

---

## Research on the Coordinated Development of Urban Tourism Economy and Traffic Coupling--- Taking Kaifeng as an example

Beibei Yao <sup>1, a</sup>, Qi Zhong <sup>1, b</sup>, Shuaiwei Guan <sup>2, c</sup>

<sup>1</sup> Henan University, Kaifeng 475000, China.

<sup>2</sup> Shanghai University of Engineering Science, Shanghai 201620, China

<sup>a</sup>15537837762@163.com, <sup>b</sup>1542820835@qq.com, <sup>c</sup>807437785@qq.com

---

### Abstract

In recent years, tourism in Kaifeng has continued to grow rapidly, and breakthroughs have been made in traffic construction. Urban tourism cooperation in the Central Plains has developed rapidly. In fact, due to the special geographical environment of Kaifeng, the tourism economy and transportation development in the city still need to be optimized. The relationship between urban tourism economy and the level of transportation development is in the process of dynamic change, which promotes and restricts each other. In order to promote the further improvement of tourism industry in Kaifeng, it is necessary to study the coupling degree and coordination level between Kaifeng's tourism industry transportation system. Based on the development of traffic and tourism in Kaifeng, this paper establishes a reasonable evaluation index system and uses the coupling coordination degree model to analyze the coupling coordination degree between Kaifeng tourism and traffic development in 2009-2014. The results show that the tourism economy and transportation system evaluation index and coupling coordination degree of Kaifeng are generally rising slowly, and the coupling coordination degree still has a large room for improvement. Finally, based on the empirical results, this paper puts forward effective suggestions for the problems in Kaifeng's tourism economy and transportation.

### Keywords

Kaifeng, Tourism economy, Transportation, Coupling.

---

### 1. Introduction

After the Nineteenth National Congress report, the state has put forward the concept of precise poverty alleviation projects, "Green Water and Green Mountains are Jinshan and Yinshan" to promote economic development by tourism and take the road of characteristic tourism development, which also puts forward higher requirements for the traffic development of tourist cities. The well-known saying that "To get rich, build the road first" has always practiced the impact of transportation on economic prosperity. So how does the relationship between the tourism industry and the transportation industry evolve? How do the two work together to drive the growth of the regional economy? Foreign studies has gathered on the impact of tourism traffic on tourism economic development, the sustainable development of tourism transportation, the attraction of tourism destinations, and the coupling and coordination relationship between regional tourism economy and transportation. The research of domestic scholars mainly gathered the use of models and evaluation system to analyze the coordinated development relationship between the two, focusing on the impact of transportation on the tourism economy. Bruce (2017) discussed the impact of transportation network and transportation efficiency on tourism destinations; Moyano et al. (2016) used the efficiency evaluation model to calculate the travel efficiency of high-speed rail and private cars to determine the efficient travel mode of weekend travel. Wang Zhaofeng et al. (2013) and Yu Qiuyang

et al. (2017) believed that transportation facilities can improve the development of the tourism industry; Hu Hao et al. (2012) pointed out that the change of accessibility of tourism destinations under different standards will lead to local development potential. With different changes, transportation can guide the development of tourism. Some research results have been achieved in the breadth and depth of tourism traffic research. However, the research on the coupling and coordination relationship between tourism economy and transportation in the Central Plains needs to be strengthened, for the relationship between traffic optimization and urban tourism economic improvement. There is also a lack of literature on the study of coupling relationships. This paper can make up for the gaps in these two aspects and has important practical significance.

## **2. Regional overview**

### **2.1 Kaifeng Overview**

Kaifeng is a prefecture-level city in Henan Province. It is located in the Central Plains and borders the Yellow River. It is one of the eight ancient capitals of China. Culture gives the scenic spot a strong vitality, and tourism carries a regional civilization. At present, there are 7 4A-level tourist scenic spots (points) and 1 5A-level tourist scenic spots (points) in the city, which are rich in tourism resources. In recent years, the contribution rate of tourism in Kaifeng has been increasing. In 2017, Kaifeng received a total of 58.626 million domestic and foreign tourists, an increase of 15.4% over the previous year, and realized a comprehensive tourism income of 48.32 billion yuan, an increase of 21.2%. In 2017, the road traffic in Kaifeng completed 22.7 million passengers, and the total mileage of highways reached 7223.3 kilometers, ranking the forefront of Henan Province. Since the "Twelfth Five-Year Plan", the traffic in Kaifeng has been actively deepened and reformed, and the traffic conditions have been greatly improved. In terms of urban spatial structure, a strip-shaped group layout structure of "one belt, two corridors and three pieces" has been formed. Zhengkai Avenue-Dalliang Road-Xincao Road is the core axis of tourism internationalization and regional function development. The key industrial corridors in the southern part of Kaifeng are the key layout ecological, tourism, leisure and cultural corridors in Kaifeng. The development of the tourism economy provides infrastructure guarantees for Kaifeng.

### **2.2 Tourism and transportation development problems**

As one of the ancient capitals, Kaifeng is rich in cultural tourism resources, and the tourism industry has gradually become the pillar industry of Kaifeng, providing power and support for the development of this City. However, there are still many problems in Kaifeng in terms of tourism and transportation. First of all, the problems in the tourism economy of Kaifeng are mainly reflected in accommodation and entertainment; In terms of accommodation, the number and quality of hotels in Kaifeng are difficult to meet the needs of tourists. Some local hotels have aging facilities, weak infrastructure, low-level buildings and monitoring facilities, which also lead to property security issues. The hotel needs to be upgraded with the development of the city to meet the diverse and high-quality needs of tourists. In terms of entertainment, although Kaifeng is rich in tourism resources, there are few ancient buildings preserved to this day. The sightseeing tourism mainly based on antique buildings lacks interest and is less attractive to tourists. In terms of leisure and play, there is a tour scene showing the "Song Culture" in the scenic area. The old campus of Henan University provides various entertainment facilities for tourists. Although the culture and entertainment are rich and colorful, the typical humanities with their own characteristics travel resources have not yet been developed. Secondly, the traffic problems in Kaifeng is mainly reflected in transportation facilities and roads. In terms of transportation facilities, Kaifeng has not yet built airport stations and subway that are convenient for foreign tourists, resulting in long travel distances for tourists in remote areas. The main transportation facilities in Kaifeng City are mainly bus and rental. The bus is cheap and convenient to travel. However, the local bus in Kaifeng is very old and there is no fast payment function such as Internet payment. Taxi has obvious charges during holidays, especially during the Chrysanthemum Exhibition. The phenomenon affects the impression of foreign tourists on the ancient city. In terms

of urban roads, the road construction in Kaifeng is unreasonable, and the construction of roads lags behind the growth rate of human flow and traffic flow. Due to historical reasons, urban roads are narrow, and the diversion effect of primary and secondary trunk roads is not obvious. The flooding of various tricycles in the city, the seriousness of the night market on both sides of the road, and the increasing population density of the holidays have caused frequent road congestion problems in Kaifeng. It is still an urgent problem to fundamentally solve the road planning left over from the ancient city so as to smooth the traffic system.

### **3. Relationship between Tourism Economic and Transportation System**

The tourism economic system and transportation system are two important subsystems for the development of tourism cities. The relationship between the two also affects and restricts the economic development of tourism cities.

#### **3.1 Transportation system promotes the development of tourism**

The evolution of the transportation system is the driving force for the development of tourism economy. The transportation system is an important basic component of the development of tourism economic activities. It is the carrier of material flow and energy flow such as tourist passenger flow, tourism economic flow and tourism information flow. The developed regions of the transportation system can drive the tourism material and energy flow to the tourism development advantage zone because of its high attraction ability, while the less developed regions lose most of the tourism material and tourism energy flow. In general, the development of transportation will affect the spatial flow direction of tourist areas and change the scope of tourism gathering.

The evolution of the transportation system has a guiding effect on the development of tourism economy. First, policy orientation has accelerated the process of Kaifeng's transportation system, which has stimulated the coordination of transportation network construction and tourism development. Urban and Rural Planning Bureau pointed out in the 2018 Kaifeng City Master Plan that it is necessary to plan to form a "one-axis, one-hearted, multi-point drainage, regional connectivity" urban space structure, transportation development and geographical location create convenient conditions for the development of tourism economy in Kaifeng. Second, the overall economic development supports the coordination between Kaifeng's regional transportation and tourism economy. The economic development level of the central area of Kaifeng is relatively high, and the central polarization effect is obvious; moreover, the production factors in the central area of the city show a gradual spillover trend, which promotes the expansion of the overall transportation network construction and tourism economic development elements of Kaifeng City to the peripheral areas of the city, thus further inspiring the emergence of gathering areas in the peripheral areas, this continuous cyclical accumulation model allows Kaifeng's transportation and tourism economy to spiral upward in a coordinated development.

#### **3.2 Tourism economy promotes the development of transportation**

The development of tourism economy will "force" the improvement of urban transportation system. The development of regional tourism system cannot be separated from the support of transportation system. Under the rapid development of tourism, the expansion of passenger flow has put forward higher requirements for traffic carrying capacity and safety, forcing the transportation industry to respond accordingly, alleviating the contradiction between tourism development and transportation supply, forming a good economic cycle, and ultimately the coordinated development of tourism and transportation systems.

Tourism development has a feedback effect on the evolution of transportation system, and feedback to the transportation system through the evolution of tourism spatial structure. In recent years, the construction of a space structure complex with geographical connectivity, resource replenishment, cultural recognition, and transportation has been widely concerned. The Central Plains Tourism Circle refers to the regional tourism cooperation within Henan Province. Zhengzhou is the most

concentrated and technologically advanced region, playing the role of “leader”. Other marginal regions rely on the development of this central city in Zhengzhou, which also puts forward higher requirements for the construction of transportation facilities in Kaifeng.

## 4. Research methods and data

### 4.1 Coupling coordination model

Coupling refers to the phenomenon that two or more subsystems interact and restrict each other under the influence of parameters and describes the dynamic relationship between subsystems. Coupling degree describes the degree of interaction between systems or elements. Coupling coordination refers to the degree of benign coupling of interactions between systems (elements), including the strength of the coupling degree and the degree of health of the coordination level. There is a complex dynamic development relationship between tourism economy and transportation. Therefore, tourism economy and transportation are taken as two subsystems, and relevant index systems are constructed to measure the coupling relationship and coordination between systems.

We draw on the research results of existing scholars and establishes the following model:

$$D(x, y) = \sqrt{C * T}$$

$$C = \frac{(u_1 * u_2)}{\sqrt{\prod(u_1 + u_2)}}$$

$$T = \alpha u_1 + \beta u_2$$

Where, D is the coupling coordination degree ( $0 \leq D \leq 1$ ); C is the coupling degree of tourism economy and transportation system; T is the comprehensive evaluation index reflecting the contribution of tourism economy and transportation system development level to coupling coordination degree;  $u_1$ ,  $u_2$  are the comprehensive development level of tourism economic system and transportation system respectively;  $\alpha$ ,  $\beta$  are undetermined coefficients, reflecting the importance of tourism economy and transportation system. This paper assumes that both have the same importance,  $\alpha$  and  $\beta$  are both taken as 0.5.

In order to quantify the coupling and development level of tourism economic system and transportation system in Kaifeng, this paper divides the coupling coordination degree of tourism economy and transportation system in Kaifeng City, as shown in Table 1:

Table 1 Coordination degree classification

Coupling coordination degree	Coordination level
$0 \leq D < 0.1$	Extreme imbalance
$0.1 \leq D < 0.2$	Serious imbalance
$0.2 \leq D < 0.3$	Moderate maladjustment
$0.3 \leq D < 0.4$	Mild maladjustment
$0.4 \leq D < 0.5$	On the verge of imbalance
$0.5 \leq D < 0.6$	Barely coordination
$0.6 \leq D < 0.7$	Primary coordination
$0.7 \leq D < 0.8$	Intermediate coordination
$0.8 \leq D < 0.9$	Good coordination
$0.9 \leq D \leq 1$	Quality coordination

### 4.2 Measurement of the comprehensive development level of tourism economic system and transportation system

#### 4.2.1 Data Sources

The research data of this paper is from the Kaifeng Statistical Yearbook of 2009-2014. Due to the availability of data, the statistics of tourism development in 2013 and 2014 do not include Lankao

County. The data of the number of domestic and foreign tourists and the total tourism income only include Kaifeng.

4.2.2 Index system establishment

This paper draws on the existing multi-index comprehensive evaluation analysis method, and establishes the evaluation index system in combination with the current situation of Kaifeng city tourism transportation system. Specifically, the indicators of the tourism economic system include the number of inbound tourists, the number of domestic tourists, international tourism income, domestic tourism income and total tourism revenue; the indicators of the transportation system include highway mileage, road passenger traffic, road passenger turnover, urban public transport vehicles and road length.

4.2.3 Comprehensive evaluation model

The weighted measurement of the comprehensive development level of the urban tourism economic system and the transportation system is as follows:

$$u_i = \sum_{j=1}^m h_{ij}u_{ij} ; u_{ij} = \frac{x_{ij}-\min(x_j)}{\max(x_j)-\min(x_j)}$$

Where,  $u_i$  represents the comprehensive development level of the system in the  $i$ -th year;  $j$  represents an indicator;  $h_{ij}$  is the weight of the indicator;  $u_{ij}$  is the contribution of the indicator to the efficiency of the system;  $\max(x_j)$  and  $\min(x_j)$  respectively represent the maximum and minimum values of an indicator in the system; this paper uses the positive power function to process each index, so the range of  $u_{ij}$  is  $(0 \leq u_{ij} \leq 1)$ . it reflects the contribution of the index to the whole system. The closer  $u_{ij}$  is to 0, the lower the contribution is; the closer  $u_{ij}$  is to 1, the higher the contribution.

The determination of the index weight  $h_{ij}$  in this paper uses the entropy weighting method. First, the entropy weighting method selects the objective original information, and then determines the weight of the index by analyzing the degree of association between the indicators and the amount of information provided by each index. To a certain extent, it avoids the bias caused by subjective factors. The details are as follows: Let  $x_{ij}$  be the  $j$ -th indicator in the  $i$ -th system ( $i = 1, 2, \dots, n ; j = 1, 2, \dots, p$ ).

Non-negative processing of indicators

$$x'_{ij} = \frac{x_{ij} - x_{\min}}{x_{\max} - x_{\min}} + 0.01$$

Proportional transformation of indicators

$$S_{ij} = \frac{x'_{ij}}{\sum_{i=1}^n x'_{ij}}$$

Calculate the entropy of the  $j$ -th indicator

$$W_j = -\frac{1}{\ln n} \sum_{i=1}^n S_{ij} \ln S_{ij}$$

Calculate the difference in the  $j$ -th indicator

$$\alpha_j = 1 - h_j$$

Calculate the weight of the indicator

$$h_{ij} = \frac{\alpha_j}{\sum_{i=1}^n \alpha_j}$$

### 5. Empirical analysis

According to the coupling coordination model and the comprehensive evaluation model, the original data is processed to obtain the comprehensive evaluation index u1, u2 and coupling coordination value D of the tourism economic system and transportation system in Kaifeng from 2009 to 2014. The calculation results are shown in Table 2 and Figure 1.

Table2 Tourism Economy and Transportation Comprehensive Development Level and Coordination Degree Classification in Kaifeng

Year	U1	U2	D	Coordination level
2009	0.163	0.109	0.259	Moderate maladjustment
2010	0.378	0.228	0.383	Mild maladjustment
2011	0.638	0.536	0.541	Barely coordination
2012	0.950	0.735	0.646	Primary coordination
2013	0.329	0.946	0.528	Barely coordination
2014	0.569	0.704	0.563	Barely coordination

(Note: This table does not include Lankao in the calculation of 2013-2014 data)

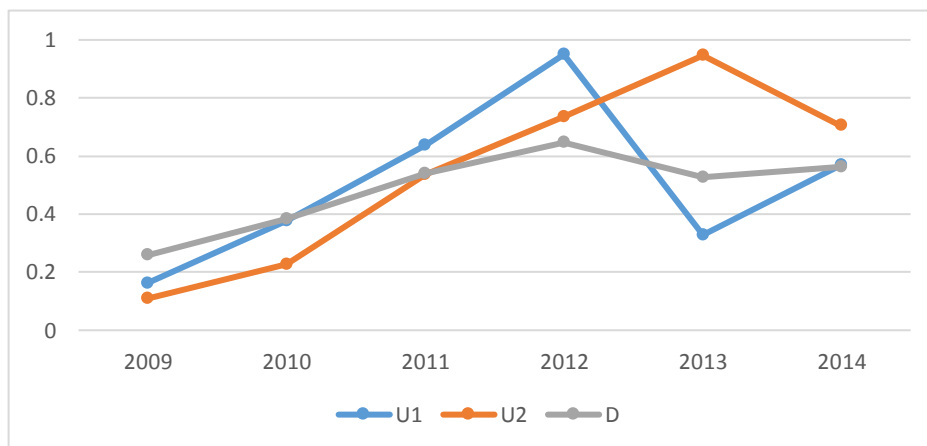


Figure1. Comprehensive evaluation value and coupling coordination degree of tourism economic system and transportation system in Kaifeng

#### 5.1 Coordination Degree analysis

The information in Table 2 and Figure 1 indicates that the coupling coordination degree of the two systems in Kaifeng has been increasing during the period of 2009-2014, and the coordination status has gradually improved. Specifically, the moderate imbalance develops into a barely coordinated state. From 2009 to 2010, the coupling coordination between the two systems is in an unbalanced state, and the synergy effect is weak. During the period 2011-2014, the state of coordination was achieved and the synergy between tourism economy and traffic development increased. However, the coupling coordination degree in 2014 was 0.563, which only reached a state of reluctance and coordination. The coupling degree of tourism economy and transportation system was small and the room for increase was large. This paper finds that during the period of 2009-2012, the degree of coupling coordination has been increasing, but the coupling coordination degree has decreased to a barely coordinated state in the two years from 2013 to 2014. The reason is mainly due to the fact that the tourism data in the Kaifeng Statistical Yearbook from 2013 to 2014 does not include Lankao County. This has caused the number of tourists and tourism revenue in Kaifeng to decline. However, it can be

generally determined that the coupling and coordination degree between Kaifeng City's tourism and transportation systems is barely coordination and to a good coordination, or ultimately to the coordinated development of quality, it is also necessary to actively expand tourism resources and increase investment in urban transportation construction.

In 2009-2014, only the comprehensive evaluation value  $u_1$  of the tourism economic system in 2013 and 2014 is lower than the evaluation value  $u_2$  of the transportation system. In other periods,  $u_1 > u_2$ , which shows that the traffic development lags behind. That is to say, the traffic development speed of Kaifeng in that year is lower than the development of the tourism economy and fails to meet the growing needs of the tourism economy. This provides feasible suggestions for Kaifeng to develop traffic construction in the future. During the period of 2013-2014,  $u_1 < u_2$ , showing that the tourism economy is lagging behind, compared with the rapid development of transportation, the tourism economy has gradually entered a relatively lagging development period, and the tourism industry needs timely structural transformation and upgrading to develop competitive tourism products. This is also the problem that Kaifeng's tourism economy needs to be optimized.

## 5.2 Comprehensive development evaluation

It can be seen from Table 2 and Figure 1 that the comprehensive development of tourism economy and transportation system in Kaifeng has steadily increased. During the period of 2009-2012, the tourism economy developed faster than the development of the transportation system. During 2013-2014, the transportation system developed faster than the tourism economic system. The correlation coefficient of the two systems is 0.48, indicating that there is a positive correlation between the tourism economy and the transportation system. The development of one of the two systems will promote the development of another system. Combined with the development status of Kaifeng, the growth of transportation system is faster than the development of tourism economy due to the construction of the Central Plains economic circle, the integration of Zhengzhou, and the spatial layout of the comprehensive functional transportation belt in Kaifeng; The reason why the tourism economy is faster than the development of the transportation system is because the industrial structure of Kaifeng has been transformed and upgraded to the tertiary industry. In order to build Kaifeng into a well-known tourist city rich in cultural characteristics of the Central Plains, the government placed tourism in a strategic pillar industry and strived to achieve a leap to a strong cultural city.

From the comprehensive evaluation value of tourism economy, from 2009 to 2012, it rose from 0.163 to 0.950, and the tourism economy showed a rapid development trend. However, in 2012-2014, the comprehensive evaluation value of tourism economy dropped from 0.950 to 0.569. From the point of view of indicators, the number of domestic and foreign tourists and tourism revenue decreased in 2013 compared with the previous year. This is mainly due to the fact that the Lancao County data was not counted when the two years of coupling coordination was calculated, which reduced the number of tourists and income or the flow of tourists to surrounding cities, such as Luoyang.

From the comprehensive evaluation value of the transportation system, it increased from 0.109 to 0.704 during the period of 2009-2014, which indicates that the traffic construction has been vigorously developed during this period. From the perspective of indicators, highway mileage, urban public transportation vehicles and long roads are increasing, and intercity traffic, railways, highways and other transportation network systems are constantly improving.

## 6. Conclusions and recommendations

There is a complex dynamic development relationship between the tourism economic system and the transportation system. The coupling coordination between the two systems can reflect the sustainable development level of the urban economy. Taking Kaifeng City as an example, this paper uses the coupling coordination degree model and comprehensive evaluation model to study the comprehensive development level of tourism transportation in Kaifeng. The results show that in 2009-2014, although the coupling coordination degree between the tourism economic system and the transportation system is increasing, there is still room for improvement; The overall level of coupling and coordination

between tourism economy and transportation in Kaifeng is not high. To develop well and even high quality, it is necessary to increase the development of tourism resources in Kaifeng and improve the transportation network of Kaifeng. Therefore, this paper proposes the following recommendations:

1. Accelerate the strategy of “industrial strong city and cultural development”. The industrial sector will focus on promoting the optimization and upgrading of Kaifeng's industrial structure, and strengthen the role of the eastern Kaifeng area in Zhengbianluo Industrial Base. The cultural aspect is to improve the quality and structural adjustment of cultural products, and to form the advantages of Kaifeng's human resources. Focus on the development of the "Literature Business Travel" integration, solve the problem of tourism infrastructure; seize the policy advantages, strengthen regional tourism cooperation, in response to the national precision poverty alleviation policy, develop its own characteristic tourism poverty alleviation project, and cooperated with surrounding cities such as Lankao and Xinxiang to create special tourist routes with the theme of Yellow River tourism and eco-tourism, and promote the “Song Culture” to go out and solve the lack of entertainment in Kaifeng tourism development.

2. Taking advantage of the location advantages of Kaifeng, we will seize the opportunities brought by Kaifeng, such as the construction of the Central Plains Economic Zone and the integration of Zhengzhou, and continuously optimize and upgrade the existing transportation system. Accelerate the automation of transportation and information management, solve the problem of backward transportation infrastructure, and improve the accessibility of tourist destinations; Utilizing the unique conditions created by the Central Plains Tourism Circle, we will improve the transportation network connecting Kaifeng with the surrounding tourist cities, form a pattern of interconnection and interconnection, develop potential tourism resources, and realize the diversified needs of tourists; Reasonably plan the allocation of parking resources in time and space, create convenient parking conditions for self-driving tourists and creating safe tourist transportation service quality for other tourists.

## References

- [1] Moyano A, Coronado J M, Garmendia M. How to choose the most efficient transport mode for weekend tourism journeys: An HSR and private vehicle comparison[J]. The Open Transportation Journal, 2016, (10).
- [2] Wang Yongming, Ma Yaofeng. Analysis of the Coupling Coordination Degree of Urban Tourism Economy and Transportation Development --- Taking Xi'an as an Example [J]. Journal of Shaanxi Normal University, 2011, (1).
- [3] Guo Feng, Chen Qirong. Analysis of the Coordination Degree of Tourism Industry and Transportation System in Guizhou Province[J]. Western Economic Management Forum, 2018, (3).
- [4] Jian Cuili. Research on the Interaction between Domestic Tourism and Railway Transportation Industry Based on VAR Model[J]. Journal of Hunan University of Technology, 2018(5).
- [5] Sun Huijuan, Chen Yuying. Research on Coordinated Development of Tourism Economy and Traffic in Henan Province[J]. Journal of Changchun Normal University, 2017, (8).
- [6] Zhu Shirong. Analysis of the Coupling Coordination Degree between Urban Tourism Economy and Transportation Development [J]. Tourism Overview, 2015(3).
- [7] Yang Yan. Research on the Coordination Degree Model of Tourism Economy and Traffic Development[J]. Modern Business and Industry, 2012, (1).
- [8] Cheng Xiaoli, Zhang Leqin, Cheng Haifeng. Research on the Coordinated Development of Tourism Economy and Ecological Environment in Small and Medium-sized Cities——Taking Chizhou City as an Example[J]. Geography and Geo-Information Science, 2013, (5).
- [9] Wang Zhaofeng. An Empirical Analysis of the Impact of Tourism Traffic on the Development of Tourism Industry——Taking Zhangjiajie as an Example[J]. Finance and Economics Theory and Practice, 2009(4).



- [10] Lu Song. Progress and Enlightenment of Tourism Transportation Research [J]. Tropical Geography, 2009 (4).
- [11] Song Xiongwei, Deng Chuxiong. Analysis of Tourism Economy-Traffic Development-Ecological Environment Coupling Coordination Degree in Hunan Province since the New Century[J].Journal of Central South University of Forestry and Technology,2018(4).