

Analysis of Coupling Coordination Degree based on Panel Data

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Abstract: With the rapid development of internet of things, cloud computing, mobile Internet, artificial intelligence, block chain and other information technologies, new technologies marked by digitization and big data processing have been widely used in people's daily life. By crawling the network data and establishing the relevant index system, this paper empirically analyzes the temporal and spatial law of coupling coordination by using the coupling coordination degree model, and discusses its influencing factors and driving mechanism. The results show that the coupling degree of the two systems generally shows an upward trend, with relatively obvious stage characteristics, and the coordinated development of the coupling of the two systems is the result of the comprehensive action of many factors.

1 INTRODUCTION

In recent years, the tourism consumption demand of Chinese residents has become increasingly strong, and the tourism investment has continued to grow. Tourism has injected vitality into the development of regional economy and become a new engine to promote regional economic development. (Gong, et al., 2021) At the same time, the enhancement of regional economy has also created a good environment for the development of tourism. (Li, et al., 2021) The 19th CPC National Congress clearly pointed out that at present, China's economic development mode has changed from high-speed development stage to high-quality development stage. The coordinated development of regional economy and the optimization of industrial structure are an important part of building a modern economic system. Therefore, the research on the coupling and coordination between tourism industry and regional economy is of great significance. At present, domestic and foreign academic circles have done a lot of research on the relationship between tourism and regional economy, but the existing research mainly takes the province as the unit for empirical research, which can not well reflect the coupling and coordination relationship between regional tourism industry and regional economy. (Mateusz, 2021) There are relatively few dynamic studies from the perspective of time series for typical tourist

destinations. Therefore, taking Tai Erzhuang District as an example, this paper introduces the coupling coordination model to empirically analyze the relationship between tourism industry and regional economy from the perspective of time series.

2 EVALUATION SYSTEM AND RESEARCH METHODS

The prosperity of tourism provides vitality for the development of regional economy, and the development of regional economy provides necessary material guarantee for the improvement of the ability of tourism industry. In the process of this dynamic development, they coordinate with each other, promote and develop together. (Wang, et al., 2021) This coordinated development is called coupling coordination in physics. In physics, coupling refers to the phenomenon that two (or more) systems or motion forms affect each other through various interactions. The coupling degree is a measure of the degree of synergy between the internal parameters of the system, and its value reflects the degree of coordination between regional economy and tourism industry.

2.1 Evaluation System

In this paper, the interaction mechanism between tourism industry and regional economy is divided into tourism industry system and regional economic system, which are composed of many indicators. (Yang, et al., 2021) There are many indicators reflecting the development degree of tourism industry and regional economy. This paper is based on the principles of feasibility, scientificity and relevance and relevant research. The indicators are filtered and set. The evaluation index system of tourism industry is: number of domestic tourists, domestic tourism income, number of inbound tourists, inbound tourism income, number of star hotels, number of travel agencies and tourism status. The evaluation index system of regional development is: GDP, output value of tertiary industry, fiscal revenue, traffic and passenger volume, and per capita disposable income. The data in this paper comes from *the statistical yearbook of Zao Zhuang City from 2011 to 2018* and the statistical bulletin of national economic and social development of Tai Erzhuang district.

2.2 Coupling Coordination Model

In order to explore the relationship between tourism and regional economic development, this paper uses relevant literature and data for reference and uses the coupling degree model (1) in physics to measure and evaluate, but its limitation is that it can not reflect the development level of the two systems and is prone to the illusion of "virtual high". Therefore, the coupling coordination degree model (2) is introduced to accurately evaluate the coupling coordination relationship between them.

$$C = \sqrt{\frac{u_1 \times u_2}{u_1 + u_2}} \tag{1}$$

$$D = \sqrt{C \times T}, T = \alpha U_1 + \beta U_2 \tag{2}$$

Where, C is the coupling degree, U1 is the comprehensive output value of the tourism industry system, U2 is the comprehensive output value of the regional economic system. D is the coupling cooperative dispatching, and t is the comprehensive coordination index between the tourism industry and the regional economic system, α , β is the undetermined coefficient. Tai Erzhuang District is rich in tourism resources, and the quality of tourism resources is relatively high. Therefore, the tourism industry in Tai Erzhuang District plays an obvious role in promoting the regional economy α , β This

paper refers to the research results of Yu Jie (Yu, 2014) $\alpha= 0.6$, $\beta= 0.4$. If $U1 > U2$, it shows that the contribution of tourism to regional economy is greater than the support of regional economy to tourism industry. In order to better reflect the degree of coupling and coordination between regional economy and tourism, based on the existing research results, this paper divides the coupling and coordination state into two categories: coordination and imbalance, with a total of 10 sub levels. See Table 2 for the specific evaluation criteria.

Table 1: Classification of Coupling Coordination Degree.

Number	Degree	Level	Number	Degree	Level
1	0—0.10	Extreme Disorder	6	0.501—0.60	Reluctantly Coordinate
2	0.101—0.20	Severe Imbalance	7	0.601—0.70	Primary Coordination
3	0.201—0.30	Moderate Disorder	8	0.701—0.80	Intermediate Coordination
4	0.301—0.40	Mild Disorder	9	0.801—0.90	Good Coordination
5	0.401—0.50	Verge of Disorder	10	0.90—1.0	High Quality Coordination

3 ANALYSIS OF TOURISM INDUSTRY AND REGIONAL ECONOMIC DEVELOPMENT LEVEL

Through the above methods, the development level of tourism industry and regional economy in Tai Erzhuang District from 2011 to 2018 and the coupling and coordination level between the two systems are calculated, as shown in Table 2.

According to table 3, the development level of tourism and regional economy in Tai Erzhuang District increased year by year from 2011 to 2018. From the perspective of tourism development, the tourism industry development level of Tai Erzhuang District was the lowest (0.14) in 2011, mainly because there were no attractive tourism hotspots in Tai Erzhuang District before 2012, and the tourism industry development level also reached the highest

level (0.94) in 2018, among which various tourism indicators also reached the highest level.

3.1 Analysis on the Role of Tourism in Promoting Regional Economy

Since 2011, various indicators of tourism industry in Tai Erzhuang District have been greatly improved. According to the bulletin on national economic and social development issued by Tai Erzhuang District, the total number of domestic and foreign tourists and tourism revenue in the region have increased significantly since 2011, with the number of tourists in 2011 and 2018 respectively 1.5 million and 11 million, an increase of about 7.3 times; The tourism revenue was 855 million Yuan and 8.97 billion Yuan respectively, an increase of about 10.4 times.

Table 2: Division of Coupling Coordination Degree Between Tourism Industry and Regional Economy in Tai Erzhuang District.

Year	U1	U2	C	D	Coupling Level
2011	0.14	0.20	0.16	0.39	Mild Disorder
2012	0.35	0.36	0.42	0.39	Mild Disorder
2013	0.54	0.42	0.45	0.51	Reluctantly Coordinate
2014	0.62	0.52	0.49	0.54	Reluctantly Coordinate
2015	0.65	0.55	0.54	0.57	Reluctantly Coordinate
2016	0.74	0.63	0.58	0.64	Preliminary Coordination
2017	0.78	0.68	0.88	0.81	Good Coordination
2018	0.94	0.85	1.00	0.99	High Quality Coordination

3.2 Analysis on the Supporting Effect of Regional Economy on Tourism

In terms of regional economic development, the GDP of Tai Erzhuang District in 2018 increased by 1.5 times compared with that in 2011, the fiscal revenue reached more than twice, and the general public service expenditure reached more than four times, providing a foundation and support for the development of tourism. Firstly, the development of regional economy has increased the income of residents. In 2018, the per capital GDP in the region was 28203 Yuan, which stimulated tourism consumption, improved residents' lives and made it

possible for the development of tourism. The development of regional economy has increased fiscal revenue, increased fiscal expenditure and injected funds into the development of tourism industry. Tourism is an industry with long investment cycle and long profit return cycle, which needs a lot of financial support. In order to promote the development of local tourism, the local government has raised more than 7 billion Yuan to build a tourism circle led by the ancient city of Tai Erzhuang, and launched local unique musical, Lu Nan drum and other tourism performance projects. Finally, the development of regional economy promotes the improvement of regional service scope and service capacity, creates a good regional image and improves regional popularity. The development of regional economy promotes the improvement of management level and service capacity. While improving infrastructure, it will also promote the formation of a perfect tourism service system.

3.3 Analysis on the Coupling Coordination Degree Between Tourism and Regional Economy in Tai Erzhuang District

According to table 2, the coupling and coordination between tourism industry and regional economy in Tai Erzhuang District from 2011 to 2018 can be divided into two stages: coordination and imbalance, namely, the imbalance stage in 2011 and 2012 and the coordination stage in 2013-2018. $U1 < U2$ in 2011 and 2012 shows that the role of tourism in promoting regional economy is less than that of regional economy in supporting tourism. This period is called regional promotion type in this paper. At this stage, Tai Erzhuang District has not yet had attractive tourist attractions. In 2011 and 2012, the contribution rate of the primary and secondary industries to GDP was 58.7% and 71.4%, and the development level of the tertiary industry is low. At the same time, it also verifies the limitations of the coupling coordination degree model (1), That is, when the development level of regional economy and tourism industry is in a low state, there will be a "virtual high" coordination state. In 2011, the number of domestic and foreign tourists in Tai Erzhuang District was only 1.5 million, and the total tourism revenue was 825 million Yuan, which was only equivalent to 6.3% of the region's GDP. At this time, the role of tourism in promoting the regional economy has not been reflected.

After 2013, $U1 > U2$ shows that the driving effect of tourism on regional economy has been greater than

that of regional economy on tourism industry. After experiencing the explosive growth of the number of tourists in 2011 and 2012, the number of tourists in Tai Erzhuang District showed a steady upward trend, and the tourism industry developed steadily. Table 3 shows that the development level of tourism industry in 2013 is bulletin on national economic and social development issued significantly higher than that in 2012. According to the bulletin on national economic and social development issued by Erzhuang District government, the comprehensive income of tourism industry in Tai Erzhuang District in 2013 was 1.602 billion Yuan, the growth rate of comprehensive output value of tourism industry was 49.1%, and the coupling coordination degree between tourism industry and regional economy was 0.51, The tourism industry began to promote the coordinated development of regional economy. In 2018, there were 65 travel agencies and 14 travel hotels in Tai Erzhuang District, receiving 11 million domestic and foreign tourists.

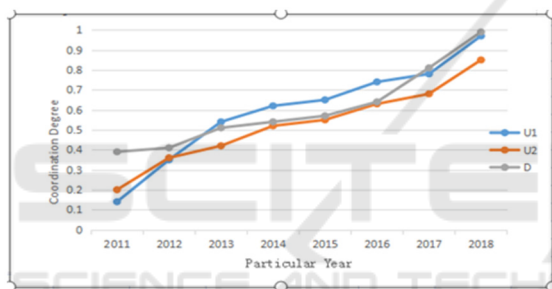


Figure 1: Tourism industry and Regional Development Level and Coupling Coordination in Tai Erzhuang District.

4 CONCLUSIONS

From the perspective of time series, this paper analyzes the development of coupling and coordination degree between tourism industry and regional economy in Tai Erzhuang district from 2011 to 2018, and draws some conclusions: (1) there is indeed a coupling and coordination relationship between tourism industry and regional economy. From the perspective of time, the coupling and coordination state of tourism industry system and regional economic system is different in different development periods, Coordinating the development relationship and state between them is an important basis for the harmonious development of tourism and regional economy. (2) The degree of coupling and coordination reflects the degree of mutual adaptation and synergy of various elements within the tourism industry system and the regional economic system.

The improvement of the degree of coupling and coordination represents the process of the tourism industry system and the regional economic system from disorder to order.

REFERENCES

- Gong Qunxi et al. Examining the Coupling Coordinated Relationship between Urban Industrial Co-Agglomeration and Intensive Land Use[J]. *Land*, 2021, 10(5): 499-499.
- Li Huimin et al. Spatiotemporal Coupling Coordination Analysis of Social Economy and Resource Environment of Central Cities in the Yellow River Basin[J]. *Discrete Dynamics in Nature and Society*, 2021, 2021.
- Tomal Mateusz. Evaluation of coupling coordination degree and convergence behaviour of local development: A spatiotemporal analysis of all Polish municipalities over the period 2003–2019[J]. *Sustainable Cities and Society*, 2021, 71.
- Wang Aoyang et al. Comprehensive Evaluation of Green Development in Dongliao River Basin from the Integration System of “Multi-Dimensions” [J]. *Sustainability*, 2021, 13(9): 4785-4785.
- Yang Yun et al. Coupling Coordination and Prediction Research of Tourism Industry Development and Ecological Environment in China[J]. *Discrete Dynamics in Nature and Society*, 2021, 2021.