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A Study on the Coupling Coordination of Urban Resilience and the Tourism Economy in the Beijing–Tianjin–Hebei Region

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Abstract: The high-quality economic growth of tourism is intimately related to a city's overall strength, and urban resilience is an important index to measure the comprehensive strength of a city. Therefore, determining how to enhance the construction of urban resilience, improve the quality of tourism development, and promote the coupling coordination of these two systems has attracted academic attention in recent years. Based on the panel data of 13 cities in the Beijing–Tianjin–Hebei region from 2010 to 2021, an entropy weight method, coupling coordination model, and obstacle degree model were used to analyze the coupling coordination degree, spatiotemporal evolution characteristics, and obstacle factors between urban resilience and the tourism economy. The results show the following: (1) Urban resilience and tourist economic development levels in the Beijing–Tianjin–Hebei region show an overall upward trend, and both of them show obvious spatial differences. (2) The coupling coordination degree of urban resilience and the tourism economy shows a trend of first rising and then declining in the temporal dimension, while it shows a spatial differentiation pattern of “high in the middle and low in the surrounding area” in the spatial dimension. (3) The obstacle degree structure of the coupling coordination of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region is relatively stable, with economic resilience as the leading obstacle in the urban resilience system and tourist economic development benefits as the leading obstacle in the tourism economy system. In the future, the Beijing–Tianjin–Hebei region needs to strengthen regional cooperation, enhance the driving role of central cities, continuously improve urban resilience, and promote the high-quality development of the tourism economy.

Keywords: urban resilience; tourism economy; coupling coordination; Beijing–Tianjin–Hebei



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1. Introduction

Cities are composed of complex social, economic, and ecological systems. With the acceleration of urbanization and the regularity of different crisis situations, the social environment and economic situation are undergoing rapid changes. Cities are frequently subjected to threats of various natural disasters and public health incidents [1], which are essential factors limiting the sustainable development of cities [2]. The primary objective of urban resilience construction lies in mitigating the impacts of uncertain factors on urban development, strengthening the city's defense against external shocks, and adjusting its adaptability. Therefore, urban resilience construction is a crucial tactic to support sustainable urban development [3]. Improving urban resilience has emerged as a crucial strategy for modern urban construction and management, and it is also an important topic of the Outline of the 14th Five-Year Plan (2021–2025) for National Economic and Social Development and Vision 2035 of the People's Republic of China.

Tourism has evolved into a vital component of urban development as the tourism industry has grown rapidly. However, due to the sensitivity and fragility of tourism's economic system, it is easily influenced by the outside world. Therefore, urban resilience

and the economic development of tourism are closely related [4]. A city with strong urban resilience has perfect infrastructure, along with a good economic foundation and ecological environment. Therefore, it can quickly adapt and respond to external disturbances, ensure the normal operation of tourism-related infrastructure and service functions, and offer substantial assistance for the growth of tourism. In crisis periods when the tourism industry has been hit hard, urban resilience is critical to its recovery and reconstruction. Additionally, tourism development demands higher requirements for the urban infrastructure and ecological environment, which can stimulate the expansion of urban economic desires and solve employment problems faced by local residents, thereby enhancing urban resilience. Thus, examining the connection between the two systems is helpful to scientifically understand the general law of urban resilience and high-quality tourism development, as well as providing references for the formulation of policies to exert the positive impacts of tourism and promote high-quality tourism development.

The Beijing–Tianjin–Hebei region is the most dynamic region in northern China [5]. It is geographically close, with people living in close proximity to one another, and has deep historical roots. The tourism industry in the region has made remarkable achievements in resource development, product innovation, brand building, and market expansion. Furthermore, the prosperous development of the tourism industry has effectively promoted the flow of market factors, the diversification of economic risks, and scientific and technological innovation. In 2014, the coordinated development of the Beijing–Tianjin–Hebei region ascended to a national strategic level, which had a significant impact on the regional tourism economy [6]. The previous literature has studied urban resilience and tourism economic development separately [7,8], but there are few studies exploring the relationship between these two systems. In this context, this study measures and analyzes the levels of urban resilience and tourism's economic development within the region, investigates the coupling coordination relationship between urban resilience and the tourism economy, and employs the obstacle degree model to identify the hindering factors influencing the coupling coordination degree of the two systems. This study can provide ideas and suggestions for the coordinated development of urban resilience and tourism's economic development in the Beijing–Tianjin–Hebei region, as well as providing theoretical support and an empirical basis for regional coordinated development.

The remainder of this study is structured as follows. Section 2 presents a literature review on the city resilience and tourism economy. Section 3 introduces the research methods, including the entropy weight method, coupling coordination degree model, kernel density estimation, and obstacle degree model. Section 4 offers the results. Section 5 provides the discussion. Finally, Section 6 presents conclusions based on the empirical results and provides some policy implications.

2. Literature Review

2.1. The Concept of Urban Resilience

Resilience is a concept derived from physics; it was first introduced into social ecosystems by Holling, who defined it as the ability of ecosystems to recuperate and rebound following disturbances [9]. In the 1990s, the study of resilience evolved from natural ecology to social ecology. This expansion not only facilitated the further development of the concept of resilience, but it also laid the foundation for the subsequent emergence of urban resilience theory. According to Meerow et al. [10], Widianingsih et al. [11], and McIntyre-Mills et al. [12], urban resilience refers to the system's capacity to adapt, evolve, and respond to future disturbances or challenges, so as to achieve the normal operation of public safety, social order, and economic construction in sustainable urban development. Therefore, urban resilience can also refer to an institutional resilience strategy and community adaptation efforts to vulnerabilities and disruptions, involving multiple dimensions, such as the ecological environment, economic development, social development, and engineering facilities [13].

2.2. Urban Resilience and the Tourism Economy

Because the concept of urban resilience has complicated connotations, the creation of its evaluation index systems varies. Scholars have established different evaluation index systems for urban resilience from the perspective of different disciplines. Despite the lack of consensus on the selection of evaluation indicators, the establishment of an index system can offer a more precise reflection of the comprehensive state of urban resilience [14]. Dong et al. proposed that public infrastructure, economic development, and social security are closely related to urban resilience [15]. Liu L et al. set up 23 indicators to measure the urban resilience of Henan Province from four dimensions of ecological, economic, social, and infrastructure resilience [7]. Some other studies have also analyzed urban resilience from these four dimensions but with a slightly different index for each dimension [16,17].

The advancement of tourism economics signifies the competitiveness and influence of a specific region within the tourism sector. In order to thrive, the tourism industry must adapt to evolving circumstances, bolster its resilience against risks, and leverage the market's critical role in allocating resources [8]. Tourism's development has a direct correlation with tourism revenues, tourism facilities, the tourism environment, and tourism market size, which cannot be separated from the support of urban systems. Areas with strong urban resilience can effectively resist external disturbances and promote the restructuring and innovation of urban internal structures, ensuring the stable operation of the tourism economy and enhancing the realization of high-quality tourism development. High-quality tourism development can feed back to the construction of urban resilience through various means, such as technological innovation, green development, and the sharing of achievements. In short, there is a close interaction between the two systems.

Previous studies have found that resilience is generally regarded as a tool for tourism crisis management, and the rapid recovery of tourism in crisis situations is closely related to regional government support and economic strength [18]. Scholars have mostly conducted research from the perspectives of influencing factors and spatiotemporal evolution [19], using qualitative analysis or quantitative methods such as the spatial Durbin model and the coordination degree model to investigate the correlation of urban resilience and economic development levels from the perspectives of economy, society, and ecology. With further research, some scholars have begun to concentrate on tourism resilience. However, the research on urban resilience and tourist economic systems remains in the exploratory stage, with limited relevant research findings. Wang K established an index system for evaluation from three levels of economic, social, and ecological resilience to study the resilience of the tourist environment system [20]. Cheng et al. found that the tourism sector recovered the fastest and was crucial to the economic recovery and restoration of the area [21]. Lin et al. pointed out that the resistance, adaptability, resilience, and transformation of regional economic systems will affect the healthy and stable development of regional tourism economics [22].

Coupling theory can help us identify the relationship between urban resilience and the tourism economy. Based on general system theory, coupling refers to the phenomenon of interaction and mutual influence between two or more subsystems [23]. At the same time, the intricate interactions between subsystems change dynamically over time. Zhang et al. studied the synergistic relationship between the resilience and efficiency of the tourism economy using the coupled model [24]. Wang et al. employed a coupled model integrating multi-indicator group evaluation and the entropy weight method to assess the synergy between tourist economic growth and urban ecological health in the M city cluster from 2009 to 2022 [25]. Li et al. analyzed the coupling coordination of urban resilience and natural capital utilization [26]. Tang applied the coupling coordination theory to explore the coordinated relationship between the economic development, ecological environment, and tourism industry of tourist skiing destinations [27].

Through reviewing the literature on urban resilience and tourist economic development, it was found that although the basic theoretical research on urban resilience and the tourism economy has been well conducted, the research on the interaction mechanism

between urban resilience and the tourism economy still needs to be further expanded. The following problems remain: (1) In terms of research content, most studies focus on the one-way correlation analysis between urban resilience and tourism economic development, while the discussion of coupling coordination between the two systems is limited. (2) In terms of research perspective, there has been relatively little research on the spatiotemporal evolution characteristics of the coupling relationship between urban resilience and the tourism economy from a two-dimensional geographical perspective, with urban agglomerations as the research object. (3) In terms of research methods, existing studies usually use qualitative descriptions and spatial measurements to test the levels of urban resilience and tourist economic development, while there has been relatively little exploration of the spatial distribution of the coupling coordination index between urban resilience and the tourism economy using spatial visualization methods in geography.

This study aims to explore the relationship between urban resilience and tourism economic development, and it attempts to answer the following three questions: Firstly, what are the levels of urban resilience and tourist economic development in the Beijing–Tianjin–Hebei region? Secondly, what is the spatiotemporal evolution trend of the coupling and coordination between urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region? Thirdly, what are the obstacles that affect the coupling coordination between urban resilience and the tourism economy? In order to answer these questions, this study takes the Beijing–Tianjin–Hebei region as the research object and constructs an evaluation index system for urban resilience and the tourism economy. Research methods such as the entropy weight method, coupling coordination degree model, and obstacle model are introduced to analyze the coupling coordination and spatiotemporal characteristics of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region. Countermeasures and suggestions are proposed to address these issues, in order to provide reference for the coordinated promotion of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region. China's experience can also provide reference for the construction of resilient cities and tourist economic development in other countries.

3. Research Methods and Data Sources

In this study, the entropy weight method is introduced to determine the weight of indicators, and the comprehensive index method is used to evaluate the level of urban resilience and tourism economic development. Then, the coupling coordination model is applied to analyze the coupling coordination relationship between urban resilience and the tourism economy. The kernel density function is introduced to analyze the spatiotemporal evolution characteristics of coupling coordination. At last, the obstacle degree model is used to identify the main obstacles that affect the coupling coordination degree of urban resilience and the tourism economy. The research data are obtained from Chinese statistics.

3.1. Research Methods

3.1.1. Entropy Weight Method

The entropy weight method is an objective approach for evaluating weights. In the actual operation process, it calculates the weight of each indicator based on the information entropy associated with the degree of variation among the indicators. Subsequently, the entropy is used to adjust the weights of the indicators, resulting in objective weights for each indicator. The advantage of this method is that it can avoid the subjective influence of researchers in weighting, and it has been widely used in quantitative analysis. To eliminate the influence of magnitude differences on the weights, this study applies extreme value standardization to carry out the dimensionless processing of each index. Finally, the comprehensive index method is used to calculate the development levels of urban resilience and the tourism economy. The detailed calculation steps are outlined below:

First, the original data matrix is processed using the method of extreme value standardization. The expressions of positive indicators and negative indicators are presented in Formulae (1) and (2), respectively:

$$x_{ij} = \frac{x_{ij} - x_{\min}}{x_{\max} - x_{\min}} \quad (1)$$

$$x_{ij} = \frac{x_{\max} - x_{ij}}{x_{\max} - x_{\min}} \quad (2)$$

Second, determine the weight of the j -th index for the i -th evaluation object:

$$y_{ij} = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}} \quad (3)$$

Third, calculate the information entropy of the j -th index:

$$e_j = -\ln \frac{1}{m} \sum_{i=1}^m y_{ij} \cdot \ln y_{ij} \quad (4)$$

Fourth, determine the indicator weight w_j :

$$w_j = \frac{1 - e_j}{\sum_{j=1}^n 1 - e_j} \quad (5)$$

Fifth, calculate the levels of urban resilience and the tourism economy:

$$\begin{aligned} UR &= \sum_{i=1}^n x_{ij} \cdot w_j \\ TD &= \sum_{i=1}^n x_{ij} \cdot w_j \end{aligned} \quad (6)$$

In Formulae (1)–(6), x_{ij} represents the original data, UR represents the urban resilience index, and TD denotes the tourism economy index.

3.1.2. Coupling Coordination Degree Model

The coupling coordination degree model can comprehensively reflect the overall effectiveness and synergistic effects of multiple subsystems. This model has been widely applied in empirical studies. In this study, a coupled coordination degree model was employed to investigate the intricate relationship between urban resilience and the tourism economy.

The expression of the coupling degree model is as follows:

$$C = 2 \times \sqrt{\frac{U_1 \times U_2}{(U_1 + U_2)^2}} \quad (7)$$

where C denotes the coupling degree, and U_1 and U_2 represent the urban resilience and tourism economy indices, respectively. The coupling degree (C) is used to measure the degree of interaction between different systems, but it is difficult to reflect the development level of each system. Thus, the coupling coordination degree model (D) is proposed to reflect the coupling and coordination development of urban resilience and the tourism economy. The calculation formula is as follows:

$$T = \alpha U_1 + \beta U_2 \quad (8)$$

$$D = \sqrt{CT} \quad (9)$$

T is the comprehensive coordination index of urban resilience and the tourism economy, and α and β represent the contribution degree of urban resilience and the tourism economy, respectively, where $\alpha + \beta = 1$. Considering the equal importance of the urban resilience system and the tourism economy system, the value was chosen as $\alpha = \beta = 0.5$. D

is the coupling coordination degree of urban resilience and the tourism economy. Based on the previous works of Peng et al. [28] and Luo et al. [29], the coupling coordination degree was divided into five classes: severe disorder, ranging from 0.0 to 0.2; moderate disorder from 0.2 to 0.4; bare coordination from 0.4 to 0.6; moderate coordination from 0.6 to 0.8; and excellent coordination, spanning from 0.8 to 1.0.

3.1.3. Kernel Density Estimation

Kernel density estimation is a non-parametric statistical method used to estimate data distribution, which can be used to draw smooth density curves. Through the estimation of variable probability densities, the density curve offers an illustrative portrayal of variable distributions, reflecting the distribution position, shape, and ductility of variables [30]. Furthermore, the kernel density function exhibits a low degree of dependency on the model and possesses remarkable robustness. If the kernel density curve shows the distribution of two peaks, it indicates that the coupling coordination degree has convergence in two directions. If the height of the peak shows a downward trend, it indicates that the difference in the value continues to decline, and the concentration of the distribution also shows a downward trend. This study uses the kernel density function to analyze the evolution trend of the coupling coordination degree of urban resilience and the tourism economy in the 13 cities of the Beijing–Tianjin–Hebei region.

For data $X_1, X_2, \dots, X_n$, the probability density of the random variable at point X can be estimated by the following formula [31]:

$$f(x) = \frac{1}{nh} \sum_{i=1}^n K\left(\frac{X_i - \bar{X}}{h}\right) \quad (10)$$

where n represents the number of observed values, referring to the 13 cities; X_i is the observed value; $\bar{X}$ is the average value; h is the bandwidth of density estimation; and $K(u)$ is the kernel function.

3.1.4. Obstacle Degree Model

The obstacle degree model is used to comprehensively identify the specific indicators and classification indicators that hinder the coupling coordinated development of urban resilience and the tourism economy. Thus, we can provide a scientific foundation for adjusting and formulating targeted countermeasures to enhance the integration of these two systems. The obstacle degree model mainly includes three elements: the factor contribution degree, index deviation degree, and obstacle degree [32]. The calculation formulae are presented below.

$$O_{ij} = \frac{d_{ij}w_j}{\sum d_{ij}w_j} \quad (11)$$

$$d_{ij} = 1 - r_{ij} \quad (12)$$

$$A_j = \sum_{i=1}^j O_{ij} \quad (13)$$

Here, O_{ij} represents the retarding degree of the j -th index in year i to the coupling coordination degree of urban resilience and the tourism economy in that year, d_{ij} is the index deviation degree of item j in year i , w_j signifies the weight value assigned to the j -th indicator, and A_j represents the obstacle degree of the subsystem towards achieving coupling coordination.

3.2. Index System

It is necessary to establish a comprehensive evaluation index system of urban resilience and the tourism economy to study the coupling coordination degree of the two systems. We constructed the corresponding evaluation index based on the findings of previous studies and the development status of the cities in the Beijing–Tianjin–Hebei region. Finally, 16 urbanization indicators and 5 tourism economy indicators were selected to constitute an

indicator system, and the index weight was determined using the entropy weight method; the results are presented in Table 1.

Table 1. Urban resilience and tourism economy index systems and weights.

Target Layer	Dimension Layer	Codes	Indicator Layer	Indicator Units	Weights	References
Urban resilience	Economic resilience	C1	Per capita GDP	CNY	0.0741	Peng et al. [28]
		C2	Per capita total retail sales of consumer goods	CNY	0.1085	Yuan et al. [33]
		C3	Proportion of tertiary industry in GDP	%	0.0553	Yuan et al. [21]
		C4	Per capita fiscal revenue	CNY	0.1637	Zeng et al. [34]
	Social resilience	C5	Number of college students per 10,000 people	/	0.0881	Gao et al. [35]
		C6	Beds in medical and health institutions per 10,000 people	/	0.0465	Yuan et al. [33]
		C7	Average → salary → of employees on the job	CNY	0.0555	Yuan et al. [33]
		C8	Registered urban unemployment rate	%	0.0130	Peng et al. [28]
	Ecological resilience	C9	Per capita park green area	m ² /person	0.0463	Peng et al. [28]
		C10	Green coverage rate of built-up area	%	0.0213	Peng et al. [28]
		C11	Garbage disposal rate	%	0.0047	Chen et al. [36]
		C12	Urban → domestic sewage treatment rate	%	0.0185	Peng et al. [28]
	Infrastructure resilience	C13	Per capita urban road area	m ²	0.0968	Chen et al. [36]
		C14	Density of drainage pipes in built-up areas	km/km ²	0.0407	Chen et al. [36]
		C15	Internet → users → per 10,000 people	Households	0.1029	Chen et al. [36]
		C16	Number of buses per 10,000 people	Vehicles	0.0642	Chen et al. [36]
Tourism economy	Tourism economic scale	T1	Total number of tourist arrivals	10,000 people	0.2500	Yu et al. [37]
	Tourism economic development benefits	T2	Total → tourism revenue	CNY	0.3695	Ke et al. [38]
		T3	Total tourism revenue/GDP	%	0.2321	Ke et al. [38]
	Tourism economic development potential	T4	Growth rate of total tourism revenue	%	0.0555	Ke et al. [38]
		T5	Growth rate of total tourist arrivals	%	0.0928	Ke et al. [38]

3.2.1. Indicators of Urban Resilience

Based on the concept of urban resilience, we established a comprehensive measurement system consisting of 16 resilience indices in four dimensions, namely, economic resilience, social resilience, ecological resilience, and infrastructure resilience [39,40].

(1) Economic resilience index

Economic resilience reflects the adaptability and recovery stability of urban systems to tackle external economic shocks. Key indicators such as per capita GDP, per capita retail sales of consumer goods, the proportion of the tertiary industry in GDP, and per capita fiscal revenue serve as fundamental metrics to assess the economic development level. These indicators effectively reflect the economic status of cities within the Beijing–Tianjin–Hebei region. In general, as the values of the four indicators increase, so do the levels of urban

economic development and economic resilience, thereby enhancing the cities' ability to resist risks.

(2) Social resilience index

Social resilience reflects cities' adaptability and resilience to social development in the face of external environmental shocks. Social capital, social security services, and the city's potential for individual development are all strongly correlated with social resilience [41]. In this study, the number of college students per 10,000 people, the number of beds in medical and health institutions per 10,000 people, the average salary of employees on the job, and the registered urban unemployment rate were used to estimate the level of social resilience. The number of college students per 10,000 people reflects the education level of a city: the more college students, the higher the social resilience level. The number of beds in medical and health facilities serves as the primary indicator to measure the medical and health status of a city. The medical and health level is an important guarantee for a city to resist social public health security crises, and it has a positive effect on social resilience. The salary of employees reflects people's living standards and is crucial to social resistance ability. Social resistance and resilience show an inverse association with urban registered unemployment rates, with greater rates associated with lower levels of social resilience.

(3) Ecological resilience index

Ecological resilience demonstrates the capacity of each city to use ecological resources to cope with ecological damage, decreased environmental carrying capacity, or natural disaster impacts induced by social and economic development. This represents a city's capacity to withstand ecological risks and adjust itself to restore its original state as much as possible. The improvement in the ecological environment and the rational development of natural resources are conducive to promoting the sustainable utilization of tourism resources, thereby promoting the sustainable growth of the tourism sector. The index of ecological resilience was determined from the forest coverage rate, green coverage rate of built-up areas, per capita park green area, and urban domestic sewage treatment rate [42,43]. Forest coverage reflects the richness and ecological balance of forest resources in a region. Moreover, it represents the stability and carbon sequestration capacity of the ecosystem, and it directly affects the ecological wellbeing of the people. The per capita park green area and the green coverage rate of built-up areas reflect the level of urban greening, which affects the living environment and quality of urban residents. The urban domestic sewage treatment rate reflects the treatment degree of residential wastewater by the city, which imparts resilience to environmental damage.

(4) Infrastructure resilience

The resilience of urban infrastructure serves as an important indicator in evaluating the overall quality of urban development [44]. Public infrastructure, as the vital material foundation of the urban environment, is essential for enhancing urban safety and safeguarding sustainability [45]; it is also directly related to a city's ability to withstand disaster risks. We selected four indicators to analyze infrastructure resilience, namely, per capita urban road area, the density of drainage pipes in built-up areas, internet users per 10,000 people, and the number of buses per 10,000 people. These four indicators are effective reflections of the level of social infrastructure construction, and they are also positively correlated with social resistance factors.

3.2.2. Indicators of the Tourism Economy

With reference to the results of previous research [37,38], this study comprehensively represents the development levels of the tourism economy from three perspectives: tourism economic development scale, tourism economic development benefit, and tourism economic development potential. The scale of the tourism economy's development can directly show the economic volume of tourism in the Beijing–Tianjin–Hebei region. This study applied the total number of tourist arrivals to express this development. Tourism devel-

opment benefit represents the significance and impact of tourism in regional economic development. Therefore, total tourism income, the proportion of total tourism income in GDP, and the proportion of total tourism income in the tertiary industry were selected. The development potential of the tourism economy offers insight into the future development trends of a region's tourism economy. The growth rate of total tourism revenue and the growth rate of total tourist arrivals can demonstrate the future development of the tourism economy to some extent. On that account, these two indicators were chosen to represent the development potential of the tourism economy. The development level of the tourism economy in the Beijing–Tianjin–Hebei region was determined by the entropy weight approach in this study.

3.3. Data Sources

The research data utilized in this study primarily originated from the China City Statistical Yearbook, Beijing Municipal Statistical Yearbook, Hebei Provincial Statistical Yearbook, and Tianjin Statistical Yearbook, as well as the statistical yearbook of prefecture-level cities in Hebei Province from 2011 to 2022.

4. Results

According to the comprehensive evaluation index system of urban resilience and the tourism economy, the comprehensive scores of urban resilience and tourism economy levels of 13 cities in the Beijing–Tianjin–Hebei region were estimated (Table 2).

4.1. Urban Resilience Level

As illustrated in Figure 1, the urban resilience of the Beijing–Tianjin–Hebei region shows a trend of fluctuating growth. The average value experienced a steady growth, rising from 0.160 in 2010 to 0.304 in 2021, achieving an average annual growth rate of 7.5%. This shows that the Beijing–Tianjin–Hebei region has continuously improved its infrastructure, increased residents' income, improved quality of life, and gradually promoted the construction of ecologically livable cities against the strategic background of coordinated development. Under the combined influence of many factors, urban vulnerability has been reduced, such that the urban resilience against external risks has been enhanced. However, the overall level of urban resilience is unstable because of the combined effects of numerous elements, such as economic, social, and environmental issues. During this period, the government has paid much attention to fostering coordinated development. Policy documents such as the Outline of the Plan for the Coordinated Development of the Beijing–Tianjin–Hebei Region and the Plan for the Integration of Transportation for the Coordinated Development of the Beijing–Tianjin–Hebei Region defined the functional positioning of cities, improved infrastructure construction, and established an environment that fosters the seamless flow and efficient allocation of resources.

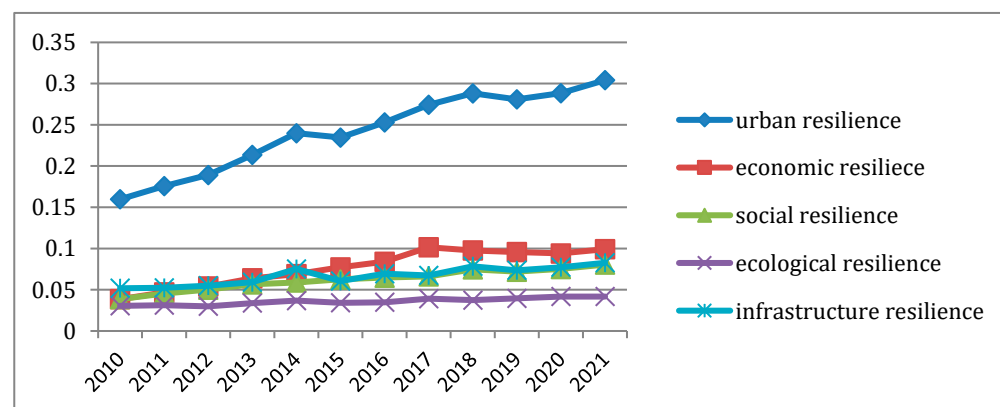


Figure 1. Variations in urban resilience levels.

Table 2. Urban resilience and tourism economic development levels from 2010 to 2021.

Cities	2010	2013		2016		2019		2021		Average		
	Urban resilience	Tourism Economic Development Level	Urban Resilience	Tourism Economic Development Level	Urban Resilience	Tourism Economic Development Level	Urban Resilience	Tourism Economic Development Level	Urban Resilience	Tourism Economic Development Level	Urban Resilience	Tourism Economic Development Level
Beijing	0.497	0.325	0.622	0.435	0.694	0.509	0.758	0.592	0.791	0.416	0.648	0.450
Tianjin	0.339	0.156	0.500	0.264	0.565	0.351	0.540	0.463	0.542	0.246	0.510	0.299
Shijiazhuang	0.161	0.089	0.237	0.104	0.278	0.152	0.319	0.229	0.347	0.095	0.280	0.144
Tangshan	0.160	0.102	0.204	0.072	0.221	0.144	0.268	0.165	0.316	0.070	0.229	0.105
Qinhuangdao	0.223	0.125	0.304	0.084	0.333	0.176	0.294	0.225	0.320	0.059	0.299	0.126
Handan	0.118	0.076	0.144	0.090	0.169	0.161	0.164	0.184	0.187	0.077	0.155	0.117
Xingtai	0.075	0.057	0.081	0.058	0.119	0.093	0.180	0.108	0.184	0.078	0.125	0.086
Baoding	0.078	0.094	0.102	0.106	0.142	0.171	0.154	0.258	0.190	0.103	0.128	0.152
Zhangjiakou	0.087	0.134	0.117	0.127	0.134	0.227	0.184	0.239	0.207	0.078	0.158	0.151
Chengde	0.106	0.078	0.133	0.101	0.160	0.203	0.189	0.247	0.208	0.072	0.157	0.146
Cangzhou	0.066	0.048	0.102	0.037	0.148	0.065	0.171	0.080	0.189	0.024	0.133	0.060
Langfang	0.122	0.058	0.156	0.075	0.221	0.126	0.275	0.367	0.300	0.041	0.212	0.106
Hengshui	0.044	0.071	0.073	0.091	0.104	0.117	0.155	0.081	0.175	0.028	0.108	0.072
Average	0.160	0.109	0.213	0.127	0.253	0.192	0.281	0.249	0.304	0.107		

As can be seen from the distribution of the subsystems of urban resilience in Figure 1, infrastructure resilience had the biggest influence on the resilience level of the Beijing–Tianjin–Hebei region during 2010 to 2012, while the impact of economic resilience was greater than that of other subsystems from 2013 to 2021. During the study period, the Beijing–Tianjin–Hebei region produced substantial outcomes in various fields, such as transportation and people’s livelihoods. Based on sharing development achievements, the cities jointly promoted policy coordination and linkage in education, medical and health care, social security, and public service integration. Consequently, the resilience level of each subsystem gradually increased.

From the spatial point of view, cities in the Beijing–Tianjin–Hebei region have unequal development, and their urban resilience levels are significantly different. Overall, there is a spatial distribution pattern in which the center is higher, and the surrounding parts are lower. The urban resilience of the central cities Beijing and Tianjin is greater than that of other cities. Langfang is adjacent to Beijing and Tianjin, and it has achieved a relatively high level of city resilience due to the economic development of these two cities. Shijiazhuang is the capital city of Hebei Province, with a stronger ability to gather various resources and elements, and has stronger advantages compared to other cities. As a port city, Qinhuangdao has good geographical advantages and transportation conditions. Its urban resilience has always been relatively high, and it is less affected by Beijing and Tianjin. Xingtai and Baoding are located in the central and southern region of Hebei Province, adjacent to Shijiazhuang. They are significantly affected by the siphon effect of Shijiazhuang, and their resilience level is growing slowly.

In terms of time sequences, each dimension of urban resilience continued to rise as industrialization and urbanization progressed. Although cities with high resilience occupy a certain proportion, many cities with low resilience still exist. Therefore, the problem of discoordination and imbalance among cities is still prominent. It is urgent to increase the development levels of low-resilience cities and to coordinate the relationships between urban resilience and its subsystems.

4.2. Tourism Economic Development Levels

Figure 2 depicts the development levels of the tourism economy in the Beijing–Tianjin–Hebei region.

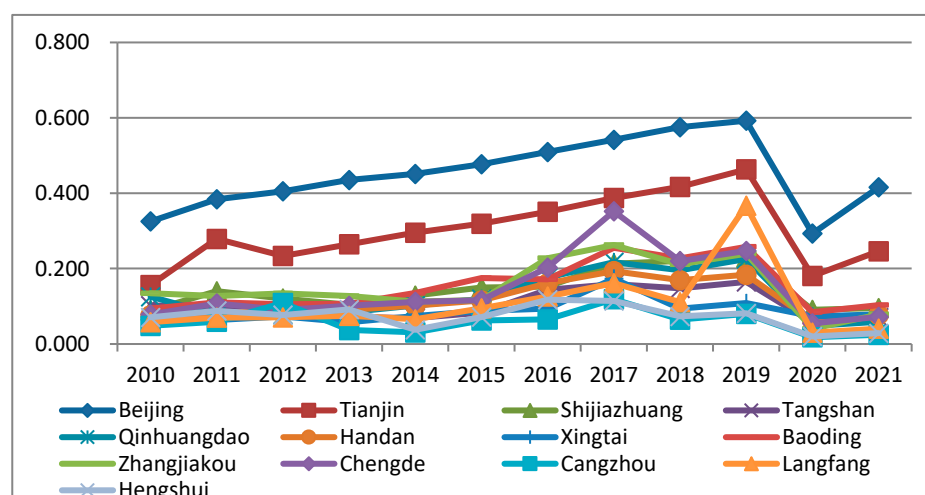


Figure 2. Tourism economic development level trends in the Beijing–Tianjin–Hebei region.

From the perspective of time, although the general level of the tourism economy in the Beijing–Tianjin–Hebei region was relatively low, it expanded quickly between 2010 and 2019. Then, it declined rapidly in 2020 and 2021 as a result of the COVID-19 pandemic. The average annual development level of the regional tourism economy increased from

0.109 in 2010 to 0.249 in 2019, with a growth rate of 128.4%. This indicates that the tourism economy in the Beijing–Tianjin–Hebei region has greatly improved. This is consistent with the existing state of tourism development in the region. Due to the emphasis on tourism development, the tourism economy in all cities is steadily transitioning from low to high. Otherwise, collaborative development has a significant positive direct effect on the tourism economy [6].

Considering the viewpoint of spatial structure, Beijing and Tianjin have relatively high average levels of tourist economic development, due to the two cities' abundant tourism resources and impact. Among them, the most representative city is Beijing, whose annual average level of tourist economic development is 0.45, indicating that Beijing makes full use of tourism resources to develop tourism products and has a high tourism development level on the whole. Meanwhile, Cangzhou, Hengshui, and Xingtai have low levels of tourist economic development, with annual averages of 0.060, 0.072, and 0.086, respectively. This indicates that these three cities still need to explore local tourism resources and constantly innovate tourism products driven by surrounding cities. Despite the weak economic foundation of tourism in cities in Hebei Province, with the support of national policies, cities have paid more attention to tourist resource investment since 2015. Therefore, the tourism economy has demonstrated a trend of rapid upward fluctuation. Overall, the Beijing–Tianjin–Hebei region has implemented relevant measures for the construction of tourist public service facilities, the innovation of tourism products, and the convenience of tourism consumption, providing a guarantee for the coordinated development of regional tourism.

4.3. The Coupling Coordination Degree of Urban Resilience and the Tourism Economy

This study applied the coupling coordination model to determine the coupling coordination degree of urban resilience and the tourism economy of 13 cities from 2010 to 2021. Additionally, a spatiotemporal analysis was carried out.

4.3.1. The Dynamic Evolutionary Characteristics

Kernel density estimation was used to analyze the dynamic evolutionary characteristics of the coupling coordination degree of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region. Figure 3 shows the estimation results for 2010, 2013, 2016, 2019, and 2021, where the vertical axis illustrates the kernel density, and the horizontal axis represents the coupling value.

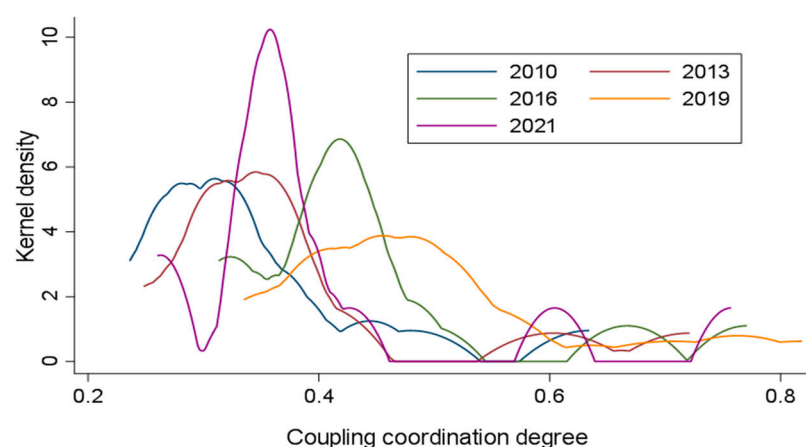


Figure 3. The kernel density estimation results of the coupling coordination degree.

From the distribution position, the kernel density curve dramatically moves towards the right over time, with the peak value increasing year by year from 2010 to 2016. However, the peak value then declines dramatically, while the wave crest spreads in 2019, indicating that the coupling coordination degree of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region is diverse, but the polarization phenomenon has weakened.

Compared with 2019, the peak value in 2021 is greatly increased, showing a “big and small” double peak and showing a trend of moving to the left. In 2021, the coupling coordination degree of the two systems declines significantly. Affected by COVID-19, the external risk of the city is intensified, resulting in heightened uncertainty in the external environment. Consequently, the level of tourism development has experienced a considerable decline, causing a significant contraction in the correlation between the two systems and resulting in a pronounced differentiation.

4.3.2. Spatial Distribution Characteristics

Using data from the years 2010, 2013, 2016, 2019, and 2021 as illustrative examples, the coupling coordination degree was visually analyzed by ArcGIS 10.8 (Figure 4). This comprehensive analysis allowed for the quantitative assessment of regional disparities and spatial evolution trends.

The distribution pattern of the coupling coordination degree in the Beijing–Tianjin–Hebei region exhibited a distinct trend, with higher levels concentrated in the central areas and lower levels observed in the surrounding cities. In other words, Beijing and Tianjin, as the two central cities, are the coupling coordination centers, while the surrounding cities are weakened, and the inter-city differences in the region are obvious.

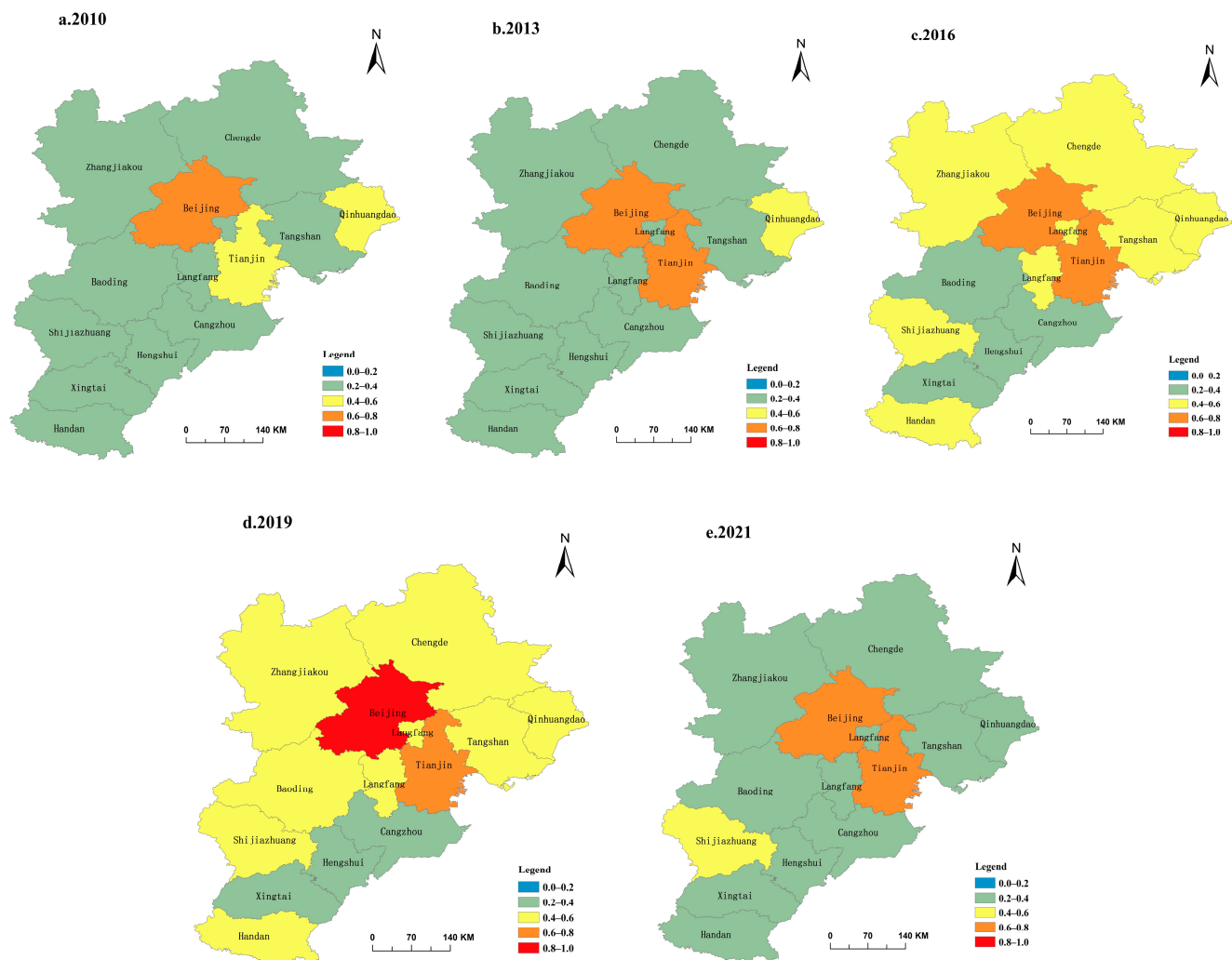


Figure 4. Spatial trends of the coupling coordination degree from 2010 to 2021.

In 2010, Beijing was the city with the highest coupling coordination degree. With its excellent historical and cultural resources and economic strength, urban resilience and

tourism development were far ahead in the region, taking the lead in entering the moderate coordination stage. Tianjin and Qinhuangdao were in the bare coordination stage. These two cities have strong historical and cultural resources and natural tourism resources, respectively. Local governments pay attention to urban environmental governance and infrastructure construction, actively cultivate urban tourism resilience, and promote high-quality tourism development. The coupling coordination degree of the other cities was in a state of moderate disorder, which was the predominant state of the coupling coordination in the Beijing–Tianjin–Hebei region in 2010. Because of insufficient attention to tourism's development, the economy of most cities was dominated by industry at this stage.

In 2013, the Beijing–Tianjin–Hebei region primarily exhibited moderate disorder in the coupling coordination between urban resilience and the tourism economy, indicating that the relationship between the two systems in the region was not obvious, and the effect of tourism's development had not yet appeared. Beijing remained in the moderate coordination stage, while Qinhuangdao was in the bare coordination stage. Tianjin had evolved from bare coordination to the moderate coordination, indicating that Tianjin had consistently fostered tourism's growth by capitalizing on its unique urban features and harnessing the impetus function of tourism on its urban economy.

In 2016, Beijing, Tianjin, and Qinhuangdao maintained their previous coupling coordination status, while Chengde, Zhangjiakou, Tangshan, Shijiazhuang, and Handan evolved from the state of moderate disorder to the state of bare coordination. In 2015, the state implemented Several Opinions of The State Council on Promoting the Reform and Development of the Tourism Industry in order to promote the reform and development of the tourism industry and inject new impetus into the high-quality development of tourism. In this year, the coordination degree between urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region changed significantly, which is indicative of the positive impact of the expansion of tourism's market scale, the optimal allocation of tourism factors, and enhanced urbanization levels. These factors have collectively contributed to the transformation and enrichment of the industrial structure system and the activation of the resource factor market. Ultimately, these developments have bolstered the economic resilience of the region. Meanwhile, the improvement in economic resilience also enables the tourism industry to better resist and cope with external economic, political, and cultural shocks, so the coordination degree of urban resilience and the tourism economy has improved dramatically.

In 2019, the coupling coordination degree between urban resilience and the tourism economy in Beijing steadily improved to excellent coordination. Driven by surrounding cities, Baoding increased from moderate disorder to bare coordination, while Cangzhou, Hengshui, and Xingtai continued to present moderate disorder. This indicates that there is still a lot of potential for improvement in the level of linkage cooperation between urban resilience and the tourism industry.

In 2021, due to the severe impact of COVID-19 on the tourism economy and the significant challenges faced in terms of urban resilience, the coupling coordination degree between urban resilience and the tourism economy experienced a rapid decline. As a result, Beijing and Tianjin are in a state of moderate coordination, while Shijiazhuang barely maintains coordination, and other cities have regressed to a state of moderate disorder.

4.4. The Main Obstacle Factors Affecting the Coupling Coordination Degree

The obstacle degree model was employed to assess the factors impeding the coupling coordination of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region. This comprehensive analysis was carried out at both the dimension and indicator levels, with the ultimate goal of providing valuable insights to foster sustainable urban development and enhance the high-quality expansion of tourism.

At the dimension level (Figure 5), economic resilience is the leading obstacle in the urban resilience system, followed by infrastructure resilience, while ecological resilience is the weakest obstacle. Therefore, the Beijing–Tianjin–Hebei region should continue to

boost its economic development. A city with strong economic resilience is more stable against external shocks. In addition, stronger economic resilience means that the city has better security, infrastructure, and tourism public service systems. In the dimension of the tourism economy, tourism development benefits pose the biggest obstacle to the coupling coordination degree, followed by the tourism economic development scale. This demonstrates that cities in the Beijing–Tianjin–Hebei region should increase their tourism income and tourist arrivals, strengthen the strategic pillar position of tourism in the local economy, and boost the coordinated development of the two systems.

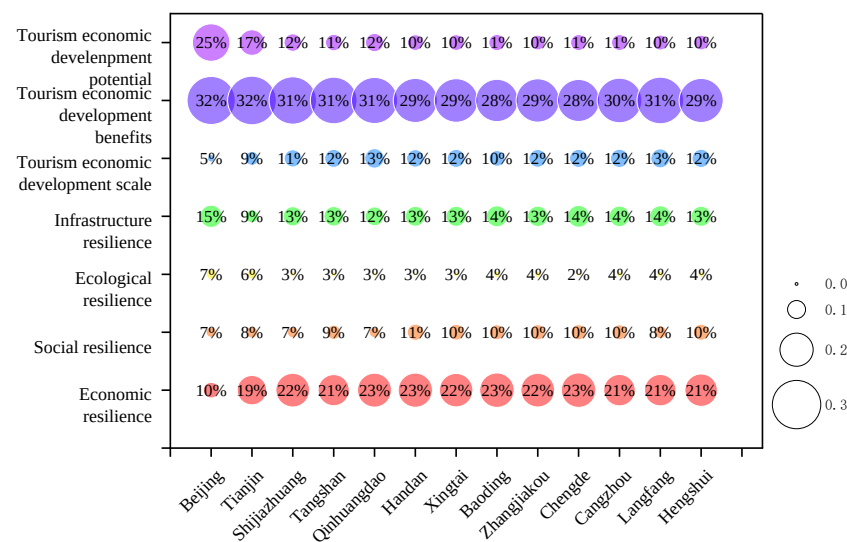


Figure 5. Obstacle factors of the coupling coordination system.

As shown in Table 3, the barrier structure of the dimension layer for the coupling coordination of urban resilience and the tourism economy was essentially stable from 2010 to 2021. The top two factors in terms of the average obstacle degree were consistently stable: tourism economic development benefits and economic resilience. It should be noted that within the system of urban resilience, the infrastructure resilience's obstacle degree fluctuated slightly and then decreased, while in the tourism economy system, the tourism economic development potential's obstacle degree increased significantly. This indicates that tourism's economic development factors have significantly increased their impeding effect on the coupling coordination of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region, and the inhibitory effect of infrastructure resilience has slightly increased. Therefore, focusing on the urban infrastructure resilience and improving the number of tourist arrivals and total tourism revenue are important directions for promoting the coordinated development of these two systems in the Beijing–Tianjin–Hebei region.

From Table 4, it is evident that the primary factors influencing the coupling coordination between urban resilience and the tourism economy at the index level within the urban resilience system are C4 (per capita fiscal income), C2 (per capita total retail sales of consumer goods), and C15 (number of buses per 10,000 people). Except for Beijing and Tianjin, the cities present the same top two obstacle indicators. In the tourism economy system, the primary factors influencing the coordination between urban resilience and the tourism economy include T2 (total tourism revenue), T1 (total number of arrivals), and T3 (total tourism revenue/GDP). Except for Beijing and Tianjin, the top three obstacle indicators are consistent across the cities.

Table 3. Obstacle degree for urban resilience and tourism economy systems at the dimension level.

Year	Urban Resilience System				Tourism Economy System		
	Economic Resilience	Social Resilience	Ecological Resilience	Infrastructure Resilience	Tourism Economic Development Scale	Tourism Economic Development Benefits	Tourism Economic Development Potential
2010	0.219	0.099	0.037	0.128	0.119	0.298	0.100
2011	0.218	0.097	0.038	0.131	0.117	0.302	0.097
2012	0.215	0.094	0.039	0.130	0.115	0.301	0.105
2013	0.210	0.091	0.038	0.130	0.114	0.302	0.116
2014	0.212	0.091	0.036	0.122	0.113	0.303	0.122
2015	0.207	0.090	0.038	0.134	0.111	0.300	0.119
2016	0.209	0.092	0.039	0.133	0.110	0.303	0.113
2017	0.207	0.095	0.039	0.142	0.110	0.282	0.125
2018	0.207	0.088	0.040	0.134	0.103	0.293	0.136
2019	0.210	0.092	0.040	0.141	0.098	0.287	0.132
2020	0.192	0.080	0.033	0.123	0.116	0.309	0.147
2021	0.192	0.079	0.034	0.123	0.110	0.309	0.152

Table 4. The main obstacle factors and obstacle degree of urban resilience and tourism economy systems at the indicator level.

	Urban Resilience System			Tourism Development System		
	1	2	3	1	2	3
Beijing	T3 (21.44)	T5 (12.95)	T4 (11.82)	C16 (5.09)	C13 (4.18)	C14 (3.73)
Tianjin	T2 (16.36)	T3 (15.85)	T1 (9.21)	C4 (7.64)	C2 (6.14)	C9 (3.72)
Shijiazhuang	T2 (19.04)	T3 (12.27)	T1 (11.47)	C4 (10.04)	C2 (6.02)	C15 (4.08)
Tangshan	T2 (18.84)	T3 (12.04)	T1 (11.98)	C4 (9.28)	C2 (5.49)	C15 (4.56)
Qinhuangdao	T2 (19.81)	T1 (12.85)	T3 (10.72)	C4 (10.02)	C2 (6.29)	C15 (4.56)
Handan	T2 (18.13)	T1 (11.53)	T3 (11.04)	C4 (9.63)	C2 (6.24)	C15 (4.61)
Xingtai	T2 (18.15)	T1 (11.92)	T3 (10.66)	C4 (9.41)	C2 (6.09)	C5 (4.87)
Baoding	T2 (17.52)	T3 (10.55)	T1 (10.45)	C4 (9.71)	C2 (6.23)	C15 (4.83)
Zhangjiakou	T2 (18.58)	T1 (11.81)	T3 (10.02)	C4 (9.57)	C2 (6.25)	C5 (4.61)
Chengde	T2 (18.51)	T1 (11.91)	T3 (9.30)	C4 (9.74)	C2 (6.37)	C15 (4.85)
Cangzhou	T2 (18.26)	T1 (12.14)	T3 (11.27)	C4 (9.07)	C2 (5.89)	C15 (4.67)
Langfang	T2 (19.20)	T1 (12.57)	T3 (11.58)	C4 (8.96)	C2 (5.96)	C15 (5.00)
Hengshui	T2 (18.19)	T3 (12.11)	T1 (10.96)	C4 (9.15)	C2 (5.89)	C5 (4.99)

5. Discussion

(1) The levels of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region generally demonstrate an upward trend, with each city experiencing varying degrees of growth from 2010 to 2021. This is consistent with the findings of Zhou et al. [46] and Li et al. [26]. In terms of spatial distribution, both systems exhibit a distinct regional coherence, typically characterized by a pattern of higher values in the center and lower values on the periphery. Notably, the high-value regions are primarily concentrated in Beijing, Tianjin, and their surrounding areas, whereas the low-value regions are predominantly found in the southern part of the region. Additionally, the differences between cities are obvious. Within the urban resilience system, ecological resilience has grown more slowly than the other subsystems' resilience. The Beijing–Tianjin–Hebei region has experienced significant infrastructure construction and economic development, which has enhanced urban resilience; yet, its internal development is still unbalanced. Hebei Province continues to struggle with issues like low levels of economic development, as well as inadequate infrastructure and public services. Therefore, in response to the advantageous resource elements of Beijing and Tianjin, the radiation capacity of the central cities to various cities in Hebei should be improved. In addition, facing many challenges such as environmental pollution control, energy conservation, and emission reduction, the Beijing–Tianjin–Hebei region should strengthen joint prevention and control, as well as ecological collaborative governance.

(2) During the course of this study, the coupling coordination degree of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region increased from 2010 to 2019, but it decreased from 2019 to 2021, mainly due to the impact of COVID-19 on tourism, which induced a severe global economic downturn [47]. From the spatial perspective, the regional differences in coupling coordination are obvious, forming a spatial pattern of high in the middle and low in the surrounding areas. The results of our research indicate that the coupling between urban resilience and the tourism economy in Beijing and Tianjin has always shown a high degree of coordination. This is different from the characteristics of strong wings on either side and a core depression in the Chengdu–Chongqing urban agglomeration [48]. There is a certain degree of spatial dependence and difference in the coupling coordination between urban resilience and the tourism economy in various cities in the Beijing–Tianjin–Hebei region. Although Hebei Province has made great contributions to the development of Beijing and Tianjin, it has not received much of a feedback effect. In addition, due to the backwardness of tourism’s development, the coordination between urban resilience and tourism development in most cities is not high.

(3) In terms of obstacle degree, tourism economic development benefits and economic resilience are the primary obstacle factors that restrict the coupling coordination of urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region. Per capita fiscal income, per capita retail sales of consumer goods, the number of buses per 10,000 people, total tourism revenue, total tourist arrivals, and the proportion of total tourism revenue in GDP are the top three specific obstacle indicators for the urban resilience and tourism economy systems, respectively. Due to the different economic levels and characteristic industries in Beijing, Tianjin, and Hebei Province, the specific performance of the obstacle indicators also differs slightly.

This study makes the following three key contributions to the study of urban resilience and the tourism economy: Firstly, this study comprehensively evaluated the levels of urban resilience and the tourism economy, as well as their coupling relationship, in the prefecture-level cities in the Beijing–Tianjin–Hebei region. Empirical methods such as the entropy weight method, empirical model, and obstacle model were used to quantitatively analyze the coupling and coordination relationship between urban resilience and tourism’s economic development, enriching the research findings on the relationship between the two. Secondly, this study made new improvements to the measurement indicators of urban resilience and the tourism economy, evaluating the degree of coordination between the two. As the largest urban agglomeration in northern China, the Beijing–Tianjin–Hebei region has relatively mature development experience and models in its urban infrastructure, tourism economy, policy environment, and other aspects, providing a case study contribution to the expansion of the coupling theory of urban resilience and the tourism economy. Finally, this study explored the obstacle factors of the coupling and coordination between urban resilience and the tourism economy in the Beijing–Tianjin–Hebei region, in order to provide a more scientific analysis of the coupling and coordinated development of the two systems.

6. Conclusions and Recommendations

6.1. Conclusions

This study constructed a comprehensive evaluation index system for urban resilience and the tourism economy to assess the degree of coupling coordination between the two systems in the Beijing–Tianjin–Hebei region. Additionally, we analyzed the temporal and spatial characteristics, as well as obstacle factors. The resilience levels of cities and the development levels of the tourism economy in the Beijing–Tianjin–Hebei region both increased, but the degree of growth varies in line with the actual development laws. The coupling coordination between urban resilience and the tourism economy in Beijing and Tianjin is relatively high, while the coupling coordination among cities in Hebei Province is relatively low. In terms of temporal evolution trends, the degree of coupling and coordination between the two systems increased before 2019 and weakened thereafter. At the level of obstacles, the coupling and coordination of urban resilience and the tourism economy are

the result of multiple factors, and economic resilience and tourist economic development benefits face stronger obstacles to the coordinated development of the two systems.

6.2. Policy Implications

First, we should strengthen the urban resilience and narrow the resilience gap among cities in the Beijing–Tianjin–Hebei region, as well as providing stable support for the development of the tourism economy. We should concentrate on the leading role of Beijing and Tianjin, actively provide resource support for the surrounding cities with low degrees of coupling coordination, and drive improvements in resilience and the high-quality development of the tourism industry. In the context of the coordinated development of Beijing, Tianjin, and Hebei, cities with low degrees of coupling coordination such as Xingtai, Hengshui, and Cangzhou should implement some measures. Optimizing the transportation network and extending the tourism industry chain can be adopted to promote the development of industrial linkages with surrounding cities, so as to promote coordinated development within the region.

Second, in view of the obstacles that restrict the coupling coordination of urban resilience and the tourism economy, cities in the region should improve the allocation efficiency of capital, talent, information, science and technology, and other resource factors, improve urban public service facilities, and foster the advancement of modern service industries, so as to enhance the resistance, resilience, and innovation of cities. At the same time, it is necessary to integrate tourism resources, innovate tourism products, increase tourism income and tourist arrivals, and stimulate the coordinated development of tourism in the region.

6.3. Limitations and Future Studies

This study has certain limitations, and there is scope for improvement. Due to limitations in data acquisition, the indicators of urban resilience and the tourism economy may not be comprehensive. In subsequent investigations, big data technology could be employed to discuss the coupling relationship between urban resilience and the tourism economy from multiple spatial and temporal scales. In addition, this study analyzed obstacle factors affecting the degree of coupling coordination, but the obstacle degree model lacks the capability to assess the interactions between variables. Therefore, in future studies, geographic detectors and other methods could be employed to investigate the interaction effects of various factors.

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