



Economic Vulnerability Assessment and Its Influencing Factors in Tourism-Dependent City of Zhangjiajie City, China

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Abstract: The emergence of the COVID-19 epidemic has caused a huge impact on the tourism industry in Zhangjiajie, and the economic vulnerability of Zhangjiajie as a tourism-dependent city has been exposed. In order to achieve high-quality and sustainable economic development, we took Zhangjiajie City in China as the research object and constructed the economic vulnerability assessment index system of tourism-dependent cities. Then we selected the vulnerability index values of Zhangjiajie's urban economic system in 10 years from 2011 to 2020 as the research data, and using the improved Critic method, S/R model, obstacle model and other research methods, we quantitatively analyzed and assessed the economic system vulnerability of Zhangjiajie City, revealing the characteristics and main factors contributing to the economic system vulnerability of Zhangjiajie City. The research results show that the economic development of Zhangjiajie has been in a medium and high vulnerability state for a long time. The main obstacles to the sustainable economic development of Zhangjiajie are the small proportion of educational funds, the over-dependence on tourism for economic development, the high proportion of the number of foreign tourists in the total number of tourists, the large elasticity of urban registered unemployment rate, and the low degree of industrial structure diversification. Finally, the suggestions are putting forward, which include increasing investment in education, diversifying tourism forms, diversifying economic and industrial structure, developing cultural and sports industries. These suggestions are helpful to reduce vulnerability of a tourism-dependent city and ensure its high quality and sustainable development of economy.

Keywords: Tourism-Dependent Urban Economy, Vulnerability Assessment, Influencing Factors, Zhangjiajie

1. Introduction

The concept of vulnerability has been widely discussed in many disciplines, and the study of vulnerability has become one of the predominant fields within environmental change and sustainable development [1]. The first scientific understanding of vulnerability originated in the scientific study of natural disasters and was first proposed by Timmerman in 1981. Influenced by global climate and environmental changes, frequent natural disasters and other factors, research on vulnerability by scholars from numerous fields has gradually extended from the field of natural science

to the field of social science. With the extension of the scientific research field and the deepening of practical research, the basic concept of "vulnerability" has been enriched, gradually developing into a comprehensive theory including a series of other, closely related, basic concepts, such as "risk", "sensitivity", "adaptability" and "resilience". In recent years, vulnerability has been widely used in geography, ecology, economics, engineering and other disciplines, and the theoretical methods applied to this concept are also gradually being improved.

Vulnerability research mainly focuses on ecological vulnerability and economic vulnerability. Regarding the aspect

of ecological vulnerability, scholars at home and abroad have conducted extensive research. Brooks *et al.* studied the development of vulnerability and capacity indicators for adaptation to climate disasters at the national level [2]. Adger *et al.* focused on the synergies between vulnerability studies and socio-ecological resilience studies [3]. Turner *et al.*'s research adopted the main theme of sustainable development and expanded and reoriented the focus of vulnerability analysis in several ways [4]. Considering the different landforms and different degrees of regional ecosystem vulnerability, the karst area, Loess Plateau, Tarim River basin are taken as examples and carried out comprehensive evaluation and research on ecosystem vulnerability [5-8]. The key to reducing ecosystem vulnerability is to rebuild the vegetation ecosystem and improve the agro-pastoral ecosystem.

In 1999, the United Nations decided to establish "economic vulnerability" as an important indicator to measure the degree of sustainable development of the economies of all countries and regions of the world. Economic vulnerability refers to the exposure of an economy to external shocks due to its inherent characteristics, and economic resilience is the policy guidance ability of the economy to recover from the impact of adverse shocks. Economic vulnerability is an important attribute of the regional economic system. The research on economic vulnerability shows a trend of cross-integration among different disciplines, and it is recognized by scholars in different fields. In the 21st century, the research on vulnerability tends to be diversified, and the research focus has shifted towards the vulnerability of resources and socio-economic systems. At the same time, the introduction of quantitative analysis models and measurement technology has made the study of vulnerability more scientific and standardized. Some representative scholars, such as, Patela *et al.* have used the SCADA method to evaluate the security of important information systems as part of a quantitative vulnerability assessment [9]. Guo *et al.* evaluated the economic system vulnerability of tourist cities based on set pair analysis. Based on the improved CRITIC method, Liu and Wei conducted the measurement of the new urbanization level in Western China. Hofmann *et al.* analyzed the factors contributing to the economic vulnerability of typical tourism cities in China, and Yang *et al.* explored this from the perspective of regions that are economically dependent on tourism and studied the sustainable development of a regional economy with rich tourism resources [10-13].

At the beginning of 2020, the emergence of the COVID-19 epidemic had a huge impact on all walks of life around the world. The tourism industry, characterized by comprehensiveness, extroversion and non-locality, has been particularly affected. Zhangjiajie City is an internationally recognized tourist city. Zhangjiajie City's economic and social development mainly relies on its tourism industry, which is based on a traditional ticket income, and it is especially responsible for the satisfaction of Zhangjiajie's citizens.

The research methods applied in this paper combine the improved critic method, S/R model, obstacle model and other research methods. Based on the concept of sustainable

development and the existing research, we construct a vulnerability evaluation index system for Zhangjiajie's economic system while analyzing the tourism development status as a result of the epidemic. The vulnerability assessment model of the urban economic system is used to quantitatively analyze and evaluate the vulnerability of Zhangjiajie's economic system from 2011 to 2020 and then reveal the characteristics and main influencing factors associated with Zhangjiajie's economic system vulnerability. The purpose is to put forward reasonable suggestions to improve the economic stability and sustainable development of Zhangjiajie City in response to the epidemic situation, and to provide a reference that has relevance for the sustainable economic development of similar tourism-dependent cities.

2. Overview of Study Area and Data Source

2.1. Overview of Study Area

Zhangjiajie City, located in Central China, is a prefecture-level city under provincial jurisdiction. Zhangjiajie is home to the first national forest park in China, so tourism has become a pillar industry in Zhangjiajie. Zhangjiajie has a total area of 9,653 km². In 2020, Zhangjiajie had a permanent population of 1,549,000 and a GDP of 55.668 billion yuan. The city, characterized by a quartz sandstone peak forest landscape, has won the titles of "China's Most Overseas Influential City", "National Double Support Model City", "National Forest City", "Green Development Excellent City" and "China's Most Eco-Competitive City". Zhangjiajie city has 26 tourist attractions, including 12 above 4A. In 2019, Zhangjiajie received 79.123 million domestic tourists and 1.37 million inbound tourists. The total tourism revenue reached 90.56-billion-yuan, accounting for 91% of the GDP. Tourism is the most important industry in Zhangjiajie. In 2020, the total tourism revenue was 56.9 billion yuan, a decrease of 31.50% from the previous year, and the number of domestic and foreign tourists received was 49.492 million, a decrease of 26.40%. It can be seen that the COVID-19 epidemic has exerted a strong impact on the economic development of Zhangjiajie City and also exposed the economic vulnerability of the region.

2.2. Data Source

We referred to the Statistical Yearbook of Zhangjiajie City, and searched the Statistical Bulletin of National Economic and Social Development of Zhangjiajie City from 2011 to 2020 to obtain the original statistical data of relevant evaluation indicators, which are presented in Table 1.

3. Research Methods

3.1. Economic System Vulnerability Assessment Model of Zhangjiajie City

The S/R model is one of the most commonly used models in the study of regional economic vulnerability assessment [14,

15]. The model considers that regional economic vulnerability has a positive correlation with the sensitivity of economic development to disturbance and a negative correlation with the ability to deal with disturbances. In this study, we built a model to evaluate the economic vulnerability of Zhangjiajie City from 2011 to 2020. The formula is

$$EV_i = \frac{S_i}{R_i} \quad (1)$$

where EV_i refers to the economic vulnerability value in the i th year of the region, S_i refers to the economic development sensitivity value in the i th year of the region, and R_i refers to the economic development resilience value in the i th year of the region.

3.2. Analysis Model of Economic System Barriers in Zhangjiajie City

The obstacle degree analysis model can calculate the disorderly reduction degree of each index with regard to the economic system vulnerability, and determine the main factors affecting the economic vulnerability reduction, so as to take targeted measures to reduce the economic vulnerability. Therefore, this paper introduces the barrier model to identify the barriers that reduce the vulnerability of the economic system. The formula for the calculation of the economic vulnerability barrier is:

$$F_{ij} = w_{ij} \cdot w_j \quad (2)$$

$$I_{ij} = 1 - Y_{ij} \quad (3)$$

$$P_{ij} = \frac{F_{ij} \cdot I_{ij}}{\sum_{i=1}^m (F_{ij} \cdot I_{ij})} \times 100\% \quad (4)$$

where w_{ij} is the weight of the criterion layer where the index is located, and w_j represents the weight of the index in the criterion layer. In addition, Y'_{ij} is the value of the i th indicator after standardization. The higher the obstacle degree of an indicator—that is, the greater the P_{ij} —the greater the obstacle degree of the indicator to reduce the vulnerability of the economic system, and vice versa.

3.3. Establishment of Evaluation Index System and Determination of Weight

Based on the concept of sustainable development and the full consideration of regional characteristics and relevant research results, 14 indicators were selected from “sensitivity” to “resilience” to construct the vulnerability evaluation index system for tourism-dependent urban economic systems (Table 1). The sensitivity index is used to reflect such attributes and characteristics as the degree of dependence of the urban economy on tourism, the degree of dependence of tourism on overseas tourism and the potential expansion of the tourism market scale. The coping ability index is used to reflect the comprehensive economic strength of the city, the capacity of urban tourism economic growth and the elasticity of tourism economic growth to economic growth.

Table 1. Economic Vulnerability Assessment Indicator System of Tourism-Dependent Cities.

Target	Sub-target layer	Code	Indicators	Indicator interpretation	Indicator weight
The Economic Vulnerability Index of Tourism - dependent Cities	Sensitivity (+)	S1	Proportion of total tourism income to GDP (%) (+)	Reflect the dependence of urban economy on tourism	0.075916
		S2	Proportion of tourism foreign exchange income in total tourism income (%) (+)	Reflect the dependence of tourism on overseas tourism	0.05679
		S3	Proportion of inbound tourists to total tourists (%) (+)	Reflect the degree of attraction to overseas tourists	0.064065
		S4	Urban registered unemployment rate (%) (+)	Reflect urban unemployment	0.123492
		S5	Urbanization rate (%) (-)	Reflecting the potential for expansion of the tourism market	0.050473
	Resilience (-)	S6	GDP growth rate (%) (-)	Reflect economic development	0.050203
		S7	Sewage treatment rate (+)	Reflect the ecological environment	0.055649
		R1	GDP per capita (yuan) (+)	Reflect the comprehensive economic strength of the city	0.058811
		R2	Total tourism revenue growth rate (%) (+)	Reflect the growth capacity of urban tourism economy	0.082545
		R3	Elasticity coefficient of tourism growth (%) (+)	Reflect the elasticity of tourism economic growth to economic growth	0.084097
		R4	Growth rate of tourist reception (%) (+)	Reflect the degree of tourist attraction of the city	0.082675
		R5	Industrial structure diversification index H (+)	Reflect the composition of urban economic industry	0.069353
		R6	Proportion of education expenditure in local fiscal expenditure (%) (+)	Reflect the city's investment in improving the quality of labor force	0.097123
		R7	Urban and rural per capita savings deposits (yuan) (+)	Reflect the economic capacity of urban residents	0.048807

Note: Elasticity coefficient of tourism growth = annual average growth rate of total tourism revenue / annual GDP growth rate, which refers to how many percentage points of economic growth can be driven by every 1 percentage point of tourism growth. Industrial structure diversification index, where, is the proportion of the added value of the i th industry in GDP ($i=1,2,3$). The higher the H value, the higher the diversification degree of the regional industrial structure. $H = \sum I_i \ln I_i$.

If the nature of the sensitivity index is positive (+), this means that the greater the value of the index, the stronger the

sensitivity of the tourism economic system, the weaker the ability of the tourism economic system to bear the damage and the greater its vulnerability; moreover, if the nature of the coping index is positive (+), this means that the greater the value of the index, the stronger the coping ability of the tourism economic system, and the stronger its capacity for self-maintenance and adaptation. If the nature of the sensitivity indicator is negative (-), this means that the larger the indicator's value, the weaker the sensitivity of the tourism economic system and the stronger the ability of the tourism economic system to bear the damage; if the coping indicator is positive (+), this means that the larger the indicator value, the weaker the coping ability, and the more difficult it is for the system to adapt to an emergency. When the vulnerability of the tourism economic system is high, this indicates that the ability of the tourism economic system to bear the damage of various crises is poor, the speed of the tourism economic system to recover to a stable state is slow, but, on the contrary, the tourism economic system is safer.

We use the improved CRITIC weighting method to determine the weight. The CRITIC method is an objective weighting method. The basic idea is to comprehensively measure the weight of the index from the two dimensions of contrast intensity and conflict. In this method, the standard deviation is used to characterize the contrast intensity of the index—that is, the size of the index value difference. The larger the standard deviation is, the greater the fluctuation of the index value is and the higher the weight is. The correlation coefficient is used to characterize the conflict of the index. The greater the degree of positive correlation of the index, the smaller the conflict and the lower the weight. On the contrary, the larger. Compared with the traditional CRITIC method, the improved CRITIC weighting method can better reflect the degree of variation and mutual obstruction of the index, while eliminating the obstruction of equal correlation between positive and negative correlation coefficients of the absolute value, so as to meet the requirements that the calculated results are more consistent with the actual results [16, 17]. The specific algorithm is as follows:

(i). Standardization treatment:

Step 1: Calculation of positive indicators:

$$X'_{ij} = \frac{(X_{ij} - \min X_j)}{(\max X_j - \min X_j)} \quad (5)$$

Step 2: Calculation of negative indicators:

$$X'_{ij} = \frac{(\max X_j - X_{ij})}{(\max X_j - \min X_j)} \quad (6)$$

Step 3 is to calculate the specific gravity of the index value of item j in year i:

$$Y'_{ij} = \frac{X'_{ij}}{\sum_{i=1}^m X'_{ij}} \quad (7)$$

Y'_{ij} is the value after standardization. However, the result of the index data may be 0 after standardization. In this study, all of the data after standardization were shifted to the right by 0.01 units, i.e., $Y_{ij} = (Y'_{ij} \times 0.9) + 0.01$, so that the value of 0 after standardization is significant.

(ii). SPSS software was used to calculate the standard deviation and correlation coefficient of each index data. $s_j r_{ij}$

(iii). We then calculated the information amount of each index C_j :

$$C_j = s_j \sum_{i=1}^n (1 - |r_{ij}|) \quad (8)$$

(iv). Next, we calculated the weight of each index:

$$w_j = C_j / \sum_{j=1}^n C_j \quad (9)$$

4. Vulnerability Assessment and Analysis of Factors Influencing of Economic System in Zhangjiajie City

4.1. Economic System Vulnerability Assessment and Evolution Trend Analysis of Zhangjiajie City

4.1.1. Evaluation Results

In this study, the improved critic weighting method was used to calculate the weight of each index, and then the S/R model was used to measure the sensitivity, resilience and vulnerability of the economic system of Zhangjiajie City from 2011 to 2020 (Table 2). According to Table 1, we drew the evolution curve of relevant index values of Zhangjiajie's economic system from 2011 to 2020 (Figure 1).

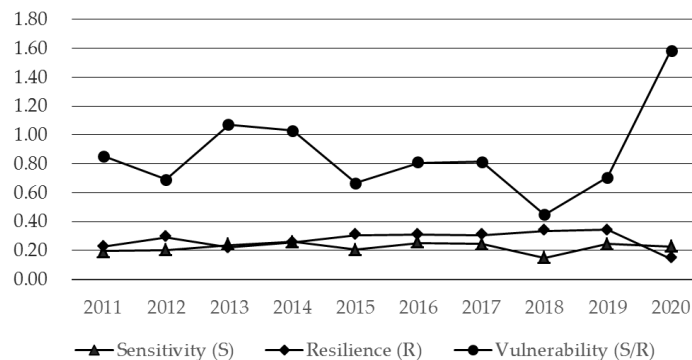


Figure 1. Trend of Economic Vulnerability, Sensitivity and Resilience Index in Zhangjiajie City from 2011 to 2020.

Table 2. Economic System Vulnerability Assessment Results of Zhangjiajie City from 2011 to 2020.

	Sensitivity (S)	Resilience (R)	Vulnerability (S/R)
2011	0.19450314	0.22715105	0.85627223
2012	0.20195885	0.29122737	0.69347483
2013	0.23736030	0.22163270	1.07096244
2014	0.26174338	0.25432034	1.02918773
2015	0.20419673	0.30570945	0.66794379
2016	0.25050036	0.31062223	0.80644699
2017	0.24735784	0.30430922	0.81285030
2018	0.14885203	0.33376867	0.44597366
2019	0.24351519	0.34382963	0.70824377
2020	0.22765165	0.14393908	1.58158336

4.1.2. Result Analysis

The economic system vulnerability of Zhangjiajie City from 2011 to 2020 was divided into four levels, i.e., low

vulnerability, medium vulnerability, high vulnerability and extreme vulnerability, using the mean–standard deviation classification method [18, 19] (Table 3).

It can be seen from Tables 2 and 3 that the degree of economic system vulnerability of Zhangjiajie City in 2011–2020 generally showed a fluctuating upward trend, among which one year (2018) experienced a low degree of vulnerability, with a vulnerability value of 0.446; six years (2011, 2012, 2015, 2016, 2017, 2019) experienced a medium degree of vulnerability, with vulnerability values of 0.856, 0.693, 0.668, 0.806, 0.813, 0.708; two years (2013, 2014) experienced a high degree of vulnerability, where the vulnerability values were 1.071 and 1.029, respectively; during one year (2020), the system was extremely vulnerable, with a vulnerability value of 1.582.

Table 3. Vulnerability Classification Standard.

Project	Classification criteria			
	(0, V-B]	(V-B, V]	(V, V+B]	(V+B, 2]
Vulnerability index	(0, 0.574]	(0.574, 0.867]	(0.867, 1.160]	(1.160, 2]
Degree of vulnerability	Low vulnerability	Moderate vulnerability	High vulnerability	Extremely fragile

4.1.3. Analysis of Evolution Trend

It can be seen from Figure 1 that, during the research period, the trend change of each index value for the economic system of Zhangjiajie City was obvious, and it can be roughly divided into two stages.

Phase I (2011–2013): During this period, the resilience of Zhangjiajie's economic system decreased, and the sensitivity and vulnerability, which formed a “V” shape, increased. In 2013, due to the yellow card warning given to the Zhangjiajie World Geopark by the United Nations Educational, Scientific and Cultural Organization (UNESCO), and other tourism crisis events, the annual number of tourists and the total tourism revenue of Zhangjiajie City decreased significantly, the sensitivity of Zhangjiajie City's economic system increased, the resilience decreased, and the overreliance of the economic development of Zhangjiajie on tourism was gradually exposed.

Phase II (2014–2020): In addition to the obvious abnormal changes in each indicator in 2020, the sensitivity and vulnerability indicator values generally showed a gradually rising trend in fluctuation, and the vulnerability formed a “W”-shaped change trend. In 2020, Zhangjiajie City faced increasing downward economic pressure, the highest rainfall ever experienced and, in particular, the severe impact of the COVID-19 epidemic. Therefore, the number of tourists, the total tourism revenue and the overall tourism benefits were significantly reduced, as well as the tourism system's resilience. In order to reduce the sensitivity of the economic system, Zhangjiajie City has taken a series of measures, such as holding half-marathons, extreme sports festivals and other large-scale events. These measures, which are limited to the

tourism economy and have obvious randomness, cannot effectively reduce the sensitivity of its economic system; rather, they highlight the vulnerability of the system.

4.1.4. Relationship Between Economic System Sensitivity, Resilience and Vulnerability in Zhangjiajie City

In order to reveal the relationship among economic system sensitivity, resilience and vulnerability in Zhangjiajie City, in this study, we conducted multiple linear regression analysis on the changes in the above three indicators from 2011 to 2020, and we obtained the following regression equation:

$$V = 1.36 + 3.057S - 4.279R (R^2 = 0.938) \quad (10)$$

In Eq. (10), S, R and V are the sensitivity, coping ability and vulnerability of Zhangjiajie's economic system, respectively, and the significance level of the model is 0.00, which passes the test. The results of the regression analysis showed that vulnerability (V) increased by 3.057 units per unit of sensitivity (S), and vulnerability (V) decreased by 4.279 units per unit of resilience (R). Therefore, the impact of resilience on vulnerability was more significant, indicating that the current resilience has a deeper impact on Zhangjiajie's economic system vulnerability.

4.2. Analysis of Factors Influencing Economic System Vulnerability in Zhangjiajie City

We input the data into Eqs. (5)–(7) for standardization processing and input the standardized data into Eqs. (2)–(4) to calculate and screen out the top five indicators in 2011–2020, in order to identify the following main factors affecting the economic vulnerability of Zhangjiajie City (Table 4).

Table 4. Main Obstacles Affecting Economic Vulnerability Reduction in Zhangjiajie City.

Urban	Year	First Obstacle		Second Obstacle		Third Obstacle		Fourth Obstacle		Fifth Obstacle	
		Indicators	Barriers	Indicators	Barriers	Indicators	Barriers	Indicators	Barriers	Indicators	Barriers
Zhangjiajie City	2011	R6	0.170471	R5	0.124134	S1	0.123724	S4	0.122848	S7	0.090695
	2012	S4	0.167281	S1	0.135412	R5	0.126072	R1	0.120733	R7	0.090876
	2013	S1	0.129571	R5	0.114249	S4	0.108511	R4	0.101497	R2	0.087976
	2014	S1	0.141686	R6	0.140435	R5	0.117929	R1	0.079967	R7	0.075171
	2015	R6	0.185288	S1	0.122224	R5	0.095927	S3	0.091670	S4	0.085055
	2016	R6	0.193040	S1	0.118142	S3	0.101810	R5	0.086823	S2	0.080705
	2017	R6	0.219368	S3	0.115360	S2	0.101865	S5	0.082034	S1	0.080617
	2018	S4	0.228086	R6	0.197008	S3	0.100261	S2	0.090444	S5	0.080349
	2019	R6	0.231429	S4	0.158665	S3	0.112007	S5	0.111667	S2	0.072260
	2020	R6	0.150136	R3	0.137355	R4	0.135033	R2	0.134820	S3	0.095275

**Figure 2.** Main Obstacles Affecting Economic Vulnerability Reduction in Zhangjiajie City.

It can be seen from the above table that the first factor hindering the reduction of the economic vulnerability of Zhangjiajie City has changed slightly in the last ten years. Specifically, the most significant factor for Zhangjiajie City in 2011, 2015-2017 and 2019-2020 was the proportion of education expenditure in the local financial expenditure (R_6); the most important obstacle in 2013 and 2014 was the proportion of total tourism income among the GDP (S_1); the most important obstacle in 2012 and 2018 was the registered urban unemployment rate (S_4).

In terms of the frequency of occurrence of the obstacles, the factors most frequently affecting the economic system vulnerability of Zhangjiajie City from 2011 to 2020 were the proportion of education expenditure within the local financial expenditure (R_6), which was 8 times, and the proportion of total tourism income within the GDP (S_1), which was 7 times; in addition, the proportion of inbound tourism among total tourism (S_3), the urban registered unemployment rate (S_4) and the industrial structure diversification index (R_5) occurred 6 times.

In summary, the proportion of education expenditure within the local financial expenditure has had the largest impact on Zhangjiajie's economic system vulnerability among the 14 indicators. In the context of the knowledge economy era, the demand for high-quality talent is increasing continuously. With regard to the relationship between economic growth and education expenditure, many scholars at home and abroad have mentioned that education has undoubtedly played an important role in economic development. The investment of education funds plays a significant role in promoting

sustainable economic development. Therefore, it is a realistic requirement to ensure the stability of education expenditure. An increase in education expenditure would also be an effective means to improve the region's ability to cope with economic vulnerability [20].

Secondly, the proportion of total tourism income among the GDP represents a relatively obvious contribution to Zhangjiajie's economic vulnerability. In Zhangjiajie City, "with tourism to establish the city, tourism to strengthen the city", the contribution rate of tourism tax to the overall financial revenue occupies an important position, and the role of tourism in Zhangjiajie City's economic relevance has gradually strengthened. On the one hand, the development of tourism plays an important role in promoting regional economic development, but it is hindered by such factors as ecological damage, economic structure simplification, resource depletion or deindustrialization [21]. The high dependence of Zhangjiajie on tourism is also responsible for the high sensitivity of Zhangjiajie's economic system and its low adaptability to sudden public health events, which brings the risk of economic vulnerability.

Tertiary industry development has an important influence in terms of alleviating unemployment. The service industry is a labor-intensive industry with strong absorption capacity and high employment elasticity. Tourism occupies an important position within the tertiary industry, and Zhangjiajie's tourism industry is responsible for providing urban and rural employment opportunities. Once tourism suffers, the urban unemployment rate will be affected by elasticity. Therefore,

the unemployment rate of cities and towns reflects whether the economic system is stable [22].

With the development of tourism in Zhangjiajie, the benefits brought about by the externality of industrial specialization has decreased. The transformation of the industrial structure from a “one-level concentration type”, with a single industry as the main body, to a “multi-polar type”, with both potential growth and strategically emerging industries developing together, is one of the means to improve Zhangjiajie's ability to cope with economic vulnerability [23]. At the same time, in recent years, inbound tourists visiting Zhangjiajie City have occupied a large share of the tourist market of the region. However, the development of the international market is restricted by such factors as tourism carrying capacity, traffic, language and consumption habits [24].

5. Conclusions and Suggestions

Under the normalization of epidemic situation, the question of how to reduce urban economic vulnerability and realize the sustainable development of the urban economy in Zhangjiajie remains unsolved, and it is the main focus of this paper.

- (1) According to the vulnerability assessment results, the economic system vulnerability of Zhangjiajie City from 2011 to 2020 generally shows a fluctuating upward trend, including 1 year (2018) in a low-vulnerability state, 6 years (2011, 2012, 2015, 2016, 2017, 2019) in a medium-vulnerability state, 2 years (2013, 2014) in a high-vulnerability state and 1 year (2020) in an extreme-vulnerability state. During the first stage (2011-2013), the economic system indicators of Zhangjiajie City showed an upward trend, forming a “V”-shaped change trend. During Phase II (2014-2020), in addition to the obvious abnormal changes in each indicator in 2020, the sensitivity and vulnerability indicator values generally show a gradually rising trend in fluctuation, forming a “W”-shaped change trend. The results show that the economic development trend of Zhangjiajie is generally good, but the dependence on the traditional tourism industry is too strong, and the city's poor resilience when dealing with public emergencies directly affects the high-quality and sustainable development of Zhangjiajie's tourism economy.
- (2) From the perspective of obstacle factors, the first five factors hindering the sustainable economic development of Zhangjiajie City from 2011 to 2020 are the proportion of education expenditure within the local financial expenditure (R_6), the proportion of total tourism income within the GDP (S_1), the proportion of inbound tourism within total tourism (S_3), the registered urban unemployment rate (S_4) and the industrial structure diversity index (R_5). The results of the obstacle degree analysis show that the economic development of Zhangjiajie is highly dependent on the tourism industry, and the characteristics of the tourism industry, such as comprehensiveness, extroversion and non-localization, make it very unstable. Therefore, the

sensitivity of tourism-dependent urban economic development cannot be greatly improved. By using multiple linear regression analysis, the impact of coping ability on vulnerability is found to be more significant, indicating that the current coping ability has a stronger impact on Zhangjiajie's economic system vulnerability. According to the analysis results, if appropriate measures are taken, the capacity for sustainable development among tourism-dependent cities can be greatly improved. Firstly, the investment in education should be increased, the proportion of financial education expenditure should be continuously increased, the proportion of public expenditure in education expenditure and financial education expenditure should be further increased, the supervision and management mechanisms of education expenditure should be improved and the efficiency of expenditure use should be practically improved; secondly, the forms of tourism should be diversified [25], sightseeing tourism should be integrated into popular scenic spots with leisure and rural vacation tourism and high-end guesthouse products should be developed, etc.; it is also important to diversify the economic industrial structure, develop “agriculture + tourism”, take the countryside around popular scenic spots as the focus of tourism and leisure and form a tourism service system for various groups; thirdly, it is crucial to develop “sports + tourism”, in order to significantly develop the entertainment and sports industry, so that Zhangjiajie's may be established as a new urban area and an international sports center, giving a new strategic mission to the city's tourism industry in response to pressure to disperse, thereby reducing the region's vulnerability.

- (3) Following the epidemic situation, the tourism industry in Zhangjiajie City is in urgent need of change, so it is necessary to recognize the consumers' consumption habits and travel modes, re-position the business and role of medium and micro-enterprises and enable the digital transformation of the tourism industry and introduction of online services. Only by effecting change and keeping up with the times and market demand can the tourism-dependent urban economy be revitalized.

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