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The Spatiotemporal Relationship between Tourism Eco-Efficiency and Economic Resilience from Coupling Perspectives in China

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Abstract: Efficiency and resilience are two essential challenges that require attention for high-quality development under the new normal. In this research, we measured tourism eco-efficiency using the Super-SBM model with undesirable output about data from 31 provinces in China from 2010 to 2019; economic resilience through the entropy weighted Topsis model; and finally, the coupling coordination degree (CCD) of tourism eco-efficiency and economic resilience. The findings showed that, from 2010 to 2019, the 31 provinces' eco-efficiency values were low, with large and low variances in efficiency values among provinces with an uneven distribution. The economic resilience values of the 31 provinces were relatively low. Still, the economic resilience of each province had been relatively stable over the years, and the pattern of regional distribution of resilience values was generally consistent. The level of coupling coordination between tourism eco-efficiency and economic resilience was low in the 31 provinces, with low coordination type dominating, and the spatiotemporal patterns were the same. Its coupling coordination degree fluctuated and increased, but the increase was minor.

Keywords: tourism eco-efficiency; economic resilience; coupling coordination degree; sustainable development; China

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1. Introduction

Tourism is a strategic pillar industry in China. The development of tourism can meet the growing material and cultural needs of the people [1,2]. However, in the process of rapid development of tourism, there are obstacles such as fragile ecological environment, weak infrastructure, unreasonable industrial structure, uneven regional development, and insufficient capital investment [3]. Eco-efficiency and economic resilience are two key issues in the sustainable development process of tourism [4]. Tourism eco-efficiency is an effective measure of sustainable tourism development with the ideal goal of pursuing "minimum input, maximum output" and achieving a two-way measurement of tourism development efficiency [5–7]. The term resilience was first applied to the field of engineering and was later cited in ecology, economics, and other fields [8]. The increased economic resilience helps to counter the impediments to sustainable development [9]. In the new economic normal, a one-sided focus on the resilience of the tourism industry will to some extent produce industrial redundancy and lag in development [10,11]. Therefore, the tourism industry needs to closely integrate efficiency and resilience to form a rational and orderly endogenous growth mechanism based on synergistic development. The concept of coupling was first seen in physics theory, which refers to the process of two or more systems eventually reaching a joint state through interaction and mutual attraction, thus completing a transformation from disorder to order. Tourism eco-efficiency and economic resilience are closely linked in the tourism land system, and problems in either of them will threaten the development of the tourism system as a whole. From the sustainability research paradigm, it is crucial to promote the coupled and coordinated research of tourism eco-efficiency and economic resilience, which can serve both as a scientific basis for the realization of

sustainable development goals in tourism places and as a reference for the practical work of ecological civilization construction [12,13]. The 20th Party Congress report proposed that "building an ecological civilization is a thousand-year plan for the sustainable development of the Chinese nation", emphasizing the importance of environmental protection in Chinese economic development [14,15]. Therefore, this study explores the development level of tourism eco-efficiency and economic resilience based on the coordination degree model to analyze the coupled coordination relationship between the two and puts forward targeted development suggestions in order to reduce the vulnerability of the tourism industry, enhance the resilience of the tourism economy, and achieve high-quality sustainable development of tourism. In addition, it can also provide a theoretical reference for the coordinated development of tourism eco-efficiency and the tourism economy in China in the new era.

The remaining sections of this paper are organized as follows: Section 2 elaborates on the literature on tourism eco-efficiency and economic resilience in dialogue with cutting-edge and authoritative literature. Section 3 contains the research methodology and data sources, and it not only constructs the indicator system of tourism eco-efficiency and economic resilience but also lists the specific methods used. Section 4 presents the research findings, including the development levels and spatial and temporal distribution patterns of tourism eco-efficiency, economic resilience, and the coupling degree of both. Section 5 is the discussion, including theoretical implications, managerial implications, and sustainability recommendations. Section 6 is the findings and limitations of this study for future research.

2. Literature Review

2.1. Tourism Eco-Efficiency

Schaltegger first proposed the concept of eco-efficiency in 1990 [16]. Gössling et al. proposed the concept of tourism eco-efficiency in 2005 [17]. Based on sustainability theory, Sariannidis et al. used accounting as a mediating element to link environmental practices to business performance [18]. Cole et al. and others used an ecological footprint approach to measure the impact of tourism and its development on sustainable development to assess the eco-efficiency of tourism in regions such as the Himalayas [19]. Wang et al. investigated the spatial pattern of tourism eco-efficiency and its relationship to environmental regulations [20]. Liu et al. measured tourism eco-efficiency using a single ratio method and conducted a comparative study of differences between provinces [21]. However, many scholars prefer the application of model method multi-indicator measurement, such as DEA and other methods. Li et al. used the DEA to analyze the spatial pattern and influencing factors of the Wuling Mountain area's tourism eco-efficiency [22]. Tourism eco-efficiency aims to create more tourism products and services while reducing resource consumption and pollutant emissions, and it has become an important evaluation indicator for sustainable tourism growth. The direction that tourism eco-efficiency focuses on is the integration of tourism, ecology, and efficiency, which not only considers the degree of resource and energy consumption and environmental pollution but also measures the importance of tourism economic output, which coincides with the essence of sustainable tourism development. Tourism eco-efficiency has a significant impact on the quality of tourism growth, green transformation, and eco-economic management systems and, to a certain extent, changes the basis, driving force, and key to tourism development. In recent years, as the construction of ecological civilization in China continues to deepen, low-carbon tourism, green tourism, and other tourism formats have emerged one after another, having promoted the process of tourism eco-efficiency research. Tourism eco-efficiency not only provides decision support for the sustainable development of tourism but also promotes the transformation of tourism development modes and forms a new pattern of modern tourism with harmonious human and natural development. Tourism eco-efficiency is an important form of support for the implementation of ecological civilization strategy and the construction of a beautiful China and ecological civilization society, and moreover,

the research on tourism eco-efficiency has important strategic value and theoretical and practical significance for tourism development and tourism research.

2.2. Economic Resilience

Reggiani et al. pioneered the concept of economic resilience, defined as a regional financial system's ability to withstand shocks and recover and rebuild in the face of changes in the environment, markets, and other factors [23]. Li et al. point out that economic resilience is derived from evolutionary resilience and is dynamically changing [24]. In academia, there are currently two approaches to measuring and assessing economic resilience. The first uses simulations such as resilience evolution curves or impulse response functions, which can reflect external shocks [25,26]. In quantitative measurement, economic resilience is measured by constructing a system of relevant indicators [27–29]. Liu et al. use risk absorption intensity and absorption duration to quantitatively measure macroeconomic resilience [30]. The other is to construct a system of indicators for comprehensive measurement, which can reasonably consider the multidimensional influencing factors of economic resilience and help to avoid subjective errors. The combination of efficiency and toughness is also gradually being studied. Xu et al. (2017) defined regional economic resilience as the adaptive capacity exhibited by a region in the face of external crisis disruptions [25]. They measured the strength of resilience during economic downturns using a sensitivity index. Regional economic resilience is measured by selecting a core variable in regional economic development (e.g., regional employment or unemployment rate, GDP, gross value added, and disposable income) in a state of shock. The prerequisite for using this method is the identification of shocks and perturbations and the delineation of the phases of change, and the technique focuses on the ability to cope with short-term shocks [26]. Resilience involves high-quality regional economic development and has been one of the hot issues in tourism geography research in recent years. Resilience is an important entry point for studying the high-quality development of regional tourism under the new development concept. Resilience theory provides both a new theoretical perspective for regional tourism to cope with external risk shocks and the improvement of its own adaptive capacity, as well as a decision-making basis for managers to formulate global tourism recovery countermeasures.

2.3. Literature Comparison

According to the above literature, the research content and the primary trend is to introduce it into various industries, enterprises, and regions as an environmental management tool, while emphasizing the synergistic development of economic and environmental benefits, so that the theoretical system of eco-efficiency has been sublimated [31,32]. Both at home and abroad, people generally believe that improving tourism eco-efficiency is a vital guarantee to promote the sustainable tourism development and have begun to focus on the governance of tourism ecosystems and the contradictions between tourism economic systems, social systems, and ecosystems. Due to the broad and multiple sectors involved in tourism, the difficulty of counting and quantifying data on tourism products, and the consumption of tourism resources and their impact on the environment, the existing studies on tourism eco-efficiency at home and abroad are relatively weak compared to other industries [33,34]. The majority of foreign studies are more microscopic, taking the form of qualitative and quantitative studies on a particular tourism enterprise or sector, being more instructive for the development of individual cases. Domestic research is still relatively simple in terms of index system construction and measurement methods. The investigation of its spatial and temporal dimensions is primarily based on overall spatial and temporal characteristics, lacking a more refined spatial and temporal representation of the region [35,36]. Currently, most measures of regional economic resilience in China are based on core variables and indicator systems, mainly by selecting indicators such as employment, GDP, and trade volume, or by constructing indicator systems to create a comprehensive measurement of economic resilience [37]. However, the regional financial system is complex and variable, and the size using the core variable method is too macro

and single to reflect the different dimensions of the concept of resilience. Its explanatory power is far from sufficient [38]. In terms of measurement, most domestic scholars use the core variable approach and the composite indicator system approach to measure economic resilience. In terms of the study area, it is limited to resource-based cities, the Jiangsu and Zhejiang regions, and the old industrial base areas in the northeast. The study scale is also relatively homogeneous, mainly at the provincial level or county level of a province or city cluster level [39]. Most of the existing studies measure tourism development in terms of a single dimension of efficiency or resilience. However, attention to the coupled and coordinated relationship between tourism eco-efficiency and economic resilience is lacking. Resilience and efficiency are key elements of tourism development, and promoting synergy between them is an important goal to achieve sustainable tourism development [40].

In response to the deficiencies of existing studies in the analysis of the spatial characteristics of tourism eco-efficiency, spatial agglomeration analysis and its evolutionary process are studied in combination with exploratory spatial data analysis for tourism eco-efficiency in each province [33]. The main contributions are as follows: First, from the perspective of economic resilience, which can evaluate the resistance, recovery, adaptation, and transformation capacity of regions in the face of external shocks, we measured the economic resilience of each province in China and analyzed its spatial and temporal evolution process in depth. Second, the coupling coordination of tourism eco-efficiency and economic resilience were explored to provide practical references for further enhancing the coupling and achieving development goals in China's land provinces. Third, in terms of research methodology, the super-SBM model with undesirable output was used to measure the eco-efficiency of tourism. The entropy-weighted Topsis model was used to measure the economic resilience value. The coupling coordination degree of tourism eco-efficiency and economic resilience was measured using the coupling coordination degree model. Fourth, the ESDA method was chosen to investigate and analyze the spatial and temporal dynamics of the coupling coordination of tourism eco-efficiency and economic resilience [41].

3. Research Methods and Data Sources

3.1. Data Sources

This was a study of 31 provinces in China from the 2011–2020 data analysis period, utilizing data from the China statistical yearbook in 2011–2020. If some of the data were missing, they were supplemented by interpolation of the measures.

3.2. Index Construction

3.2.1. Tourism Eco-Efficiency Index

Tourism eco-efficiency is indicator to measure the degree of coordination between regional tourism development and ecological protection, which is of great theoretical and practical significance to promote high-quality tourism development, such as input, desired output, and undesired output (Table 1) [22,42].

3.2.2. Economic Resilience Index

Economic resilience includes four dimensions: resistance, resilience, reorganization, and regeneration. Since resistance and resilience are strongly correlated, they are combined into one dimension because of the availability of indicators. Therefore, economic resilience is divided into three dimensions, and a total of 15 indicators are collected to measure economic resilience (Table 1) [43,44].

Table 1. Index system of tourism eco-efficiency and economic resilience subsystems.

Subsystem	First-Level Indices	Second-Level Indices
Tourism eco-efficiency	Input	The sum of star hotels, travel agencies, and weighted scenic spots (person)
		Number of workers in the tertiary industry (person)
		Investment in fixed assets for tourism (billion yuan)
	Desired output	Total tourism revenue (billion yuan)
		Total number of visits (million people)
	Undesired output	Tourism wastewater discharge (%)
		Sulfur dioxide emissions from tourism (%)
Economic resilience	Resistance and resilience	Per capita GDP (yuan/person)
		Regional GDP (billion yuan)
		Number of employed persons (million people)
		Per capita disposable income (yuan/person)
		Foreign trade dependency = total import and export/regional GDP (%)
	Adaptability and adjustability	Local financial expenditures (billion yuan)
		Fixed asset investment (billion yuan)
		Total retail sales of social consumer goods (billion yuan)
		Financial self-sufficiency level = local revenue/local financial expenditures (%)
		Number of participants in unemployment insurance at the end of the year (million people)
		Urbanization rate (%)
	Innovation and transformation	Total post and telecommunications business (billion yuan)
		Number of students enrolled in general colleges and universities (person)
		Advanced industrialization = the proportion of primary production value × 1 + the proportion of secondary production value × 2 + the proportion of output value of three industries × 3
		R&D funding investment (million yuan)

3.3. Research Methods

3.3.1. Super-SBM Model with Undesirable Output

The SBM model is able to further decompose the results based on input and output slack perspectives on the evaluation results [40].

$$\begin{cases} \min\rho = (1 - \frac{1}{m}\sum_{i=1}^{m}\frac{s_i^-}{x_{ik}}) / \left[1 + \frac{1}{q_1+q_2}(\sum_{r=1}^{q_1}\frac{s_r^+}{y_{rk}} + \sum_{r=1}^{q_2}\frac{s_t^{b-}}{y_{tk}})\right] \\ s.t. \\ x_k = X\lambda + s^-, y_k = Y\lambda - s^+, b_k = b\lambda + s^{b-} \\ \lambda \geq 0, s_i^- \geq 0, s_r^+ \geq 0, s_t^{b-} \geq 0 \end{cases} \quad (1)$$

where ρ is the efficiency; m, q_1, q_2 are the number of indicators for inputs, desired outputs, and undesired outputs respectively; x_k, y_k, b_k are input, desired output, and undesired output variables, respectively; x_{ik}, y_{rk}, y_{tk} are elements of input and output vectors; X, Y, b are input–output matrices; s_i^-, s_r^+, s_t^{b-} are slack variables of input, desired output, and undesired output, respectively; and λ are column vectors.

3.3.2. Entropy Weight Topsis Model

The Topsis model is a multi-objective decision analysis approximating the ideal ranking. The objective evaluation score is obtained by calculating the distance between the evaluation object and the perfect solution. This research adopts the improved Topsis method to measure the comprehensive evaluation index of economic resilience in 31 provinces, mainly

through the steps of original matrix normalization, normalization of the normalization matrix, and calculation of scores and normalization [45,46]. The theoretical steps are as follows:

(1) Construct the evaluation index system matrix X: $X = (x_{ij})_{m\times n} (i = 1,2,\ldots,m; j = 1,2,\ldots,n)$

(2) Standardization of the index matrix using the extreme difference method: $x_{ij} = x_{ij}/x_{max}$

(3) Calculate the entropy weight of evaluation index H_i: $H_i = -\frac{1}{\ln m}\left(\sum_{j=1}^{m} f_{ij}\ln f_{ij}\right)$

(4) Determine the entropy weight of evaluation index W: $W = (w_i)_{1\times n}, w_i = \frac{1-H_i}{n-\sum_{i=1}^{n} H_i}$

(5) Determining the optimal solution S_j^+ and the worst solution s_j^-: $s_j^+ = \max(r_{1j}, r_{2j}, \ldots, r_{nj}), s_j^- = \min(r_{1j}, r_{2j}, \ldots, r_{nj})$.

(6) Calculate the Euclidean distance between the optimal and inferior solutions: $D_i^+ = \sqrt{\sum_{j=1}^{n}\left(S_j^+ - r_{ij}\right)^2}, D_i^- = \sqrt{\sum_{j=1}^{n}\left(S_j^- - r_{ij}\right)^2}$.

(7) Measuring the value of economic resilience level: $C_i = \frac{D_i^-}{D_i^+ + D_i^-}, C_i \in [0,1]$.

3.3.3. Coupling Coordination Model

The coupling coordination degree attempts to measure the degree of coupling of two systems interacting with each other and the matching of the development level and process of both [47]. The coupling coordination degree model of tourism eco-efficiency and economic resilience is as follows:

$$\begin{aligned} T &= \alpha U_1 + \beta U_2, \alpha + \beta = 1 \\ C &= 2 \times \frac{\sqrt{U_1 \times U_2}}{U_1 + U_2} \\ D &= \sqrt{C \times T} \end{aligned} \tag{2}$$

where T is the integrated inter-system coordination index, C is the coupling degree, and D is the coupling coordination degree of both. Since tourism eco-efficiency is as crucial as economic resilience, both α and β take the value of 0.5. The coupling coordination degree is divided into five levels, with values ranging from 0 to 0.3, 0.3 to 0.4, 0.4 to 0.5, 0.5 to 0.8, and 0.8 to 1, representing serious imbalance, moderate imbalance, reluctant coordination, primary coordination, and moderate coordination, respectively.

3.3.4. Local Space Autocorrelation

Local spatial autocorrelation can analyze the degree of element clustering in local space and identify hot and cold spots, which are usually reflected by using the G_i^* index [48]. The calculation formula is

$$G_i^*(d) = \sum_{j=1}^{n} W_{ij}(d)X_j / \sum_{j=1}^{n} X_j \tag{3}$$

$W_{ij}(d)$ represents the impact degree of individual i to individual j in space, and X_j is the attribute value of the location j.

4. Results

4.1. Tourism Eco-Efficiency Measures and Their Spatiotemporal Distributions

The Super-SBM model was used to measure tourism eco-efficiency and explore the spatial and temporal evolution and differences of tourism eco-efficiency, which is conducive to timely regulation of the sustainable development of tourism. From the data for 2010–2019, it can be seen that the overall level of tourism eco-efficiency in the country was low, with an average value of only 0.76. It can be seen that there were phenomena that went against

sustainable development in the process of tourism development in all provinces and regions, such as waste of resources, inefficiency, and environmental pollution. Therefore, there is still much room for development and improvement in tourism eco-efficiency. According to the data analysis, it can be seen that the tourism eco-efficiency values of Beijing, Shanghai, and Guangdong provinces and cities were much higher than the average value; however, Inner Mongolia, Xinjiang, and Tibet provinces and regions were much lower than the average value, so the differences in tourism eco-efficiency between domestic provinces and regions were relatively large (Figure 1). The eco-efficiency of tourism in the 31 provinces and municipalities nationwide was classified into five levels according to the natural fracture method, i.e., high efficiency value, higher efficiency value, medium efficiency value, lower efficiency value, and low efficiency value, and three years, 2010, 2015, and 2019, were selected for presentation (Figure 2). Due to the rapid growth of total tourism revenue and the total number of visitors in the eastern region, it has driven the development of the regional economy. In addition, the southeast region actively implements environmental protection, energy conservation, emission reduction, and other related policies to promote the green and low-carbon development of tourism, which has begun to bear fruit [20]. The main reason for the low efficiency in the northwest region is that although tourism is in a stage of high growth, the economic growth rate has started to slow down. Coupled with insufficient technological innovation and excessive investment in tourism fixed assets, the cumulative effect of tourism development on the environment has been increasing [21,22]. In general, the tourism eco-efficiency value shows a spatial pattern of "high in the southeast and low in the northwest".

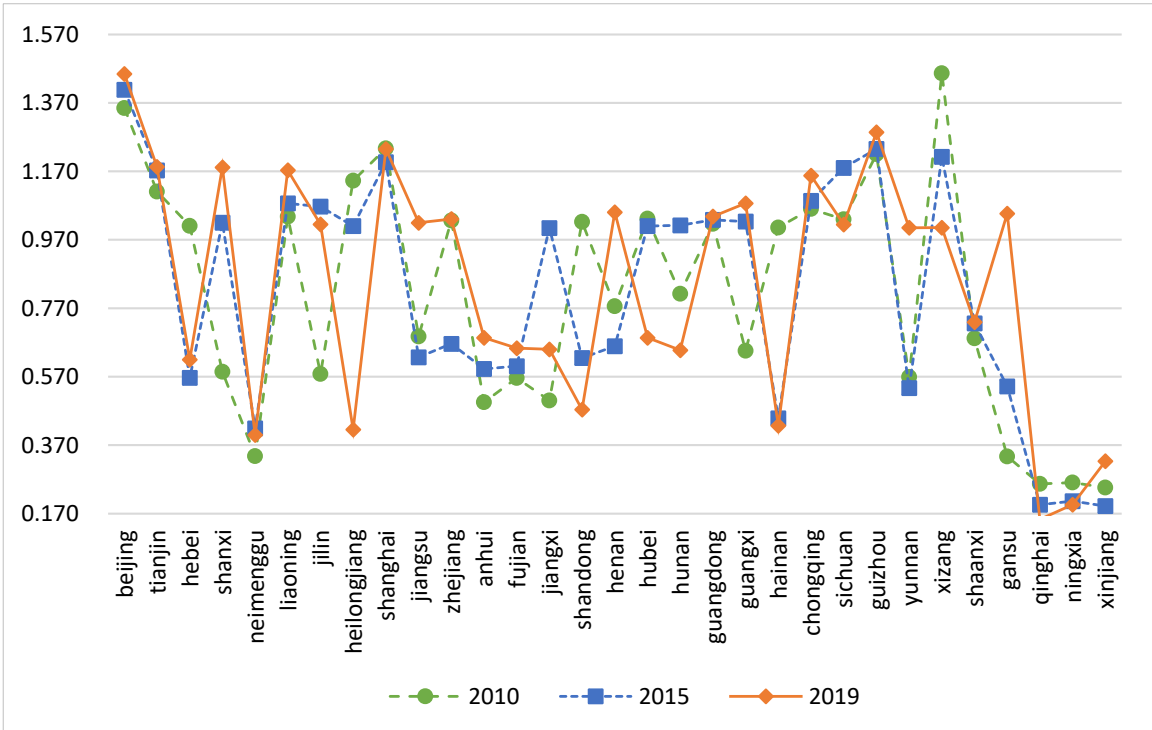

Figure 1. Tourism eco-efficiency in China from 2010 to 2019.

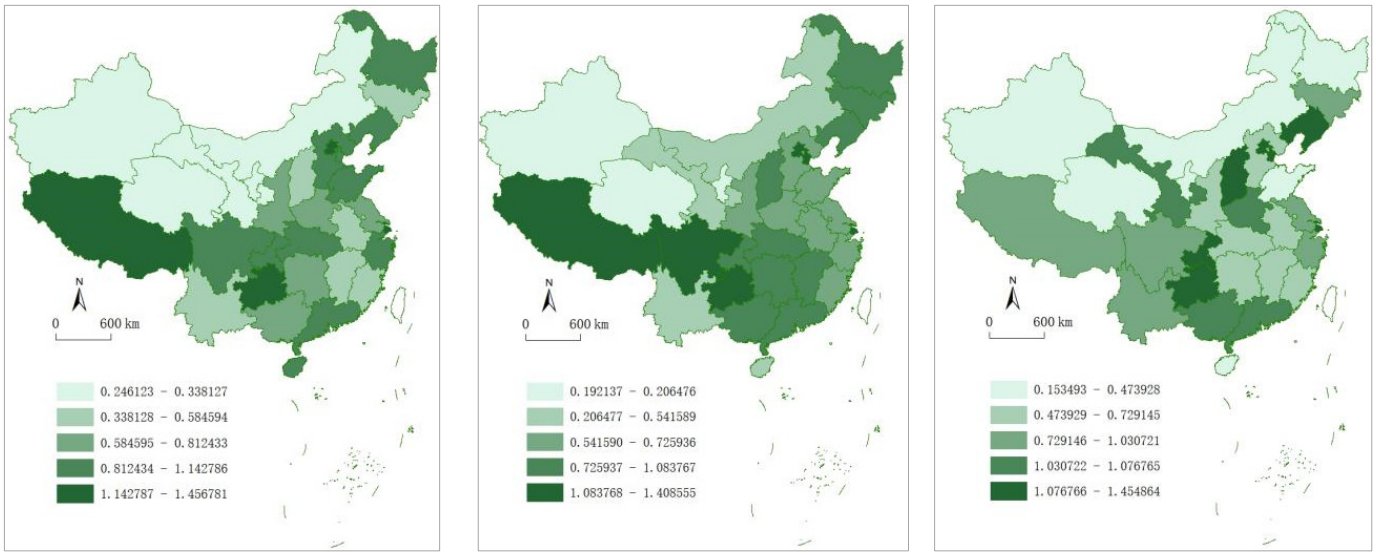

Figure 2. Spatiotemporal distributions of tourism eco-efficiency in China from 2010 to 2019.

4.2. Economic Resilience Measures and Their Spatiotemporal Distributions

The combined level of economic resilience can be measured based on the Topsis assignments of the combined economic resilience indicators in the 31 provinces nationwide from 2010 to 2019. In this study, data from 2010, 2015, and 2019 were selected for visualization (Figure 3), while the economic resilience values of 31 provinces and municipalities across the country were classified into five levels based on the natural fracture method, namely, high resilience value, higher resilience value, medium resilience value, lower resilience value, and low resilience value (Figure 4). Overall, the average economic resilience value of the 31 provinces nationwide was found to be 0.376, a relatively low value. Still, the economic resilience of each province was relatively stable. According to Figure 3, the regional distribution pattern of the economic resilience values in the observed three years was generally consistent. The economic resilience values showed a fluctuating upward trend in terms of time, but the fluctuations were relatively small. According to the five types of economic resilience zones divided by natural breakpoints, high resilience values were dominated by Beijing, Shanghai, Guangdong, Zhejiang, and Jiangsu provinces, and higher values were dominated by east-central provinces. Medium values were dominated by central and western provinces, while lower and low values were dominated by Xinjiang, Tibet, Qinghai, Gansu, and Ningxia provinces. Spatially, the pattern of economic resilience showed a decreasing pattern in the East, Central, and West regions. Influenced by economic development and infrastructure, as well as other factors, there is a clear heterogeneity in the evolution pattern of economic resilience due to the existence of regional differences [24]. The stronger the economic resilience of a region, the stronger its ability to withstand external shocks, and stronger economic resilience will also be influenced by various aspects such as industrial layout, innovation capacity, and foundation, and, in this way, have a favorable impact on the regional economy [25]. Economic resilience is an important guarantee for smooth and high-quality economic development. Given the overall low level of economic resilience, provinces should make great efforts to improve their comprehensive economic strength in all aspects [26].

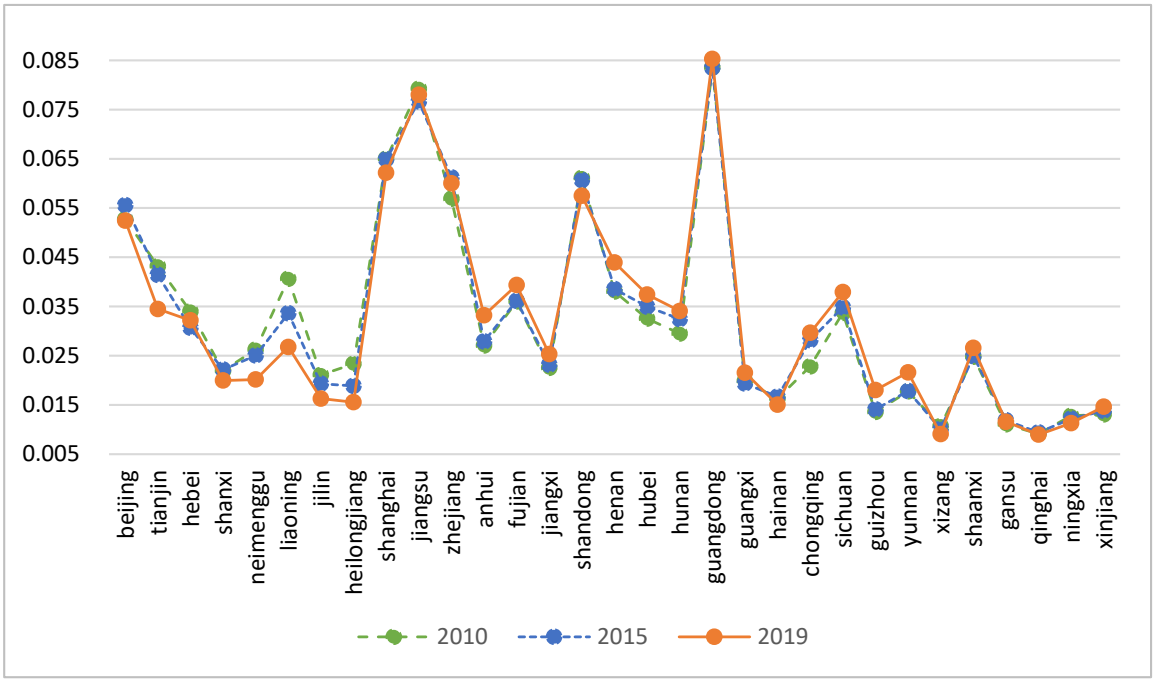

Figure 3. Economic resilience in China from 2010 to 2019.

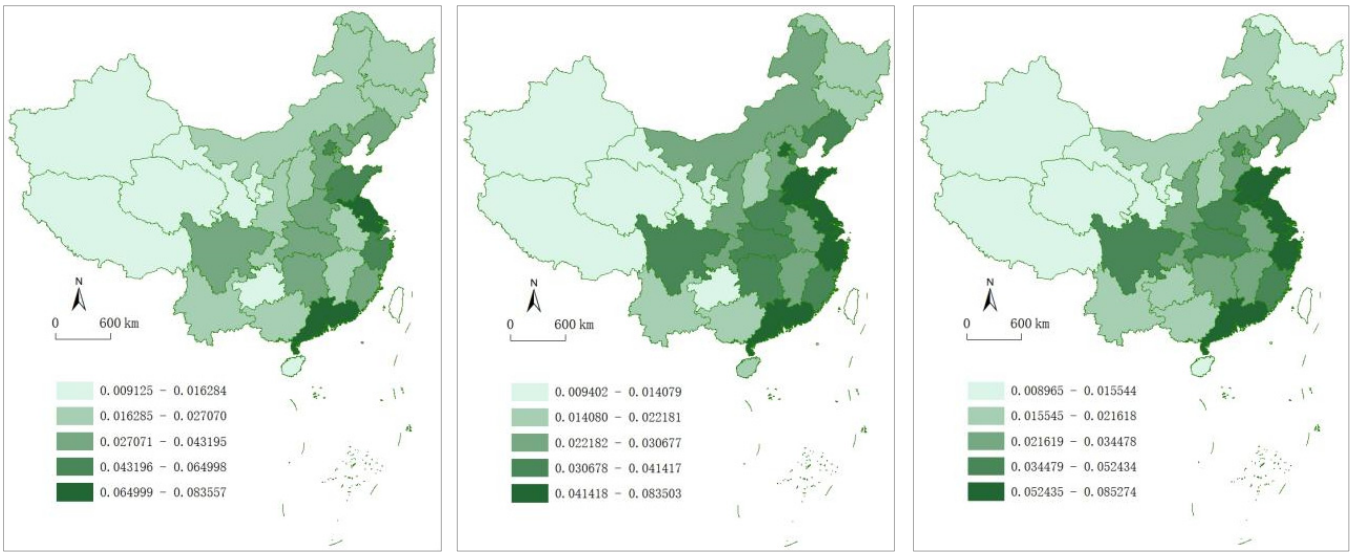

Figure 4. Spatiotemporal distributions of economic resilience in China from 2010 to 2019.

4.3. Coupling Coordination Analysis of Tourism Eco-Efficiency and Economic Resilience

4.3.1. Spatiotemporal Distributions of Tourism Eco-Efficiency and Economic Resilience Coupling Coordination

The coupling coordination degree of tourism eco-efficiency and economic resilience was measured based on the combined scores of the two in 31 provinces nationwide from 2010 to 2019. Its average value for all years was 0.376, indicating poor coupling coordination. The coupling coordination was also plotted for 2010, 2015, and 2019 (Figure 5). There were four types of coupling coordination of tourism eco-efficiency and economic resilience in the 31 provinces across the country: serious imbalance, moderate imbalance, reluctant coordination, and primary coordination. The spatiotemporal patterns of the coupling coordination types of tourism eco-efficiency and economic resilience were consistent. From a temporal perspective, the coupling coordination degree of tourism eco-efficiency and

economic resilience in the 31 provinces across the country were fluctuating and increasing, but the increase was relatively small. From a spatial standpoint, there was serious imbalance coupling coordination degree, which was roughly close to 0.3, and the distribution of provinces were very small, with the majority of provinces concentrated in Qinghai, Gansu, Xinjiang, and other provinces. The majority of provinces were concentrated in the moderate imbalance and reluctant coordination. Still, the coupling coordination was in 0.3–0.5, and the interaction effect of tourism eco-efficiency and economic resilience was relatively weak. The primary coordination type was dominated by Beijing, Shanghai, and Guangdong, where the interaction between tourism eco-efficiency and economic resilience is relatively strong. Still, none of their coupling coordination degrees exceeded 0.6. There were no moderate coordination type zones, indicating that the coupling coordination between tourism eco-efficiency and economic resilience is relatively poor across the country's 31 provinces and districts (Figure 6). In general, the interaction between tourism eco-efficiency and economic resilience of tourism cities has increased significantly, and the phenomenon of regional divergence has improved, but the trend of "low in the west and high in the east" has not yet been broken [40,41]. The coupling level in the eastern region is relatively better than that in the western region, showing obvious regional differences, which are related to the long-established differences in economic development levels between the east and the west [43]. This brings about differences in regional development and infrastructure construction, thus making tourism eco-efficiency and economic resilience show obvious regional characteristics in the process of mutual drive and interaction [44].

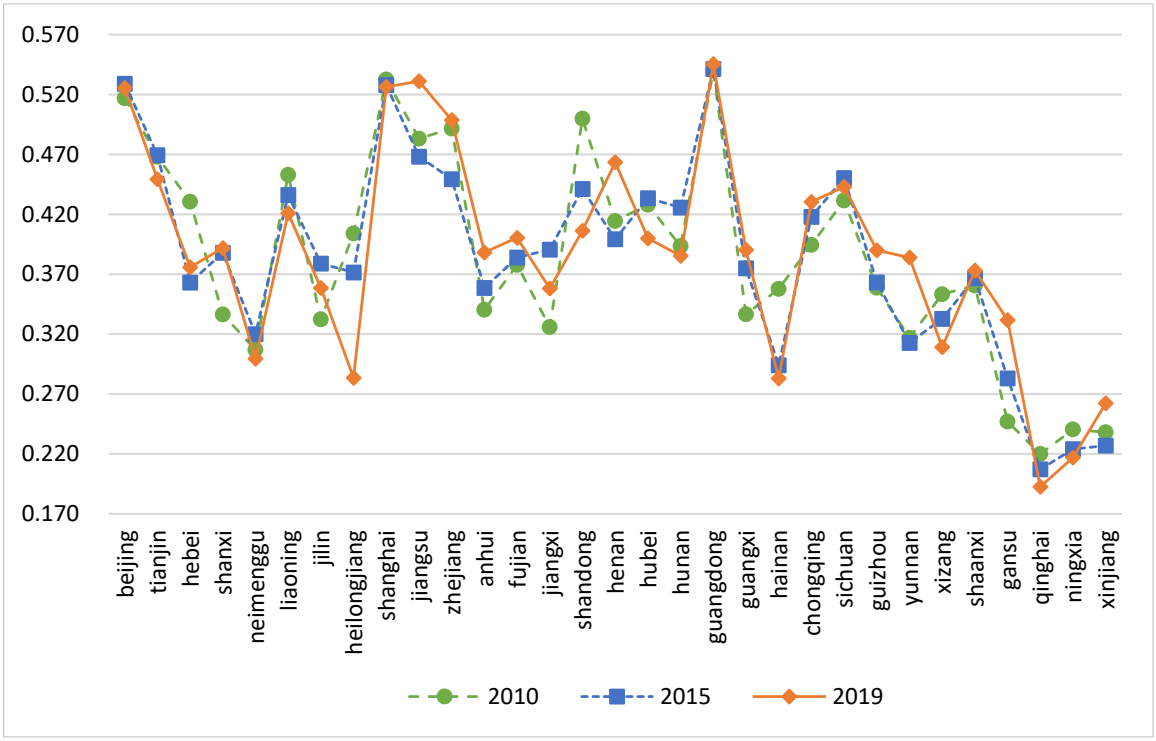

Figure 5. Coupling coordination degree between tourism eco-efficiency and economic resilience in China from 2010 to 2019.

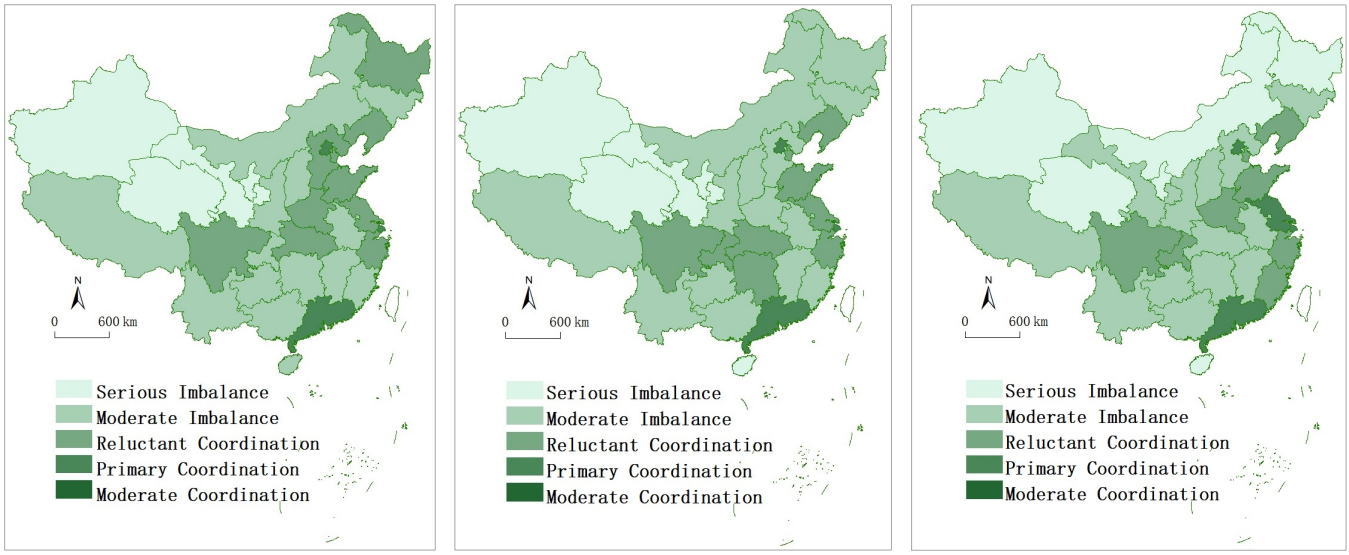

Figure 6. Spatiotemporal distributions of coupling coordination degree between tourism eco-efficiency and economic resilience in China from 2010 to 2019.

4.3.2. Spatial Correlation Distributions of Tourism Eco-Efficiency and Economic Resilience Coupling Coordination

The ESDA analysis was used to explore the spatial correlation of coupling coordination of different time periods, where the values of Moran's I in 2010, 2015, and 2019 were 0.225, 0.154, and 0.169, respectively. The test results were significant at the 95% confidence, indicating a strong positive spatial correlation between tourism eco-efficiency and economic resilience coupling coordination each year (Table 2). The high and low values of tourism eco-efficiency and economic resilience coupling coordination showed a certain degree of clustering in the spatial distribution. To further analyze the specific spatial patterns and coupling coordination degree of the clustering of tourism eco-efficiency and economic resilience, the local spatial association index Getis-OrdGi* was calculated for each type of coupling coordination degree and divided into five categories based on natural breakpoints (Figure 7). The distribution pattern of tourism eco-efficiency and economic resilience coupling coordination correlation is generally similar each year, and the distribution of cold and hot spots of tourism eco-efficiency and economic resilience coordination is mainly determined by area distribution, among which the hot spots of tourism eco-efficiency and economic resilience coupling coordination are primarily in Beijing, Shanghai, and Guangzhou provinces and cities, and the cold spots are mainly in the inner northeast region, northwest region, and southwest region. The primary reason can be attributed to various factors, including regional economic development, infrastructure construction, and policy support. Most of the provinces in China are at a low level of agglomeration and stability due to the coupled coordination level of tourism eco-efficiency and economic resilience, while some provinces in coastal areas are at a high level of agglomeration due to the rapid economic development, high level of infrastructure improvement, and consequent improvement of tourism industry development [30,34]. The inland provinces are rich in tourism resources, tourism attraction has its own characteristics, and tourism industry development potential is huge [47]. They should focus on the effective use of tourism resources and high-quality coordinated economic development through improving their own attraction to achieve the siphon effect in order to achieve benign development and mutual promotion of tourism eco-efficiency and economic resilience [12].

Table 2. Moran's I of coupling coordination degree between tourism eco-efficiency and economic resilience in China from 2010 to 2019.

Index	2010	2015	2019
Moran's I	0.225	0.154	0.169
E (I)	−0.033	−0.033	−0.033
Z (I)	3.308	2.420	2.606

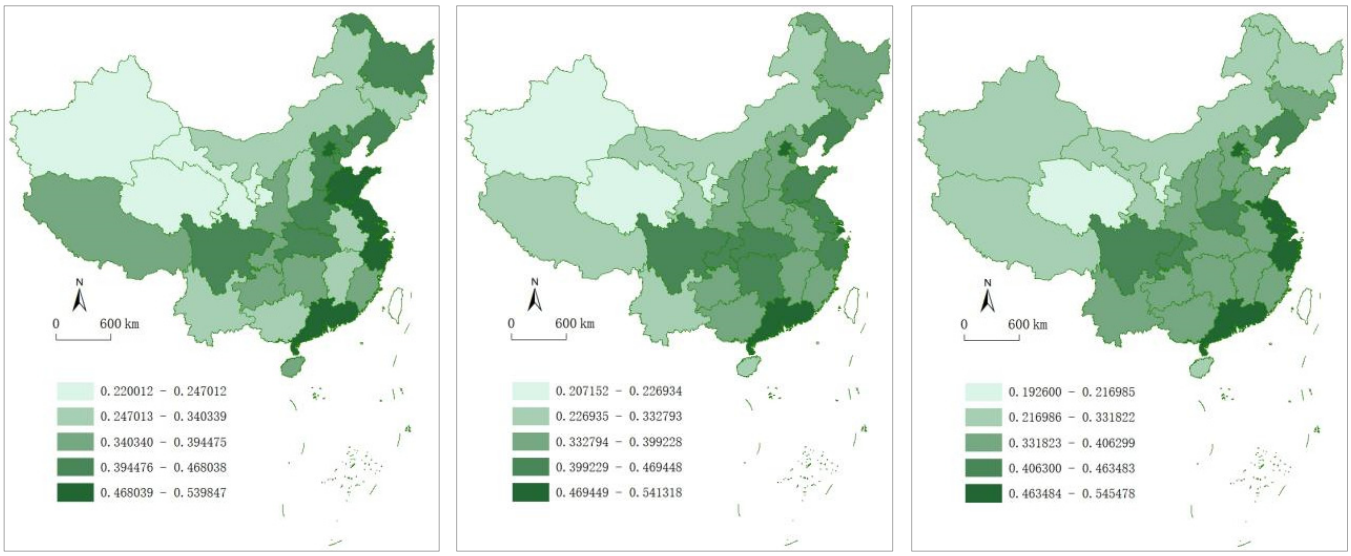

Figure 7. Spatiotemporal distributions of hot spots of coupling coordination degree between tourism eco-efficiency and economic resilience in China from 2010 to 2019.

5. Discussion

5.1. Theoretical Implications

In the context of sustainable development, the coupling coordination of two systems, tourism eco-efficiency and economic resilience, is an inevitable trend. Promoting green tourism and the harmonious coexistence of man and nature has become the primary trend of our time. The tourism industry's rapid development has become a constraint on the current high-quality development of the tourism economy due to the high cost of resources and the environment consumed by the status quo. On the one hand, this study attempts to measure tourism eco-efficiency and economic resilience through scientific research theories and yearbook data as an important support, which is conducive to a more comprehensive understanding of the current situation of tourism-level economic development in each region. The measurement of national tourism eco-efficiency not only can effectively avoid the problem of environmental efficiency loss due to blind investment or resource mismatch, but also has some exploratory significance in terms of methodology [3]. On the other hand, the research on regional economic resilience at home and abroad is still in its infancy. Although there has been tremendous progress in terms of concepts and connotations, there are still issues in terms of imperfect basic theoretical paradigms, inadequate analytical frameworks of influencing factors, and non-uniform measurement and analysis methods. This study provides a comprehensive measure of economic resilience, and on this basis, it explores the effects of different agglomeration types and other factors on economic resilience under various correlation differences, aiming to enrich and develop the theoretical study of regional economic resilience [28,29]. Based on this, this research introduces advanced models and further grasps the development law, as well as spatial and temporal evolution characteristics, and also provides feasible references to supplement and enrich the research on the theory and its significance.

5.2. Managerial Implications

Tourism is a strategic pillar industry of the national economy and an important driving force of global economic development. With the acceleration of economic globalization, greenhouse gas emissions and energy pollution generated by tourism are increasing day by day. Scholars are concerned about how to maximize economic benefits while minimizing environmental costs [35,36]. Most existing domestic studies have conducted resilience-related research at the level of individual provinces and urban agglomerations, lacking measurement and comparison of different regional economic resilience systems across the country. The spatial scale of existing studies is relatively macroscopic, and most use the data at the provincial or national level as a whole, lacking the research and exploration of more precise spatial units [31,32]. This study assesses tourism eco-efficiency and economic resilience across multiple dimensions, based on the actual development of coupling tourism eco-efficiency and economic resilience in the context of the significant increase in uncertainty in the global economy caused by globalization. Fully consider all aspects of tourism eco-efficiency and economic resilience to identify regional differences in response to the financial crisis. It can provide the decision-making basis and theoretical reference for the government to formulate regional policies for adaptive development.

5.3. Sustainability Recommendations

First, the coupling coordination of the two systems of tourism eco-efficiency and economic resilience is relatively poor, concentrated in the low coupling type, with the provinces focusing on low input and high output while improving their economic resilience. To support the sustainable development of tourism, it is vital to define the relationship between the two systems' coordinated development [33,34]. On the one hand, it is important to be aware of the rigidity of the economic system in regions with high rates of economic growth and improve the resilience of the regional economy to shocks. Scale effect and economic diversification must be balanced in every area. On the other hand, it is necessary to promote the rapid concentration of factors of production such as labor, capital, and technology; to create a strong impetus to promote the accumulation of economical bases; and to enhance the natural shock resistance of the region by raising the level of regional economic aggregation and factor accumulation [39,40]. In less developed and poorer regions, we should combine local resource endowments, reasonably allocate factors, find the optimal development path, form a virtuous cycle of regional economic development, rapidly enhance the level of local factor accumulation, focus on improving the resistance and recovery capacity of economic resilience, and strengthen the innovation and transformation capacity of economic resilience to achieve long-term sustainable development of the regional economy.

Second, the contradiction between tourism eco-efficiency and economic resilience has long been an issue in all provinces. In order to reasonably coordinate their development, countermeasures should be formulated based on the differentiation of historical history and development basis [14,26]. Coordination of the two should be encouraged successfully by establishing an interaction system for tourism eco-efficiency and economic resilience, establishing a linkage mechanism between tourism eco-efficiency and economic resilience to promote the coordinated development. To encourage the flow of tourism talent, capital technology, economic development, and other factors, the formation of regional coordination, industrial integration, and complementary and resource sharing patterns is necessary, promoting the spatial agglomeration of tourism industry and the balanced development of regional economic development, further enhance the coupling coordination of tourism eco-efficiency and economic resilience, as well as achieving mutual benefit and a win–win situation [27]. It also strengthens economic ties with neighboring regions, actively promotes the two-way flow of factors, and improves regional resilience and adaptability.

Third, it is necessary to enhance government control, formulate scientific and reasonable coordinated development strategies, and promote the coupling product of provincial tourism eco-efficiency and resilience. The government should strengthen environmental

regulation, strictly implement environmental regulatory policies, and develop tourism development plans that are reasonable [3,33], as well as increase the financial investment in the tourism industry and special funds for tourism and implement long-term effective incentive mechanisms for tourism enterprises that are the first to adopt advanced ecological and environmental protection technologies to increase the endogenous motivation and behavior of other tourism enterprises and to implement green innovation behaviors, such as ecological protection subsidies, tax concessions, green bonds, etc. At the same time, they should strengthen supervision and inspection of tourism enterprises with high emissions, as well as encourage enterprises to take the initiative to participate in environmental management activities, with policies to guide and help them to a green, low-carbon, sustainable development path [41,42]. Moreover, they should increase financial investment into the tourism industry and tourism special funds through environmental protection subsidies, tax breaks, green bonds, and other means. Simultaneously, according to the front and end of pollution prevention and control for tourism enterprises with high emissions, it is necessary to strengthen supervision and inspection and encourage enterprises to actively participate in environmental management activities, as well as to use policies to guide and assist them in moving toward green, low-carbon, and sustainable development [27,28].

6. Conclusions

6.1. Findings

(1) The national tourism eco-efficiency level in 2010–2019 was low, and although there were individual provinces and regions that were greater than the average, there were still more provinces and regions that were below the average. There were phenomena that went against sustainable development in the process of tourism development in all provinces and regions, such as waste of resources, inefficiency, and environmental pollution. There is still much room for development and improvement in tourism eco-efficiency. The differences between provinces and regions were relatively large, and there was an imbalance in the distribution. Moreover, the tourism eco-efficiency value showed a pattern of "high in the southeast, low in the northwest".

(2) The economic resilience values of 31 provinces nationwide from 2010 to 2019 were relatively low, but the economic resilience of each province was relatively stable, and the pattern of regional distribution of resilience values was generally consistent. The economic resilience values revealed a fluctuating rising tendency over time, although the size of the fluctuation was quite moderate. In terms of spatial distribution, economic resilience showed a decreasing pattern in the east, middle, and west. This was mainly attributed to factors such as the economic level and regional development of each region. Given the relatively low level of economic resilience in general, each province should make significant efforts to improve the comprehensive economic strength of the province in all aspects.

(3) From 2010 to 2019, the overall level of coupling coordination of tourism eco-efficiency and economic resilience in the 31 provinces nationwide was relatively low, dominated by low coordination type, with largely consistent spatial and temporal patterns. The coupling coordination degree between tourism eco-efficiency and economic resilience in the 31 provinces nationwide showed a fluctuating upward trend, but the increase was relatively small. The spatiotemporal patterns of the coupling coordination types of tourism eco-efficiency and economic resilience were consistent. The high and low values of tourism eco-efficiency and economic resilience coupling coordination showed a certain degree of clustering in the spatial distribution.

6.2. Limitations and Future Research

This study delved deeply into the coupling coordination of the two systems of tourism eco-efficiency and economic resilience, for which there are implications for future research on tourism eco-efficiency, economic resilience, and sustainable development in various regions of the country. However, there are still some shortcomings in this study that need to be addressed:

(1) Because theoretical and empirical studies in related fields are still in their early stages, the accounting coefficients of tourism carbon emissions have not been able to be further adjusted for each province, resulting in slightly conservative tourism eco-efficiency measurement results.

(2) Considering the availability of research data, this paper analyzed tourism eco-efficiency, economic resilience, and their coupling coordination degree by provinces and districts nationwide, which can, to some extent, reflect the actual development of the two systems of tourism eco-efficiency and economic resilience of provinces and districts, and the research perspective can be further expanded down to the relatively microscopic scale analysis of areas and city clusters in the future.

(3) This research has not yet considered the impact of COVID-19 on tourism eco-efficiency and economic resilience. COVID-19 has brought huge shocks and challenges to the global tourism industry, and the impact on tourism is characterized by high stress and long duration. Follow-up studies can explore the impact of COVID-19 on tourism and the subsequent recovery.

(4) The policy implications of this paper are missing, and future research should be targeted to point out countermeasure suggestions based on the analysis of the results. Countermeasure suggestions can be given to local governments, industries, and enterprises with a view to promoting sustainable development of tourism.

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