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Analysis on the Spatial Agglomeration and Coupling of Socioeconomic Factors in Qinghai Tourism Under the Background of "Belt and Road"

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Qinghai is the strategic base and important fulcrum of the Belt and Road Initiative while tourism is a strategic pillar industry in Qinghai Province. Due to its rich tourism resources and unique ecological environment, the integration of tourism in Qinghai into the Belt and Road has attracted great attention of the Asian Development Bank (ADB). With the spatial data of tourism elements POI and the statistical data of 44 counties in Qinghai to analyze the characteristics and influencing factors of the spatial agglomeration of tourism in Qinghai, the paper conducts research on spatial coupling and concludes with the following results: The spatial agglomeration of tourism in Qinghai presents the distribution pattern of "one circle and one belt"; economic density and population density play an important role in the formation of the spatial agglomeration pattern of tourism with some spatial spillovers; Belt and Road has a significant impact on the promotion of tourism agglomeration in Qinghai. The paper suggests that tourism in Qinghai should fully integrate into the Belt and Road, giving full play to the guiding role of Belt and Road in the allocation of social and economic resources, and optimizing the spatial layout.

Keywords: Belt and Road, tourism in Qinghai, spatial agglomeration, spatial econometrics model

Since China proposed the "Silk Road Economic Belt" and "21st Century Maritime Silk Road" Strategy (the "Belt and Road" Strategy) in 2013, it has been expanding regional cooperation based on the principle of wide consultation, joint contribution, and shared benefits, and has achieved fruitful results by focusing on policy communication, facility connection, smooth trade, capital integration, and people-to-people communication, providing historical opportunities for industrial development along the Belt and Road (National Development and Reform Commission, Ministry of Foreign Affairs, Ministry of Commerce, 2015). Tourism has an important role in supporting the "Belt and Road" Strategy. Firstly, as a way of humanistic exchange, it has a lubricating effect on promoting people-to-people and cultural sharing along the "Belt and Road". Secondly, it has a pioneering effect on economic growth, promoting employment and industrial linkage in the "economic depression areas" along the Belt and Road. Meanwhile, the development mode of "ecotourism" has an improving effect on the economic and ecological benign development of the "ecological fragmentation zone" along the Belt

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and Road (Dong et al., 2016). It is important for the high-quality development of the Belt and Road to discuss how tourism can be integrated into it.

Based on this, some scholars have explored the idea of tourism cooperation along the Belt and Road from the perspective of tourism cooperation models and institutional mechanisms (Dong et al., 2016; Zou, 2017; Li & Nan, 2010; C. X. Li, Y. F. Ma, Z. T. Li, & H. L. Ma, 2009; Ma & Liu, 2014; Huang & Zou, 2016). Some scholars have studied on the spatial distribution of tourism along the Belt and Road from the perspective of spatial layout of tourism (Zou, 2017; Lin & Zou, 2016; Li, You, Zhang, & Wu, 2017). Some other studies have assessed and measured tourism development along the Belt and Road from different perspectives, such as tourism efficiency (Zhang & Lv, 2018; Tang & Feng, 2018), tourism industry efficiency (Wang & Hu, 2017; Li & Xiao, 2016), tourism development quality (He & Hu, 2020), tourism TFP (He & Wang, 2020), tourism specialization (Bai, Abdukhalik, & Deng, 2017), and tourism resource conversion rate (Wang, Chu, A. X. Guo, & Y. Z. Guo, 2020), and conducted quantitative researches on the influencing factors or external effects to find out the problems and improvement measures of tourism development along the Belt and Road. There are also some scholars who explore new ideas for tourism development in the context of the Belt and Road Strategy from provincial perspectives (Hu, 2016; Liang & Mao, 2017; Fu & Li, 2015).

As an important node of the “Silk Road Economic Belt”, Qinghai Province has rich and unique tourism resources, but the special geographical and humanistic environment, weak industrial foundation, and low level of regional cooperation have increased the difficulty for Qinghai’s tourism industry to integrate into the Belt and Road. In this regard, the Asian Development Bank (ADB) commissioned a Chinese consultancy to provide knowledge and technical assistance to Qinghai’s tourism industry in its integration into the Belt and Road. The technical assistance project provides technical support to Qinghai’s tourism industry in terms of resource development, industrial development, tourism products and routes, brand marketing, ecological and cultural preservation, and rural revitalization (Dou et al., 2021). This paper, as one of the research results, aims to study the current situation and influencing factors of tourism agglomeration in Qinghai Province from the perspective of industrial agglomeration, explore the problems in the development of tourism agglomeration in Qinghai Province, and provide policy suggestions for solving the development problems, optimizing the spatial layout, and accelerating the integration into the Belt and Road.

Data Source and Research Methodology

Data Sources

This study selects the 2019 cross-sectional data of 44 districts and counties in Qinghai Province, covering the area of administrative regions in Qinghai Province, GDP, population, road mileage, tourism revenue, income of accommodation and catering enterprises above the designated limit, income of wholesale and retail enterprises above the designated limit, and income from tourism public institutions, etc., from the Statistical Yearbook of Qinghai Province, China County Statistical Yearbook, Qinghai Province Cultural Tourism Statistics, and Qinghai Province Tourism Statistics at a Glance, with supplements from the statistical bulletin on economic and social development of each prefecture and city in Qinghai Province.[1]

[1] The Dachaidan and the Tanggula escrow area of Golmud City are not included; lack of relevant statistics: The statistical data of the resident population in Qinghai Province is replaced by the data of the registered household population in this case.

Meanwhile, this study used Python technology to extract the POI data of tourism elements of Qinghai Province, including: tourist attractions, restaurants, accommodation, shopping, leisure and entertainment, from the open platform of Baidu Maps. After processing the POI points with positioning errors, duplicates, and those that do not match the corresponding elements, a total of 30,218 POI samples were obtained with their names and latitude and longitude coordinates.[2] In addition, this study also obtains vector road network data including railroads, highways, national roads, provincial roads, ring roads, urban trunk roads, urban streets, rural roads, etc., and vector data such as water system and contour lines in Qinghai Province through BIGEMAP.

The scope of districts and counties along the Belt and Road in Qinghai Province in this study was sourced from the planning materials of the Qinghai Provincial Department of Culture and Tourism.[3]

Study Indicators and Methods

Study indicators. There are various methods to measure industrial agglomeration, such as locational entropy and Hurdle index (Ren, Xu, & You, 2010; Zhong, 2011; Sheng, 2014), but such indices focus on reflecting the agglomeration status of the studied industry in a certain region among all industries with more emphasis on reflecting the concept of industrial agglomeration. This study focuses on spatial agglomeration, i.e., the density of tourism in the study area.

According to the definition of *Introduction to Tourism* (1994, p. 91) by the Department of Personnel, Labor and Education of the National Tourism Administration, this study takes the six elements of "food, accommodation, transportation, traveling, shopping and entertainment" as the basic aspects of tourism, selects tourism income, tourism public utility income, accommodation and catering income, and wholesale and retail income in Qinghai Province, calculates their densification indexes (divided by the area of the administrative region), and then determines a comprehensive index of tourism spatial agglomeration by using the entropy weighting method to weight the densification indexes of each element to reflect the overall spatial agglomeration of tourism, and the equation is as follows:

$$TI_i = \sum_{j=1}^{5} w_j * f_{ij} \quad (1)$$

where: TI_i is the composite index of tourism spatial agglomeration in region i. f_{ij} is the densification index of tourism element j in region i, and w_j is the weight of the index derived with the entropy weighting method.

GIS analysis methods.

Nearest-neighbor analysis. Nearest neighbor analysis is one of the common methods to study the spatial distance distribution of point elements (Tang, Chen, Ma, & Li, 2019), and in this study, the nearest neighbor index of POI data of tourism elements in Qinghai Province was calculated to determine the clustering or dispersion status of tourism elements. The equation is:

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[2] POI categories include tourist attractions, catering, accommodation, shopping, leisure and entertainment, which correspond to tourism elements of tour, food, accommodation, shopping, and entertainment respectively, of which, in second categories, hotel covers star hotels, economic hotels, B&B, etc., shopping covers shopping centers, shopping malls, etc., leisure and entertainment covers resorts, farmhouses, etc., catering covers all kinds of restaurants, caf és, bars, etc., and tourist attractions covers scenic spots, monuments, and museums etc.

[3] According to the planning materials of the Qinghai Culture and Tourism Department, the Silk Road is divided into two branches passing through Qinghai in the north and south respectively. The North Branch enters from Gansu into Qinghai Province and pass through Minhe, Ledu, Pingan, Huzhu County via Xining City, Datong County to Menyuan, Qilian County and goes out of Qinghai Province to Zhangye, Gansu Province. The South Branch also enters from Gansu Province and passes through Minhe, Ledu, Ping'an, Huzhu, via Huangyuan County, Guide, Gonghe, Dulan County, Golmud City, and goes westward out of Qinghai Province to Ruoqiang, Xinjiang.

$$R_n = \frac{2\sqrt{n/A} * \sum d}{n} \quad (2)$$

where: R_n is the nearest neighbor ratio of tourism elements, d is the distance from each POI to the nearest neighbor POI, A is the area of the study area, and n is the number of POIs of tourism elements. When $R_n > 1$, tourism elements are evenly distributed, and when $1 > R_n > 0$, tourism elements are distributed in clusters.

L function. L function is one of the common methods to study the degree of spatial clustering and dispersion of point elements at different scales (Tang et al., 2019), and this study investigates the spatial distribution characteristics of POI data of tourism elements in Qinghai Province at different spatial scales by using L function. The equation is:

$$L(d) = \sqrt{\frac{A}{\pi}\sum_i^n \sum_i^n \frac{w_{ij(d)}}{n^2}},\ w_{ij}(d) = \begin{Bmatrix} 1 & (w_{ij} \le d) \\ 0 & (w_{ij} > d) \end{Bmatrix} \quad (3)$$

where: A is the area of the study area, n is the number of POI of tourism elements, d is the observed distance, and w_{ij} is the geographical distance between POI sample i and sample j. When L(d) > d, tourism elements are concentrated within d radius, and otherwise, they are dispersed.

Kernel density estimation. Kernel density estimation is a spatial analysis method for estimating unknown density functions (Tang et al., 2019), and this study uses kernel density estimation to measure the spatial distribution density of tourism elements. The equation is:

$$f(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x - x_i}{h}\right) \quad (4)$$

where: f(x) denotes the kernel density function at x, h is the bandwidth, n is the number of POI of tourism elements, K denotes the spatial weight function, and $(x - x_i)$ denotes the distance from the estimated point x to xi. A larger kernel density function indicates a denser tourism element.

Econometric analysis methods.

Spatial correlation analysis. In this study, we choose to construct an econometric model to study the influencing factors of tourism agglomeration in Qinghai Province, and the construction of the econometric model needs to consider the spatial effect of the data first, according to Cliff and Ord (1972), if there is no spatial auto-correlation in the residual after OLS regression, then the OLS model can be used, and otherwise, the spatial econometric model needs to be considered.

The main measure of global spatial auto-correlation is the global Moran's index, which value (I) is between -1 and 1. A value close to 1 indicates the existence of a global positive correlation in the data, and a value close to -1 indicates the existence of global negative correlation in the data. Its calculation equation is:

$$I = \frac{n}{S_0} \times \frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij}(y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^n (y_i - \bar{y})^2} \quad (5)$$

where: y_i denotes the variable value of sample i, w_{ij} denotes the spatial weight, $\bar{y}$ denotes the average of all spatial sample variables, and n is the number of spatial samples. $S_0 = \sum_{i=1}^n \sum_{j=1}^n w_{ij}\ \bar{y}$

Spatial lag and error model. The error of spatial correlation is mainly due to the inevitable error of economic linkages between regions with the collected data measurements and therefore corresponds to two spatial correlation analysis models namely spatial lag model (SLM) and spatial error model (SEM).

The spatial lag model takes into account the endogenous spatial interaction effect of the explanatory variables, i.e., the tourism agglomeration within a county is influenced by the tourism agglomeration in the neighboring counties, which is added to the traditional linear regression model with a spatial lag term for the explanatory variables. The model is generally expressed as follows:

$$y = \rho W y + X\beta + \varepsilon \tag{6}$$

where: y denotes the explanatory variable of n * 1, ρ for the spatial auto-regressive coefficient to be estimated, W denotes the spatial weight matrix of n * n, X denotes the explanatory variable of n * k, β for the coefficient of the explanatory variable of k * 1 to be estimated, and ε for the error term of n * 1.

The spatial error model takes into account the spatial interaction effect between the error terms, and is converted by adding the spatial lag term to the error term of the traditional linear regression model. The general equation of the model is:

$$y = X\beta + \varepsilon, \text{ here } \varepsilon = \lambda W\varepsilon + \upsilon \tag{7}$$

where, y denotes the explanatory variable of n * 1, X denotes the explanatory variable of n * k, β is the coefficient of the explanatory variable of k * 1 to be estimated, ε is the error term of n * 1, W denotes the spatial weight matrix of n * n, and λ denotes the coefficient of the spatial lag term from the error term to be estimated.

The selection of the spatial lag model or the spatial error model is mainly done by LM test with the significant LM-lag for the spatial lag model and the significant LM-error for the spatial error model, and when both LM-lag and LM-error are significant, the model is selected by the robust-LM, proposed by Anselin (1996), with the significant robust LM-lag for the spatial lag model and the significant robust LM-error for the spatial error model.

Spatial Agglomeration Characteristics of Tourism in Qinghai Province

Analysis of the Current Spatial Agglomeration of Tourism Elements Based on POI Data

Spatial agglomeration characteristics. The study investigated the degree of spatial agglomeration of tourism elements in Qinghai Province by using the nearest neighbor analysis (Table 1). The results show that (1) all the tourism elements in Qinghai Province display the characteristics of spatially clustered distribution. (2) By element, the lowest agglomeration is found in tourist attractions, influenced by the physical geography. The shopping and accommodation clusters are more aggregated than the restaurants and leisure and entertainment.

Table 1

Results of Nearest Neighbor Analysis of Tourism Factors in Qinghai

Tourism elements	Types of POI	Number of POI samples	Average of nearest neighbor distance (m)	Expected nearest neighbor distance (m)	Nearest neighbor ratio	Type of spatial distribution
Tour	Tourism attractions	1,301	7,259.06	16,255.11	0.45***	Significant agglomeration
Food	Catering	6,495	777.59	7,165.96	0.11***	Significant agglomeration
Living	Accommodation	5,088	402.49	7,595.62	0.05***	Significant agglomeration
Shopping	Shopping	16,081	127.37	4,292.77	0.03***	Significant agglomeration
Entertainment	Leisure and entertainment	1,253	2,446.98	15,310.48	0.16***	Significant agglomeration

Note. *** indicates passing the 1% significance test.

Spatial aggregation scale. This study analyzes the clustering degree of different distances between the POIs of tourism elements in Qinghai Province by multi-distance spatial clustering analysis with ArcGIS 10.7 and generates the L-function graph (Figure 1). The results show that (1) the observed values of L(d) function of each tourism element are always located above the observed distance d and 99% confidence interval, indicating that there is significant spatial agglomeration of tourism elements in Qinghai Province, which is consistent with the results of nearest neighbor analysis. (2) The difference between the L function value of tourism elements and the observed distance d shows a trend of "increasing first and then decreasing" and reaches the maximum value around 150 km, which indicates that the concentration of tourism elements in Qinghai Province "increases from the beginning and then decreases" with the observed distance and reaches to its maximum near 150 km.

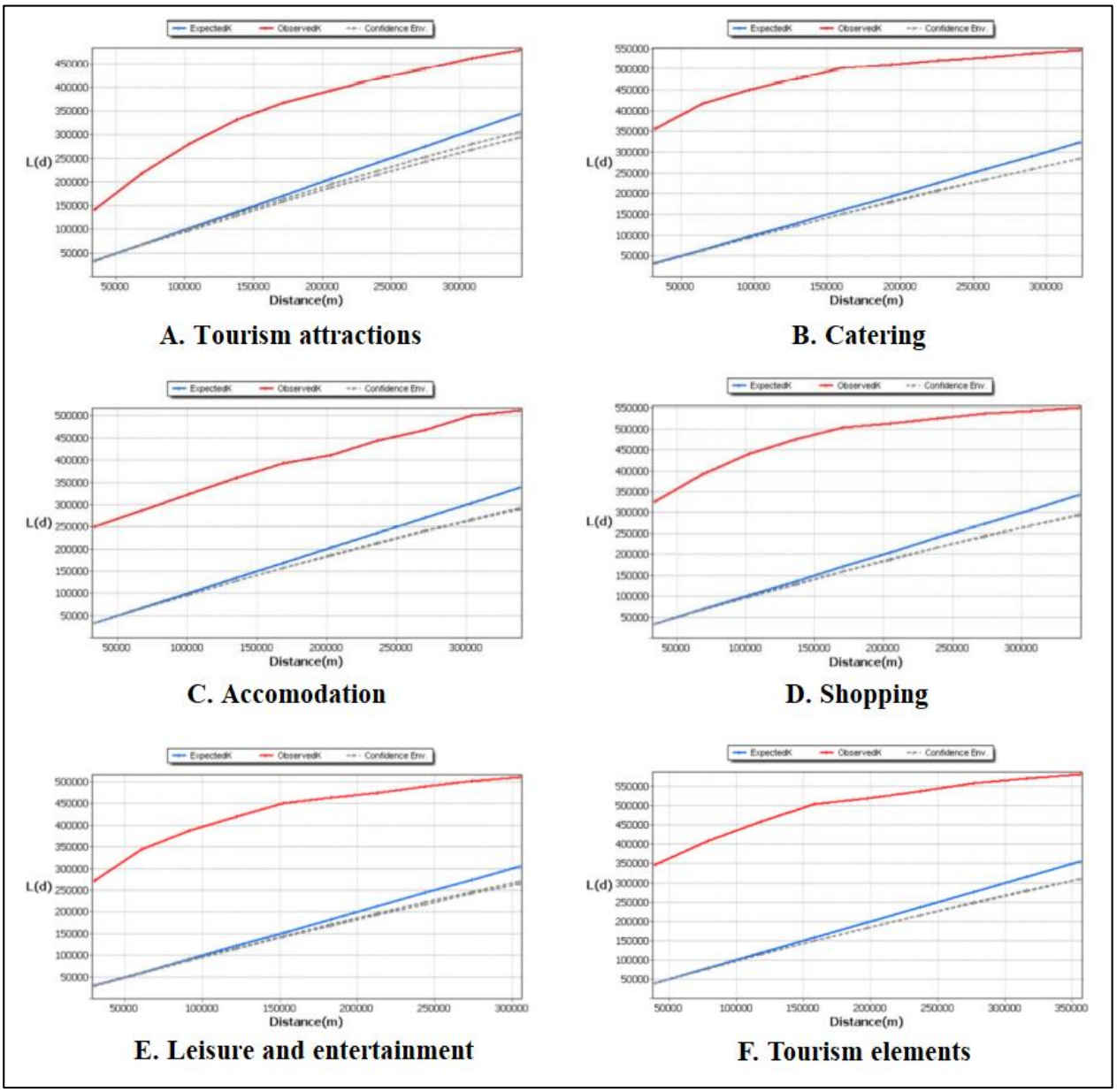

Figure 1. L-function diagram of the spatial distribution of tourism elements in Qinghai Province.

Spatial distribution patterns. Referring to the study of Weixuan Xian et al. (2021), the appropriate column width of the kernel density function was determined by the maximum agglomeration scale of the L function, and the spatial distribution pattern of tourism elements in Qinghai Province was explored by using kernel density analysis in ArcGIS 10.7 (Figure 2). The results showed that:

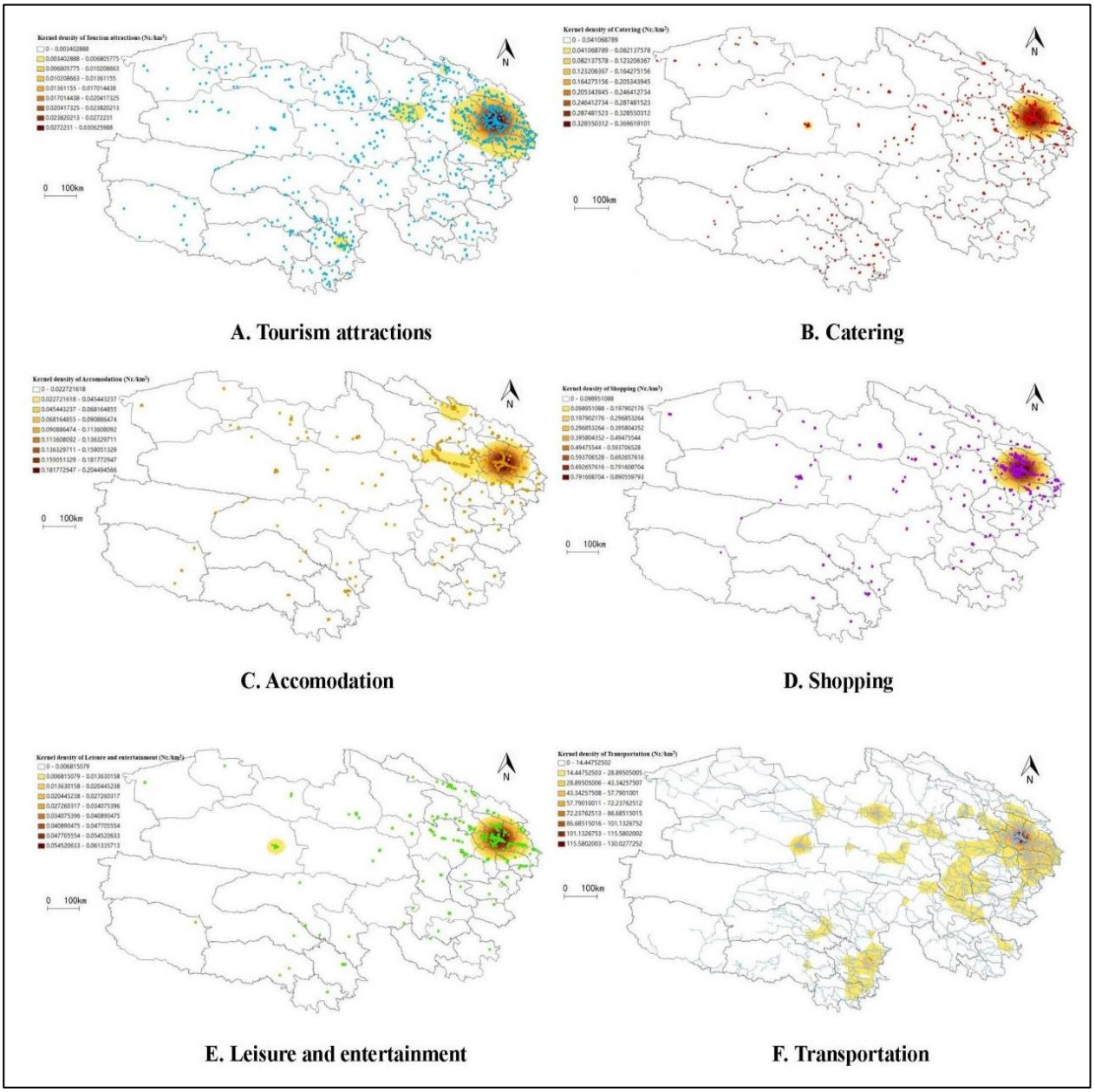

Figure 2. Distribution of Kernel density of travel elements in Qinghai.

1. The overall spatial distribution of tourism elements in Qinghai Province is unbalanced, being dense in the east and sparse in the west, forming a high-density core area in the tourism circle around Xining, and generally showing the characteristics of decreasing in a ring from Xining City to the peripheral districts and counties. The spatial distribution of different tourism elements is approximately similar but with subtle differences.

2. The distribution of tourist attractions forms a cluster distribution pattern of “one major, one subordinate and one minor group”, forming the major core of tourist attractions in the pan-Xining tourism circle, one subordinate core of tourist attractions around Qinghai Lake, and one minor group of tourist attractions in Yushu City. Catering, shopping, and entertainment elements generally show a “one major and one secondary” clustering distribution pattern: the major core of the pan-Xining metropolitan area and the secondary core of Golmud. The accommodation elements show a clustering distribution pattern of “one core, one belt and one group”, with the pan-Xining metropolitan area as a main core of accommodation elements clustering, the area surrounding Qinghai Lake as an intermediate dense belt of accommodation elements clustering extended from the main core, and the area of Qilian county as an intermediate dense group of accommodation elements clustering. The kernel density analysis on the vectored road network of travel elements shows that the road network in Qinghai Province is dense in the east and sparse in the west, forming a “C” shaped agglomeration pattern in general with several moderately dense clusters in the traffic hub cities of Golmud, Delingha, Yushu, and the vicinity of Qinghai Lake.

Analysis of Spatial Agglomeration Characteristics Based on the Comprehensive Index of Tourism Spatial Agglomeration

Since the POI data cannot capture the income scale of the sample points, this paper constructs a comprehensive index of tourism spatial agglomeration (Equation 1) and draws a distribution map (Figure 3). According to the figure, it can be seen that the spatial agglomeration characteristics of tourism in Qinghai Province are as follows:

1. In the eastern part of Qinghai Province including Xining City, Haidong City, the agglomeration of tourism elements is obviously formed between developed areas while the development of tourism elements in Yushu Prefecture, Guoluo Prefecture, and Haixi Prefecture in the south and west of Qinghai Province are insufficient and the spatial distribution of tourism elements is unbalanced.

2. The tourism industry in Qinghai Province has formed the tourism agglomeration of “a circle and a belt” distribution pattern. The elements of tourism are highly aggregated in the two-hour drive tourism circle around Xining, showing the trend of decreasing outwardly in a ring from the east to the middle and west with Xining City as the core. Along the Belt and Road has maintained a high degree of tourism agglomeration with the north and south branches converging at Xining tourism circle, where there is a high degree of tourism agglomeration, while the north route passes through Datong, Menyuan, and Qilian Counties, where the tourism agglomeration index is relatively high, and the south route passes through Dulan County and Golmud City, where the tourism agglomeration index is relatively high in the Haixi region. Along the Belt and Road has formed a development corridor with relatively high tourism agglomeration connecting the east and the west of Qinghai Province.

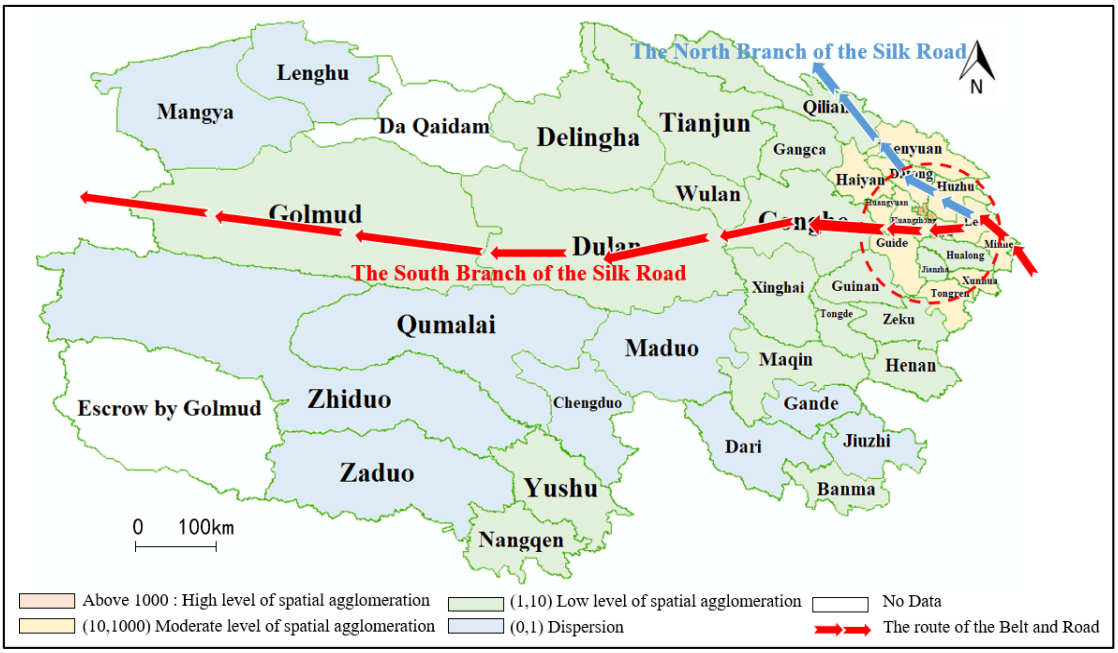

Figure 3. Spatial distribution map of comprehensive tourism spatial agglomeration index in Qinghai.

Spatial Agglomeration Influencing Factors and Mechanism of Tourism in Qinghai Province

Physical Geography

The physical geography is the basic force and plays a fundamental role in the process of tourism agglomeration, and the physical geography that affects tourism agglomeration mainly includes: geological and geomorphological environment, water body environment, climate and biology, etc. (Li, 2013). Qinghai Province has a relatively diverse geological and geomorphological environment (Figure 4), with the plateau in the south forming a unique plateau tourist attraction such as Hoh Xil, the central basin landscape features plateau deserts, salt lakes, and Yadan landforms, the mountains in the north forming a unique vertical mountain landscape; and the valleys in the east forming valley scenery tourism resources such as the Huangshui Valley. The water system has an important influence on the tourism resources of Qinghai Province because as the birthplace of many large rivers, many tourist attractions are distributed along the rivers and lakes (Figure 5), forming a unique water scenery including lakes, rivers, glaciers and snow mountains, springs and waterfalls, etc. In addition, the unique climatic conditions of Qinghai Province, with no scorching summer under the plateau climate, make it a holy place for tourism. The construction of national forest parks and the diverse flora and fauna resources also add to the charm of Qinghai Province as a tourist destination.

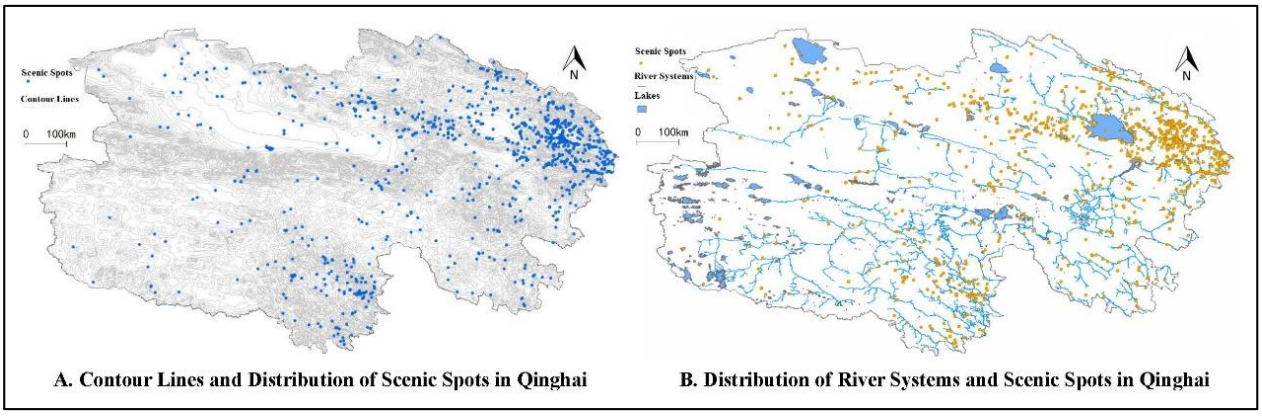

Figure 4. The influence of physical geographical environment on tourism agglomeration.

Socioeconomic Factors

Socioeconomic factors are the core factors of tourism agglomeration, among which the economic factors such as the size of the source market, the comprehensive reception capacity of tourist destinations, and the role of industrial linkages directly affect the agglomeration of tourism factors, and social factors such as population size, public security and hygienic conditions, local customs and religions also have an important impact on tourism agglomeration (Tang et al., 2019; Ning, 2000; Xue, Ying, & Liu, 2016; Zheng & Hou, 2012; Shen et al., 2021; Deng, Yu, & Wu, 2004; Xu et al., 2017). As an urban area is a highly dense socioeconomic area, the paper took into account the analysis of urban buffer zone in Qinghai Province and found that 76.46% (23,104) of the POIs of tourism elements are concentrated within the buffer zone of 30 km from the downtown of a district and county level cities, and 84.66% (25,583) of the POIs of tourism elements are concentrated within the buffer zone of 50 km from the downtown of a district and county level cities, indicating that socioeconomic factors have a key influence on the distribution of tourism elements.

The unbalanced spatial distribution of socioeconomic factors in Qinghai Province brings about an unbalanced spatial agglomeration of tourism elements (Figure 5). Xining City and Haidong City, as the most densely populated areas with the highest level of economic activities in Qinghai Province, are highly dense in socioeconomic factors with more adequate support for the development of tourism elements; in contrast, the prefectures in the west and south of Qinghai Province are relatively sparse in socioeconomic factors due to the physical geography, and the development of tourism elements is more severely restricted.

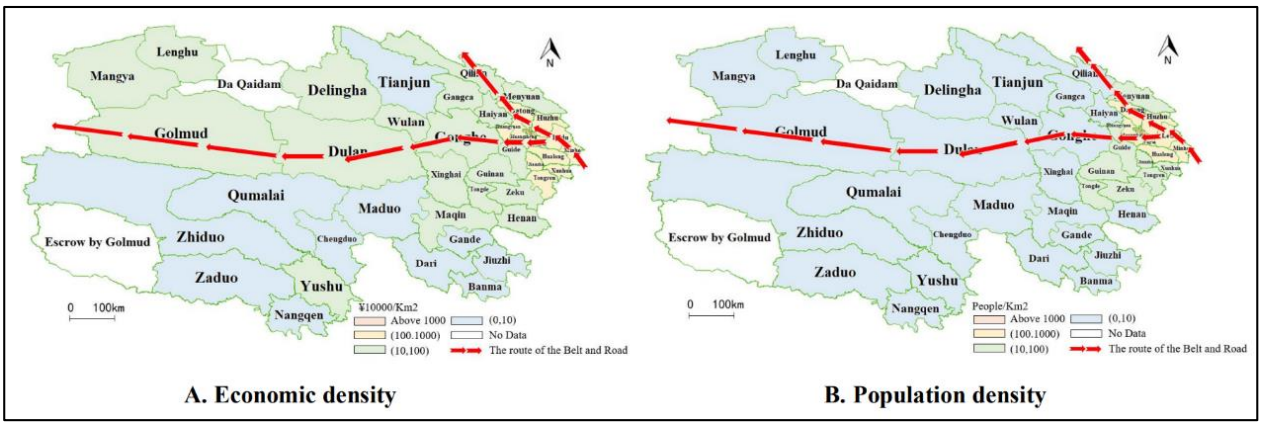

Figure 5. Distribution of socioeconomic factors in counties of Qinghai Province.

Transportation Factors

Due to the non-migratory nature of tourism products, transportation is particularly important (Deng et al., 2004), and this study takes into consideration of the buffer zone of road network in Qinghai Province with the result that 90.46% (27,335) of the POIs of tourism elements are concentrated in the buffer zone of 100 m of road at all levels and 98.14% (29,656) of the POIs of tourism elements are concentrated in the buffer zone of 1,000 m of road at all levels. The tourism elements are distributed along the road network. Xining City, Haidong City, and some districts and counties in Hainan and Yushu Prefecture have a high road network density (Figure 2f) and also maintain a high agglomeration of tourism elements (Figure 3). Compared to the area with richer tourism resource elements, the area in the western Haixi Prefecture and in the southern Guoluo Prefecture have a low road network density (Figure 2f), constraining the development of tourism to a certain extent.

Policy Factors

Policy factors have an important influence on tourism agglomeration, as tourism resource development, construction of tourism media, tourism regional cooperation, and tourism planning are inseparable from government participation (Li, 2013). The Belt and Road, as a strategic initiative at the national level, has brought opportunities for the development of tourism in Qinghai Province with related infrastructure construction and counterpart projects facilitating the development of tourism and tourism activities. The construction of investment projects dedicated to tourism and the development of cultural exchange activities directly contribute to the development of the tourism industry. The construction of high-level policy communication and regional cooperation mechanisms is conducive to promoting regional synergy in tourism development and breaking down the barriers to tourism spatial development. Therefore, this paper selects the policy factor as one of the focus in the Belt and Road tourism.

In summary, physical geography, socioeconomic factors, transportation factors, and policy factors are all important factors affecting tourism agglomeration, and all play an important role in the process of tourism agglomeration. However, the role of the status of the above factors and the way they influence are different (Figure 6).

The influence of the physical geography on tourism agglomeration is fundamental. On one hand, the distribution of tourism resources by the physical geography directly affects tourism agglomeration, and on the other hand, the physical geography affects tourism agglomeration through influencing socioeconomic factors (Li, 2013). Economic and social factors directly affect the tourism agglomeration status (Tang et al., 2019; Ning, 2000; Xue et al., 2016; Zheng & Hou, 2012; Shen et al., 2021; Deng et al., 2004; Xu et al., 2017) with the growth of economic and population size directly bringing about the growth of tourism market and industry size, and the increase of tourism agglomeration. The transportation and policy factors play a role to a greater extent in tourism agglomeration by influencing economic and social factors. The improvement of transportation brings about the expansion of market size on the one hand, and the improvement of logistics and people flow efficiency brings about the enhancement of product and service supply capacity on the other hand (Wang, Lai, & Yu, 2021), because the transportation factor acts as an exogenous factor to influence tourism agglomeration through its effect on economic and social factors. Similarly, policy factors also act as exogenous factors on tourism agglomeration by directing the allocation of economic and social resources (Deng et al., 2004; Nie, 2008).

Therefore, the economic and social factors, on the one hand, carrying the force of natural conditions, and on the other hand, conveying the force of transportation and policies, act directly on tourism agglomeration. It is important to study the spatial coupling of tourism agglomeration and socioeconomic factors for analyzing the role of influencing factors in tourism agglomeration.

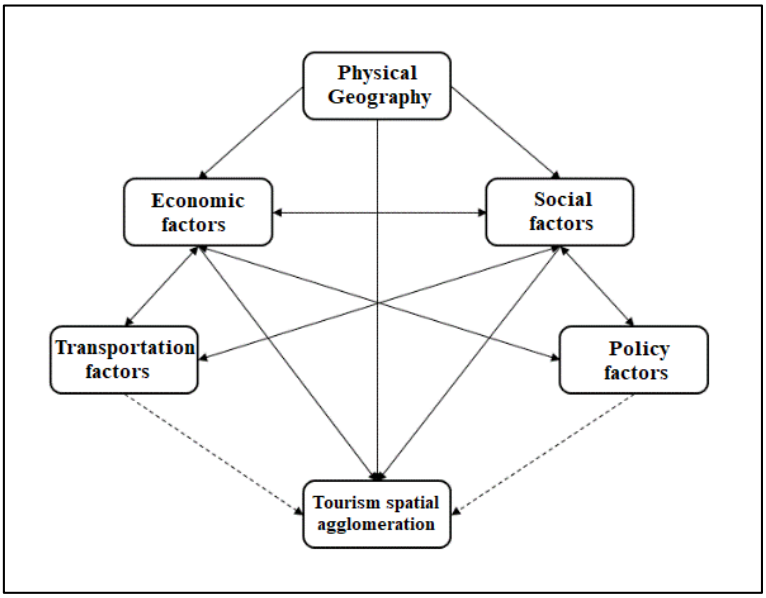

Figure 6. Relations among factors affecting tourism agglomeration.

Spatial Econometric Analysis of Tourism Agglomeration and Socioeconomic Coupling in Qinghai Province

Indicator and Model Selection

In this study, economic density and population density are selected as the indicators for measuring economic and social factors. In addition, considering the strategic significance of the Belt and Road Initiative to the development of tourism in Qinghai Province, this study introduces the Belt and Road Initiative as a virtual variable to influence the spatial agglomeration of tourism in Qinghai Province, with the value of 1 for being a district or county along the Belt and Road Initiative and 0 for the rest.

Table 2

Influencing Factors and Indicators of Tourism Spatial Agglomeration

Influencing factors	Measuring indicators	Symbol	Calculation method
Economic factors	Economic density	ED	Regional GDP/area of the region
Social factors	Population density	PD	Regional population/area of the region
Belt and Road	Virtual variable of Belt and Road	Belt	Value of being a district or county along the Belt and Road as 1, the rest as 0

The tourism spatial agglomeration composite index (TI) was selected as the explanatory variable in this study. Economic density (ED), population density (PD), and Belt (Belt and Road) were selected as explanatory variables to construct the econometric model. In order to choose the best analytical model, this study measured

the statistics related to OLS regression (Table 3), and the results showed that the global Moran's Index I of OLS regression residuals was significant at the 1% level, so a spatial econometric model could be selected, and due to the fact that both LM-lag and robust LM-lag were more significant than LM-error and robust LM-error, a spatial lag model was more appropriate and selected.

Table 3

Statistical Tests for Model Selection

Statistical quantities	Statistical values
Moran's Index I	-0.2267**
LM-lag	17.9732***
Robust LM-lag	16.7642***
LM-error	2.7204*
Robust LM-error	1.5115

Notes. *** indicates passing the 1% significance test, ** indicates passing the 5% significance test, and * indicates passing the 10% significance test.

Result Analysis of Model Estimation

To further validate the model selection, evaluation of the three models was performed in this study. According to Ord (1975), OLS estimation by spatial econometric models might yield biased and inconsistent estimates while that by the great likelihood estimation (ML) would be more preferable and has become the most popular estimation method for spatial econometric models; therefore, the great likelihood estimation method is selected for spatial econometric models in this paper. The paper applied the inverse distance spatial weight matrix to the spatial measurement model in this study, and the results of the analysis are shown in Table 4.

1. The log-likelihood value of SLM is greater than OLS and SEM, and the values of AIC and SC are smaller than OLS and SEM, so comprehensively the spatial lag model is the optimal model for evaluating the factors influencing tourism agglomeration in Qinghai Province.

2. Economic density (0.0780) and population density (0.0871) are significant at 1% and 10% significance levels, respectively, indicating that economic density and population density have a significant positive contribution to the spatial agglomeration of tourism. The increase in economic density and population density contributes to the expansion of the tourism market and the improvement of tourism reception capacity, which in turn contributes to tourism agglomeration. The Belt and Road (57.3828) is significant at the 1% level, indicating that the districts and counties located along the Belt and Road have a higher level of tourism agglomeration.

3. The spatial lag ρ (-0.1070) passed the 1% significance test, indicating that the spatial agglomeration of tourism in the county has a negative spatial spillover effect, possibly due to the polarization effect, by which the increase in regional tourism agglomeration has an attractive effect on tourism factor resources in the surrounding areas, thus bringing about a lack of tourism development in the surrounding areas. At the same time, in the case of a relatively stable market scale, the tourism elements in the neighboring areas, especially the food, accommodation, and shopping elements such as accommodation and catering, wholesale and retail, have a certain degree of substitution, and the resulting competitive effect leads to the increase of the spatial agglomeration of tourism in the surrounding districts and counties and brings about the decrease of the spatial agglomeration level of tourism in the county.

Table 4

The Results of OLS and ML Estimation of SLM and SEM

Variable	OLS			SLM			SEM		
	β	t	p	β	t	p	β	t	p
Constant	3.9468	0.2574	0.7982	18.0603	1.5376	0.1241	3.3273	0.3807	0.7035
ED	0.0940	24.9974	0.0000	0.0780	18.9245	0.0000	0.0929	25.4755	0.0000
PD	-0.1252	-3.0857	0.0037	0.0871	1.7229	0.0849	-0.1161	-3.2071	0.0013
Belt	10.0708	0.3675	0.7152	57.3828	2.5872	0.0097	8.4786	0.4133	0.6794
ρ/λ	--	--	--	-0.1070	-5.2221	0.0000	-0.6290	-2.3949	0.0166
LogL	-252.9530			-226.8732			-234.4562		
AIC	513.9060			461.7465			476.9124		
SC	521.0428			468.8832			484.0492		

Spatial Effects Analysis

Since the model introduces a spatially lagged term for the explanatory variable, the explanatory variable coefficient is not the true effect of the explanatory variable on the explained variable, and the true effect is divided into a direct effect and an indirect effect according to LeSage and Pace (2009). Based on the regression results of the above spatial lag model, the direct effect, indirect effect, and total effect were calculated as shown in Table 5.

Table 5

Direct and Indirect Effects of Different Factors on Tourism Spatial Agglomeration

Variable	Direct effect	Indirect effect (spatial spillover effect)	Total effect
ED	0.0778***	-0.0076***	0.0702***
	(19.0891)	(-6.9715)	(14.8471)
PD	0.0907*	-0.0096	0.0810*
	(1.8034)	(-1.5209)	(1.8357)
Belt	56.9997**	-5.7932**	51.2065**
	(2.4913)	(-2.0262)	(2.5324)

Notes. *** indicates passing the 1% significance test, ** indicates passing the 5% significance test, * indicates passing the 10% significance test, and that in brackets is the t-statistic value.

1. In terms of direct effects, economic density (0.0778) and population density (0.0907) are significant at the 1% and 10% levels respectively, indicating that an increase in economic density and population density in a county can lead to an increase in local tourism agglomeration.

2. In terms of indirect effects, the negative indirect effect of economic density implies that economic density in Qinghai Province has a negative spatial spillover, probably because the increase of economic density in a region, the concentration of production elements, and the prosperity of the tourism market bring about an increase in tourism revenue, but the production elements and the consumer market have a certain competitive effect, thus restricting the development of tourism in the surrounding areas and bringing about a decrease in the agglomeration of tourism in the surrounding areas. The indirect effect of population density is negative, probably due to the fact that the increase in population density mainly comes from population movement. The inflow of people from one area means an outflow of people from the surrounding area, which brings deterioration to the tourism development of the surrounding area and consequently a decrease in the tourism agglomeration in the surrounding districts and counties. Belt and Road also has negative spatial spillover effects, mainly due to the fact that the Belt and Road is a scarce policy resource and is somewhat competitive between regions.

3. The polarization effect of socioeconomic factors explains to some extent the uneven spatial agglomeration of tourism in Qinghai Province. With relatively limited market, production elements, and policy resources, the competition between regions brings about the growing strength of the more advantageous regions and widens the regional development gap.

Policy Recommendations

1. Improve the spatial layout of the tourism industry with the orientation by the Belt and Road Initiative. As a bridge between the "Xining tourism circle" in the eastern part of Qinghai Province, where tourism is well developed, and the relatively backward southern and western parts of the province, the "Belt and Road", with its mature tourism products and routes, and high tourism agglomeration, is of great significance in breaking the spatial barriers to tourism development between the eastern and western parts of Qinghai Province, boosting the development of tourism in the central and western regions, and alleviating the imbalance in tourism spatial agglomeration. The spatial layout of tourism industry in the future should be more close to area along the Belt and Road, giving play to the positive spillover and driving effects of the Belt and Road, taking Xining as the core to expand the tourism development northward along the northern branch of Qinghai Belt and Road strengthening the connection with the ecological tourism landscape corridor of the Qilian Mountain scenic belt, and to further the tourism development westward along the southern branch of Qinghai Belt and Road enhancing the links with the Qinghai Lake Humanistic Tourism Corridor and the Yellow River Tourism Corridor, as well as to facilitate the interchange of tourism with the Qaidam tourism sector.

2. Play a leading role in the allocation of socioeconomic factors by the Belt and Road. Economic density and population density are the core influencing factors of tourism agglomeration. As the unbalanced spatial distribution of such socioeconomic factors brings about the unbalanced spatial agglomeration of tourism, it is important to play the guiding role of the Belt and Road Initiative in the allocation of socioeconomic resources to alleviate the unbalanced spatial agglomeration of tourism. With the role of Belt and Road Initiative in guiding the allocation of economic factors, the economic factors will be directed to move and aggregate along the Belt and Road towards to the central and western regions by promoting the layout of tourism elements such as accommodation and catering, shopping and entertainment along the route and enhancing the vertical and horizontal industrial linkages. In the same time, as a strategic channel for China's opening up to the outside world, the Belt and Road Initiative can promote the development of an export-oriented economy in the central and western regions of Qinghai Province and alleviate the unbalanced spatial development of economic factors by promoting the construction of city nodes and ports along the Qinghai Belt and Road. With the role of the Belt and Road Initiative in guiding the allocation of social factors, the industrial development and population flow of permanent residents will be promoted by strengthening the construction of tourism products and routes along the Belt and Road, and by guiding the flow of tourists along the Belt and Road towards the central and western regions. In the same time, the imbalance spatial distribution of population will be gradually alleviated by the pulling effect of the Belt and Road on the new urbanization of nodes and ports along the Belt and Road.

3. Strengthen the functions of top-level design at the provincial level to promote the regional differentiation of tourism development. Being a system with strong spatial auto-correlation, and having a polarizing effect brought about by tourism agglomeration, the development of tourism in Qinghai Province requires proper holistic planning, taking into account the development needs of each region, encouraging differentiated competition between regions to promote a balanced development. The Belt and Road Initiative is important for establishing

regional coordination mechanisms, promoting inter-regional exchanges and cooperation, and complementing each other's strengths. It should be given a full play to the role of the Belt and Road as policy communication platform to improve the regional synergy and co-ordinate the overall development of tourism.

4. Integration of the Belt and Road tourism development with the construction of Qinghai's national ecological park province. Due to the fundamental role of physical geography in tourism agglomeration and the fragile ecosystem, poor resource support, and environmental restoration capacity determined by the special physical geography of Qinghai Province, the tourism development in Qinghai Province should be based on the premise of respecting the physical ecological environment and promoting ecotourism development in the face of the fragile ecological environment and natural background. As the strategic positioning of Qinghai as a national ecological park province has been reinforced in recent years, the value and potential of Qinghai's ecological resources have become increasingly evident with the Sanjiangyuan, Qilian Mountains, Qinghai Lake, and Kunlun Mountains along the Qinghai Belt and Road being the focus of the construction of a national ecological park in Qinghai Province and the tourism development should be coordinated harmoniously with ecological protection in order to achieve scientific and sustainable development of the tourism industry.

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