentration degree decreases from the core to the periphery. The scope of high-density agglomeration area of virtual tourism economy has been significantly expanded. The two core areas of Shandong and Henan have a good linkage effect, forming a large-scale high-density area. At the same time, under the radiation of high-density areas of Shandong and Henan, Guanzhong area of Shaanxi Province has become a new high-density

agglomeration area. The higher density core area spreads from the high-density core area to the northwest to Gansu, Inner Mongolia and Qinghai. The scope is obviously expanded, and there is a trend to form a secondary density agglomeration area. It is an important support for the tourism economy of the whole northwest region and has an important impact on improving the high-quality development of tourism in the northwest region. Therefore, we should further strengthen the construction of tourism infrastructure and the rational development of tourism resources in Northwest China, and improve the current situation of uneven spatial distribution of tourism economic development. The secondary density agglomeration area of virtual tourism economy can be divided into two distribution areas. One part is the core area formed in the northeast of Inner Mongolia; the other part is the junction of Shaanxi and Shanxi, which gathers radially along the



Beijing-Guangzhou high-speed railway in a south - north direction. It can be seen that improving the economic support and network publicity of the rise of tourism in the western and northern regions can promote the coordinated development of tourism in different regions and provinces of the Yellow River Economic Belt. On the whole, both the physical and virtual levels show a decreasing trend from the high-density area in the southeast to the low-density area in the northwest. From the above analysis, it can be seen that the spatial hierarchy is more obvious on the refined county scale. It mainly forms a high-density agglomeration area in Shandong in the coastal area and the core area of the central plain urban agglomeration, and extends from northeast to southwest along the main traffic trunk lines, showing a high state in northeast and low in southwest. This shows that the “iron triangle” formed by Shaanxi, Henan and Shandong in southeast China is in a leading position in both real tourism economy and virtual tourism economy.

## 4. Analysis of influencing factors of spatial pattern

### 4.1. Selection of influencing factors

In order to explore the impact of various factors affecting the spatial differentiation of county economy, and considering the quantifiable, typicality and accessibility of indicators, etc., this study selects 10 indicators reflecting the four aspects of regional economic support foundation, resource support, informatization level and terrain, etc. The economic support foundation is expressed by the proportion of GDP of each county and city, per capita GDP and tertiary industry. Resource support is characterized by the abundance of tourism resources, the quality of tourism resources and employees in the tertiary industry. It is worth noting that the abundance and quality of tourism resources are calculated by adding the number of scenic spots above Class A in each

county and city and the corresponding score<sup>[47]</sup>. The informatization level is expressed by the number of the Internet users, mobile phones and online business index. In addition, the geographical environment of the Yellow River Economic Belt is complex, the terrain fluctuates greatly from west to east, and there are great differences in the natural geographical environment. The level of regional economic development is closely related to the natural geographical environment. Therefore, its regional geographical environment is characterized by the altitude of each county and city, so as to further explore the impact of terrain differences on tourism economy.

### 4.2. Analysis of influencing factors

According to the principle of geographic detector model, the method of natural fracture point is used to classify the elements, and then the influence of each element on virtual and real tourism economy is calculated. Then we use the classification of county virtual and real tourism economic development level and various elements to couple, and using ArcGIS 10.3, get the matching result. According to the principle of geographic detector model, the method of natural fracture point is used to classify the elements, and then the influence of each element on virtual and real tourism economy is calculated. The specific results are shown in **Table 1** to **Table 2**. It can be seen from the ranking in **Table 1** to **Table 2** that the development of real tourism economy is mainly affected by the abundance of tourism resources, the quality of tourism resources, the number of internet users, GDP and other factors. Among them, resource support is the leading factor for the spatial differentiation of real tourism economy, while virtual tourism economy is mainly affected by the number of mobile phones, GDP, the Internet users and e-commerce index. It is not difficult to see that the level of informatization is the leading factor in the spatial differentiation of virtual tourism economy.

**Table 1.** Impact intensity of real tourism economic influencing factors at county scale in the Yellow River Economic Belt

Primary index	Secondary index	Effect	Ranking
Economic support foundation (0.138318)	GDP	0.086760	4
	Per capita GDP	0.045693	7
	Proportion of secondary industry	0.005865	10
Resource support (0.255916)	Abundance of tourism resources	0.121847	1
	Tourism resource quality	0.099353	2
	Employees in the secondary industry	0.034716	8
Development degree of real tourism economy (0.178268)	Number of the Internet users	0.089865	3
	Number of mobile phones	0.054613	5
	E-commerce index	0.033808	9
Geographical environment (0.052064)	Altitude	0.052064	6

**Table 2.** Impact intensity of virtual tourism economic influencing factors at county scale in Yellow River Economic Belt

Primary index	Secondary index	Effect	Ranking
Economic support foundation (0.188 143)	GDP	0.113380	2
	Per capita GDP	0.063575	7
	Proportion of secondary industry	0.011188	10
Resource support (0.125 208)	Abundance of tourism resources	0.023121	8
	Tourism resource quality	0.020577	9
	Employees in the secondary industry	0.08515	5
Development degree of virtual tourism economy (0.324 407)	Number of Internet users	0.107071	3
	Number of mobile phones	0.117403	1
	E-commerce index	0.099933	4
Geographical environment (0.063 717)	Altitude	0.063717	6

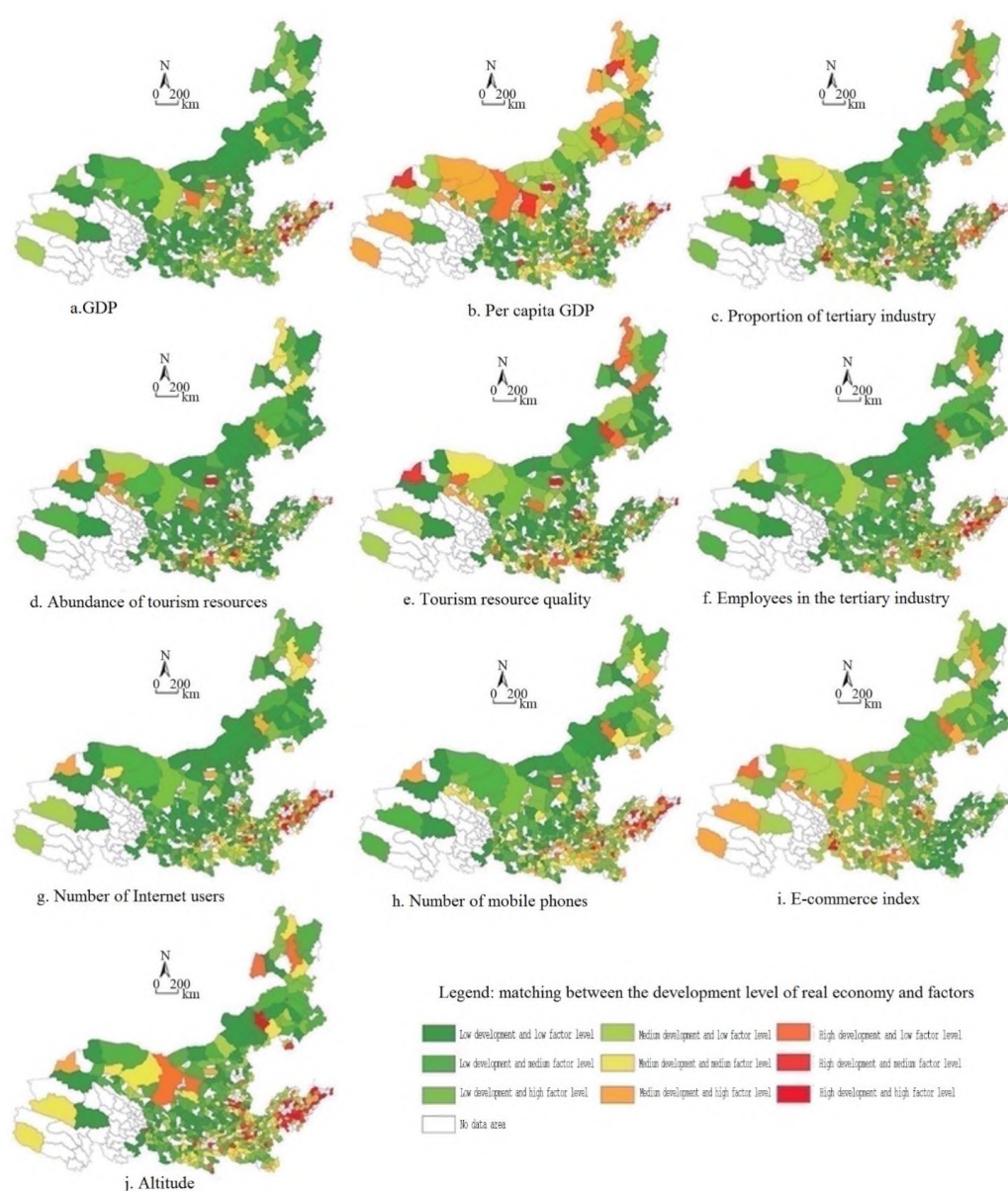
From the analysis of **Figure 5** to **Figure 6**, we can see that the spatial matching results of real tourism economy and tourism resource abundance are similar to those of tourism resource quality, but the factor driving force of spatial matching with tourism resource quality is more obvious. Generally speaking, high development and high factor level areas are scattered in the southeast half, such as Penglai city, Pingyao county, Yangcheng county and Luanchuan county, etc. These areas are either beautiful in natural scenery, or have a long history and culture, rich in human resources, and superior in quality and quantity of tourism resources. Therefore,

the overall quality of tourism resources and the development level of real tourism economy are high, indicating that the degree of tourism resource endowment has a strong support for the development of real tourism economy. Compared with virtual tourism economy, the spatial pattern of tourism resource abundance and quality is similar, but the number of high development and high factor level areas has increased significantly, but the degree of tourism resource endowment is not the leading factor affecting virtual tourism economy.

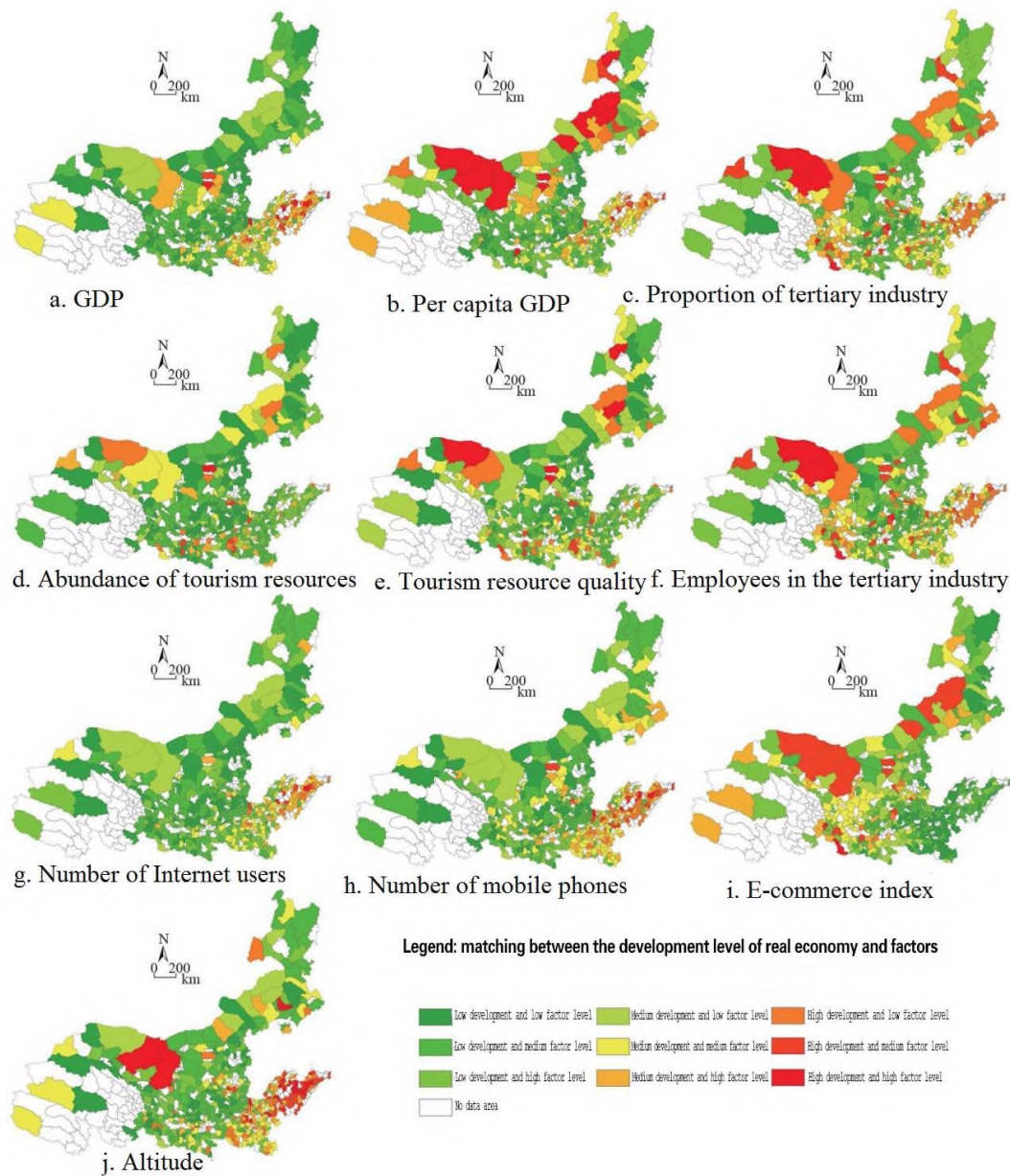
The high development and high factor level areas matching the real tourism economy and GDP

mainly distribute in Shandong and sporadically in Henan, indicating that a strong economic support foundation is the advantageous factor for the development of tourism economy in the region. The agglomeration of capital enables the region to build perfect tourism infrastructure, form a certain industrial scale, have a certain brand effect, and play a good role in promoting the further development of tourism. At the same time, GDP is also the leading factor affecting the development of virtual tourism economy, ranking second and with greater influence than the real tourism economy. From the matching

map of virtual tourism economy and GDP, the spatial differentiation pattern is basically consistent with the real tourism economy. The high development and high factor level areas still distribute in the areas with good overall economic development level, high degree of informatization and perfect infrastructure. Although the number has decreased slightly, the surrounding levels have increased rapidly. It shows that the virtual tourism economy has produced a good spatial linkage effect, so as to drive the development of surrounding areas.



**Figure 5.** Spatial coupling matching map of real tourism economic pattern and its influencing factors at county scale in Yellow River Economic Belt.



**Figure 6.** Spatial coupling matching map of county virtual tourism economy and influencing factor.

The real tourism economy and the number of the Internet users mainly distribute in three or two clusters in Shandong, and sporadically in southern Shaanxi and northern Henan. From the statistical value of the influencing factors representing the degree of informatization, this area has produced a good positive network publicity effect based on the high level of informatization. The high development and high factor level areas of virtual tourism economy tend to be scattered in spatial distribution, and the number has decreased, but their influence has not been affected. It is not difficult to see that

Shandong and Henan are dominated by high development and high factor level and medium development medium factor level areas. Compared with the real tourism economy, the overall distribution range has been expanded and the level has been improved to varying degrees. This is because the tourism economic publicity in these regions has produced a good market effect, and the economic foundation and information support environment of their network attention are good.

The number of mobile phones is the first factor

affecting the virtual tourism economy. From the matching diagram of the two, the high development high factor level and high development medium factor level areas mainly distribute in the Shandong-Henan development axis. This area has a good information infrastructure and the development foundation of virtual tourism economy. The improvement of mobile phone users can promote the development of virtual tourism economy. Although the number of mobile phones also plays a great role in the real tourism economy, it is not the dominant factor compared with other factors.

The online business index is also one of the important factors affecting the development of virtual tourism economy. Judging from the matching map of the two, the high development high factor and high development medium factor level areas are uncharacteristically, mainly distributing in three or two groups in western and northeastern Inner Mongolia, and southern Gansu, and the spatial pattern of the spatial distribution map of Baidu's search volume development level basically match. We can see that the overall virtual tourism economy in this region shows a positive development trend, but the surrounding areas are mostly in the low development areas with low development and low factor level, indicating that it has not produced a good driving effect. We can see that the development level of virtual tourism economy in the entire northwest region is uneven. Therefore, the northwest region of the Yellow River Economic Belt urgently needs to speed up the construction of information infrastructure, further enhance the integration of Internet technology and network operation platforms, innovate the operation mode of tourism enterprises, provide diversified and personalized tourism industries, and improve tourism destinations. The positive effect of network propaganda, thereby improving the development level of tourism has a positive role in promoting.

## 5. Conclusions and discussions

### 5.1. Conclusions

Taking 667 counties (cities) in the Yellow River Economic Belt as the research object, this paper compares and analyzes the entity index and virtual index, analyzing the spatial difference of county tourism economic development level in the Yellow River Economic Belt by using the methods of spatial classification, spatial data analysis and nuclear density estimation etc., and analyzing the influencing factors by using the geographic detector model. The research conclusions are as follows:

(1) From the perspective of the spatial distribution pattern, the overall tourism economy is obviously unbalanced. The high-value areas present a multi-core clustering pattern of "one big and three small", which mainly distribute in the Linhai area of Shandong, the northwest of Henan, the Guanzhong area and the central part of Shanxi. The higher development level areas mainly distribute according to the adjacent high development level areas, and the core-periphery pattern is obvious. The areas with lower and lower development levels occupy an absolute dominant position, mainly concentrating in the underdeveloped areas of the northwest provinces, with obvious flaky pattern. The development level of tourism economy in the southeastern counties is in the leading position, the development lags behind in the northwestern region, and the overall development level is relatively low.

(2) From the perspective of spatial correlation characteristics, the development level of county tourism economy has significant agglomeration characteristics in space. Judging from the number of four quadrant distributions of Moran's I scatter-plot, high-value agglomeration areas and low-value agglomeration areas dominate. From the distribution of the local LISA map, the significant HH and the significant LL areas of the real tourism economy and the virtual tourism economy are absolutely dominant, and the spatial agglomeration effect is obvious. The spatial distribution patterns of the two significant HH regions are basically consistent. The significant HH area of the real tourism economy has obvious agglomeration characteristics, which mainly distributes in the southeastern region leading by



Shandong. The significant LL area mainly forms a large-scale continuous area in the eastern part of Qinghai, and a “V-shaped” small area in the central area of Inner Mongolia and in two clusters in the northeastern part. The spatial pattern characteristics of each significant area of the virtual tourism economy have changed, the range of significant HH has expanded significantly, Inner Mongolia has highlighted two significant core areas, the sporadic distribution of significant HH areas has been newly added in Ningxia, and the distribution range of significant LL areas has been significantly reduced.

(3) From the perspective of nuclear density analysis, the spatial level of county tourism economic development is obvious, showing multiple core development areas. The spatial structure of the real tourism economy is similar to that of the virtual tourism economy. Taking the “meter” shaped high-speed railway in Henan as the axis, it extends from east to west, forming a high-density agglomeration center with the northwest of Henan and the middle of Shandong as the “double core”, and the agglomeration degree of the virtual tourism economy is higher. The distribution range of the two is different. The virtual tourism economy has a good radiation effect, and the density value of the surrounding areas increases rapidly, forming a new high-density agglomeration core with Guanzhong area of Shaanxi as the core, which is significantly expanded compared with the real tourism economy.

(4) Combined with the results of the geographic detector model and the analysis of the coupling matching diagram between the virtual and real tourism economy and various influencing factors, it can be seen that the influence ranking of the influencing factors of the real tourism economy is: tourism resource abundance > tourism resource quality > number of internet users > GDP > number of mobile phones > altitude > per capita GDP > employees in the tertiary industry > online commerce index > the proportion of the tertiary industry. It shows that the development of real tourism economy is mainly affected by the abundance of tourism resources, the quality of

tourism resources, the number of internet users and GDP, among which resource support is the leading factor of spatial differentiation of real tourism economy; The influencing factors of virtual tourism economy rank as: Number of mobile phones > GDP > number of internet users > e-commerce index > employees in the tertiary industry > altitude > per capita GDP > abundance of tourism resources > quality of tourism resources > proportion of the tertiary industry. It indicates that the virtual tourism economy is mainly affected by the number of mobile phones, GDP, the Internet users and e-commerce index, and the informatization level is the leading factor in the spatial differentiation of virtual tourism economy.

## **5.2. Discussions**

Compared with previous studies, studying the spatial characteristics of the tourism economic development level of the Yellow River Economic Belt at the county scale and exploring the reasons for the differences have strong practical significance for focusing on the balanced development of county tourism industry in the Yellow River Economic Belt. However, the paper still needs to be improved:

(1) In terms of reflecting the embodiment of tourism economy, in addition to Baidu search volume, there are e-commerce economy, tourism app platform, tourism marketing website, etc. This study only provides a virtual tourism platform, and the comparison of various virtual tourism platforms is the research direction in the future; (2) Due to the increasing difficulty of obtaining data at the county scale, this study only selects one cross-sectional data analysis, lacking the analysis of spatial evolution characteristics of time series, which is also the direction that needs to be expanded in the future. In short, the research of tourism economy in the era of Big Data will enter a new era. The research of multi data supplement will provide a new perspective for the research of tourism geography and a new support for the high-quality development of tourism economy.

## Conflict of interest

The authors declare no conflict of interest.

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