

# Spatial-temporal Coupling and Coordinating between Urbanization and Tourism Development: A Case Study of Zhoushan Archipelago, China

Shu-guang LIU<sup>1</sup>, Ying-shi SHANG<sup>2,\*</sup> and Chun-yu LIU<sup>3</sup>

<sup>1,2</sup>Ocean University of China, Qingdao 266100, China

<sup>3</sup>Ohio State University, Columbus OH 43210, USA

\*Corresponding author

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**Abstract.** Owing to the limitations of overall capacity and scattered allocations against marine environment, archipelago is always regarded as the typical area of high-level conflicts between human settlement and regional sustainability. The paper tries to apply the coupling and coordination model to clarify the relationship the urbanization initiative and tourism development in China's Zhoushan archipelago region. Using data sets from 2006 to 2016, the researches show that: (1) urbanization level of Zhoushan improved steadily but with some fluctuations; (2) the spatial disparities were obvious among islands from spatial centers to peripheries; (3) the coupling degree between urbanization and tourism development improved; (4) the tourism positively affected the coupling and coordinating development of the urbanization and tourism development while the urbanization negatively affected the coupling coefficient, on the contrary, it positively affected the coordinating coefficient at present.

## Introduction

Due to the abundant island tourism resources, tourism has become a main industry in most of China's island areas. With the development of the urbanization and improvement of the infrastructure, the tourism carrying capacity in the island area has been promoted. The development of island tourism economy, along with the development of the tourism investment and tourism consumption, played an important role in the optimizing of the regional industrial structure and the promoting of the urbanization construction in the island area. Under the background of "Marine Powers" construction and "Land-Sea Coordination Development", the research on the relationship between tourism industry and urbanization played important role in island development. Zhoushan, as the only city composed of islands in China, has achieved 67.9% urbanization rate in 2017 and 80.67 billion yuan in tourism income, accounting for 66.2% of the GDP, apparently has the better urbanization level and tourism development among all island areas in China. Therefore, the relationship study between urbanization and tourism is an important basis for further coordinated development of the two systems in all districts and counties in Zhoushan City.

Urbanization, as a major phenomenon of human social development, is a hot research field in geography, economics and demography. Studies have shown that there is a close interaction between urbanization and economic development <sup>[1]</sup>. Tourism, as a main industry in many areas, is an important driving force of modern economic development. The relationship between tourism and urbanization has been widely concerned by both domestic (Chinese) and overseas scholars. Foreign scholars began to study the relationship between urbanization and tourism in the 1990s. Mullins firstly put forward the concept of tourism urbanization and studied the negative or positive effects of tourism urbanization on local development in 1991<sup>[2]</sup>, then Hannigan and Gladstone analyzed the classification and characteristics of tourism type urbanization in 1995 and 1998 <sup>[3,4]</sup>. In recent years, more and more foreign scholars have turned their research to the impact of tourism urbanization on the environment and the impact of tourism urbanization on small administrative regions <sup>[5,6]</sup>. Domestic scholars have also studied the relationship between the two from multiple perspectives. Generally, it can be summarized into two aspects. Firstly, the internal mechanism of the relationship between the two is studied. For example, K Wang, F Yu, etc. studied the mechanism of urbanization's

impact on tourism development, C Zhang constructed a coupled coordinated development model to evaluate the coordinating degree of the two systems<sup>[7-10]</sup>. Secondly, the scholars focused on the spatial characteristics of the two systems. For example, J Zhong, G Zhang, etc. analyzed the regional differences of the coordinated development of tourism and urbanization through empirical research<sup>[11-12]</sup>.

Island area is a typical area with booming coastal tourism in China, but few scholars have studied the relationship between tourism development and urbanization. Based on this, this paper focused on the following researches: (1) This paper calculates the coupling and coordinating level of urbanization and tourism in island-type areas, in order to find out whether there is a positive interaction between them. (2) To find how deep the urbanization and tourism affect the coordination development, this paper takes the panel regression to calculate the influence that urbanization and tourism have on coupling and coordinating coefficient.

## Research Area and Methodology

### Research Area

Zhoushan Archipelago, located in the northeast of Zhejiang Province, is on the south bank of the Yangtze River Estuary and adjacent to Hangzhou Bay in the west. It consists of four districts, namely, Haidian District, Putuo District, Daishan County and Shengsi County. It is the only prefecture-level city composed of islands in China. The abundant island resources provide unique congenital resources for the development of Zhoushan's tourism. In 2017, Zhoushan received 550.07 million tourists, with a total tourism income of 80.67 billion-yuan, accounting for 66.18% of Zhoushan's regional GDP. Island tourism not only provides an important source of income for the social and economic development of Zhoushan, but also plays an important role in the improvement of economic structure of the city. In 2017, the urbanization rate of Zhoushan reached 67.9%, ranking in the forefront of Zhejiang Province. With the development of new urbanization and the construction of Zhoushan Archipelago New Area, Zhoushan, with tourism as the main industry, has great potential for urban development.

### Index Selection and Data Sources

Urbanization is a process in which labor and capital elements flow between cities and towns to redistribute them. Based on the coordinated development model of economy, environment, resources and society advocated by the new urbanization<sup>[13]</sup>, this paper defines the new urbanization of island as the process of the flow of labor and capital between cities and towns in the island area, so as to realize the redistribution of factors and promote the coordinated development of economy, environment, society and resources. Referring to the practices of existing literature, this paper selected population urbanization, economic urbanization, social urbanization and ecological urbanization as secondary indicators of new urbanization. Based on upon, this paper chooses 16 basic indicators to represent urbanization level (Tab.1)

Tourism-driven urbanization is a typical consumption-driven urbanization. The realization of tourism consumption depends on the supply capacity of tourism industry. On the other hand, it is directly related to the recognition degree of tourists. Combining with the existing research methods, this paper chooses 4 indicators to represent tourism input factors and 2 indicators to represent output capacity. Specially, the number of star-level scenic spots is weighted by using Z Zhang's method<sup>[14]</sup>, which assigned the number of 3A and higher-level scenic spots as 2 and other scenic spots as 1. (Tab.1)

Based on the principles of comprehensiveness, operability and comparability, the above indicators are selected to construct an index reflecting the level of new urbanization and tourism. Then this paper uses the Entropy Method to measure the level of new urbanization and tourism development, the specific calculation methods and related steps can be found in the reference<sup>[15]</sup>.

Table 1. The index of new urbanization and tourism

Target Layer	Criterion Layer	Indicator Layer	Index Attribute	Weight
New Urbanization Level	Population Urbanization	Proportion of non-agricultural population	+	0.0358
		Number of urban employees	+	0.1244
		Natural population growth rate	+	0.0478
	Economic Urbanization	Per capita GDP	+	0.0504
		Contribution rate of secondary and tertiary industries to GDP	+	0.0478
		Fixed assets investment	+	0.1598
		Total social consumer goods	+	0.0822
		Actual use of foreign capital	+	0.0526
	Social Urbanization	Population with basic medical insurance insured	+	0.0893
		Number of beds in medical institutions	+	0.0968
		Number of students in ordinary middle schools	+	0.0519
		Ratio of disposable income between urban and rural residents	+	0.0056
		Number of Internet access users	+	0.0771
	Ecological Urbanization	Emissions of industrial waste gas	-	0.0196
Production of industrial solid waste		-	0.0211	
Emissions of industrial wastewater		-	0.0378	
Tourism Industry Development Level	Input Element	Number of scenic spots	+	0.1749
		Number of star-rated hotels	+	0.0923
		Number of tourist agencies	+	0.1708
		Number of tertiary industry employees	+	0.0958
	Output Capacity	Number of tourist receivers	+	0.2006
		Tourism receipts	+	0.2656

The data of this paper are derived from *Zhoushan Statistical Yearbook*, *Zhejiang Statistical Yearbook* and the statistical bulletins of national economic and social development of related districts and counties from 2007 to 2017.

### Coupling Mechanism of New Urbanization and Tourism Development Level

The concept of coupling originates from physics. It refers to the process in which two or more systems interact with each other. Effective intervention in the elements of the system can promote the coordinated development of the system. New urbanization and tourism development interact and promote each other. On the one hand, new urbanization is the premise and guarantee of tourism development. The upgrading of new urbanization level promotes the improvement of infrastructure, industrial institutions, living standards of residents, ecological environment optimization and labor employment structure adjustment in island areas, which provides more abundant labor and capital elements for the development of tourism. On the other hand, tourism development is an important driving force for urbanization. Tourism receipts is an important source of income in island areas. Tourism development provides economic support for the construction of new urbanization, makes great contributions to the optimization of industrial structure in island areas, and provides a large number of employment opportunities. Tourism, as a typical consumption-driven industry, is of great significance to the improvement of regional industrial structure. Negatively, with the increase of the number of tourists, the pressure of ecological environment in island areas is increasing (Fig. 1).

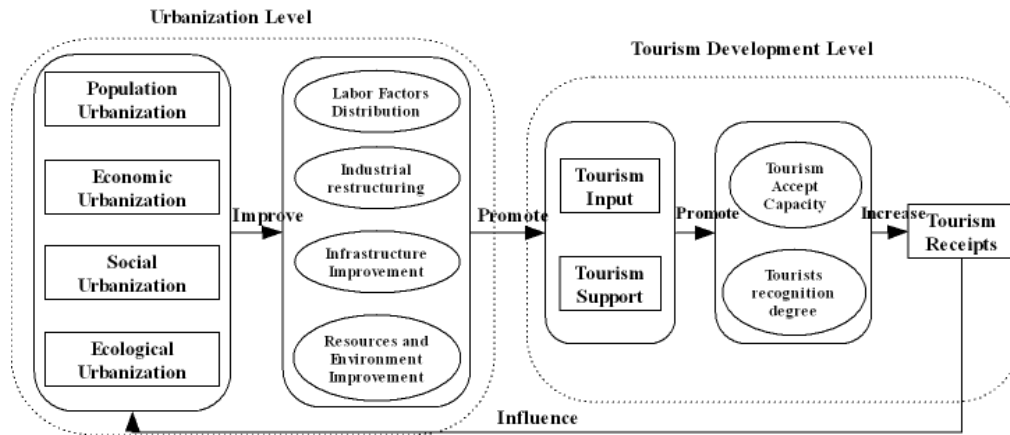


Figure 1. Coupling mechanism of new urbanization and tourism development level

### Methodology

This paper uses the coupling coordination degree model to calculate the coupling coordination degree between new urbanization and tourism development in Zhoushan and its four subordinate districts and counties. Coupling degree is one measure of the interaction between or within the research objects. It can be used to calculate the interaction coupling relationship between the new urbanization level and tourism development level of island areas. However, the disadvantage is that the coordinated development level between the two can not be measured, so this paper chooses the coupling coordination degree model. The concrete model structure is as follows [16]:

$$U = \left\{ \frac{F_{(x)} \cdot G_{(x)}}{\left[ \frac{F_{(x)} + G_{(x)}}{2} \right]^2} \right\}^k \tag{1}$$

$U$  is the coupling coefficient, ranges from 0 to 1, and represents the different coupling grades of the relationship of the two systems (Table 2).  $F(x)$  is the urbanization level, and  $G(x)$  is the tourism development level.  $k$  is the adjustment coefficient, ranges from 2 to 5, and is set to be 2 in this paper.

$$D = \sqrt{U \cdot T} \tag{2}$$

$$T = \alpha \cdot F_{(x)} + \beta \cdot G_{(x)} \tag{3}$$

$D$  is the coordinating coefficient, ranges from 0 to 1 as well, and represents the different coordinating grades of the two systems (Table 2).  $\alpha$  and  $\beta$  are set due to the significance of each system (the sum of  $\alpha$  and  $\beta$  should be one all the time). To evaluate the coordinating degree of the urbanization and tourism development,  $\alpha$  is set to be 0.7 and  $\beta$  is set to be 0.3 according to existing literature [10].

Table 2. Grade standards of coupling and coordinating [16]

Coupling Coefficient	Coupling Grade	Coordinating Coefficient	Coordinating Grade
0-0.3	Low level coupling	0-0.1	Extremely maladjusted
0.3-0.5	Antagonistic coupling	0.1-0.2	Seriously maladjusted
0.5-0.8	Grinding-in period	0.2-0.3	Intermediatly maladjusted
0.8-1	High level coupling	0.3-0.4	Slightly maladjusted
		0.4-0.5	Nearly maladjusted
		0.5-0.6	Barely coordinated
		0.6-0.7	Primary coordinated
		0.7-0.8	Intermediatly coordinated
		0.8-0.9	Well coordinated
		0.9-1	Perfect coordinated

## Result and Analysis

### Urbanization and Tourism Level Analysis

**Urbanization Level Analysis.** From 2006 to 2016, the overall level of urbanization in Zhoushan showed a fluctuating upward trend. The level of urbanization was greatly improved in 2012, exceeding 0.5 in 2013 and reaching the highest level in 2014 (Fig.2). The establishment of Zhoushan Archipelago New Area played an important role in the improvement of the overall urbanization level of Zhoushan. With the goal of building an international port city, a leading marine economy city and an island tourism city, Zhoushan Archipelago New Area constructs a "one city, three belts" urban spatial structure. It is estimated that the urbanization rate will reach more than 83% by 2030, which will inject new vitality into the urban development and construction of Zhoushan Archipelago. The new urbanization level of Dinghai District, Putuo District, Daishan County and Shengsi County also showed a fluctuating upward trend from 2006 to 2016 with slight difference among the four areas. Dinghai District has the highest degree of new urbanization, with an average value of 0.4953, which is higher than the overall average value of Zhoushan City (0.4590), followed by Putuo District, with an average value of 0.3938. Compared with Dinghai and Putuo, the islands of Shengsi County and Daishan County are more dispersed, and the level of new urbanization is relatively low, with the average values of 0.3149 and 0.3138.

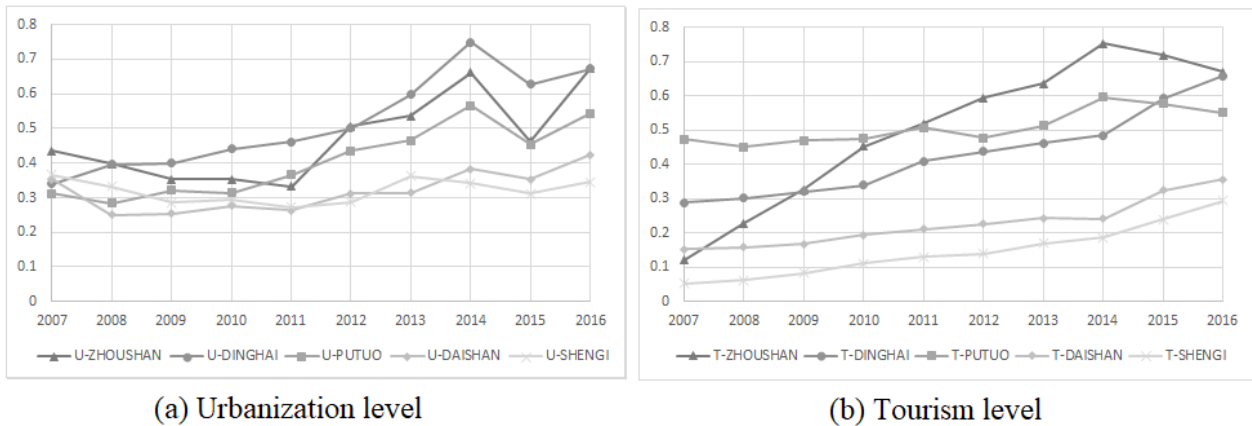


Figure 2. Urbanization and tourism development level of Zhoushan during 20016-2016

**Tourism Development Analysis.** From 2006 to 2016, the overall level of tourism development in Zhoushan Archipelago showed an upward trend with slight slowdown in 2007, 2015 and 2016 (Fig.2). As an island city, tourism has always been the main industry of Zhoushan Archipelago. The Putuo International Tourism Island Group, Shengsi Fishery and Tourism Island Group, and Marine Ecological Island Group provide unique conditions for the development of Zhoushan's tourism industry. The tourism development level of Dinghai District, Putuo District, Daishan County and Shengsi County increased steadily from 2006 to 2016, with the average values of 0.4292, 0.5089, 0.2274 and 0.1465. There are obvious spatial differences with a standard deviation of 0.1467. The Tourism Level of Dinghai and Putuo districts has always been higher than that of Daishan and Shengsi counties. This is mainly because natural tourism resources, like the Putuo International Tourism Islands, and the tourism projects such as Dongyi Valley in Dinghai provide strong support for the tourism development in Putuo and Dinghai Islands. Due to the disperation of the islands and traffic constraints, Shengsi County is quite weak in tourism development, however, with the promotion of Shengsi fishery and tourism archipelago projects in Zhoushan Islands New Area, the tourism industry in Shengsi County has also developed rapidly, and the tourism development level index has been raised from 0.05 in 2006 to 2016. 0.3101.

### Coupling and Coordinating Relationship between Urbanization and Tourism

**Coupling Relationship.** The coupling degree between urbanization and tourism development in Zhoushan Archipelago keeps rising during 2007 to 2016. The coupling grade stayed at the high level

except in 2007. In 2009, 2014 and 2016, the coupling coefficient was even higher than 0.99, which shows that the urbanization of Zhoushan Archipelago is well coupled with the development of tourism. This result shows that the existing urbanization and tourism development model of Zhoushan Archipelago, which promotes each other and develops together, is a positive and feasible common development path. The average coupling coefficient of urbanization and tourism development in Dinghai, Putuo, Daishan and Shengsi counties was 0.9750, 0.9577, 0.9242 and 0.6663, showing an overall growth trend with slight spatial differences and dynamic changes. The coupling coefficient of 2007, 2011 and 2016 show that only Shengsi and Putao are in the antagonistic coupling grade in 2007, while the rest are all in the high-level coupling grade. The coupling degree between urbanization and tourism in Daishan County has always been higher than that in other three districts and counties, while that in Shengsi County is the lowest. Under the development concept of Zhoushan as a service-oriented island city with tourism as its main component, the development of tourism, logistics and other service industries has promoted the coupling development of urbanization and tourism.(Fig.3)

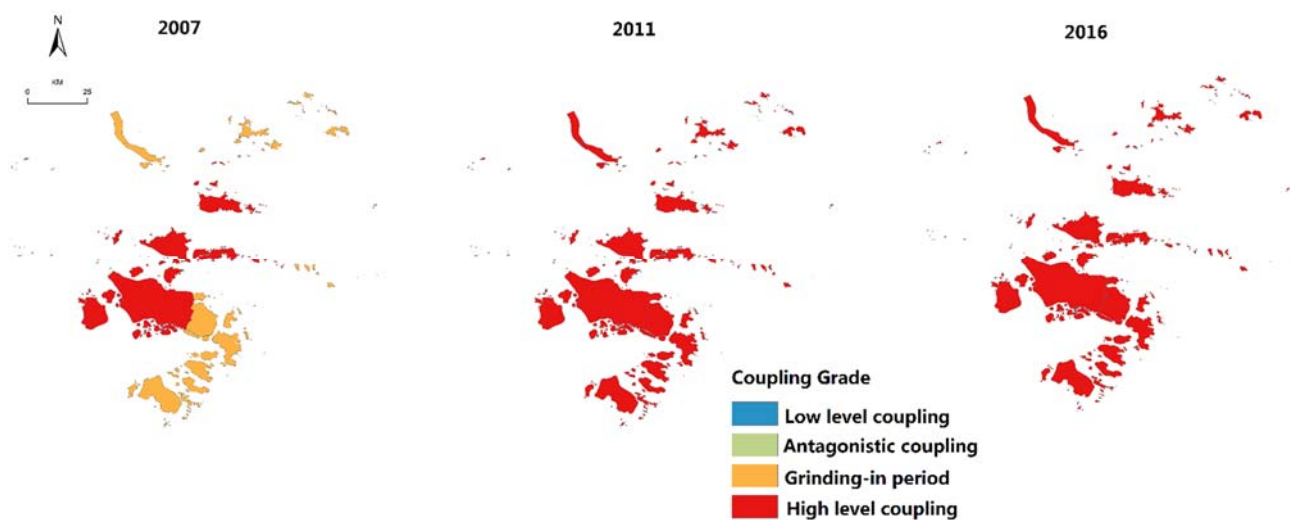


Figure 3. The spatial-temporal characteristic of coupling degree between new urbanization and tourism of Zhoushan

**Coordinating Relationship.** From 2007 to 2016, the coordination degree between urbanization and tourism development in Zhoushan Archipelago synchronized grow with the coupling degree, but keeps lower than the coupling level. In 2007, the urbanization and tourism are slightly maladjusted, while the other years they are coordinated development. In 2014 and 2016, the coordination level was significantly higher than 0.8, implying that they are well coordinated during this period. With the improvement of urbanization and tourism development, they become better coordinated. However, the coordinating coefficient show that there is higher potential for their coordinated development, making it necessary to take improvement measures. The average coordinating coefficient of urbanization and tourism development in Dinghai, Putuo, Daishan and Shengsi counties was 0.6870, 0.6452, 0.5161 and 0.4138, keeping rising during 2007 to 2016. Dinghai has the highest coordinating coefficient, reaching the well coordinated grade in 2016, while Shensi has the lowest one, staying the maladapted grade among the ten years.(Fig.4)

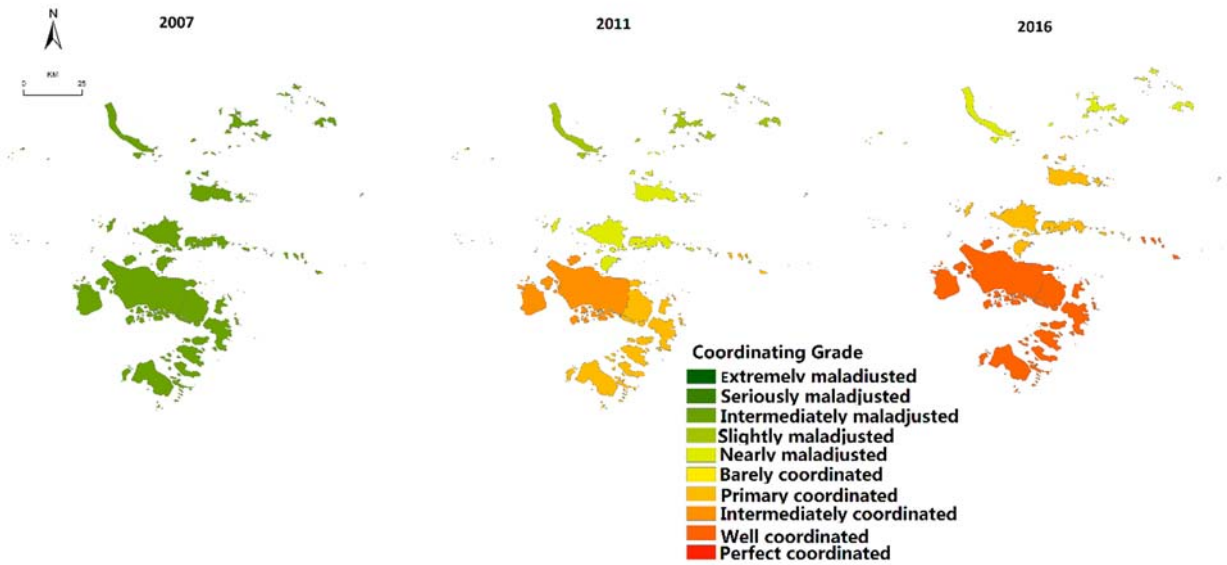


Figure 4. The spatial-temporal characteristic of coordinating degree between new urbanization and tourism of Zhoushan

**Correlation Analysis.** This paper uses STATA to do panel regression analysis on the data from 2006 to 2016 to calculate the influence that urbanization and tourism have on coupling and coordinating coefficient. After taking Hausman test, this paper selects the fixed effect model for regression. The fitting equation between coupling coefficient (COUP) and urbanization level (U), tourism development level (T) is obtained as follows:

$$COUP = -1.0385U + 1.5865T + 0.7663, (R^2 = 0.5423, P = 0.000)$$

Similarly, the fitting equation between coordinating coefficient (COOR) and urbanization, tourism development is obtained as follows:

$$COOR = 0.3464COUP + 0.7432U - 0.2586U^2 + 0.2371T + 0.646, (R^2 = 0.9980, P = 0.000)$$

Regression results show that urbanization and tourism development have significant effect on the coupling and coordinating coefficient. The coupling coefficient is positively affected by the tourism and negatively affected by the urbanization level. Similarly, the coordinating coefficient is positively affected by the tourism. However, the influence path of urbanization on coordination coefficient is inverted U-shaped. Since the values are on the left side of the curve, urbanization positively affects the coordinating coefficient at present.

## Conclusions

By calculating the urbanization and tourism development level of Zhoushan Archipelago and its coupling coordination coefficient, this paper draws the following conclusions:

- ① The urbanization and tourism development level of Zhoushan Archipelago keep increasing from 2007 to 2016.
- ② The coupling and coordinating coefficients keep rising from 2007 to 2016, and the coupling coefficient stays higher than that of coordination. At present, urbanization and tourism are well-coordinated. However, Shengsi is still in maladapted grade, implying that the coordinated development of urbanization and tourism needs to be further improved.
- ③ Tourism promotes the coupling and coordinating development of the urbanization and tourism development. Similarly, urbanization also promote the coordinating development at present, while it has negatively effect on the coupling coefficient.

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