

ECONOMIC VULNERABILITY OF SPECIALIZED TOURISM CITY: A CASE STUDY IN SOUTHWEST OF CHINA

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Abstract: Global epidemics, wars, and lack of resources pose threats to society and the tertiary industry. After the world went through a period of de-globalization for a short period of time since the year 2019, the Global tourism industry suffers a fatal blow. The main objective of this paper is to evaluate the economic vulnerability of a specialized tourism city Dali (a typical tourism city in China) and propose risk avoidance strategies for its sustainable tourism development. This paper establishes a vulnerability assessment model from the aspects of sensitivity and responding capacity by using the set pair analysis (SPA) model to evaluate the economic vulnerability of Dali. The obstacle evaluation model and the entropy value method were used to analyze its obstacle factors. This research employs the National Economic and Social Development Statistics as its primary data source, augmented by the Statistical Yearbook and Yearbooks from different years. The results show that the change of the vulnerability of Dali's tourism economic system is relatively stable, but in general the vulnerability is at a high level in most years. According to the analysis of obstacle factors, the ratio of tourist arrivals to local population, Elasticity coefficient of tourism to industrial growth and National economy (GDP) output value are the main obstacles to reduce the vulnerability of Dali's tourism economy.

Key words: Tourism Industry Vulnerability, Tourism Specialization, Tourism Economic system, Sustainable Tourism Development, Set Pair Analysis

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INTRODUCTION

The global economy faces mounting challenges arising from epidemics, conflicts, and the unequal allocation of resources. Simultaneously, human beings and the natural environment share an interconnected existence, emphasizing the imperative of safeguarding and promoting sustainable development of the ecological milieu (Corrigan, 2014; Torvik, 2012; Pitlik et al., 2010). In light of these circumstances, it becomes crucial to explore avenues for sustainable development within the realm of global governance, system revitalization, comprehensive governance, eco-friendly progress, and inclusive participation. Since 2019, the advent of the COVID-19 pandemic has precipitated a brief phase of deglobalization and inflicted severe repercussions on the global tourism industry, thereby refocusing attention on the vulnerability of tourism from an economic perspective (Hojcska et al., 2022, Hojcska-Szabó, 2022).

Vulnerability is one of the important directions of current global change and sustainability scientific research. In recent years, relevant research results have shown a rapid growth trend. With the continuous development of vulnerability theory, vulnerability research has gradually expanded to the field of economics. In 1999, the United Nations Development Program (UNDP) formally proposed the concept of "economic vulnerability" and used it as a measure of the sustainable development of national and regional economies important indicators (Suhrke, 1999). Vulnerability research emphasizes how to achieve sustainable economic development by reducing system vulnerability, and has become one of the important analytical paradigms in the field of urban and regional economic research (Burton et al., 2002).

Tourism industry, as a typical service industry with strong sensitivity, is easily influenced by external environment and own factors (Huang et al., 2021, Kostilnikova et al., 2022). At the same time, it is difficult for cities developed with tourism resources to achieve industrial transformation and upgrading (Guillaumont, 2004). Under the combined influence of sensitivity factors and coping ability factors, the urban tourism economic system finally shows a certain vulnerability. The vulnerability of the tourism economic system is opposed to the sustainable development of tourism, and the degree of vulnerability determines whether the tourism city can achieve sustainable development (Student et al., 2020; Calgaro et al., 2014). Given the rapid growth of tourism, it is crucial to prioritize the vulnerability of the tourism economic system. By accurately predicting vulnerabilities, timely and effective measures can be implemented to mitigate risks and promote the sustainable development of the tourism economic system. Additionally, the resilience of tourism is shaped by the competitive advantage and specialization exhibited by each country (Koufodontis and Gaki, 2022).

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In academia, various methods like set pair analysis, principal component analysis, and TOPSIS are commonly used to assess the vulnerability of tourism economic systems (Li, 2013). For example, Li et al. (2021) applying the Delphi-AHP-TOPSIS algorithm to assess the environmental suitability of 684 cities in 2019. But more literature examines the consequences of tourism vulnerability, such as Qin and Chen (2022) conducted a comprehensive study on major tourist cities in China, developing a vulnerability index based on sensitivity and responsiveness. Their research revealed that cities heavily dependent on tourism, with limited economic diversification and weak institutional support, were more susceptible to economic shocks during the pandemic. They emphasized the need to address mechanisms such as reliance on external demand, limited capacity for innovation and adaptation, and inadequate risk management strategies to improve the resilience of tourist cities' economic systems in future crises. Huang et al. (2021) expanded on the analysis of tourism economic vulnerability (TEV) in major Chinese tourist cities, observing an increasing trend in the TEV index from 2010 to 2019, with coastal cities showing higher vulnerability than inland cities. They highlighted the importance of government measures in reducing TEV and promoting sustainable development in regional tourism. Understanding the spatiotemporal evolution of vulnerability allows policymakers to tailor interventions, mitigating adverse impacts from crises like the COVID-19 pandemic. Shifting the focus to Portugal, Lopes and Sargento (2021) explored the vulnerability of the Portuguese tourism and hospitality industry. The research emphasized the necessity of targeted support measures to address vulnerabilities specific to the Portuguese tourism and hospitality industry, ensuring a more inclusive and resilient recovery.

Existing literature primarily focuses on examining the aftermath of tourism economic vulnerability following emergencies. Nonetheless, the tourism industry is a multifaceted system influenced by numerous factors. This study aims to integrate both qualitative and quantitative elements into the decision-making process using mathematical methods. Moreover, it seeks to address and analyze the effects brought about by uncertain elements such as randomness, ambiguity, and incompleteness. By exploring uncertain systems, this research endeavors to unveil implicit knowledge and uncover underlying laws.

CONCEPT AND CHARACTERISTICS OF ECONOMIC VULNERABILITY OF TOURIST CITY

1. Concept of Economic Vulnerability

The study of vulnerability began in the disaster research in 1981. The scholar Timmerman first proposed the concept of vulnerability, which refers to the degree of damage suffered when adverse events occur (Timmerman, 1981). In 1990, at the UNCTAD conference held in Malta, the term "economic vulnerability" was first proposed; in 1992, Briguglio L. introduced vulnerability to the field of economic research and established the economic vulnerability index (Briguglio, 1992). In 1999, UNDP gave a formal definition of the term "economic vulnerability", arguing that economic vulnerability refers to the ability to deal with the damage caused by emergencies in the process of economic development. In 1999, UNDP gave a formal definition of the term "economic vulnerability", arguing that economic vulnerability refers to the ability to deal with the damage caused by emergencies in the process of economic development (Guillaumont, 2010). This paper argues that the economic vulnerability of tourist cities refers to an inherent property that the economic system of tourist cities is restricted by its own characteristics, sensitive to various disturbances inside and outside the system, and lack of coping ability, which makes the system structure and function easily damaged (Gesthuizen and Scheepers, 2010, Kozma, 2010). This property only manifests when disturbed.

2. Characteristics of Economic Vulnerability

The formation of the vulnerability of the tourism economic system is affected by many factors, which can be roughly divided into two aspects: external factors and internal factors of the system (Xie, 2008).

1) The external factors: The complex performance of the external environment of the tourist destination disturbs the tourism economic system. Xie Chaowu calls the external disturbance factors as emergencies outside the tourism industry, and divides them into political crises, social and cultural crises, and economic crises according to the nature of each event. There are four categories of crises and security crises, as shown in Figure 1.

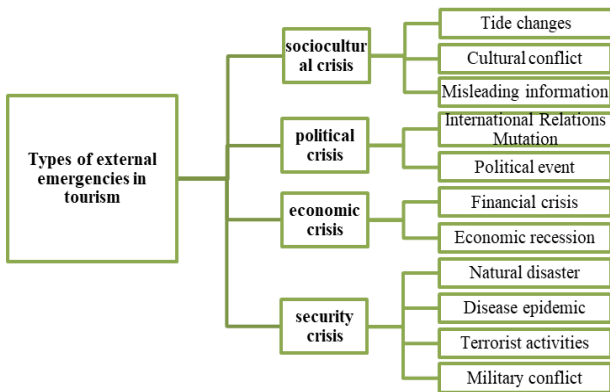


Figure 1. Types of external emergencies in tourism Types of external emergencies in tourism (source: Own compilation)

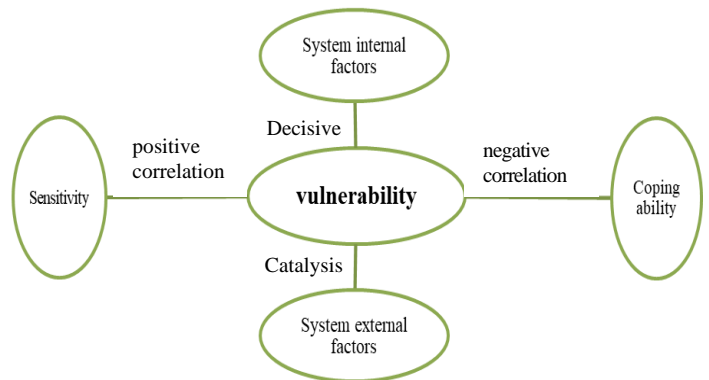


Figure 2. The formation mechanism of the vulnerability of the tourism economic system (Source: Author Modified from different sources)

2) The internal factors: The vulnerability of the tourism economic system is influenced by internal factors, specifically sensitivity and coping capacity. High sensitivity combined with low coping capacity increases the system's vulnerability. Sensitivity refers to the impact on the economic system of a tourist city during internal disturbances and

external shocks. Coping capacity, on the other hand, refers to the system's ability to respond to and recover from adverse impacts caused by various disturbances. This study considers both internal and external coping capabilities, using indicators that cover these factors. In summary, the vulnerability of the tourism economic system is determined by the balance between sensitivity and coping ability. When sensitivity outweighs coping capacity, the system becomes more vulnerable. Figure 2 illustrates how vulnerability increases with higher sensitivity.

RESEARCH METHODS AND MODEL BUILDING

1. Construction of evaluation index system

We finally selected indicators from two aspects: sensitivity and coping ability. In terms of sensitivity indicators, we mainly select five indicators directly related to the tourism economic system; in terms of coping ability indicators, we mainly focus on external economic and social factors. The indicators are selected from two aspects: internal tourism attraction factors. The positive and negative values of the indicator represent the direction of impact on vulnerability, the positive value represents a positive correlation between the indicator and vulnerability, and the negative value represents a negative correlation between the indicator and vulnerability.

Sensitivity index (Table 1) under the condition of certain coping ability, sensitivity and vulnerability are positively correlated. That is, the higher the sensitivity, the higher the vulnerability, and vice versa. Because the economic development of specialized tourism cities is highly dependent on tourism, tourism is the main influencing factor of the economic sensitivity of specialized tourism cities. Therefore, this paper focuses on the relevant indicators reflecting the level of dependence of regional economy on tourism to characterize the sensitivity of economy, which can be divided into two categories: one is the indicators directly reflecting the degree of dependence of regional economic development on tourism, such as S₁, S₄, S₅ and S₈; The other is an indicator that indirectly reflects the dependence of regional economic development on tourism through comparison with other industrial development, such as S₂, S₃, S₆ and S₇.

Among them, S₁ reflects the dependence of the economy on tourism, S₄ reflects the contribution of tourism foreign exchange income to exports, and S₈ reflects regional tourism, The level of industry development can be calculated by directly querying relevant data; S₂ reflects the unbalanced degree of industrial development and S₃ reflects the concentration degree of industrial development structure. S₅ reflects the response of tourism development to economic growth, S₆ reflects the response of tourism to industrial growth, and S₇ reflects the response of tourism to agricultural growth. The calculation method is as follows (Dritsakis, 2004; Sofield, 2003):

$$S_5 = \frac{\text{Growth rate of tourism income}}{\text{Growth rate of GDP}} \quad (1)$$

$$S_6 = \frac{\text{Growth rate of tourism income}}{\text{Growth rate of secondary industry}} \quad (2)$$

$$S_7 = \frac{\text{Growth rate of tourism income}}{\text{Growth rate of primary industry}} \quad (3)$$

$$H = \frac{1}{\sum_{i=1}^n X_i} \quad (4)$$

Coping capability index (Table 1): There are three main considerations in the selection of coping capacity indicators: one is an indicator reflecting the overall economic strength, R₁ reflects the economic aggregate, and R₂ reflects the economic growth capacity; R₆ reflects the contribution of the industrial structure to economic development, which reflects; the economic development capacity. Since investment, consumption and net export are the three major factors driving economic growth, they are represented by R₃, R₄ and R₅ respectively; the third is an indicator reflecting the resilience of the tourism industry. R₇ reflects the growth capacity of tourism economy, and R₈ reflects the attractiveness of tourism.

Among them, R₁, R₂, R₃, R₄, R₅, R₇, and R₈ can be directly queried. The calculation method of the R₆ industrial structure diversification index is as follows (Herfindahl and Hirschman, 1950): (The diversification index formula, also known as the Herfindahl-Hirschman Index (HHI), was developed by economists Orris C. Herfindahl and Albert O. Hirschman independently in the 1950s). In the industrial structure diversification index formula, X_i is the proportion of the added value of the i_{th} industry to GDP, and i is 1, 2, and 3 respectively)

Table 1. Vulnerability Evaluation Index of Tourism Economic System (Source: Author Modified from different sources)

primary indicator	code	Secondary indicators	properties
Sensitivity index	S ₁	Tourism revenue as a share of GDP (%)	+
	S ₂	Industrial Structure Gini Coefficient	+
	S ₃	The first degree of tourism industry	+
	S ₄	Proportion of tourism foreign exchange earnings in exports	+
	S ₅	Elasticity coefficient of tourism to GDP growth	+
	S ₆	Elasticity coefficient of tourism to industrial growth	+
	S ₇	Elasticity coefficient of tourism to agricultural growth	+
	S ₈	The ratio of tourist arrivals to local population	+
Coping capability index	R ₁	National economy (GDP) output value -	-
	R ₂	National economy (GDP) growth rate (%)	-
	R ₃	Fixed asset investment growth rate	-
	R ₄	Urban and Rural Consumption Growth Rate	-
	R ₅	export growth rate (%) -	-
	R ₆	Growth rate of total tourism revenue (%)	-
	R ₇	Industrial Structure Diversification Index	-
	R ₈	Tourism revenue growth rate	-

“+” indicates a positive correlation, “-” indicates a negative correlation

2. Determination and calculation of the weights of the vulnerability index

Using the entropy method to calculate the weight of the vulnerability index of the tourism economic system in Dali Prefecture, in this paper, the entropy value method commonly used in the objective assignment method is selected to calculate the weight. the calculation results are shown in Table 2. Calculate the contribution of the j_{th} index of the i_{th} year or the i_{th} evaluation object, and the calculation formula is (Chen et al., 2009):

$$P = \frac{x_{ij}}{\sum_{i=1}^m x_{ij}} \tag{5}$$

Calculate the information entropy of the j_{th} index of the i_{th} year or the i_{th} evaluation object, and the calculation formula is (Chen et al., 2009):

$$e_j = \frac{1}{\ln n} \sum_{i=1}^n p_{ij} \ln p_{ij} \tag{6}$$

In the formula, n represents the number of years or the number of evaluation objects. Calculate the effect value of the j_{th} index of the i_{th} year or the i_{th} evaluation object, and the calculation formula is (Chen et al., 2009):

$$d_j = 1 - e_j \tag{7}$$

Calculate the weight value of the j_{th} index of the i_{th} year or the i_{th} evaluation object, and the calculation formula is (Chen et al., 2009):

$$w_j = \frac{d_j}{\sum_{i=1}^n d_j} \tag{8}$$

3. Construction of Vulnerability Assessment Model

The tourist city economic system is an open and complex system, and there are many deterministic and uncertain factors. Therefore, this paper chooses the set-pair analysis method, which focuses on solving the problems of certainty and uncertainty in the system, to evaluate the degree of vulnerability of the tourist city's economic system. Set Pair Analysis (SPA) is a method for quantitative analysis of similarities, differences and inversions for deterministic and uncertain problems, which can effectively solve the problems of multi-objective decision-making and multi-attribute evaluation (Li, 2013a; Su and Zhang, 2010). The core idea of set pair analysis is to regard certainty and uncertainty factors as a system, and regard set A and set B that have a certain connection as a set pair H. Assuming that according to the needs of the problem W, we analyze the characteristics of the set pair H, and obtain a total of N characteristics, of which S characteristics are shared by set A and set B, P characteristics are set A and set B are opposed, and in the rest On the F =N -S -P features of , the set A and the set B are neither opposite, nor one (Zhao, 2000). Then the connection degree μ of set A and set B under specific problem W can be expressed as. Determine the optimal and worst scheme, and obtain the optimal value and the worst value vector (Su and Zhang , 2010):

$$D_i^+ = \sqrt{\sum_{j=0}^n (Z_{ij} - Z_j^+)^2 \alpha} = b \tag{9}$$

$$D_i^- = \sqrt{\sum_{j=0}^n (Z_{ij} - Z_j^-)^2 \alpha} = b \tag{10}$$

Calculate the overall evaluation value (Su and Zhang ,2010):

The comprehensive evaluation value Ci is between 0-1. A higher Ci value indicates a more fragile system, and vice versa (Xiang et al., 2022; Su et al., 2020; Li, 2013b).

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \tag{11}$$

4. Construction of Obstacle Assessment Model

The main function of the obstacle degree evaluation model is to calculate the degree of obstacles of each index to reduce the vulnerability of the tourism economic system, so as to determine the main factors affecting the vulnerability (Cutter, 1996; Watson et al., 1998; Briguglio, 1992). The larger the obstacle degree value, the greater the hindering effect of this index on reducing the vulnerability of the tourism economic system; the smaller the obstacle degree value, the less the hindering effect of this index on reducing the vulnerability of the tourism economic system. In this paper, the calculation formula of the obstacle degree evaluation model is given as (Su and Zhang , 2010):

$$Q_i = \frac{w_i \times F_i}{\sum_{i=1}^{16} w_i \times F_i} * 100\% \tag{12}$$

In the formula, Q_i is the fragility obstacle degree of the economic system; F_i is the index deviation degree, $F_i = 1 - x_i^*$ (x_i^* is the standardized value of the i_{th} index) (Zhang et al., 2021; Zhao et al., 2022; Chen et al., 2022).

RESEARCH AREA

Dali Prefecture is a famous tourist city in the southwestern border of China. It is one of the cities with an early start of tourism in Yunnan Province and even the whole country. Its rich tourism resources have enabled the rapid development of tourism in Dali Prefecture. Dali, situated in southwestern Yunnan Province, China, boasts a captivating blend of natural and cultural features. Geographically, it lies at approximately 25.6°N, 100.2°E, encompassing an area of 14,500 square kilometers (Figure 3). Dali Ancient City, enclosed by well-preserved Ming Dynasty city walls, retains its traditional architectural style and offers a glimpse into the region's historical heritage. To the east, Erhai Lake, covering 250 square kilometers, showcases scenic beauty with its clear waters mirroring the surrounding mountains. The Cangshan Mountain Range, with peaks exceeding 4,000 meters, serves as a picturesque backdrop to Dali and provides opportunities for hiking

and exploration. Moving south from Dali Ancient City, Xiaguan serves as the modern district and serves as the economic and transportation hub of the region. Noteworthy attractions in the vicinity include Xizhou and Zhoucheng villages, renowned for their Bai ethnic minority culture, traditional architecture, and tie-dye techniques.

Dali experiences a mild climate, characterized by warm summers (averaging 25-28 degrees Celsius) and cool winters (8-12 degrees Celsius). Spring and autumn offer pleasant temperatures and vibrant landscapes.

Dali's geographical composition, encompassing the ancient city, Erhai Lake, the Cangshan Mountains, and surrounding villages, showcases a captivating interplay of natural beauty and cultural heritage, making it a remarkable destination for exploration and appreciation of southwestern China's allure.

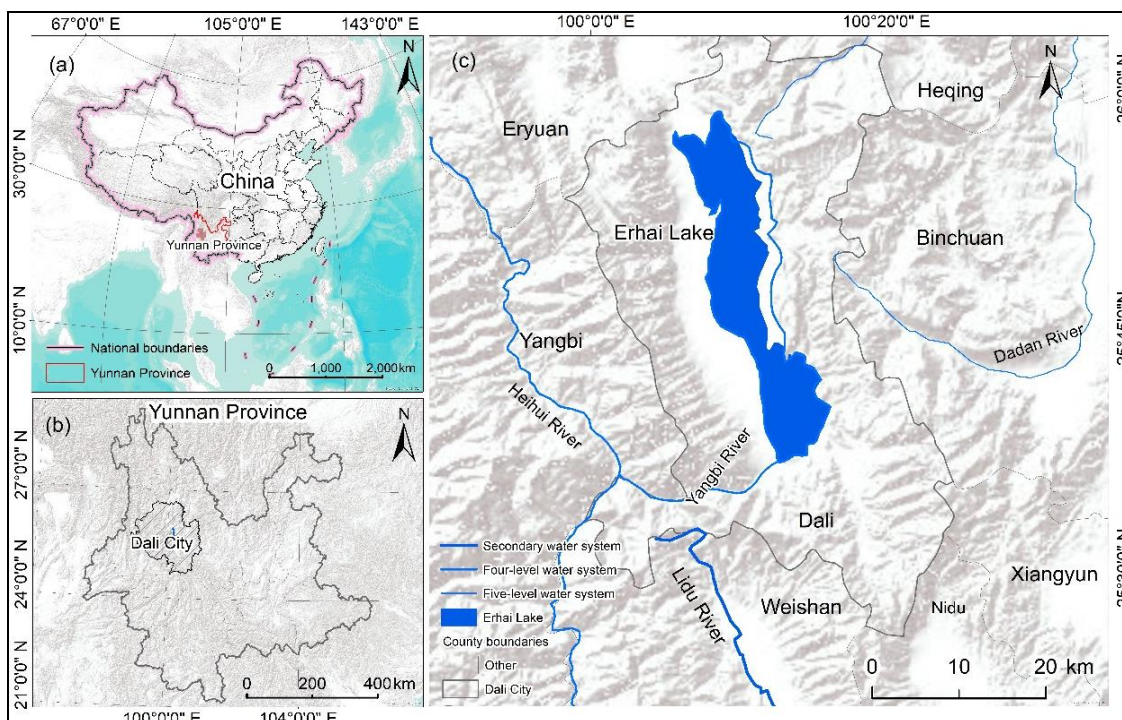


Figure 3. The location of the research area (Source: Own compilation)

In 2016, the tourism revenue of Dali Prefecture exceeded 5 billion yuan (1CNY= 0,12 EUR) for the first time, reaching 534.6 billion CNY, accounting for 54.9% of the GDP. In 2019, tourism revenue was 941.9 billion CNY, accounting for 67.68% of the GDP. It can be seen that tourism has become the pillar industry of Dali Prefecture. Since 2015, the local economy has been highly dependent on the development of the tourism industry. In 2020 and 2021, the epidemic will have a huge impact on the local tourism industry, and the local economy from tourism industry has been hit hard.

Table 3. The economy's dependence on tourism (Source: Data from Dali year books)

particular year	2015	2016	2017	2018	2019	2020	2021
Total tourism revenue (billion CNY)	388.4	534.6	647.8	795	941.9	604.6	539.5
GDP (billion CNY)	910.1	1026.7	1127.6	1254.8	1391.7	1484	1633
Tourism revenue as a share of GDP (%)	42.68%	52.07%	57.45%	63.36%	67.68%	40.74%	33.04%

Table 4. The evaluation results of the vulnerability of tourism economy in Dali (Source: Own compilation)

Particular year	Sensitivity	Coping ability	Vulnerability	Degree of vulnerability
2004	0.271748	0.46866	0.3670	moderately
2005	0.240159	0.503247	0.3231	low
2006	0.244324	0.437946	0.3581	moderately
2007	0.261539	0.521633	0.3339	moderately
2008	0.24231	0.445938	0.3521	moderately
2009	0.370759	0.578751	0.3905	moderately
2010	0.37002	0.685562	0.3505	moderately
2011	0.337589	0.645243	0.3435	moderately
2012	0.478494	0.655694	0.4219	moderately
2013	0.472507	0.657774	0.4180	moderately
2014	0.596404	0.563393	0.5142	higher
2015	0.53316	0.446586	0.5442	higher
2016	0.838263	0.666352	0.5571	highly
2017	0.649494	0.52269	0.5541	highly
2018	0.696765	0.546926	0.5602	highly
2019	0.917439	0.464007	0.6641	highly

VULNERABILITY EVALUATION RESULTS AND ANALYSIS

1. Vulnerability Analysis

Evaluation results: The entropy method was used to calculate the weight of the vulnerability index of the tourism economic system in Dali Prefecture from 2004 to 2019. According to the SPA model of formulas (1) - (5), the economic vulnerability, sensitivity and coping capacity of tourism cities are calculated Index (Table 4 and Figure 4). In order to reveal the economic vulnerability among tourist city, the vulnerability mean $M=0.4407$ and standard deviation $Std=0.1074$ as the evaluation basis, the economic vulnerability rm is divided into four categories (Table 5), In-depth analysis from two aspects of economic sensitivity and coping capacity. Economic system is divided into six levels: low vulnerability, moderate vulnerability, high vulnerability and high vulnerability. The results are shown in Table 5.

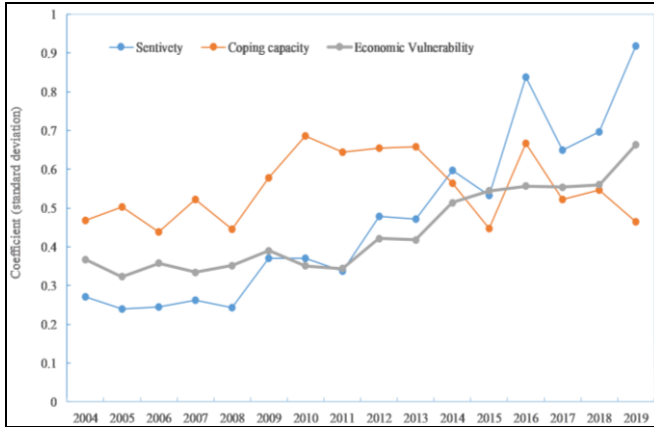


Figure 4. Line chart of tourism economic sensitivity, coping capacity, and vulnerability changes

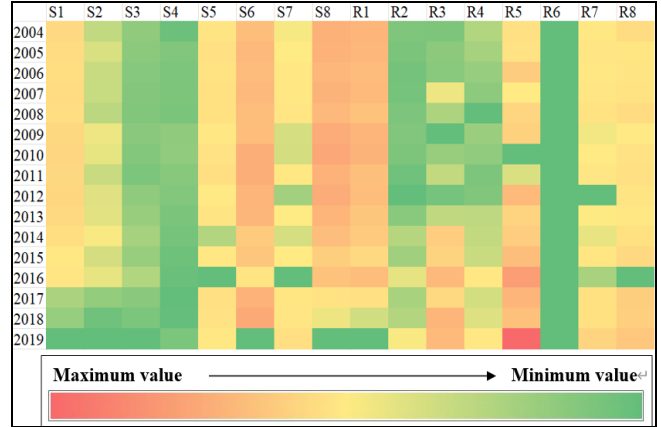


Figure 5. Visualization analysis applied in obstacle factor of tourism economic (2004-2019) (Source: Own compilation)

Table 5. Vulnerability classification evaluation of tourism economic system (Source: Own compilation)

Project	Grading standards			
	(0,M-Std]	(M-Std,M]	(M, M+Std]	(M+Std,1]
Vulnerability Index	(0,0.333]	(0.333,0.441]	(0.441,0.548]	(0.548,1]
Degree of vulnerability	low vulnerability	moderately vulnerable	higher vulnerability	highly vulnerable

M stands for mean, Std stands for standard deviation

Base on Table 4, Table 5, and Figure 3 show that the vulnerability of Dali's tourism economic system has shown a fluctuating upward trend in the past fifteen years.

In the 2008, the global financial crisis that broke and strong domestic inflation expectations, and the outbreak of the H1N1 virus, greatly affected the travel demand and travel ability of residents. The two reasons together led to the growth of Dali's tourism economic sensitivity and fluctuations; however, the government also quickly responded to the financial crisis with corresponding policies, and the coping ability was also significantly improved from 2009 to 2010. Therefore, after the 2008 financial crisis, Dali's tourism vulnerability did not have a significant effect.

From the year of 2015, the tourism industry in Dali Prefecture recovered rapidly. Sensitivity indicators such as the proportion of tourism revenue in GDP and the elasticity coefficient of tourism growth all maintained high values. Sensitivity has also increased, but the ability to respond has a downward trend relative to the sensitivity value from 2014, which led to a relatively fragile period for Dali's tourism economic system from 2015 to 2019.

The change of the vulnerability of Dali's tourism economic system is relatively stable, but in general the vulnerability of Dali's tourism economic system is at a high level in most years. In order to further explore the main factors hindering the decline of the vulnerability of Dali's tourism economic system, this paper adopts the obstacle degree model to carry out calculation and analysis, and obtain the research results.

2. Obstacle Assessment

Reducing system vulnerability is the key to sustainable economic development premise, in order to further reveal the obstacles to the economic development of cities.

The primary focus for reducing vulnerability entails the introduction of the obstacle degree concept. By applying calculation formula 12, the obstacle degree value of Dali's tourism economic system vulnerability over the preceding ten-year period is determined. The subsequent analysis of these results is visually presented and documented in Table 6.

According to the analysis of the visualization chart results, during the 2004 to 2014, the highly frequency obstacle indicators to reduce the vulnerability of tourism economy in Dali Prefecture are sensitivity (S_5, S_6) and coping ability (R_1); after the 2014 the coping ability (R_3, R_5) obstacles become increasingly prominent, during the 2014 to 2019 the mainly obstacle indicators gradually changed to R_3, R_5 .

Looking at the overall situation, in the early stage, it was restricted by the system's internal factors, which are the industrial structure of the region and its own economic development; in the later stage, it was restricted by external factors, that is, the boosting force of investment and exports to the industry.

And we select the top five indicators in each year (Table 6), and determine the main factors that hinder the reduction of the vulnerability of Dali's tourism economic system (Shown in Figure 5). On the whole, in the past fifteen years, the most frequent obstacles to the vulnerability of the tourism economic system in Dali Prefecture are the ratio of tourist arrivals to local population (S_8), Elasticity coefficient of tourism to industrial growth (S_6) and National economy (GDP) output value (R_1), which are the biggest obstacles to reducing the vulnerability of Dali's tourism economy; It is worth noting that the Sino-US trade war broke out in 2018, China's export economy was seriously affected, and the impact of the export economy on the local tourism industry was also shown in the obstacle analysis. Export growth rate (R_5) is called the maximum obstacle degree in the 2019 annual data.

Table 6. Table of top 5 Obstacle Factors of Tourism Economic System in Dali

Year	1st obstacle		2nd obstacle		3rd obstacle		4th obstacle		5th obstacle	
	index	obstacle	index	obstacle	index	obstacle	index	obstacle	index	obstacle
2004	S_8	0.1897	R_1	0.1795	S_6	0.1564	S_1	0.0885	R_8	0.0841
2005	S_8	0.1866	R_1	0.1747	S_6	0.1711	S_1	0.0812	S_5	0.0690
2006	S_8	0.1742	R_1	0.1608	S_6	0.1606	R_5	0.1216	S_1	0.0776
2007	S_8	0.1840	S_6	0.1707	R_1	0.1668	S_1	0.0844	S_5	0.0701
2008	S_8	0.1685	S_6	0.1604	R_1	0.1473	R_5	0.0996	S_1	0.0831
2009	S_8	0.2014	R_1	0.1780	S_6	0.1560	R_5	0.1100	S_1	0.0932
2010	S_8	0.2132	R_1	0.1964	S_6	0.1837	S_1	0.1004	S_5	0.0673
2011	R_5	0.1970	R_1	0.1876	S_6	0.1528	S_1	0.0930	S_5	0.0757
2012	R_5	0.2023	S_6	0.1789	R_5	0.1667	R_1	0.1564	S_1	0.0976
2013	S_6	0.1780	S_6	0.1777	R_1	0.1360	R_5	0.1009	S_1	0.0882
2014	S_6	0.1598	S_6	0.1249	R_1	0.1244	R_5	0.1196	R_3	0.1188
2015	R_5	0.1575	S_6	0.1375	S_8	0.1170	R_3	0.1042	R_1	0.0897
2016	R_7	0.2386	R_3	0.1691	R_1	0.1566	S_8	0.1450	S_6	0.0618
2017	S_4	0.1860	R_5	0.1780	R_8	0.1164	R_3	0.0901	S_5	0.0718
2018	S_5	0.2096	R_3	0.1781	R_5	0.1485	R_8	0.1151	R_7	0.0696
2019	S_1	0.3672	R_3	0.1672	R_8	0.1342	R_7	0.1011	S_7	0.0735

CONCLUSION

This study focuses on Dali Prefecture and establishes a vulnerability index system for the tourism economic system based on sensitivity and coping ability. The analysis reveals the following findings:

- Dali's tourism economic system exhibits an upward fluctuating trend in sensitivity, with a relatively stable ability to respond to small fluctuations. The vulnerability shows a steady increase, reaching a high level in most years.
- Factors impeding the reduction of Dali's tourism vulnerability include the ratio of tourist arrivals to the local population, the elasticity coefficient of tourism to industrial growth, and the national economy's output value (GDP).

Addressing the vulnerability of the tourism economic system requires considering both internal and external factors. Internally, optimizing the system's structure is essential. This involves focusing on customer sources, particularly by reducing the proportion of inbound tourists and foreign exchange income from tourism, which are more susceptible to external influences. Additionally, enhancing tourism attractiveness by leveraging local cultural resources is crucial to reduce vulnerability.

Externally, the development of the tourism industry is reliant on the external environment. Thus, optimizing the external environment can contribute to reducing vulnerability. The national economic growth rate, national economic output value, and industrial structure diversification index are significant obstacles hindering vulnerability reduction. Therefore, Dali Prefecture should prioritize developing the national economy, optimizing economic and industrial structures, and ensuring sustainable and healthy economic growth to provide favorable support for the tourism economy's development.

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