Study on the coordinated development of urban land use, transportation and tourism economy

Zhang WeiWei,Zhang Yufan, Xiong Wenjing, Wang Yu
Business School of Xiangtan University

Abstract—Tourism transportation is an important part of tourism system. Transportation development has a profound impact on tourism economy. In addition, tourism economy and regional land use change are interrelated, and the development of tourism economy has a significant impact on land use change; On the other hand, as the carrier of transportation and tourism activities, land use change has an impact on transportation development and tourism economy. There is a complex relationship among the three, and the coordinated development of the three is conducive to the sustainable use of land resources. On the basis of previous research results, this paper studies the coupling and coordination relationship and the corresponding spatial relationship among land use, transportation development and tourism economy in Xiang tan City. Based on the statistical yearbooks of Hunan Province, statistical bulletins, and statistical yearbooks and relevant statistical data of cities in Hunan Province, this paper constructs the evaluation index system of the three systems of transportation development, land use and tourism economy by combing relevant literature and consulting experts' opinions. The entropy method is used to determine the weight of each index of the three systems. MATLAB software is used to analyze the data, and the coupling degree evaluation model is used to measure the coordination degree between the three systems. This paper studies the coupling development of the three systems in Xiang tan City from two aspects of time and space, and puts forward corresponding countermeasures.

Keywords—*Xiang tan ; land use ; tourism ; traffic ; coupling coordination*

Ⅰ. INTRODUCTION

[1]Tourism transportation is an important part of tourism system. Transportation has a profound impact on tourism development. China attaches great importance to the integrated development of tourism and transportation at the national, provincial and municipal levels. In addition, with the promulgation and implementation of "the 13th Five-year Development Plan of Urban Comprehensive Transportation System of Hunan Province", the transportation pattern of Hunan presents a new look, and the space-time compression effect it brings will inevitably have a great impact on the tourism pattern and economy. The coupling and coordinated development degree of the two is an important standard to measure the sustainable development level of regional tourism.

Tourism development and regional land use change are interrelated. At the same time, it is also one of the humanistic driving forces leading to the large-scale and diversified transformation of land use. Tourism economic development has a significant impact on land use change. On the other hand, land is an undevelopable and indispensable resource. As the carrier of transportation and tourism activities, land use change has an impact on transportation and tourism economy. There is a complex relationship among the three, and the coordinated development of the three is not only conducive to the sustainable use of land resources, but also can promote the development of transportation and tourism economy. The coupling and coordination degree of the three has an important impact on the economic development of Hunan[1-2].

Scholars have long been concerned about tourism and transportation related issues. A large number of empirical research results show that transportation has a great impact on the development of tourism destination(McElroy J L，2006；Khadaroo A J，Seetanah B，2007；Imikan A，M Ekpo，2012)[3-5], tourism demand(Massidda C，Etzo I，2012) and tourist flow(Su Jianjun，2012) [6-7]. However, in recent years, domestic studies have reached different conclusions. The role of transportation in regional tourism development is not clear (Hao Junqing, Cao Mingming, 2009; Zuo Bing, 2011; Wang Shuxin, 2012)[8-10], and even hinders the development of regional tourism (Xiang Yi et al., 2012; Mao Runze, 2012)[11-12]. In terms of coordinated development of tourism and transportation, RISTIC N,LUKIC B (2013) proposed that a linkage mechanism should be established between transportation infrastructure planning and tourism and economic development planning to better promote the coordinated development of transportation, economy and tourism[13]. Yu Feifei, Hu Wenhai and Rong Huifang (2015) evaluated Chizhou's tourism economic system and transportation system, measured the coupling and coordinated development, and found that the coupling and coordination degree gradually increased[14]. Lin Qiaoyan and Xu Changle (2016) analyzed the coordinated development of tourism economy and transportation in Chongqing and reached similar conclusions[15]. With regard to the research on land use and tourism economy, Wu Limin and Huang Zhenfang (2015) found that the development of tourism economy has a significant impact on its land use change, and the transformation and upgrading of tourism has promoted the process of transforming agricultural and forestry land into construction land such as tourism and public management services[16]. With regard to the research on transportation and land use, Li Jingtao, Zhou Shenglu (2014) used RS and GIS technology to conduct spatial analysis on the road traffic network and urban land use in developed cities. The results show that the landscape fragmentation of local areas caused by road traffic construction can reflect the land use intensity of surrounding areas to a

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certain extent, and the two show significant spatial auto correlation, with high coupling degree[17].

Previous research results provide a solid foundation for the research of this subject, but there is a lack of necessary exploration on the coupling and coordination relationship and corresponding spatial relationship among land use, traffic development and tourism economy. This paper selects the coupling coordination degree model to analyze the coupling and coordinated development of land use, transportation development and tourism economy in Xiangtan , Hunan Province from the perspective of time. On the one hand, it helps to expand the research scope of tourism geography and transportation geography and further enrich the theory and system of coordinated development of regional tourism and transportation. On the other hand, it measures the coupling development between tourism economy, transportation development and land use system in Xiangtan, Hunan Province, China, and puts forward coordinated development countermeasures to provide theoretical guidance for tourism and transportation development in Hunan Province. It is helpful to provide ideas for land use planning in Hunan Province in the future, and has important application value.

Ⅱ. RESEARCH METHODS

Based on the system theory, coupling coordination theory, sustainable development theory and regional coordinated development theory, this paper establishes a coupling coordination degree model by using entropy method and coupling evaluation, measures the coupling coordination among land use, traffic development and tourism economy in Xiang tan City, Hunan Province, and compares the results vertically and horizontally, Finally, the optimization countermeasures are put forward.

A. Construction of evaluation index system for coordinated development

By combing the literature related to transportation development, land use and tourism economy, consulting experts and combined with the specific situation of Xiangtan , Hunan Province, this paper constructs the evaluation index system of transportation development system, land use evaluation index system and tourism economy evaluation index system respectively. Among them, 13 indicators such as railway business mileage, highway mileage, civil vehicle ownership, railway passenger turnover, highway passenger turnover, air passenger turnover, railway passenger volume, highway passenger volume, civil aviation passenger volume, water passenger volume, railway freight volume, highway freight volume and water freight volume are selected to evaluate the traffic development system, and gardens, woodlands, grasslands The land use system is evaluated by five indicators, including urban villages, industrial and mining land and transportation land. Seven indicators, including total tourism revenue, total domestic tourism revenue, foreign exchange revenue of international tourism, inbound overnight tourists, number of inbound tourists, total number of tourists received and domestic tourists, are selected to evaluate the tourism economic evaluation index system. The original data

of the evaluation indicators mainly come from the data statistics of the State Administration of land and resources, the statistical yearbook of Hunan Province from 2006 to 2015, the statistical bulletin, the statistical yearbook and relevant statistical information of cities in Hunan Province. This paper uses entropy method to determine the weight of each index. The original data of the evaluation indicators mainly come from the data statistics of the State Administration of land and resources, the statistical yearbook of Hunan Province from 2006 to 2015, the statistical bulletin, the statistical yearbook and relevant statistical information of cities in Hunan Province. This paper uses entropy method to determine the weight of each index.

B. Coupling degree evaluation model and grade division

This paper mainly uses the measurement model of three coupled systems. The transportation development system, tourism economic system and land use system all contain many subsystems. The contribution degree of each subsystem can be reflected by the integration method. The linear weighting method is used to determine the comprehensive evaluation value of the two systems. The calculation formula is:

$$U_i = \sum_{j=1}^{n} h_{ij}x_{ij}, \sum_{j=1}^{n} h_{ij} = 1 \qquad （1）$$

U_i is the comprehensive evaluation value of each system, that is, U_1, U_2 and U_3 are the comprehensive evaluation values of transportation development, tourism economy and land use respectively, and h_{ij} is the weight corresponding to the parameter.

In this paper, the capacity coupling coefficient model in physics is used to measure the coupling degree between the three systems. The specific formula is as follows:

$$D = (C \times T)1/2 \qquad （2）$$
$$T = aU_1 + bU_2 + cU_3 \qquad （3）$$

Where D is the coordination degree among transportation development system, tourism economic system and land use system, C is the coupling degree among the three systems, and the value range of C is 0 ~ 1. The smaller the value of C is, the worse the correlation coordination between systems is, and the larger the value of C is, the better the coupling state between systems is. It represents the comprehensive coordination index among the three, which can reflect the overall synergy or contribution among tourism, land and transportation systems; where a, b and c are undetermined coefficients. In general, let a + b + c = 1, through literature analysis and interviews with relevant professional researchers, it is assumed that transportation development, tourism economy and land use play an equally important role in the overall economic development of Hunan Province, so a = b = c = 0.33.In order to express the calculation results more intuitively, the coupling coordination level division standard is adopted, and the coordination level between the three systems is determined by comparing the calculated coordination degree intervals. The grade is divided into four levels with the boundaries of 0.3, 0.5 and 0.8, namely imbalance, rapid development, benign development and high-level coordination.

III. OVERVIEW OF THE STUDY AREA

Xiangtan is located in the Middle East of Hunan Province. The maximum horizontal distance between East and west of Xiangtan city is 108 kilometers, and the maximum vertical distance between North and south is 81 kilometers; It borders Ningxiang County, Wangcheng County and Changsha County in the north, Hengdong County, Hengshan County and Zhuzhou County in the south, Zhuzhou and Zhuzhou County in the East, Shuangfeng County and Lianyuan County in the West. Xiangtan, a prefecture level city under the jurisdiction of Hunan Province, is referred to as Xiangtan for short. It is also known as "Lotus city" and "Tan city" because it is rich in Xianglian. It governs five counties (cities) under the jurisdiction of Xiangtan, Xiangxiang, Shaoshan , Yuhu District and Yuetang District, with a total area of 5006 square kilometers and a total population of 2.838 million in 2016. The urban area is 168.21 square kilometers and the built-up area is 79.2 square kilometers.

Xiangtan is rich in tourism resources. Xiangtan scenic spot has basically formed three plates: red tourism with Shaoshan as the representative and Peng Dehuai Memorial as the main component; Green landscape tourism, represented by Hunan Shuifu tourist area and with Xiangtan Agricultural Expo Park and Zhaoshan scenic spot as important components; Historical and cultural tourism represented by Qi Baishi. The three plates build the framework of Xiangtan tourism, especially red tourism.

Xiangtan has a developed transportation network. The Hunan Guizhou railway crosses the city, the Beijing Guangzhou railway and Shanghai Kunming railway pass through the urban area, and the Luoyang Zhanjiang railway passes through the northwest of the city. There are four stations in the territory: Xiangtan station, Xiangtan east station (freight station), Xiangxiang station and Shaoshan station. On December 26, 2012, Xiangtan station and Xiangxiang station, whose reconstruction and expansion project was basically completed, resumed passenger transport, and the hardware conditions were greatly improved. Changsha Zhuzhou Xiangtan Urban Railway was completed and opened to traffic on December 26, 2016. There are four stations in Xiangtan, including Zhaoshan, Hetang, Bantang and Xiangtan.At present, there are national highways G107 and G320; Expressway: Beijing Hong Kong Macao expressway, Shanghai Kunming expressway, Shaoshan expressway, Changtan West expressway, Yuelin expressway, tanheng west section, Changxiang section and changshaolou expressway.

Xiangtan is a typical subtropical warm and humid climate area, with obvious seasonal climate characteristics: four distinct seasons, abundant precipitation, high temperature in midsummer and cold in winter. It can be roughly divided into three geomorphic types: tectonic erosion Low Mountain hilly landform, tectonic erosion denudation low mountain landform.

IV. DATA COLLECTION AND RESULT ANALYSIS

A. Data Collection

The data of transportation development level and tourism economy are derived from the statistical yearbook of Hunan Province, the statistical yearbook of tourism of Hunan Province and the data publicized by the government, and the land use data are derived from the land survey and sharing data on the website of the Ministry of land and resources.

B. Result Analysis

The coupling coordination index system and weight of each system in Xiangtan are determined by using MATLAB software based on entropy method, as shown in Tables 1 and 2.

As shown in Table 3, figure 1, figure 2 and figure 3, the evaluation function values of Xiangtan transportation development system, land use system and tourism economic system are uc1, UC2 and UC2; Similarly, the coupling degree, coupling co scheduling and comprehensive evaluation indexes CC, DC and TC between the three systems are also calculated. As can be seen from Figure 1:

1) The land use and tourism economic system in Xiangtan has developed well

The comprehensive evaluation value of land use and tourism economic system is increasing year by year. The comprehensive evaluation value of land use is close to 1 from 0.02 in 2006 to 2015, and the evaluation value of tourism economic development has increased from 0.01 to close to 1, indicating that tourism and transportation in Xiangtan have been well developed.

2) The traffic development of Xiangtan presents a fluctuating state

Although the comprehensive evaluation value of transportation development also increased from 0.02 to 1.00, the comprehensive evaluation value decreased in varying degrees in 2014 and 2015, which was reflected in the significant decline of railway freight volume, water freight volume and highway passenger volume.

3) The coupling degree and coupling coordination degree of Xiangtan show an increasing trend, but there are fluctuations.

The coupling degree between Xiangtan transportation development system and tourism economic system shows an increasing distribution trend. From 2006 to 2015, the coupling degree value has been maintained at about 0.30 ~ 0.50, and decreased to the lowest value of 0.32 in 2008. The coordination type is moderate imbalance. The degree of coupling and coordination between the two systems of traffic development and tourism development in Xiangtan showed an upward trend, which fell slightly in 2014, and the degree of coordination in 2014 was barely coordinated. From 2006 to 2015, the coordination level between the two systems in Xiangtan changed from extreme imbalance in 2006 to near imbalance and reluctant coordination, and finally to primary coordination in 2015.Like Zhuzhou , from 2006 to 2013, the development of tourism economy lagged behind the development of transportation. In 2014 and 2015, the tourism industry developed rapidly, and the development of transportation lagged behind the development of tourism.

4) The coupling degree and coordination degree of the three systems in Xiangtan show an increasing trend, but there are fluctuations

It can be seen from table 3 and figure 3 that the coupling coordination degree among the three systems in Xiangtan shows an increasing distribution trend. From 2006 to 2015, the coupling degree value has been maintained at about 0.40 ~ 0.50. The coupling coordination degree decreased from 2013 to 2014, and then rebounded in 2015, showing fluctuation characteristics, which is due to the impact of traffic development. The coupling type between the three systems is tourism economy lag type from 2006 to 2013, and the coupling type in 2014 and 2015 is traffic lag type. The coordination level has changed from extreme imbalance in 2006 to primary coordination in 2015.

TABLE I.   INDEX SYSTEM AND WEIGHT OF COUPLING COORDINATION DEGREE OF VARIOUS SYSTEMS IN XIANGTAN

Subsystem	evaluating indicator	unit	weight
Land use status of Xiangtan City	garden plot	Ten thousand mu	0.2000
	woodland	Ten thousand mu	0.2001
	grassland	Ten thousand mu	0.2000
	Urban, rural, industrial and mining land	Ten thousand mu	0.2000
	Land for transportation	Ten thousand mu	0.1999
Tourism economic indicators of Xiangtan	Total tourism revenue	RMB100mn	0.3235
	Reception of inbound tourists	10000 person times	0.3426
	Total number of domestic tourists	10000 person times	0.3339
Traffic development level in Xiangtan	Railway passenger volume	ten thousand people	0.1643
	Highway passenger volume	ten thousand people	0.1715
	Water passenger volume	ten thousand people	0.1592
	Railway freight volume	10000 tons	0.1649
	Highway freight volume	10000 tons	0.1712
	Water freight volume	10000 tons	0.1689

TABLE II.   COUPLING DEGREE, COORDINATION DEGREE AND EVALUATION OF XIANGTAN TRANSPORTATION DEVELOPMENT SYSTEM AND TOURISM ECONOMIC SYSTEM FROM 2006 TO 2015

particular year	U_{C1} Comprehensive evaluation value of traffic development	U_{C3} Comprehensive evaluation value of tourism economy	C_C Coupling degree	D_C Coupled co scheduling	T_C Comprehensive evaluation index	Coordination level	Type division
2015	0.45	1.00	0.46	0.58	0.72	Reluctantly coordinate	Traffic lag type
2014	0.48	0.77	0.49	0.55	0.62	Reluctantly coordinate	Traffic lag type
2013	1.00	0.64	0.49	0.63	0.82	Primary coordination	Tourism lag type
2012	0.91	0.53	0.48	0.59	0.72	Reluctantly coordinate	Tourism lag type
2011	0.80	0.44	0.48	0.55	0.62	Reluctantly coordinate	Tourism lag type
2010	0.60	0.27	0.46	0.45	0.44	Verge of disorder	Tourism lag type
2009	0.41	0.14	0.43	0.34	0.27	Mild disorder	Tourism lag type
2008	0.33	0.04	0.32	0.24	0.19	Moderate disorder	Tourism lag type
2007	0.04	0.01	0.45	0.11	0.03	Severe imbalance	Tourism lag type
2006	0.02	0.01	0.50	0.02	0.01	Extreme disorder	Tourism lag type

TABLE III.   COUPLING DEGREE, COORDINATION DEGREE AND EVALUATION OF TRANSPORTATION DEVELOPMENT SYSTEM, LAND USE SYSTEM AND TOURISM ECONOMIC SYSTEM IN XIANGTAN CITY FROM 2006 TO 2015

particular year	U_{C1} Comprehensive evaluation value of traffic development	U_{C2} Comprehensive evaluation value of land use	U_{C3} Comprehensive evaluation value of tourism economy	C_C Coupling degree	D_C Coupled co scheduling	T_C Comprehensive evaluation index	Coordination level	Type division
2015	0.45	1.00	1.00	0.47	0.62	0.82	Primary coordination	Traffic lag type
2014	0.48	0.93	0.77	0.49	0.59	0.73	Reluctantly coordinate	Traffic lag type
2013	1.00	0.77	0.64	0.49	0.63	0.80	Primary coordination	Tourism lag type
2012	0.91	0.66	0.53	0.49	0.59	0.70	Reluctantly coordinate	Tourism lag type
2011	0.80	0.61	0.44	0.49	0.55	0.62	Reluctantly coordinate	Tourism lag type
2010	0.60	0.43	0.27	0.48	0.46	0.44	Verge of disorder	Tourism lag type
2009	0.41	0.36	0.14	0.46	0.37	0.30	Mild disorder	Tourism lag type
2008	0.33	0.34	0.04	0.37	0.30	0.24	Mild disorder	Tourism lag type

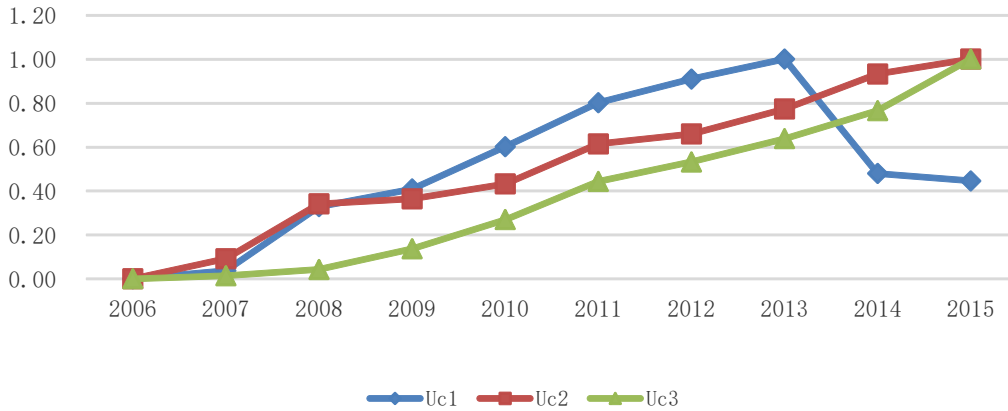| 2007 | 0.04 | 0.09 | 0.01 | 0.41 | 0.14 | 0.05 | Severe imbalance | Tourism lag type |
| 2006 | 0.02 | 0.02 | 0.01 | 0.50 | 0.02 | 0.01 | Extreme disorder | Tourism lag type |

Figure 1 Comprehensive evaluation value of transportation development system, land use system and tourism economic system in Xiangtan City from 2006 to 2015
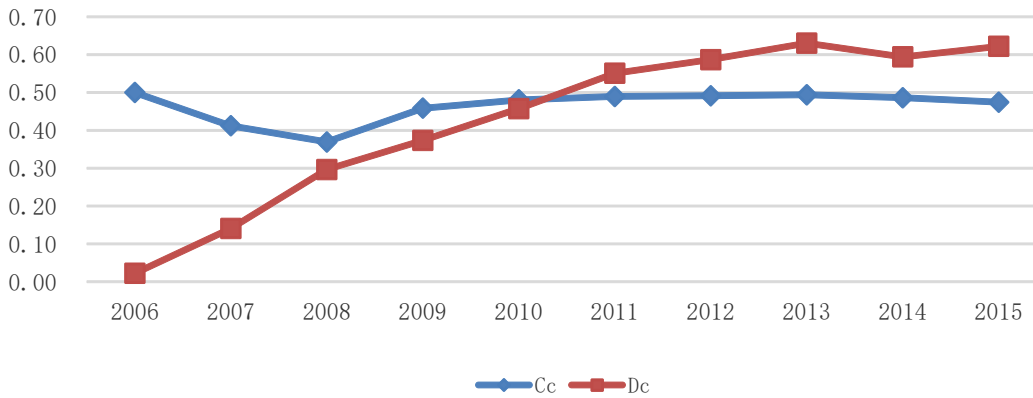

Figure2 Coupling degree and coordinated dispatching of Xiangtan transportation development system and tourism economic system from 2006 to 2015
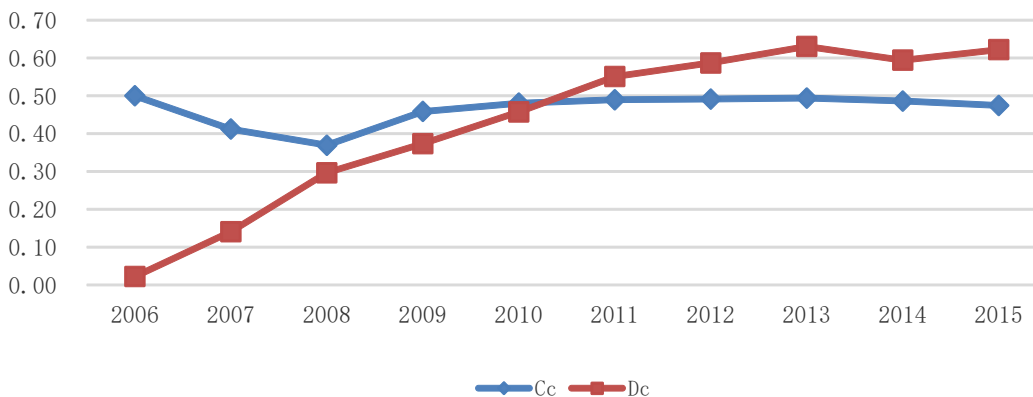

Figure3 Coupling degree and coordinated dispatching of Xiangtan transportation development system, land use system and tourism economic system from 2006 to 2015.

V. CONCLUSIONS AND RECOMMENDATIONS

The comprehensive evaluation value of the three systems in Xiangtan has increased greatly in the past 10 years. The comprehensive evaluation index is rising in a straight line, but there is fluctuation. Its development type is broken line fluctuation.

On the whole, the coupling coordination degree of the three systems in Xiangtan is good, but the situation is unstable and there are some fluctuations. We should combine the development characteristics and types of our three systems to find development countermeasures. We should enhance the attraction of tourism, realize steady and coordinated development, and promote our own steady development from the two aspects of transportation and Tourism: on the one hand, we should develop characteristic tourism products, make efforts in the construction of tourism products, supporting tourism facilities, improving tourism service quality, tourism brand construction and so on, take multiple measures and apply both soft and hard; At the same time, strengthen tourism publicity, use modern information technology to enhance publicity and precision marketing, and plan some promotional activities to expand sales, such as special promotion measures such as preferential tickets on special days and free tickets for special people. By strengthening exchanges and cooperation with other regions, achieve the effect that the tourism brand image is deeply rooted in the hearts of the people, and finally enhance the attraction of tourism, Offset traffic disadvantages; At the same time, strengthen the cooperation with the products and routes of the core scenic spots to enhance the tourism heat. On the other hand, relying on the existing traffic nodes, reasonably arrange the traffic connections with the core cities and core scenic spots, improve the "connection" function of the lines between scenic spots, so that the scenic spots can be smoothly accessible and connected; Optimize passenger lines and shifts to realize the optimization of traffic network. Similarly, we should also enrich the tourism function of the "line", pay attention to the landscape construction along the transportation line, and build the connecting line into a beautiful landscape belt, so that people can get a pleasant experience on the road.

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Zhang Weiwei (1983 -), female, from Luoyang, Henan Province, doctor, associate professor and master of Business School of Xiangtan University.