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The Spatial–Temporal Evolution and Driving Factors of the Coastal Tourism Economy in China

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Abstract: Tourism has emerged as a pivotal element of China's economic development, particularly within its coastal cities. This paper presents a comprehensive analysis of China's coastal city tourism economic development, focusing on 53 coastal cities. Through a meticulous combination of literature analysis and data crawling, a robust database is constructed, encompassing tourism resources and revenues. This study delineates the spatial–temporal evolution pattern of China's coastal city tourism development and employs geo-detector methods to quantitatively analyze the impact factors driving this evolution. Key findings reveal distinct trends in the coastal tourism economy of China from 2009 to 2019, characterized by spatial stability, similar trends in adjacent spatial units, and localized spatial structures. Notably, factors such as actual foreign investment, the presence of star-rated guesthouses, tourism industry employment, airport activity, and import–export trade volume exert significant influence on the domestic tourism economy. Similarly, tourism employment, airport activity, availability of star-rated hotels, import–export trade, and utilization of foreign capital emerge as influential factors shaping inbound tourism. Policy recommendations emphasize the need for government intervention to optimize tourism development strategies for coastal cities. This entails balancing resource exploitation with environmental protection and enhancing the quality of tourism services, fostering sustainable growth and long-term prosperity.

Keywords: coastal tourism economy; spatial–temporal evolution; driving factors; sustainable development; China

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1. Introduction

China boasts a coastline stretching over 32,000 km, placing it among the countries with the lengthiest coastlines globally and harboring abundant coastal tourism resources. Particularly noteworthy is the impact of strategies aimed at bolstering maritime prowess and initiatives like the Maritime Silk Road, which have opened new avenues for the coastal tourism economy in China. This sector has emerged as a pivotal aspect of the nation's global engagement and a cornerstone industry within the maritime economy.

From 2005 to 2019, the added value of China's tourism industry in coastal cities has experienced consistent growth. Despite facing challenges to development between 2020 and 2022 due to the disruptive impacts of epidemics, the tourism sector in coastal cities continues to make a significant contribution to national tourism revenue. This underscores the enduring importance of coastal city tourism, highlighting its potential for broader development compared to other tourism activities [1].

In 2021, the Ministry of Culture and Tourism unveiled the "14th Five-Year Plan" for Culture and Tourism Development, stressing the importance of enriching and innovating tourism offerings, particularly in advancing marine and coastal tourism. As China's tourism industry shifts towards enhancing the quality of consumption demand and diversifying tourism models, there's a critical need to foster the high-quality development of the coastal tourism economy in China. This, in turn, can catalyze the recovery of both China's marine economy and tourism sector. Given this imperative, understanding the spatial and temporal variations in the coastal tourism economy in China is paramount. Such analysis enables relevant authorities to grasp the comprehensive evolution of coastal city tourism economies and devise tailored development strategies addressing their respective strengths and weaknesses.

Based on the preceding analysis, this paper aims to examine 53 coastal cities, constructing a comprehensive tourism database through literature review, fieldwork, and big data analysis. Utilizing LISA spatial–temporal analysis, our goal is to delineate the trajectory and spatial–temporal dynamics of the coastal tourism economy in China, focusing on both domestic tourism income and foreign exchange revenue. We try to quantitatively identify the diverse factors contributing to regional disparities in the coastal tourism economy in China based on geo-detectors. Finally, we further propose tailored development strategies.

2. Literature Review

2.1. The Coastal Tourism Economy in China

Upon scrutinizing existing research on coastal city tourism economies, it becomes apparent that beach tourism has traditionally been a focal point in coastal city tourism studies. However, as research progresses, the expanding influence of urban tourism on coastal tourism resources has redirected attention towards the comprehensive development of regional tourism economies. Consequently, the coastal tourism economy in China has emerged as a crucial element in local economic development.

For instance, the changes in four kinds of ecosystem service functions—water production, carbon storage, soil conservation, and habitat quality—in both coastal and non-coastal zones of Sanya City were analyzed, and the influencing factors were discussed [2]. Traditional data envelopment analysis (DEA), bootstrap-DEA, and Malmquist models were used to measure the tourism efficiency and spatial characteristics of 61 cities across 6 coastal urban agglomerations in eastern China, and relevant development strategies were proposed [3]. The existing problems and challenges in the development of coastal tourism resources were analyzed from the perspective of global change, with key factors for future eco-friendly development and management of coastal tourism resources under the framework of sustainable development being proposed [4]. The convergence development level, spatial–temporal evolution, and spatial correlation of the sports and tourism industries in the Guangdong–Hong Kong–Macao Greater Bay Area were measured and analyzed [5].

In addition, Guo et al. [6] have shifted their focus from merely examining tourist consumption patterns on the Mississippi and Alabama Gulf Coast to assessing their broader local economic impacts. Such studies aim to equip decision-makers with insights to formulate sustainable strategies. This evolution underscores a broader trend toward understanding the interplay between coastal city tourism and local economic dynamics, highlighting the growing significance of coastal city tourism economies as drivers of regional prosperity. Triyanti et al. [7] utilized the multiplier effect as an analytical tool to evaluate the economic ramifications of tourism development in the coastal region of Mandalika. Meanwhile, scholars have observed spatially uneven development within the tourism economy, prompting research into economic disparities within coastal city tourism. Ran et al. [8] used standard deviation (S), coefficient of variation, and the Theil index to conduct a quantitative analysis of inbound tourism income in the three major Marine economic circles of 11 provinces (autonomous regions and municipalities) in China's coastal areas from 2010 to 2019. Liu et al. [9] identified several factors influencing tourism and proposed suggestions to enhance tourism eco-efficiency and the development of Chinese coastal cities.

As recognition of the tourism economy's significance in urban economic development grows, research endeavors increasingly align with national development strategies. Scholars are now examining the interplay between the tourism economy, ecological environment, and urbanization development, emphasizing the need for coordinated relationships among these aspects. Du et al. [10] studied Shandong province to explore coupling coordination characteristics and the spatial and temporal evolution of its tourism economy and urbanization development over an 18-year period. Their research provides insights and recommendations for aligning tourism economy growth with sustainable urbanization and environmental preservation efforts. Li S and Li M [11] conducted a quantitative analysis to assess the coupling coordination degree between the tourism economy and ecology in 14 coastal cities across China, offering a comprehensive evaluation of this crucial relationship. Sun et al. [12] assessed the sustainability of the utilization of the coastline and applied it to a typical case of Beibu Gulf, China with new methods. Han et al. [13] integrated dynamic components of flow space into the framework of geographic nature analysis to evaluate the adaptability of the tourism system in coastal cities across 14 cities comprehensively.

Furthermore, scholars have begun exploring topics related to the resilience of the coastal tourism economy of China in response to severe challenges posed by external forces such as financial crises and epidemics. For example, Zhang and Xing [14] quantitatively measured the impact of marine economic development pilot policies on the resilience of the tourism economy in coastal cities. Simultaneously, the research scope has expanded from individual coastal cities to encompass provincial and coastal economic belt scales.

2.2. The Driving Factors of the Coastal Tourism Economy in China

The quality of tourism services directly impacts tourists' experiences and satisfaction [15]. This paper employs the number of star-rated hotels to gauge the level of tourism reception facilities. Additionally, the total count of employees in the accommodation and catering industries, along with those in the culture, sports, and entertainment sectors, is utilized to depict the workforce in the tourism industry [16]. Rich natural resources and a healthy ecological environment enhance the allure of tourist destinations. To assess this, the paper employs per capita green space to measure the ecological environment quality of coastal cities [17]. Furthermore, the cumulative weighted count of exceptional tourism resources in each city, adjusted by the coastline coefficient, characterizes its resource endowment. An efficient transportation infrastructure is crucial for facilitating tourists' travel to destinations. Hence, the number of airport landings and takeoffs, along with high-speed rail capacity, is utilized to evaluate transportation accessibility [18]. Additionally, the density of the grade highway network in the region is employed to assess transportation convenience [19]. More openness to the global market fosters inbound tourism development. This study uses the actual utilization of foreign capital and the volume of import and export trade to measure regional openness [20]. Moreover, the proportion of the tertiary industry in GDP reflects the importance of the tourism sector within the industrial structure [21]. Regions with advanced socioeconomic development tend to attract factors of production, promoting high-quality tourism economy development. To capture this, per capita GDP and per capita disposable income are employed to gauge regional economic development [22]. Furthermore, the urbanization rate is used to assess social development levels [23].

While many existing studies assess the development and evolution of the tourism economy using metrics such as domestic and foreign tourism revenue or a comprehensive tourism economy index, this paper chooses domestic tourism revenue and tourism foreign exchange income as the dependent variables for evaluating the tourism economy. Moreover, guided by the findings of literature analysis [24,25] and data availability, this paper selects 14 indicators as influencing factors across four dimensions: tourism service level, resource ecological environment, transportation environment, and socioeconomic environment.

In summary, existing research primarily delves into individual coastal cities or economic zones, with fewer comprehensive studies portraying the tourism economy across prefecture-level cities nationwide. While many studies analyze tourism economy development within specific time frames, there's a notable dearth of research tracking its long-term evolution and quantitatively revealing influencing mechanisms. Existing literature predominantly assesses the role of ecological resources, transportation, socioeconomics, and tourism infrastructure in shaping the coastal tourism economy in China. Understanding the spatial and temporal evolution of this economy provides valuable insights into its overall development, aiding in the formulation of effective strategies to fully harness its economic potential and drive high-quality industry growth. Given national strategies like Marine Power and Maritime Silk Road, delving into the evolution and influencing factors of the coastal tourism economy in China is crucial for promoting their coordinated development within China.

3. Materials and Methods

3.1. Study Area

According to the Classification and Code of Coastal Administrative Areas (HY/T 094-2022), China's coastal regions encompass 11 provinces and cities, along with 55 prefectural-level cities and municipalities (excluding Hong Kong, Macao, and Taiwan). These areas span Liaoning Province, Hebei Province, Tianjin City, Shandong Province, Jiangsu Province, Shanghai Municipality, Zhejiang Province, Fujian Province, Guangdong Province, Guangxi Zhuang Autonomous Region, and Hainan Province. Considering the challenges in acquiring economic tourism data for Sansha City and Danzhou City, this paper focuses on the remaining 53 coastal cities for the primary investigation (Figure 1).

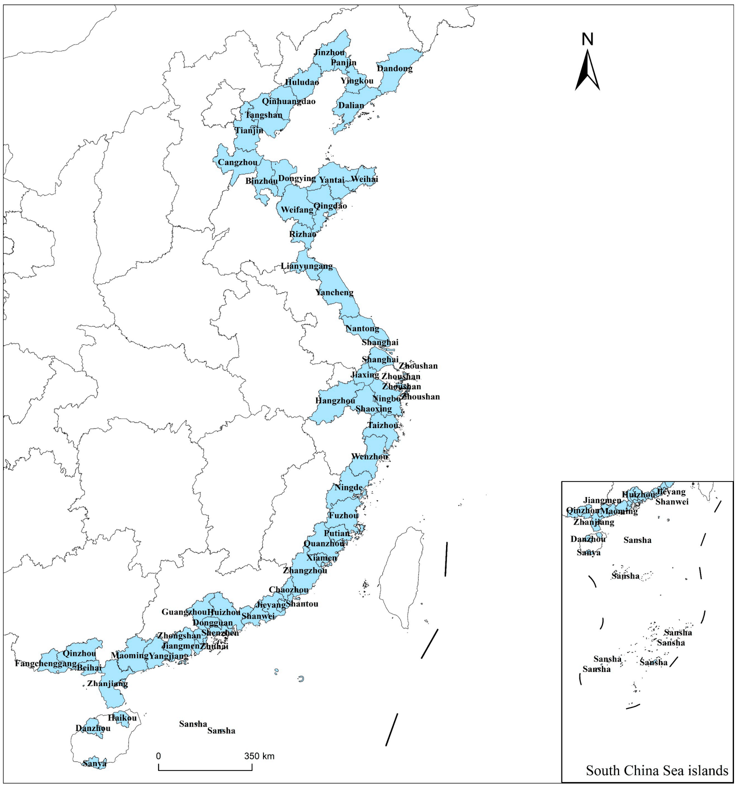

Figure 1. Distribution of coastal cities in China.

3.2. Research Methodology

3.2.1. Global Spatial Autocorrelation (Moran's I)

The global Moran index can be used to analyze the spatial correlation of the coastal tourism economy in China at the global level. The calculation formula is as follows [26,27]:

$$I = \frac{n}{\sum\limits_{i=1}^{n}\sum\limits_{j=1}^{n} w_{ij}} \frac{\sum\limits_{i=1}^{n}\sum\limits_{j=1}^{n} w_{ij}\left(X_i - \overline{X}\right)\left(X_j - \overline{X}\right)}{\sum\limits_{i=1}^{n}\left(X_i - \overline{X}\right)^2} \tag{1}$$

where I represents the global autocorrelation coefficient; n represents the number of study areas; X_i and X_j denote the coastal tourism economies in China in the i-th and j-th regions; $\overline{X}$ represents the average value; w_{ij} represents the spatial weight. The range of the I value is between -1 and 1. If the I value is greater than 0, it means that the tourism economy is positively correlated across the board and it is spatially clustered; if the I value is less than 0, it means that the tourism economy is negatively correlated across the board and it is spatially discretely distributed.

3.2.2. LISA Time Paths

The LISA time path is based on the Moran scatter plot, combining temporal and spatial attributes. By analyzing the moving trajectories of the coordinates of each point in the Moran scatter plot in different years, and then analyzing its local dynamic changes, the geometric features of the LISA time path mainly include the following: relative length, curvature, and moving direction [28], and its calculation formula is as follows:

$$\text{Relative length formula}: \ d_i = \frac{N\sum_{t=1}^{T-1} d(L_{i,t}, L_{i,t+1})}{\sum_{i=1}^{N}\sum_{t=1}^{T-1} d(L_{i,t}, L_{i,t+1})} \quad (2)$$

where N denotes the number of study units, $L_{i,t}$ denotes the coordinates of unit i at moment t, and $d(L_{i,t}, L_{i,t+1})$ denotes the distance moved by unit i from moment t to moment t + 1. If d_i is greater than 1, it means that the distance moved by cell i is greater than the average of all the study cell moves, indicating that the local spatial structure of the study cell is more dynamic.

$$\text{The formula for calculating the curvature is as follows}: f_i = \frac{\sum_{t=1}^{T-1} d(L_{i,t}, L_{i,t+1})}{d(L_{i,1}, L_{i,T})} \quad (3)$$

where $L_{i,t}$ denotes the coordinates of cell i at moment t, $d(L_{i,t}, L_{i,t+1})$ denotes the distance that cell i moves from moment t to moment t + 1, and $d(L_{i,1}, L_{i,T})$ denotes the distance of cell i at the first and last moments of the study interval. The greater the curvature, the greater the volatility of the local spatial structure of the study unit.

3.2.3. LISA Space-Time Transition

To further explore the spatial correlation of the localization of the tourism economy of each coastal city from 2009 to 2019, this paper adopts the LISA spatiotemporal transition proposed by Rey et al. for the analysis [29]. Rey et al. embedded the geometric features of the LISA time path into the traditional Markov chain proposed the concept of LISA spatiotemporal transition, and classified spatiotemporal transition into four major types, namely, Type0, Type1, Type2, and Type3, as shown in Table 1, where Type0 indicates that none of the research units have made a transition; Type1 indicates that only itself has made a transition, while the neighboring units have not; Type2 indicates that the research unit itself does not change, while the neighboring units have made a transition; and Type3 indicates that the research unit itself and the neighboring units have made transitions.

Table 1. Types of LISA temporal and spatial transitions.

Type0	$HH_t \rightarrow HH_{t+1}$	$HL_t \rightarrow HL_{t+1}$	$LL_t \rightarrow LL_{t+1}$	$LH_t \rightarrow LH_{t+1}$
Type1	$HH_t \rightarrow LH_{t+1}$	$HL_t \rightarrow LL_{t+1}$	$LH_t \rightarrow HH_{t+1}$	$LL_t \rightarrow HL_{t+1}$
Type2	$HH_t \rightarrow HL_{t+1}$	$HL_t \rightarrow HH_{t+1}$	$LH_t \rightarrow LL_{t+1}$	$LL_t \rightarrow LH_{t+1}$
Type3	$HH_t \rightarrow LL_{t+1}$	$LL_t \rightarrow HH_{t+1}$	$HL_t \rightarrow LH_{t+1}$	$LH_t \rightarrow HL_{t+1}$

3.2.4. Geo-Detector

The geographic detector is employed to analyze the spatial heterogeneity of each influencing factor. It computes the q-value by comparing the sum of variances within subregions with the sum of variances across the entire study area. This value elucidates the significance of the influencing factors on the dependent variable and assesses the impact of interactions among these factors on the dependent variable. Factor detection and interaction detection are utilized to achieve this objective. The calculation formula is presented as follows [30,31]:

$$SSW = \sum_{h=1}^{L} N_h \sigma_h^2,\ SST = N\sigma^2 \tag{4}$$

$$q = 1 - \frac{\sum_{h=1}^{L} N_h \sigma_h^2}{N\sigma^2} = 1 - \frac{SSW}{SST} \tag{5}$$

where h = 1,..., L is the stratification, i.e., categorization or partitioning, of the dependent or independent variable; N_h and N are the number of units in the h-region and the entire study area, respectively. σ_h^2 and σ are the variances of the dependent variable for region h and the entire study area, while SSW and SST are the sum of the variances for each region and the total variance for the entire study area, respectively. q-values reflect the magnitude of the effect of the evaluation factor X on the dependent variable Y.

3.3. Data Sources

Considering the significant impact of major global crises such as the financial crisis and the COVID-19 pandemic on the tourism industry, resulting in irregular patterns in tourism economic data during these periods, and acknowledging the challenges in obtaining accurate tourism economic data for coastal cities from 2020 to 2022 due to the pandemic, which reduces data accuracy and reference value, this paper opts to ensure scientific rigor in revealing the development trends of the coastal tourism economy in China. Therefore, it chooses to mitigate the influence of unforeseen events and uphold the principle of continuity by selecting a research period from 2009 to 2019.

Tourism economic data are primarily sourced from provincial and municipal statistical yearbooks, the China Tourism Statistical Yearbook, the China Marine Economy Statistical Yearbook, the China Regional Statistical Yearbook, and the statistical bulletins of national economic and social development from various administrative regions. Missing data are supplemented using Stata Linear Interpolation growth rates and statistical bulletins. Additionally, to accurately capture the temporal dynamics of the tourism economy, this paper establishes 2009 as the base year and employs the GDP deflator to adjust value-class indicators to constant prices.

Tourism resource data acquisition primarily entails a blend of literature analysis, field research, and big data analysis. Field research primarily utilizes GPS and "two-step road" software to procure spatial coordinates. Big data collection predominantly involves Gaode POI, big data semantic mining, Four-dimensional map new API, local cultural preservation data, scenic spot lists, intangible cultural heritage data, and government websites.

Based on these methodologies and guided by the requirements outlined in "Classification, Survey, and Evaluation of Tourism Resources" (GB/T18972-2017) [32], the acquired data's resource types and grades were evaluated. Subsequently, a comprehensive database of coastal tourism resources in China was constructed, comprising 77,967 tourism resource entities. Among these, a total of 26,607 resources were classified as excellent-grade (Grade 3 and above) tourism resources (Table 2).

In addition to tourism resources, data sources for each factor primarily comprise provincial and municipal statistical yearbooks (2009–2019), the China Urban Statistical Yearbook (2009–2019), the China Urban Construction Statistical Yearbook (2009–2019), statistical bulletins on national economic and social development from various regions (2009–2019), official government websites, national railroad passenger train schedules, and the official website of the China Civil Aviation Administration.

Table 2. Quality structure of various types of coastal tourism resources in China.

Resource Type	Number of Resources at the Excellent Level	Number of Resources at the General Level
Buildings and facilities	19,724	34,932
Ruins and remains	2275	2474
Geological landscapes	1647	2594
Tourism commodities	901	7126
Water landscapes	778	1551
Biological landscapes	750	1736
Human activities	401	695
Astronomical phenomena and meteorological landscapes	131	252
Sum	26,607	51,360

4. The Spatiotemporal Evolution of the Coastal Tourism Economy in China

4.1. Global Autocorrelation Analysis of the Tourism Economy

Based on the literature review, we categorized driving factors into four distinct groups by employing the natural fracture method (Table 3). Concurrently, the paper employs geo-detectors to identify and analyze how these factors interact with each other and their collective impact on the explained variables.

Table 3. Driving factors of coastal tourism economy regional differences in China.

Dimension (Math.)	Factor Selection
Level of tourism services	X_1 Number of star-rated hotels X_2 Number of persons employed in tourism (sum of persons employed in accommodation, catering, culture, sports and recreation)
Resources ecosystems	X_3 Parkland area per capita X_4 Number of good-grade tourism resources X_5 coastline factor
Transportation environment	X_6 Airport movements X_7 High-speed train X_8 Density of hierarchical road network in the region
Socioeconomic environment	X_9 Actual utilization of foreign capital X_{10} Trade in imports and exports X_{11} Share of tertiary sector in GDP X_{12} GDP per capita X_{13} Disposable income per capita X_{14} Urbanization rate

In this paper, the Global Moran's Index is utilized to analyze the spatial distribution characteristics of domestic and foreign tourism economies (Table 4). The I value spanning from 2009 to 2019 indicates that the domestic tourism economy exhibits no discernible spatial clustering or dispersion patterns, displaying a random spatial distribution. Conversely, since 2011, Moran's index of the inbound tourism economy has surpassed 0 and passed significance tests, signifying a spatial clustering phenomenon from 2011 to 2019. Furthermore, the fluctuation in Moran's I of the inbound tourism economy indicates a dynamic shift from "rising-declining-rising," reflecting the evolving spatial similarity of inbound tourism economies.

Table 4. Domestic and foreign tourism economy Moran's *I*.

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Domestic tourism economy	0.052	0.055	0.062	0.059	0.057	0.061	0.076	0.090	0.100	0.106	0.106
Inbound tourism economy	0.116	0.103	0.141 *	0.18 **	0.199 **	0.219 ***	0.185 **	0.146 *	0.151 *	0.177 **	0.189 **

Note: * indicates significant at the 0.1 level; ** indicates significant at the 0.05 level; *** indicates significant at the 0.01 level.

4.2. LISA Time Path Analysis

To delve deeper into the local dynamic evolution of the coastal tourism economy in China, this paper employs the LISA spatiotemporal analysis to examine the geometric characteristics of the tourism economy's trajectory. Simultaneously, the method of natural breakpoints is utilized to categorize relative lengths and curvatures into five levels: high, higher, medium, lower, and low. Regarding the research intervals, 2014 serves as the dividing point, splitting the entire research period into two equal time spans: 2009–2014 and 2014–2019. Equations (2) and (3) are applied to calculate relative lengths and curvatures for comparative analysis between the pre- and post-2014 stages.

4.2.1. Relative Length of LISA Time Paths

Through the analysis of the relative length of the time path of the domestic tourism economy in coastal cities (Figure 2), it is observed that from 2009 to 2014, 39 cities exhibited relative lengths of time paths less than 1, representing approximately 73.58% of the total, indicating a certain degree of stability in the local spatial structure of the study area. Conversely, 14 cities demonstrate relative lengths greater than 1, primarily situated in Guangdong Province, Zhejiang Province, Hainan Province, Hebei Province, Jiangsu Province, Shandong Province, Shanghai Municipality, and Tianjin Municipality, showcasing dynamic local spatial structures. Notably, cities with high relative lengths include Shanghai Municipality (5.755), Guangzhou Municipality (4.119), and Tianjin Municipality (3.703), illustrating more pronounced dynamics in their local spatial structures.

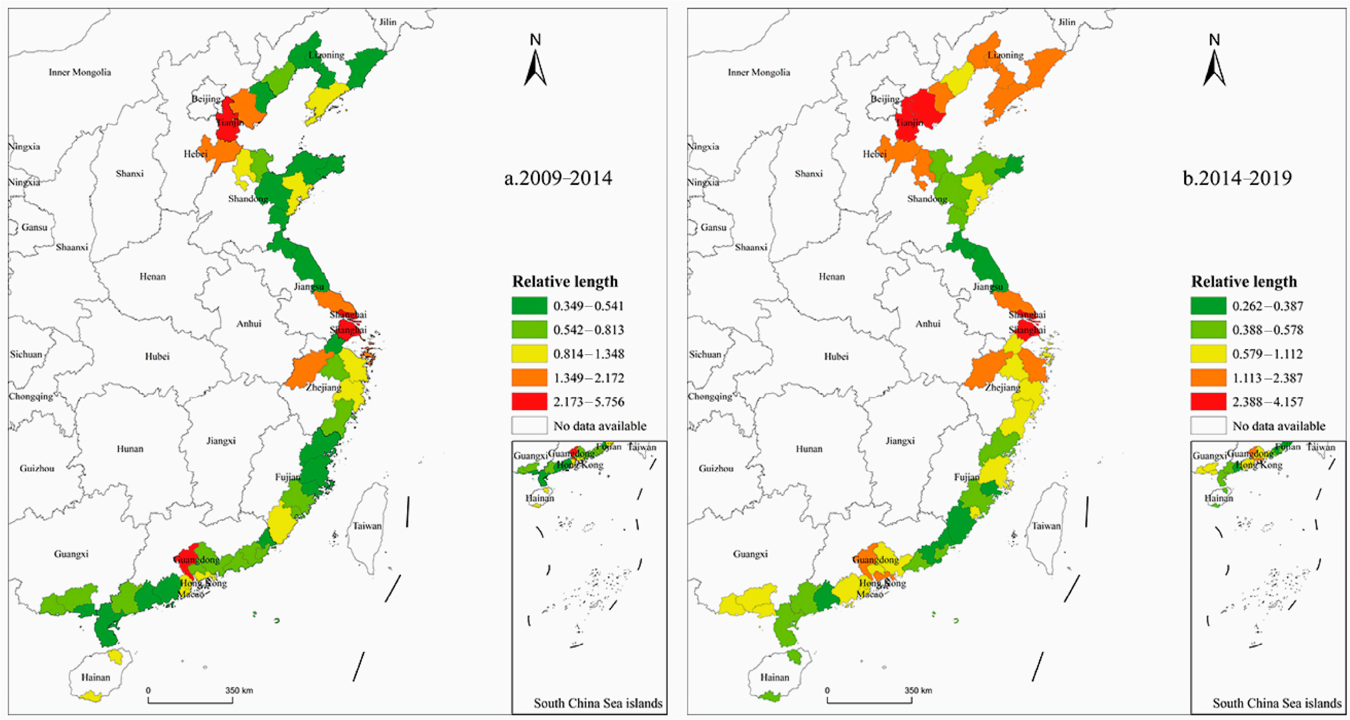

Figure 2. The relative length of LISA time path of the domestic tourism economy.

From 2014 to 2019, the relative lengths of certain cities experienced significant changes, with 34 cities displaying relative lengths of less than 1, constituting approximately 64.15% of the total. While the overall study area still retains stability, the number of cities demonstrating dynamic local spatial structures has increased. Additionally, the count of cities with relative lengths greater than 1 has risen to 19, predominantly located in Guangdong Province, Hebei Province, Jiangsu, Liaoning, Zhejiang, Shandong, Shanghai, and Tianjin. Notably, cities with high relative lengths include Tianjin (4.157), Shanghai (4.107), and Tangshan (2.916). Throughout both phases, Shanghai and Tianjin consistently exhibit high relative lengths, indicating highly dynamic local spatial structures in their domestic tourism economies.

In the case of the inbound tourism economy (Figure 3), from 2009 to 2014, 37 cities exhibit a relative length of the time path of less than 1, comprising approximately 69.81% of the total, indicating a stable local spatial structure in the study area. Conversely, 16 cities demonstrate relative lengths greater than 1, primarily located in Fujian Province, Guangdong Province, Hebei Province, Jiangsu Province, Liaoning Province, Zhejiang Province, Shanghai Municipality, and Tianjin Municipality. Notably, cities with high relative lengths include Shanghai Municipality (4.368), Shenzhen Municipality (4.302), and Tianjin Municipality (3.520).

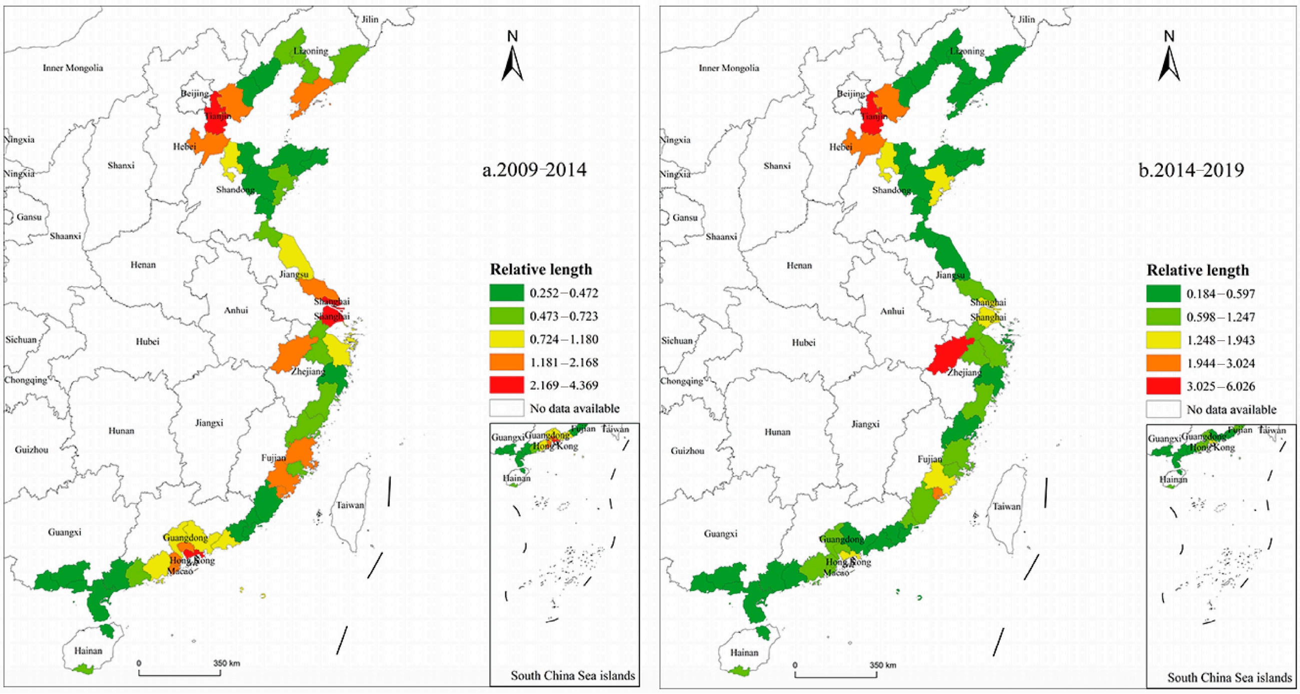

Figure 3. The relative length of the LISA time path of the inbound tourism economy.

In contrast to the dynamic shifts observed in the domestic tourism economy before and after phases, from 2014 to 2019, there are 38 cities with relative lengths less than 1, accounting for approximately 71.70%, indicating relatively minor deviations from the previous stage, with the local spatial structure of the study area maintaining a certain degree of stability. Moreover, 15 cities exhibit relative lengths greater than 1, primarily distributed in Fujian Province, Guangdong Province, Hebei Province, Zhejiang Province, Shandong Province, Shanghai Municipality, and Tianjin Municipality. Notably, cities with high relative lengths include Tianjin Municipality (6.026) and Hangzhou Municipality (5.898), suggesting a significant degree of volatility in the spatial structure of Tianjin Municipality's inbound tourism economy from 2009 to 2019.

4.2.2. LISA Time Path Curvature

From Figure 4, it is evident that the curvature of the domestic tourism economy in coastal cities during the study intervals of 2009–2014 and 2014–2019 exceeds 1, indicating that the curvature of each coastal city's domestic tourism economy surpasses the mean value, and the local spatial structure displays volatility.

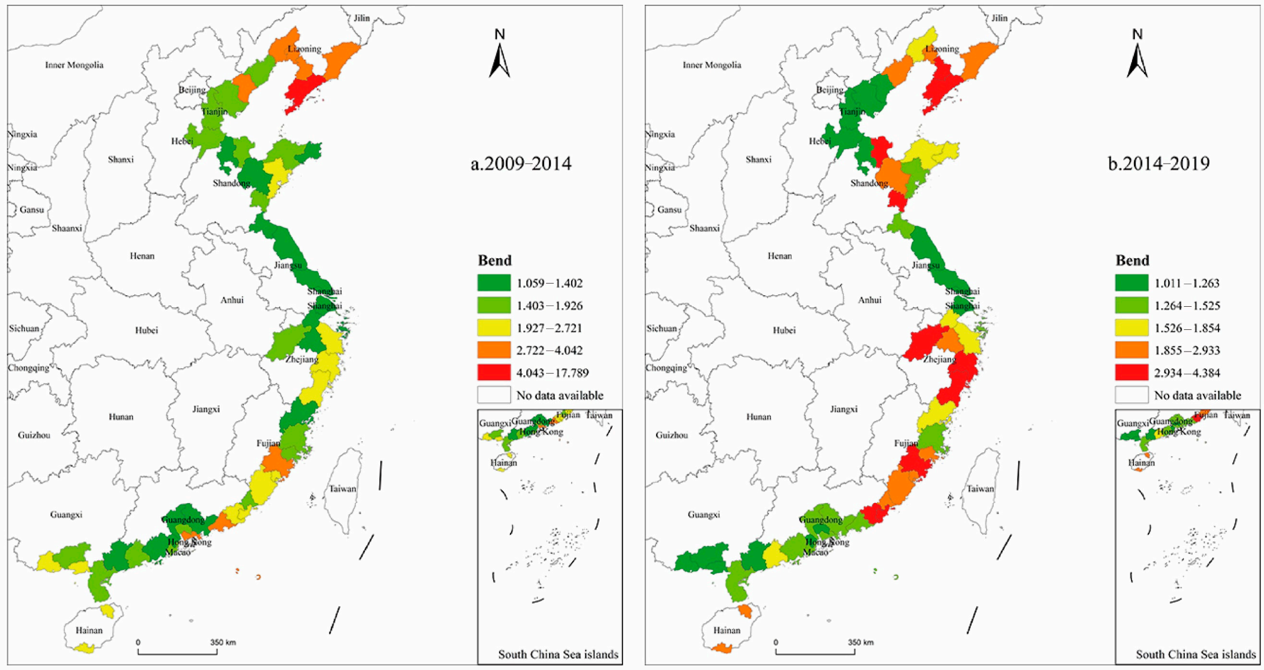

Figure 4. LISA time path curvature of the domestic tourism economy.

During the period of 2009–2014, Dalian City exhibits a high-level curvature (17.788), while cities with more advanced curvature levels include Dandong City (4.041), Quanzhou City (3.922), Yingkou City (3.724), Qinhuangdao City (3.251), Jinzhou City (3.039), Shenzhen City (3.002), Shanwei City (2.973), and Panjin City (2.845), primarily located in Liaoning Province.

In the period of 2014–2019, cities with high-level curvature include Rizhao City (4.384), Wenzhou (4.270), Hangzhou City (3.571), Shantou City (3.429), Yingkou City (3.423), Quanzhou City (3.361), Taizhou City (3.335), Dalian City (3.226), Dongying City (3.160), and Jieyang City (3.047), with cities at more advanced levels mainly distributed in Fujian and Hainan Provinces, as well as Liaoning Province.

Comparing the two stages reveals that the curvature level of coastal cities in Liaoning Province was higher in the early stage, with a decrease in fluctuations in the later stage, indicating a trend towards stable development. This trend can be attributed to the establishment of the Coastal Boulevard Tourism Consortium in 2009, enhancing product supply, resource development integration, and the vigorous development of coastal tourism. Additionally, the areas with higher curvature levels gradually shifted from north to south, driven by expansions in the tourism industry scale and the development of diverse tourism products. For instance, Rizhao City and Dongying City expanded their tourism industry scale through strategies such as "Rich City Tourism" and the Action Program for the Development of Territorial Tourism, while Wenzhou City planned tourism industry spatial layouts and promoted tourism functional zone construction. Hangzhou City focused on intelligent tourism development and quality industry improvement, while regions like Shantou City and Jieyang City tapped into tourism resource development potential and strengthened cultural heritage protection, incorporating Haisi culture into tourism development to enrich cultural content, resulting in noticeable fluctuations compared to the previous period.

From Figure 5, it is evident that the curvature of the inbound tourism economy in the study area during the phases of 2009–2014 and 2014–2019 exceeds 1, indicating that the curvature of the inbound tourism economy in coastal cities surpasses the mean value, and the local spatial structure displays volatility.

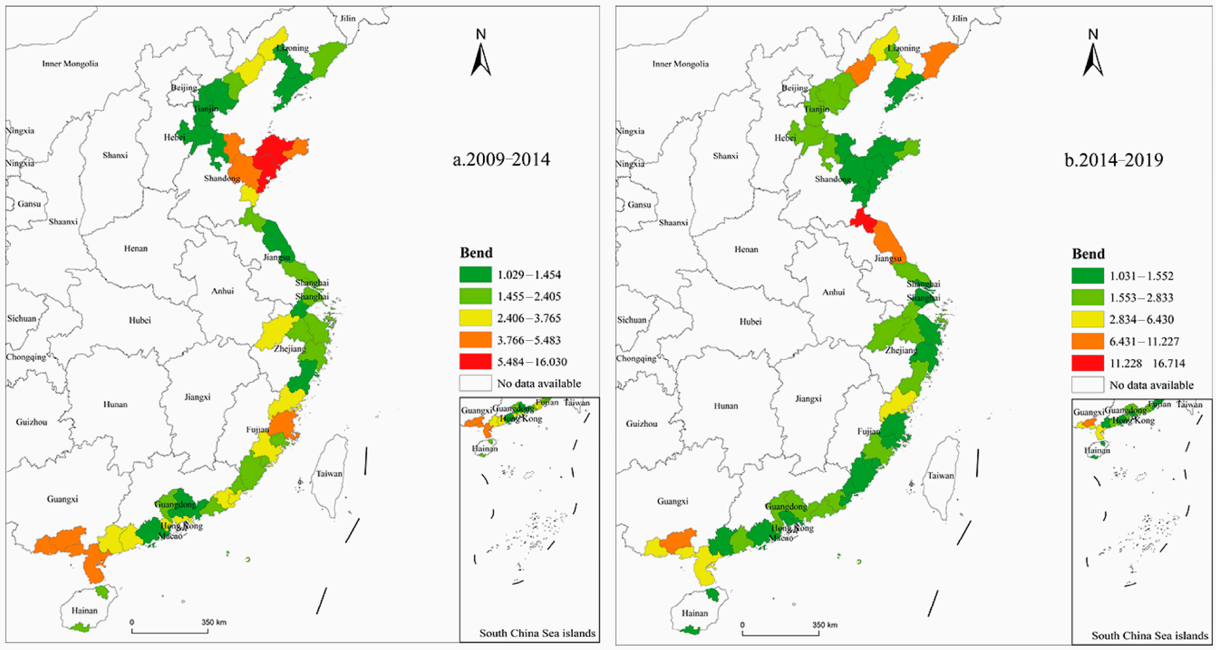

Figure 5. LISA time path curvature of the inbound tourism economy.

Cities with high-level curvature during 2009–2014 include Qingdao (16.030) and Yantai (9.965), with 8 cities exhibiting higher-grade curvatures, primarily concentrated in Guangxi Zhuang Autonomous Region and Shandong Province. In the period of 2014–2019, cities with high-grade curvatures include Lianyungang City (16.714), while those in higher grades are Huludao City (11.226), Dandong City (8.524), Qinzhou City (7.238), and Yancheng City (7.129).

The results indicate a transition in the curvature of the inbound tourism economy from high to low in Guangxi Zhuang Autonomous Region and Shandong Province, suggesting a gradual stabilization in the development of the inbound tourism economy in these provinces. However, the spatial structure of the inbound tourism economy in Lianyungang City, Huludao City, and Dandong City displays greater fluctuations in the later stage. This is attributed to the rapid development of the inbound tourism industry in these regions influenced by episodic factors such as GDP economic drive, national policy support, and structural deepening reforms. However, it is also hindered by conventional factors such as geographic location, ecological environment, and seasonal factors, resulting in a slowdown in development pace in the later stage.

4.2.3. Direction of LISA Time Path Movement

By examining the position of the domestic and international tourism economies of each coastal city in 2009, 2014, and 2019 on the Moran scatterplot, we analyze their stage-wise movement directions and classify them into four types: (1) 0–90° (high-high type): this indicates positive synergistic growth of the tourism economy of the study city and its neighboring cities; (2) 90–180° (low-high type): this signifies positive synergistic growth of the tourism economy of the study city with low growth while neighboring cities exhibit high growth; (3) 180–270° (low–low type): this denotes negative synergistic growth of the tourism economy of the study city and neighboring cities; (4) 270–360° (high-low type): this reveals the high growth of the study city and the low growth of neighboring cities.

Analyzing the trajectory of the domestic tourism economy (Figure 6), in the early stage, 30 cities (56.60%) exhibit synergistic growth, while 23 cities (43.40%) experience reverse growth. This suggests that the spatial collaboration posture within the study area outweighs the competitive posture, indicating stronger spatial integration. Among these, 8 cities (26.67%) demonstrate positive synergy, while 22 cities (73.33%) display negative synergy. The prevalence of negative synergistic growth indicates a weaker ability for tourism synergistic development in coastal cities during this stage, failing to fully leverage the advantages of spatial integration.

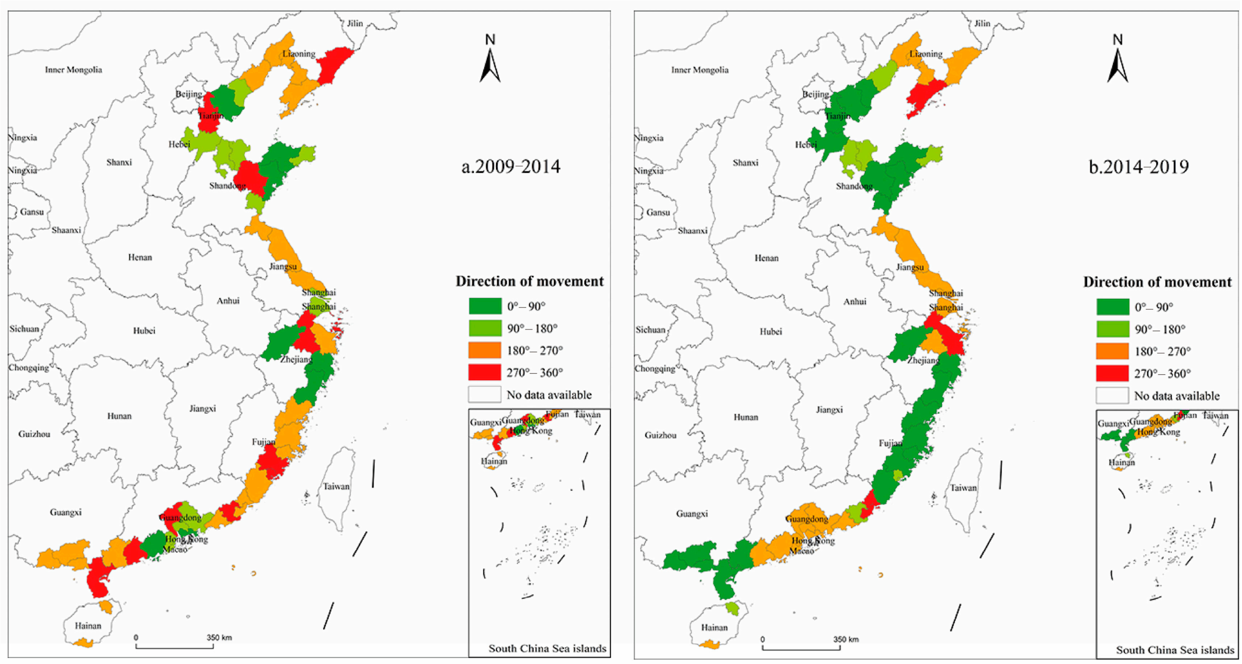

Figure 6. Moving direction of the LISA time path of the domestic tourism economy.

In the later stage, 41 cities (77.36%) demonstrate synergistic growth, while 12 cities (22.64%) exhibit reverse growth, indicating stronger spatial integration compared to the earlier stage. Among these, 21 cities (51.22%) experience positive synergistic growth, while 20 cities (48.78%) show negative synergistic growth. Although the number of cities with positive synergistic growth has increased compared to the previous stage, there is still a need for further strengthening of tourism synergistic development in coastal cities.

Analyzing the trajectory of the inbound tourism economic movement (Figure 7), in the early stage, 41 cities (77.36%) demonstrated synergistic growth, while 12 cities (22.64%) exhibited reverse growth. This suggests that the spatial dynamics of collaboration in inbound tourism within the study area surpassed the competitive dynamics, indicating strong spatial integration. Among these, 12 cities (29.27%) showed positive synergistic growth in inbound tourism, while 29 cities (70.73%) displayed negative synergistic growth, indicating a higher prevalence of cities experiencing synergistic low growth during this stage and a weaker spatial synergistic capacity in inbound tourism.

In the latter stage, 31 cities (58.49%) exhibited synergistic growth in inbound tourism, while 22 cities (41.51%) showed reverse growth, indicating continued strong spatial integration during this stage. Among these, 21 cities (67.74%) experienced positive synergy in inbound tourism, while 10 cities (32.26%) displayed negative synergy. The significant improvement in the number of cities with positive synergy in the inbound tourism economy in coastal cities during the latter stage indicates an enhanced ability for spatial synergistic development.

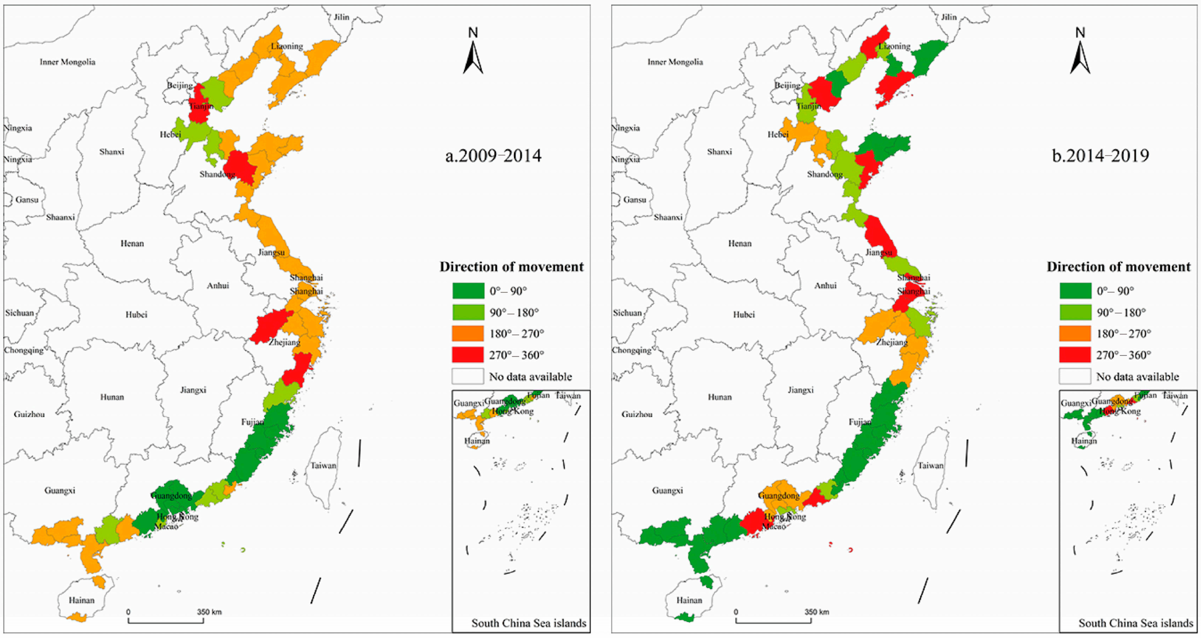

Figure 7. Moving direction of the LISA time path of the inbound tourism economy.

4.3. LISA Time-Lapse Analysis

By scrutinizing the dynamic shifts in the trajectory of the tourism economy over time, this study delves into the spatial correlation transitions of coastal cities utilizing the LISA spatiotemporal transition technique.

As depicted in Table 5, the analysis reveals a minimal number of shifts in types among China's coastal cities in the early period of 2009–2014, with only two cities experiencing such transitions, constituting a mere 0.8% of the total. Conversely, 263 data sets, accounting for 99.2%, remained stable without any type of transfer, signifying a high degree of stability in the domestic tourism economy during this timeframe.

Table 5. Local Moran's *I* transfer probability matrix of the domestic tourism economy.

Time Period	t/t + 1	HH	LH	LL	HL	Type	n	Proportions
2009–2014	HH	1.000	0.000	0.000	0.000	Type0	263	0.992
	LH	0.000	1.000	0.000	0.000	Type1	1	0.004
	LL	0.000	0.000	0.992	0.008	Type2	1	0.004
	HL	0.027	0.000	0.000	0.973	Type3	0	0.000
2014–2009	HH	0.929	0.024	0.000	0.048	Type0	250	0.943
	LH	0.032	0.889	0.079	0.000	Type1	7	0.026
	LL	0.000	0.000	0.975	0.025	Type2	8	0.030
	HL	0.026	0.000	0.026	0.947	Type3	0	0.000

Moving forward to the period of 2014–2019, there was a slight uptick in cities undergoing type transfers, totaling 15 (5.6%) during this period. Meanwhile, 250 data sets (94.3%) continued without any type of transfer, showcasing sustained spatial stability in the domestic tourism economy. Notably, most type transfers were concentrated between Type 1 and Type 2, with sporadic occurrences of Type 3 transitions in both early and later stages. This trend underscores robust spatial stability within the domestic tourism economy of Chinese coastal cities throughout the 2009–2019 period.

As depicted in Table 6, the period from 2009 to 2014 saw 7 (2.6%) of China's coastal cities experiencing type shifts in their inbound tourism economies, while 258 data sets (97.4%) remained stable without any such transitions. This underscores a high level of spatial stability within the structure of inbound tourism economies during this timeframe.

Table 6. Local Moran's *I* transfer probability matrix of the inbound tourism economy.

Time Period	t/t + 1	HH	LH	LL	HL	Type	n	Proportions
2009–2014	HH	1.000	0.000	0.000	0.000	Type0	258	0.974
	LH	0.040	0.940	0.020	0.000	Type1	3	0.011
	LL	0.000	0.014	0.986	0.000	Type2	4	0.015
	HL	0.030	0.000	0.030	0.939	Type3	0	0.000
2014–2009	HH	0.978	0.022	0.000	0.000	Type0	254	0.958
	LH	0.000	0.942	0.058	0.000	Type1	2	0.008
	LL	0.000	0.035	0.965	0.000	Type2	9	0.034
	HL	0.042	0.000	0.042	0.917	Type3	0	0.000

Similarly, during the subsequent period from 2014 to 2019, 11 cities (4.2%) underwent type shifting, while 254 data sets (95.8%) retained their stability without such transitions. Mirroring the pattern observed in the domestic tourism economy, the shifts predominantly occurred between Type 1 and Type 2, with no instances of Type 3 transitions in either period. This suggests a notable inertia in the transfer dynamics of China's coastal cities' inbound tourism economy.

In conclusion, the coastal tourism economy in China demonstrates significant spatial stability, indicating that the study unit is relatively insulated from the spatial spillover effects of neighboring units. Instead, internal factors exert a more pronounced influence on the dynamics of the tourism economy within these cities.

5. The Influencing Factors of the Spatiotemporal Evolution of the Coastal Tourism Economy in China

5.1. Analysis of the Results of One-Way Detection

Utilizing the outcomes of the influencing factor selection process for regional disparities in the coastal tourism economy in China (referenced in Table 2), geo-detectors were employed to assess the magnitude of influence, denoted as the *q*-value, of each factor on these disparities. The results, as depicted in Table 7, indicate that all factors, barring X_3 (green space per capita), X_5 (coastline coefficient), and X_8 (density of intra-regional highway network), passed the significance test. This suggests that individually, green space per capita, coastline coefficient, and density of intra-regional highway network exert a relatively weaker influence on the explanatory variables.

Regarding the inbound tourism economy, the degree of influence of each factor on the explanatory variable (foreign exchange earnings from international tourism) ranks in descending order. The top five influential factors include the number of tourism employees (0.766), airport take-offs and landings (0.710), star-rated hotels (0.707), import and export trade volume (0.685), and foreign exchange earnings (0.685). These factors demonstrate a significant influence on the inbound tourism economy. Conversely, for the domestic tourism economy, the influencing factors on the degree of influence of the explanatory variables (domestic tourism revenue) also rank in descending order. Notably, the degree of influence on the domestic tourism economy is led by the actual utilization of foreign capital (0.710). The top five influential factors include the amount of utilized foreign capital (0.767), the number of star-rated hotels (0.757), the number of people employed in tourism (0.651), airport take-offs and landings (0.627), and import and export trade volume (0.596). These factors play crucial roles in shaping the development of the domestic tourism economy.

Upon comparing the influence of identical influencing factors on different explanatory variables, variations in their impact on both the domestic and inbound tourism economies become evident. Firstly, concerning primary influencing factors, such as the number of star-rated hotels and tourism employees, they exhibit robust explanatory power for both domestic and international tourism income. This underscores the paramount importance of tourism services in coastal tourism industry development, highlighting tourists' high demand for quality services.

Table 7. One-factor detection of factors influencing regional differences in the coastal tourism economy of China.

	Domestic Tourism Revenue		Foreign Exchange Earnings from International Tourism	
Impact Factor	q_1	**Order of Explanatory Power**	q_2	**Order of Explanatory Power**
X_1	0.757 ***	2	0.707 ***	3
X_2	0.651 ***	3	0.766 ***	1
X_3	0.099	12	0.069	13
X_4	0.576 ***	6	0.385 ***	9
X_5	0.010	14	0.057	14
X_6	0.627 ***	4	0.710 ***	2
X_7	0.557 ***	7	0.548 ***	6
X_8	0.097	13	0.086	12
X_9	0.767 ***	1	0.649 ***	5
X_{10}	0.596 ***	5	0.685 ***	4
X_{11}	0.375 ***	9	0.315 **	10
X_{12}	0.411 ***	8	0.532 ***	7
X_{13}	0.347 ***	10	0.272 **	11
X_{14}	0.302 **	11	0.524 ***	8

Note: ** and *** indicate that they are significant at the 0.05 and 0.01 levels, respectively.

Secondly, regarding resources and ecological environment, the impact of green space per capita is relatively weaker for both economies, partly due to the superior ecological environment of coastal cities compared to inland counterparts. This suggests that a single ecological factor plays a limited role in promoting tourism economy development in coastal cities. However, outstanding tourism resources significantly influence both economies, albeit with slightly stronger explanatory power for international tourism income. This implies that domestic tourists are inclined towards areas with abundant tourism resources, while the potential of coastline resources in coastal city tourism remains underutilized.

In terms of transportation environment, transportation accessibility profoundly affects both domestic and international tourism economies. Specifically, airport take-off and landing frequency demonstrate stronger explanatory power, whereas the density of regional-grade highway networks shows weaker explanatory power. This indicates rapid development and effective improvement in transportation accessibility via grade highways, with their density being a less significant factor in tourism economy development.

In the socioeconomic realm, the influence of import and export trade on international tourism foreign exchange income surpasses that on domestic tourism income, primarily due to trade being influenced by international exchange rates, which play a crucial role in inbound tourism economy development. Conversely, the actual utilization of foreign capital exhibits a higher degree of influence on the domestic tourism economy compared to international tourism foreign exchange income. Foreign investment facilitates the expansion, transformation, and upgrading of the tourism industry, thereby driving domestic tourism economy development.

Lastly, the influence of industrial structure on domestic tourism revenue slightly outweighs its impact on international tourism foreign exchange earnings. Overall, the level of regional economic and social development exerts a greater influence on international tourism foreign exchange earnings, with cities at higher levels of economic and social development proving more attractive to international tourists.

5.2. Analysis of Interaction Detection Results

Building upon the analysis of single-factor influence, this paper further investigates the interplay between various influencing factors using geo-detector (Figures 8 and 9). The findings reveal that, collectively, the explanatory power of each influencing factor increases when interacting with others compared to when considered individually. Notably, the detection results of these interactions consistently demonstrate two-factor enhancement and nonlinear enhancement, without any instances of nonlinear weakening, single-factor nonlinear weakening, or independence. This suggests that the development of the coastal tourism economy in China is intricately influenced by the combined effects of tourism services, resources and ecological environment, transportation environment, and socioeconomic factors.

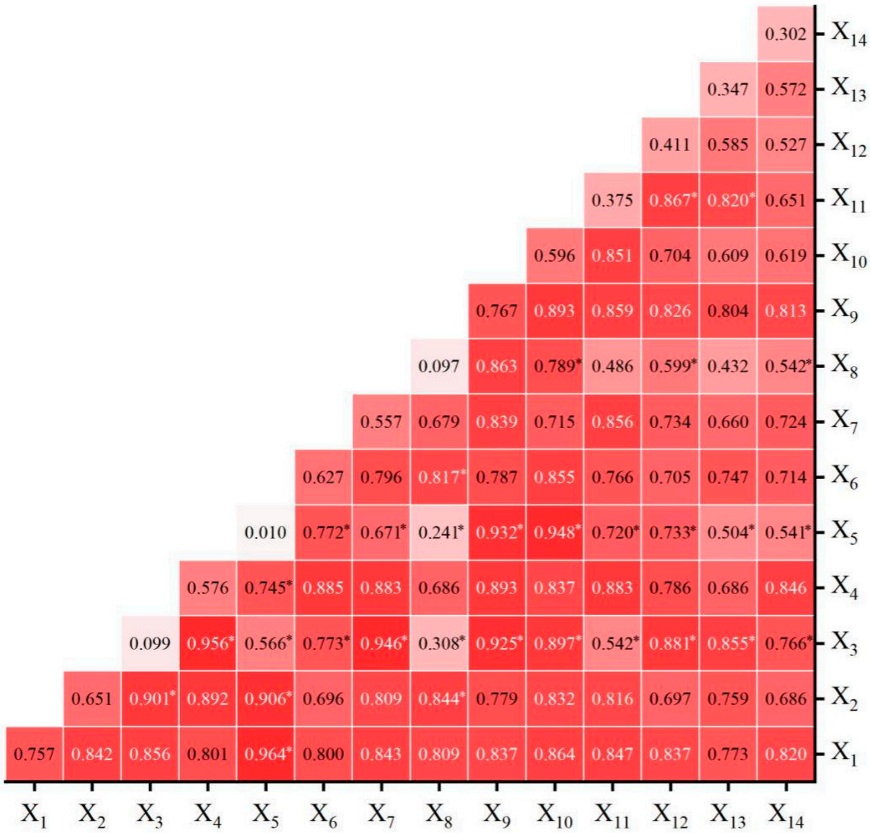

Figure 8. Results of interaction detection of factors influencing regional differences in domestic tourism income. Note: * represents nonlinear enhancement.

In the context of the domestic tourism economy (Figure 8), the interaction of each influencing factor with others yields a substantial impact, with 95.60% of the factor interaction explanatory power exceeding 0.5. This underscores the significant influence of these interactions on the development of the domestic tourism economy in coastal cities. Notably, nonlinear enhancement predominantly characterizes the interaction between X_3 (green space per capita), X_5 (coastline coefficient), and X_8 (intra-regional highway network density), and their respective factors. Despite not passing the significance test at the 0.05 level and having q-values below 0.1—indicating weaker explanatory power for the domestic tourism economy individually—these factors exhibit the most pronounced growth in explanatory power during interaction detection. This suggests that while their influence as single factors may be modest, their collaborative effect with multiple factors amplifies their economic driving force on domestic tourism.

Overall, the most potent interactions occur when factors combine with resources and the ecological environment. For instance, the joint consideration of tourism service level indicators with the coastline coefficient yields explanatory powers of 0.964 and 0.906, respectively. Additionally, the combination of high-speed rail trips with per capita park area in the transportation environment demonstrates considerable strength. Similarly, the fusion of socioeconomic and resource/ecological environment indexes exhibits robust explanatory power.

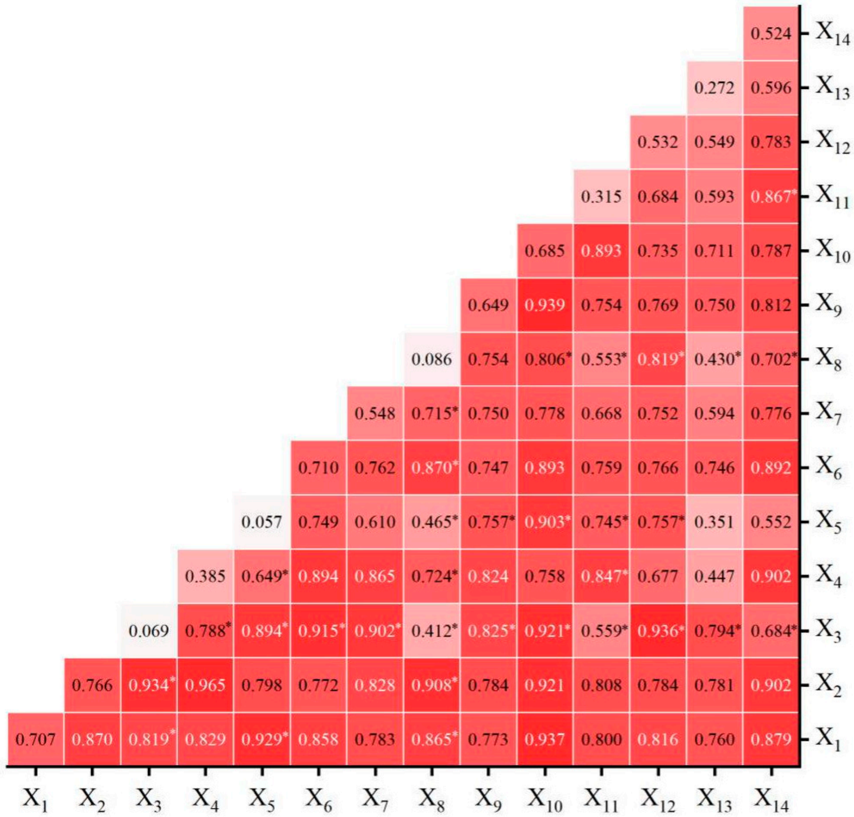

Figure 9. Results of interaction detection of factors influencing regional differences in inbound tourism income. Note: * represents nonlinear enhancement.

Furthermore, the interaction between the coastline coefficient and the number of star-rated hotels indicator emerges as the most influential among all interaction factors. This underscores the critical importance of the tourism resource base and the quality of tourism service facilities in coastal cities for driving the development of the domestic tourism economy.

In the realm of the inbound tourism economy (Figure 9), 94.51% of factor interactions exhibit an explanatory power of 0.5 or higher, underscoring the necessity for cohesive collaboration among all influential factors to drive inbound tourism development. Like the domestic tourism economy, the phenomenon of nonlinear enhancement persists in the interaction detection of factors influencing inbound tourism. This is particularly notable in the interaction of X_3 (green space per capita), X_5 (coastline coefficient), and X_8 (intra-area grade highway network density) with their respective factors. Despite their failure to pass the significance test individually, with q-values below 0.1, indicating weaker explanatory power for inbound tourism, their interaction with other factors significantly enhances their explanatory power. This highlights the imperative for these factors to interact with others to fully leverage their inherent potential.

Overall, the most pronounced interaction effects of factors are primarily associated with the number of tourism employees, green space per capita, and import and export trade volume. This suggests that among the myriad factors influencing inbound tourism economy development, interactions involving indicators of tourism service level, ecological environment quality, and openness to the outside world have a crucial impact on inbound economy development. Notably, the interaction between outstanding tourism resources and the number of tourism employees ranks highest among all interaction explanatory powers, with a q-value of 0.965. This underscores the significance of further exploration of exceptional tourism resources and enhancement of both the quantity and quality of tourism employees for fostering inbound tourism economy development.

6. Discussion: Implications for the Public Decision Makers and Tourism Operators

Through an analysis of the temporal evolution of the coastal tourism economy in China, significant disparities in tourism economy development among these cities have been observed, indicating a notable geographical imbalance in the tourism economy across Chinese coastal regions. The influencing factors of the coastal tourism economy in China also revealed that the development level of tourism in these cities was influenced by multiple dimensions of factors including the level of tourism services, the resources ecosystems, the transportation environment, and the socioeconomic environment. Moreover, distinctions were identified between the influencing factors of the domestic tourism economy and those of the inbound tourism economy. In response to these findings, this paper provides corresponding strategic recommendations for the advancement of tourism in China's coastal cities.

Public decision-makers are at the forefront of shaping the trajectory of coastal tourism economies. The spatial–temporal evolution of coastal tourism in China underscores the need for governments to enhance the quality of coastal tourism resources. The results showed that the interactions between tourism resources and various factors such as service quality, transportation infrastructure, and socioeconomic dynamics could exert an enhancing effect on the coastal tourism economy. Therefore, the government should invest in infrastructure that supports a diverse range of tourism activities, such as improving transportation networks [33], enhancing visitor facilities [34], and developing unique attractions [35] that reflect the cultural and natural resources of the coastal region.

Additionally, it is crucial to ensure that these developments are sustainable and do not compromise the integrity of the coastal environment. The ecological conditions of coastal areas are a critical factor in the success of the tourism industry. Public decision-makers must prioritize ecological preservation efforts to maintain the natural beauty and biodiversity that attract tourists. This can involve implementing strict environmental regulations, promoting sustainable practices among tourism operators, and investing in conservation projects that protect marine life and coastal ecosystems [36]. Furthermore, decision-makers should encourage the development of eco-tourism, which not only supports conservation efforts but also provides educational opportunities for visitors to learn about the importance of preserving coastal environments. By fostering a strong link between tourism and ecological stewardship, public decision-makers can ensure that coastal tourism remains a sustainable and thriving sector [37].

For tourism operators, the insights gained from the analysis of the spatial–temporal evolution of coastal tourism in China suggest several strategic actions. Firstly, operators should focus on diversifying their offerings to cater to a wide range of visitor interests and preferences. This can include developing eco-tourism packages, cultural experiences, and adventure activities that highlight the unique features of the coastal region [38]. By doing so, operators can attract a broader customer base and reduce their vulnerability to market fluctuations. Notably, the combination of coastline resources with the number of star-rated hotels emerges as the most influential factor in driving the tourism economy. Thus, delineating coastal leisure and resort zones and establishing premium coastal luxury hotels can effectively amplify the economic ripple effect and fully leverage the advantages of coastal resources [39].

Moreover, tourism operators must be agile and responsive to the changing dynamics of the tourism market [40]. The quality of tourism services significantly influences both domestic and inbound tourism economies. Notably, the interaction between the number of tourism employees and top-tier tourism resources profoundly impacts the tourism economy. Operators could invest in technology and digital marketing strategies to reach a global audience and improve the services of their operations [41]. By embracing innovation and adaptability, tourism operators can position themselves to thrive in a competitive and evolving industry landscape.

7. Conclusions

This paper examines the temporal and spatial dynamics of the coastal tourism economy in China from 2009 to 2019, utilizing data obtained through field research and comprehensive big data network collection, focusing on actual indicators of domestic and foreign tourism revenue. Building upon this analysis, it investigates the factors shaping the coastal tourism economy in China and proposes corresponding strategic recommendations. In summary, the key research findings of this paper can be encapsulated into the following three main points.

(1) From 2009 to 2019, the local spatial configuration of both the domestic tourism economy and inbound tourism economy, as well as the direction of spatial interdependence within coastal cities, exhibited volatility. Regarding transfer directions, the spatial cohesion of the domestic tourism economy undergoes a transition from weak to robust, while the inbound tourism economy maintains consistently high spatial cohesion. Additionally, there's a noteworthy increase in the number of cities experiencing positive synergistic development between the two economies in the later period. Furthermore, both the domestic and inbound tourism economies exhibit transfer inertia, making it challenging to relocate urban tourism economies.

(2) The development of the coastal tourism economy in China is influenced by a myriad of factors. In the realm of the domestic tourism economy, factors including the amount of utilized foreign capital, the number of star-rated hotels, the employment figures in the tourism sector, the frequency of airport take-offs and landings, and the value of import and export trade exhibit the highest explanatory power. For the inbound tourism economy, the key factors with the strongest explanatory power include the employment figures in the tourism sector, the frequency of airport movements, the number of star-rated hotels, the volume of import and export trade, and the amount of utilized foreign capital.

(3) Drawing from the analysis of tourism development and its influencing factors in China's coastal cities, several recommendations are proposed from the perspectives of the public decision-makers and tourism operators. Public decision-makers should enhance the quality of coastal tourism resources via infrastructure investment and ensure environmental sustainability. Tourism operators should diversify offerings, utilize coastline-starred hotel combo, and be agile in the market.

This study has two primary limitations. First, missing data for certain cities in specific years required interpolation to ensure research continuity. Although this method helps bridge gaps, it may impact data accuracy and slightly affect the authenticity of the study's conclusions. Future research should aim to implement more precise data collection techniques to mitigate this issue. Second, this paper focuses on the period before 2020, which limits the study's relevance to more recent developments. It is due to the COVID-19 pandemic, which significantly disrupted coastal tourism in China from 2020 to 2022. In the future, researchers should seek to incorporate data from the pandemic period to provide a more comprehensive analysis of the coastal tourism economy.

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