

Article

# Coupling Relationship and Interactive Response between Intensive Land Use and Tourism Industry Development in China's Major Tourist Cities

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**Abstract:** (1) Background: Exploring the interactive relationship between intensive land use (ILU) and tourism industry development (TID) is of vital significance to promote the high-quality and sustainable development of tourism and the urban economy. (2) Methods: This paper constructs an evaluation index system of ILU and TID, and comprehensively measures the coupling and interaction between ILU and TID in China's 58 major tourist cities from 2004 to 2018 by using the entropy weight method, coupling coordination degree model, and panel vector autoregressive model. (3) Results: In terms of the coupling relationship, the coupling coordination degree of ILU and TID in China's major tourist cities were optimized year by year, and the coupling coordination degree from 2004 to 2008 was less than 0.2, which is part of the serious imbalance recession stage. From 2009 to 2018, the coupling coordination degree was between 0.2 and 0.4, which is part of the moderate maladjustment recession stage. In terms of interactive response, ILU and TID formed a long-term interactive relationship, and the intensity effect of ILU on TID is significantly higher than that of TID on ILU. (4) Conclusions: There is a significant correlation and bidirectional process between ILU and TID, and they have an essential impact on the high-quality development of tourist cities.

**Keywords:** intensive land use; tourism industry development; major tourist cities; coupling relationship; interactive response

## 1. Introduction

Land is an essential material carrier for urban construction and development. The “economical, intensive and efficient” land use mode will directly affect urban economic operation and social well-being [1]. In recent years, the Chinese government has proposed the construction of a resource-saving and environmentally friendly society, which has been listed as a long-term strategic task of China. The extensive land use pattern was previously unable to meet the current needs of the social development mode [2,3]. ILU is becoming an inevitable requirement to realize the optimal allocation of land resources and high-quality development of the social economy. Among the many factors affecting ILU, the type and structure of industry are the most important factors [4]. Therefore, for China, which is at the stage of accelerated urbanization, how to achieve harmonious coexistence between ILU and industrial development is not only an important issue that should be urgently solved by the Chinese government, but the focus of academic research.

As an important industrial form of the national economy, TID can effectively reduce resource consumption [5], improve the degree of economic agglomeration [6] and bring into play the effect of industrial association [7]. It plays an important role in optimizing

the urban land use structure and improving urban land use efficiency. Research on the relationship between the tourism industry and land use has attracted the attention of academic researchers for a long time. In the 1930s, McMurry proposed the issue of the relationship between tourism and land use in his book *The Use of Land for Recreation*, highlighting that tourism is a unique and important form of land use [8]. In fact, urban land use and tourism development have a close relationship, especially in cities where all industries revolve around tourism activities and tourism function is the main function [9,10]. In this scenario, all kinds of land use changes will be directly or indirectly affected by tourism development.

Current academic studies on the relationship between land use and tourism development focus on three aspects. (1) The first focus is the relationship between tourism development and land cover change. Tourism development provides the construction of supporting facilities and an influx in tourists. These changes accelerate the transformation of land use function in a tourist area; change the original features of the tourist area; and cause land cover change phenomena, such as an increase in construction land, a decrease in woodland and grassland and the emergence of non-agricultural agricultural land [11,12]. Research on these types of phenomena usually obtains regional land cover maps using geographic information systems and remote sensing tools to explore the land use change brought about by the development of tourism in a specific period [13–15]. (2) The second focus is the relationship between tourism activities and land ecological response. A large number of tourism activities bring about a change in land use in a tourism area, which easily leads to the induction and change in the ecological environment, such as forest, soil, landform, biodiversity, and water resources [16–20]. Such studies mainly focus on negative impact analysis, including illegal construction, excessive garbage, occupation of forest land, scarcity of water resources, traffic congestion, and other problems brought about by the development of tourism, which deteriorate the aesthetic value of scenic spots [21,22]. (3) The relationship between tourism development and land use pattern is also analyzed. Tourism development can bring about significant changes in regional land use patterns and promote the transfer of urban land use types from residential, commercial, industrial, and unused land to tourist land [23,24]. In this process, the local economic level will be improved to a certain extent; however, the intensity of tourism development aggravates the scarcity of land resources, promoting an increase in land prices and rent, which further promotes the formation and development of tourism-oriented towns [25,26]. A review of the relevant literature reveals that most current studies regard tourism development as a driving factor of land use change, but is this only a one-way process between land use and tourism development? In fact, in the period of rapid urbanization, urban land use is often realized by administrative force due to certain needs, and urban tourism, as an industrial form, is likely to be subject to the overall arrangement of urban land use [9,10]. Especially in the rapid expansion of urban construction land and extensive use of land resources [27], the level of urban ILU will directly determine or affect the benefits of urban tourism development as a key factor.

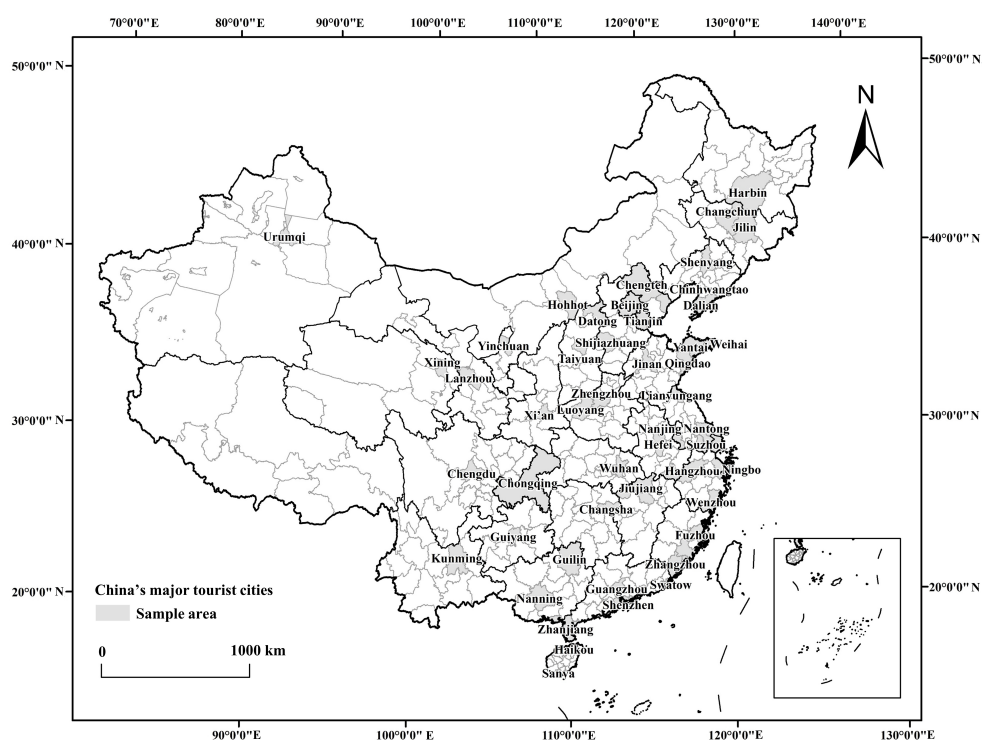
This study attempted to explore the “two-way” relationship between ILU and TID, rather than the single “one-way” approach used in the past. By taking 58 major tourist cities in China as study areas and on the basis of incremental data from 2004 to 2018, the evaluation index system was constructed. The coupling interaction relationship between ILU and TID was analyzed by using the entropy weight method, coupling coordination degree model, and panel vector autoregressive model. This study has three main contributions. First, this research aimed to construct an appropriate index system, so as to accurately measure the level of ILU and the development level of tourism industry of major tourist cities under China’s national conditions. Second, by using the coupled coordination model and the panel vector autoregressive model, the study arrived at a complete and convincing conclusion. Third, the study supplemented quantitative research on the two-way interaction between the tourism industry and land use, so as to provide an empirical basis for the sustainable development of tourist cities and government decision making.

The rest of this paper is organized as follows: Section 2 introduces the reasons for selecting the study area, coupling mechanism, research methods, and data sources. Section 3 presents the results of coupling and interaction. Section 4 includes the discussion of the results. Finally, Section 5 summarizes the main contributions and limitations of this paper.

## 2. Materials and Methods

### 2.1. Study Area

A tourist city considers tourism development as an important goal and has a prominent tourism function after a certain period of accumulation. In The Yearbook of China Tourism Statistics, a long-term tracking statistics on the tourism development of 60 major tourist cities in China has been carried out. These cities are well known at home and abroad, where the regional economies are developed, and tourism resources are rich and high quality, attracting a large number of domestic and foreign tourists. Furthermore, the development of the tourism industry in these cities has gained more general market recognition, so they are called “major tourist cities” [28]. Taking this as a case study can better reflect the actual level of China’s urban tourism industry. Owing to the incomplete statistical data of Yanbian and Lhasa among the 60 major tourist cities, this study intended to take 58 cities other than these two cities as research objects. From the perspective of spatial pattern, these 58 cities accounted for 8.63% of the total number of cities in China in 2018, which are distributed in 30 provinces (municipalities and autonomous regions) in mainland China, except Tibet, as shown in Figure 1.

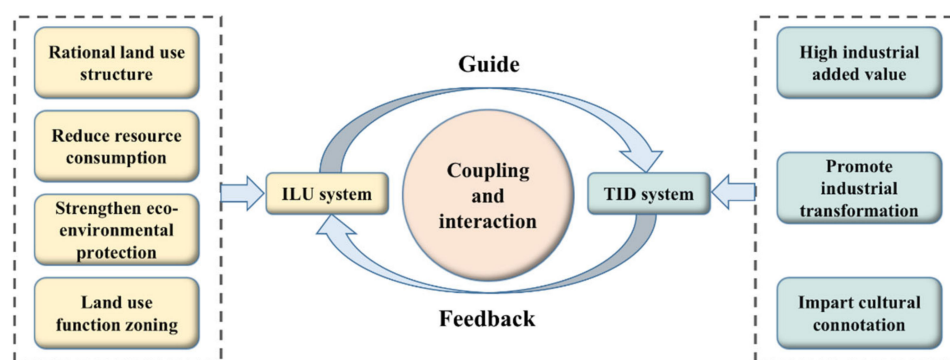


**Figure 1.** Spatial distribution of major tourist cities in China.

### 2.2. The Coupling and Coordination Mechanism of ILU and TID

According to the related theories of synergetic theory, the change in the macroscopic order properties of all systems is the result of synergetic action between internal subsystems. Thus, in the process of system operation, when the control parameters reach a critical value due to the regulation of the external environment, synergistic effects will be generated between relevant subsystems, which will give rise to the order parameters that dominate the behavior of subsystems. Through benign cooperation, the order parameters will guide the non-equilibrium changes in the system at the critical point and then form a new ordered

structure [29]. As a subsystem in the social economic system, the coupling and coordination of ILU and TID form an independent and open macrosynergy phenomenon, and its essence is the optimal allocation of resources under the influence of external economic and social factors. The developments of the two systems complement each other, and a close internal connection exists in terms of overall goals and implementation methods, jointly promoting the formation of a sustainable urban tourism development pattern [30]. Figure 2 shows the mechanism of their coupling interaction.



**Figure 2.** Coupling and interactive mechanism of ILU and TID.

### 2.3. Implementation of Methodology

#### 2.3.1. Construction of Evaluation Index System

The standard selection and correct measurement of indexes are the basis of evaluation and analysis. The selection of evaluation indexes of ILU and TID in major tourist cities in China adheres to the following principles: (1) Scientificity: the index system should be constructed on the basis of relevant policies and research; (2) Independence: under the premise of ensuring the comprehensive index system, the coupling and overlap of indexes should be reduced as much as possible; (3) Operability: the selected indicators should be applicable to different types of tourist cities on the premise of objective and accessible data. On the basis of these criteria and development requirements, this study selected 24 relevant indexes by following the multi-index comprehensive evaluation method, and constructed an evaluation index system of ILU and TID. Table 1 shows the specific index setting and index weight.

ILU regards the amount of capital, technology, and labor input per unit area of land as the degree of intensive land use; the more the capital, technology, and labor that are invested, the higher the land intensity, and vice versa [31]. In addition, in the process of ILU, how to effectively guarantee ecological benefits and achieve sustainable development is not only an important factor to measure the level of land use, but also a basic requirement for the construction of ecological civilization in China. Therefore, on the basis of the existing index system [27,32,33], this study constructed an index system with four levels, namely, input intensity, utilization degree, economic benefit, and ecological benefit of land, including 15 indexes. In terms of input intensity, fixed asset investment per unit area, the number of tertiary industry employees, and real estate construction were considered, and three indicators were selected. In terms of the utilization degree, considering the important infrastructure construction and employment situation per unit area, three indicators were selected. In terms of economic benefits, five indicators were selected considering the gross product per unit area, fiscal revenue, output value of the tertiary industry, and social consumption. In terms of ecological benefit, four indexes were selected considering the greening and environmental protection of the region.

In terms of TID, on the basis of the construction of the index system of the existing research [28,34], this study constructed an index system from the industry benefit, industry scale, and industry status of TID, including nine indicators. Among them, industry benefit is the direct reflection of measuring the level of tourism development, which is measured by domestic tourism income, foreign exchange earnings from international tourism, and

the annual growth rate of total tourism income. Industry scale is the ability of the tourism industry to expand the market and gain profit from it. It is measured by the number of domestic tourists, the number of international tourists, and the annual growth rate of total tourist arrivals. Industry status refers to the role and value of the tourism industry in the national economy, which is measured by the proportion of the total tourism income in GDP, the proportion of the total tourism income in the output value of the tertiary industry, and the density of the output value of tourism.

**Table 1.** Evaluation index system of ILU and TID.

System	Primary Indicator	Secondary Indicator	Unit	Weight
ILU system	Input intensity	Fixed asset investment per unit area	RMB10,000/km <sup>2</sup>	0.0573
		Number of tertiary industry employees per unit area	Person/km <sup>2</sup>	0.0863
		Real estate development investment per unit area	RMB10,000/km <sup>2</sup>	0.0817
	Utilization degree	Urban development land per capita	km <sup>2</sup> /person	0.0269
		Employment density	Person/km <sup>2</sup>	0.0889
		Urban road area per capita	km <sup>2</sup> /person	0.0361
	Economic benefit	GDP per unit area	RMB10,000/km <sup>2</sup>	0.0946
		Financial revenue per unit area	RMB10,000/km <sup>2</sup>	0.1334
		Retail sales of consumer goods per unit area	RMB10,000/km <sup>2</sup>	0.0821
		Output value of the tertiary industry per unit area	RMB10,000/km <sup>2</sup>	0.1095
		Total postal and telecommunications services per unit area	RMB10,000/km <sup>2</sup>	0.1356
	Ecological benefit	Green coverage rate in built-up areas	%	0.0024
		Urban green space per capita	km <sup>2</sup> /person	0.0564
		Centralized treatment rate of urban domestic sewage	%	0.0052
		Safe household garbage disposal rate	%	0.0036
TID system	Industry benefit	Earning from domestic tourism	RMB100,000,000	0.1049
		Foreign exchange earnings from international tourism	USD 10,000	0.1657
		Annual growth rate of total tourism income	%	0.0070
	Industry scale	Number of domestic tourists	10,000 person	0.0963
		Number of international tourists	Person	0.3633
		Annual growth rate of total tourist arrivals	%	0.0388
	Industry status	Proportion of total earning from tourism in GDP	%	0.0528
		Percent of total earnings from tourism in tertiary industry	%	0.0456
		Tourism output density	RMB10,000/km <sup>2</sup>	0.1256

### 2.3.2. Evaluation Method of Development Level

(1) Entropy weight method. Entropy is a measure of the degree of system disorder. The intrinsic information of the evaluation index itself is used to evaluate the utility value of the index. The smaller the value is, the greater the variation degree of the representing value of an index, the greater the information provided by the index, and the greater the weight of the index; and vice versa. Entropy weight method can overcome the overlapping of information among the index variables and the subjectivity of determining the weight. It can effectively realize the comprehensive evaluation of the evaluation target under the multiple evaluation index system. The formula is as follows [34]:

$$e_t = -k \sum_{i=1}^m y_{it} \ln(y_{it}) \quad (1)$$

$$w_t = (1 - e_t) / \sum_{t=1}^n (1 - e_t) \quad (2)$$

where  $e_t$  is the index entropy value,  $0 \leq e_t \leq 1$ ;  $y_{it}$  is the standardized value of the  $i$ -th sample and the  $t$ -th index, and the evaluation value of each index is obtained by using

min-max method through dimensionless and homogeneous processing.  $m$  and  $n$  are the number of samples and indicators, respectively;  $k = \ln m$ ;  $w_t$  is the index weight.

(2) Comprehensive evaluation model. The comprehensive evaluation model is used to measure the development level of the system, and the formula is as follows [34]:

$$S = \sum_{i=1}^n (w_i \times Y_k) \quad (3)$$

In the formula,  $S$  represents the comprehensive index of the system;  $w_i$  represents the weight of each index within the system;  $Y_k$  represents the evaluation value of each indicator.

### 2.3.3. Coupling Coordination Degree Model

“Coupling” originates from physics, which is used to represent the interaction and interaction relationship between two or more systems or modes of movement. It has been widely used in the field of geography to analyze the coupling relationship between two system elements. Therefore, using the coupling coordination degree to measure the coupling relationship between ILU and TID is reasonable. The formula is as follows [35]:

$$C = 2 \times \sqrt{(s_1 \times s_2) / (s_1 + s_2)^2} \quad (4)$$

$$D = \sqrt{(C \times T)}, T = \alpha \times s_1 + \beta \times s_2 \quad (5)$$

where  $C$  is the coupling degree between the two systems;  $s_1$  and  $s_2$  are the comprehensive indexes of the two systems.  $D$  is coupling coordination degree;  $T$  is the comprehensive coordination index between systems;  $\alpha$  and  $\beta$  are undetermined coefficients, and  $\alpha + \beta = 1$ . Given that ILU and TID are complementary, they are both assigned 0.5.

To better reflect the development characteristics of the coupling coordination degree between the subsystem of ILU and the subsystem of TID, the concept of relative development of ILU to TID is introduced, which is denoted by  $R$ .

$$R = s_1 / s_2 \quad (6)$$

On the basis of relevant studies [36], the coupling and coordination relationship between ILU and TID is divided into 5 categories and 15 specific types, as shown in Table 2.

**Table 2.** Coupled coordination classification system of LIU and TID.

Coupling Coordination	Degree	Relative Development	Meaning and Feature
$0 < D \leq 0.2$	Serious incoordination	$R < 0.8$	I-1 ILU lag
		$0.8 \leq R < 2$	I-2 Synchronized
		$R \geq 1.2$	I-3 TID lag
$0.2 < D \leq 0.4$	Intermediate incoordination	$R < 0.8$	II-1 ILU lag
		$0.8 \leq R < 2$	II-2 Synchronized
		$R \geq 1.2$	II-3 TID lag
$0.4 < D \leq 0.6$	Primary coordination	$R < 0.8$	III-1 ILU lag
		$0.8 \leq R < 2$	III-2 Synchronized
		$R \geq 1.2$	III-3 TID lag
$0.6 < D \leq 0.8$	Intermediate coordination	$R < 0.8$	IV-1 ILU lag
		$0.8 \leq R < 2$	IV-2 Synchronized
		$R \geq 1.2$	IV-3 TID lag
$0.8 < D \leq 1$	Quality coordination	$R < 0.8$	V-1 ILU lag
		$0.8 \leq R < 2$	V-2 Synchronized
		$R \geq 1.2$	V-3 TID lag

### 2.3.4. Panel Vector Auto-Regression Model

Panel vector auto-regression (PVAR) is a dynamic panel model with fixed effects. Distinguishing exogenous variables from endogenous variables is not necessary, and all variables can be regarded as endogenous variables. The relationship between ILU and TID is not a simple one-way linear relationship, and the PVAR model is only able to treat the target variable as an internal system, and take all variables and lag period into consideration to reflect the interactive relationship of each variable. Therefore, this study adopts the PVAR model to study the dynamic relationship between ILU and TID. The formula is as follows [37]:

$$Y_{it} = \gamma_0 + \sum_{k=1}^p \gamma_k Y_{it-k} + \alpha_i + \beta_t + \varepsilon_{it} \quad (7)$$

where  $i$  represents different cities;  $t$  represents year;  $Y_{it}$  includes two column vectors, namely, ILU and TID;  $\gamma_0$  represents the intercept term vector,  $p$  represents the lag order;  $\gamma_k$  represents the parameter matrix of lag order  $k$ ;  $\alpha_i$  represents the variable of individual fixed effect;  $\beta_t$  represents the time effect variable;  $\varepsilon_{it}$  represents the random disturbance term.

### 2.4. Data Sources

Taking 2004–2018 as the time series, the original index data were compiled from China City Statistical Yearbook, The Yearbook of China Tourism Statistics, statistical yearbooks of some cities, and statistical bulletins of national economic and social development in relevant years. To enhance comparability, some data were processed by secondary calculation (per capita, per unit area).

## 3. Results

### 3.1. Spatial and Temporal Characteristics of Index of ILU and TID

The above method was used to calculate the index of ILU and TID of 58 major tourist cities in China from 2004 to 2018, and the mean value was calculated by means of a five-year average summary to overcome the errors caused by data fluctuation.

#### 3.1.1. ILU Index

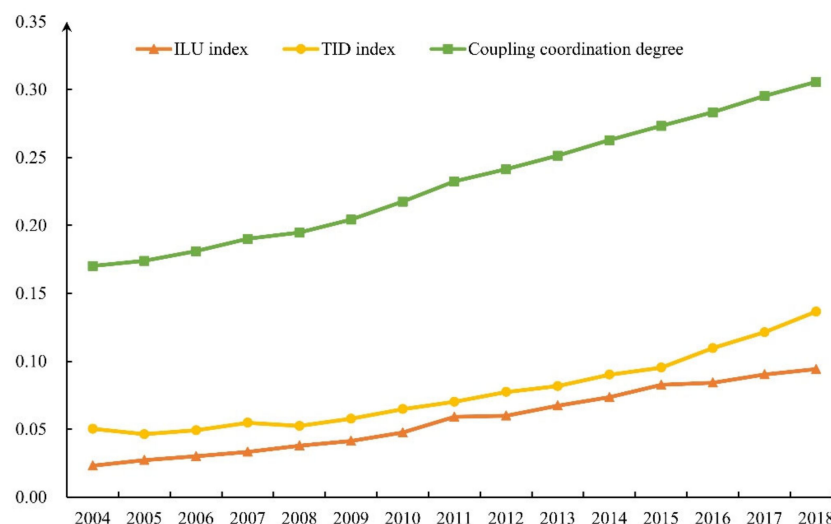
##### (1) Time series change of ILU index

The average value of the ILU index of China's major tourist cities showed an overall growth trend (Figure 3), which can be divided into three stages according to its change trend. The first was the slow growth stage from 2004 to 2009. The unbalanced land use structure and low land use efficiency caused by the extensive expansion of urban space were alleviated under the policy influence of the 11th Five-Year Plan. The ILU index increased from 0.0233 in 2004 to 0.0414 in 2009. The second was the wave-like growth stage from 2010 to 2015. The land intensification process in this stage was not stable, and the counter-cyclical urban land supply policy exacerbated this volatility, the ILU index rising from 0.0477 in 2010 to 0.0736 in 2014. The third was the rapid growth stage from 2015 to 2018. The Chinese government's new-type urbanization promoted the transformation of urbanization from a one-sided focus on the expansion of scale and space to a focus on content enhancement and high-quality development. Urban boundaries are controlled to a certain extent, the land market is effectively reformed, and land elements are unblocked. Flow, which caused a rapid growth in the urban land intensive index, increased to 0.0943 in 2018.

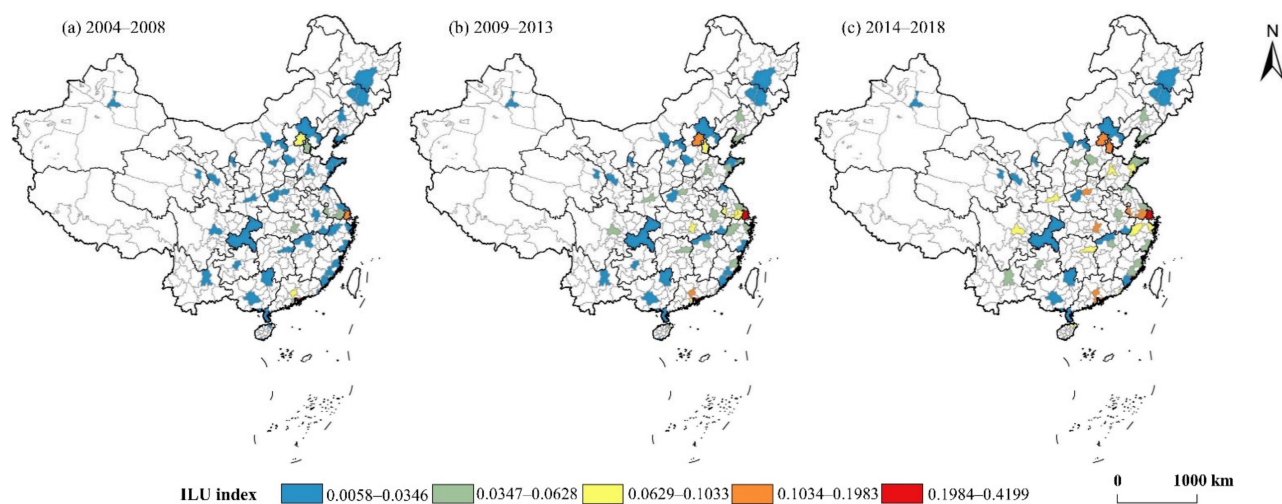
##### (2) Spatial characteristics of ILU index

At the regional level (Figure 4), the ILU index showed obvious spatial differences. In the first period (2004–2008), most of the tourist cities were at the lowest level of ILU development, as this period was still in the stage of social and economic recovery, with a low level of urbanization. The land and labor resources of each city could only basically meet the demand of urban construction land. By contrast, Beijing, Shanghai, Xiamen, Guangzhou,

and Shenzhen benefitted from their superior social and economic status, showing a higher level of development. In the second period (2009–2013), the number of low-level cities with ILU was significantly reduced, and the Yangtze River Delta, Beijing–Tianjin–Hebei, and Pearl River Delta regions had an advantage in the development of tourist cities. In the third period (2014–2018), the overall ILU in the eastern region reached a higher level of development, with Shanghai and Shenzhen showing the highest level. However, due to the backward level of social and economic development and the imbalance of land structure, the index of ILU of tourist cities in Western China was always at a lower level.



**Figure 3.** Time-series changes in ILU, TID index, and coupling coordination degree in China’s major tourist cities from 2004 to 2018.



**Figure 4.** Spatial distribution of ILU index of major tourist cities in China from 2004 to 2018.

### 3.1.2. TID Index

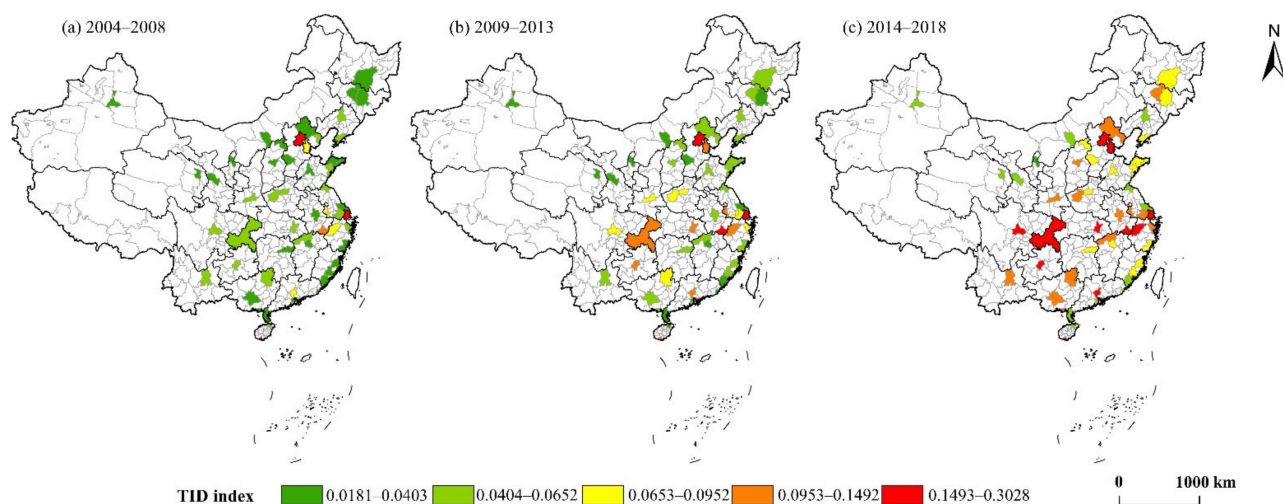
#### (1) Time-series change of TID index

Since the implementation of the reform and opening up policy, China’s social and economic level has improved rapidly, and the national tourism demand has increased dramatically. These reasons explain the TID index growth of China’s major tourist cities during the study period. According to the change trend, the development index of the tourism industry can be divided into three stages (Figure 3). The first is the fluctuating stage from 2004 to 2008, from 0.0504 in 2004 to 0.0525 in 2008; the growth rate was slow mainly

due to the tourism industry being in the primary stage of transformation. There was a lack of talent, the construction of urban service facilities was not improved, and development power was insufficient. The second is the steady growth stage from 2009 to 2014, which is largely related to the government's decision to consider tourism a pillar industry of the national economy and the implementation of large-scale investment strategy during the 12th Five-Year Plan. The third is the explosive growth stage after 2015, from 0.0954 in 2015 to 0.1367 in 2018. During this period, China's tourism development plan was included in the national key special plan of the 13th Five-Year Plan, which created opportunities for TID. With the change in the regional economy and tourism market environment, the tourism industry gradually completed transformation and upgrading, injecting new momentum into its development.

## (2) Spatial characteristics of TID index

Under the influence of different factors, such as resource endowment, economic environment, infrastructure, and traffic conditions, TID presented obvious spatial non-equilibrium changes. At the regional level (Figure 5), the development index of the tourism industry in the first period (2004–2008) presented a spatial pattern of polarization. Except for Beijing, Shanghai, Hangzhou, and Sanya, the cities showed a lower level of development. In the second period (2009–2013), Tianjin, Hangzhou, Wuhan, Ningbo, Guangzhou, Guiyang, and other tourist cities reached a higher level of development. Among them, although the social and economic environment of Guiyang was relatively backward and the foundation of tourism industry was weak, the development level of its tourism industry increased rapidly due to its unique tourism resources, the support of national policies, and the improvement of traffic conditions. In the third period (2014–2018), the development level of the tourism industry in major tourist cities across the country improved rapidly and reached a higher level of development. This growth is mainly due to the gradual development of the scale effect of urban agglomeration, and positive externalities, such as resource and knowledge sharing and technology spillover, among tourist cities weakening the overall differences in TID.



**Figure 5.** Spatial distribution of TID index of major tourist cities in China from 2004 to 2018.

## 3.2. Spatial and Temporal Characteristics of Coupling Coordination Degree

### 3.2.1. Characteristics of Time-Series Change

From the perspective of time series change, the coupling coordination degree between ILU and TID in major tourist cities in China showed a trend of optimization year by year (Figure 3). As a pillar industry of tourist cities, the growth of the tourism industry depends on the intensity of regional land investment, which is also conducive to the improvement of land use efficiency. However, due to the one-sided emphasis on the development of

industrialization in early China and the neglect of the rationality of industrial structure, tourism has not been given sufficient attention, and the input of capital, talents, land, and other elements is also insufficient. Moreover, the extensive expansion of urban space in this period further reduced the efficiency of the tourism industry within the regional unit, thus creating poorly executed developments and restrictions. Therefore, the coupling coordination degree only increased from 0.1702 to 0.1902 from 2004 to 2008, and the coupling coordination degree was always less than 0.2, which belongs to the severe imbalance recession type. Beginning in 2009, China's tourism industry may be defined as a strategic industry of national economic development. Opportunities for transformation and upgrading were given to the tourism industry and coincided with changes in urban spatial expansion. The optimization of the structural adjustment can not only improve the regional elements of the input and output units within the tourism industry, but also offers economic, social, and ecological benefits that complement one another. Therefore, compared with the previous stage, the growth rate was greatly improved.

Combined with the relative development degree, the coupling and coordination stages of ILU and TID in China's major tourist cities were further divided (Table 3). From 2004 to 2008, the tourism industry belonged to the coupling coordination type I-1, which indicated that TID was ahead of the process of ILU. The two were highly antagonistic, and the system tended to decline. The period 2009 to 2010 belonged to the coupling coordination type II-1, and the ILU process lagged behind TID. The two were highly antagonistic, and the system tended to decline. From 2011 to 2015, the coupling coordination was considered type II-2. ILU was synchronized with TID, the two were slightly antagonistic, and the system tended to be optimized. Finally, the period 2016 to 2018 belonged to the coupling coordination type II-1. TID was ahead of the ILU. The two were highly antagonistic, and the system tended to decline.

**Table 3.** Mean value and types of coupling coordination degree between ILU and TID in China's major tourist cities.

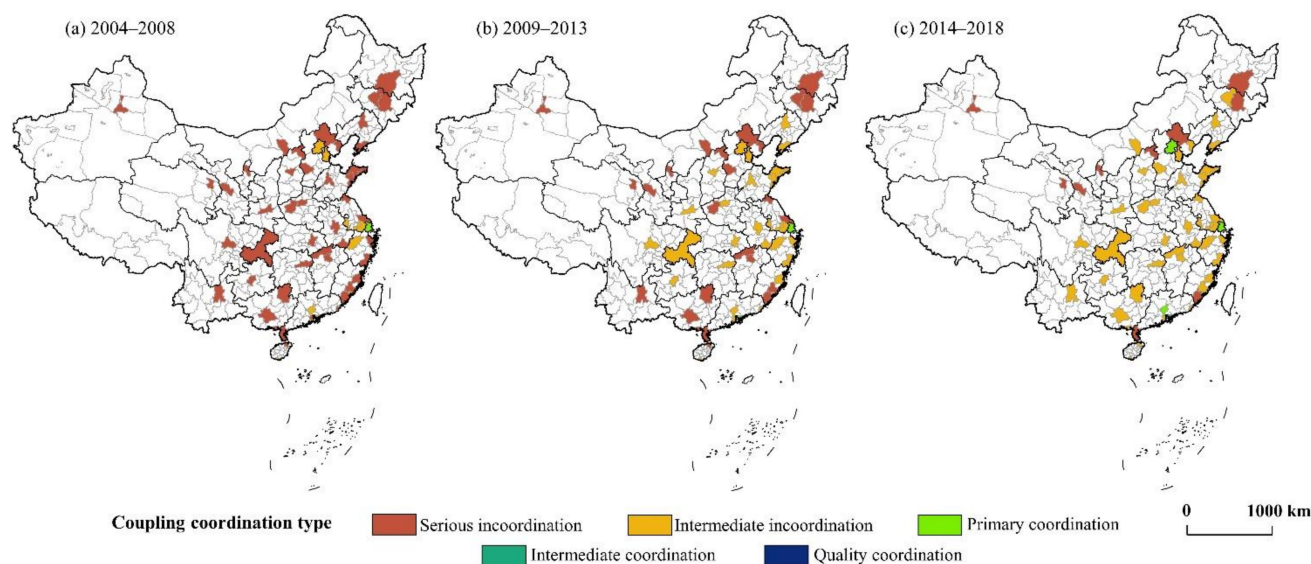
Year	Coupling Coordination	Relative Development	Type	Year	Coupling Coordination	Relative Development	Type
2004	0.1702	0.4764	I-1	2012	0.2414	0.7595	II-1
2005	0.1740	0.5959	I-1	2013	0.2514	0.8090	II-2
2006	0.1811	0.6110	I-1	2014	0.2629	0.8099	II-2
2007	0.1902	0.6192	I-1	2015	0.2718	0.8031	II-2
2008	0.1948	0.7307	I-1	2016	0.2834	0.7676	II-1
2009	0.2044	0.7254	II-1	2017	0.2954	0.7344	II-1
2010	0.2176	0.7455	II-1	2018	0.3057	0.6968	II-1
2011	0.2325	0.8487	II-2				

### 3.2.2. Spatial Characteristics

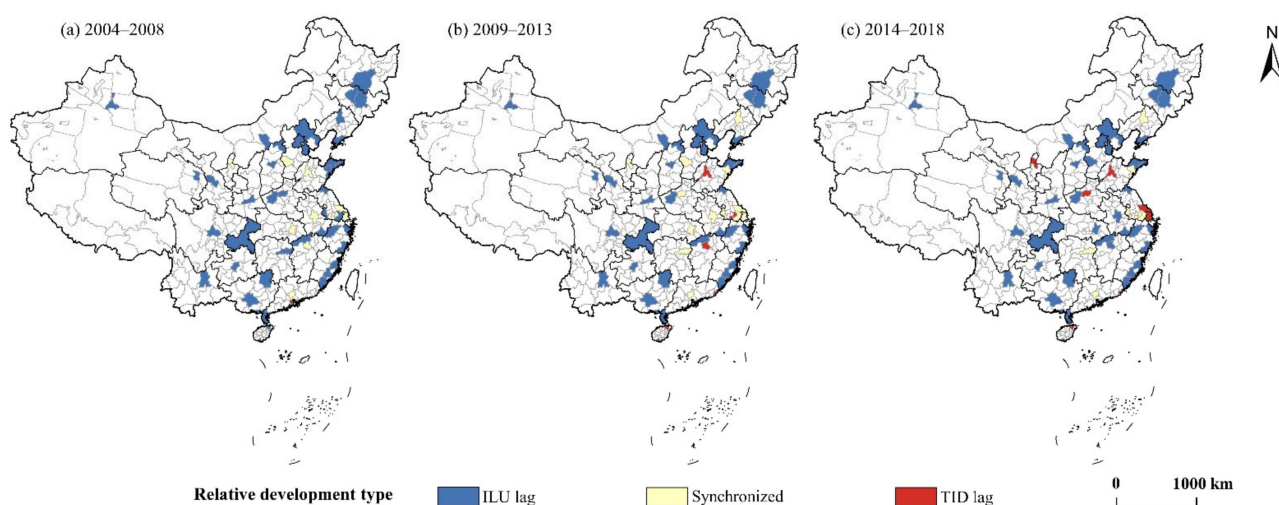
According to the spatial distribution of coupling coordination types (Figure 6), the coupling coordination degree of ILU and TID showed that cities in Eastern China were higher than tourist cities in Western China. Cities in Southern China were higher than tourist cities in Northern China. Among them, the coupling coordination degree of tourist cities in the Beijing–Tianjin–Hebei region, Yangtze River Delta, and Pearl River Delta was higher than that of other regions, and reached the level of coordinated development after three periods of changes. The main reason for this is not only the geographical location and social and economic advantages, but the city also tending to perfect its industrial structure. As a result, the tourism industry developed rapidly, and the urban unit construction land benefit improved greatly. However, the western region has always been in a state of serious imbalance. The phenomenon of “resource curse” was widespread in this region. The unit urban construction land efficiency level was low, and due to geographical constraints, the tourism industry was less progressive than the eastern major tourist cities.

From the perspective of spatial distribution of relative development types (Figure 7), the relative development degree of tourist cities in the Yangtze River Delta and the Pearl

River Delta was higher. Most of them were stable between 0.8 and 1.2, which indicates that the ILU of tourist cities in these regions is relatively coordinated with TID. The relative development degree of tourist cities in other regions was generally lower than 0.8, and the ILU lagged behind TID. This trend indicates that urban land use tends to be extensive, which hinders TID to an extent.

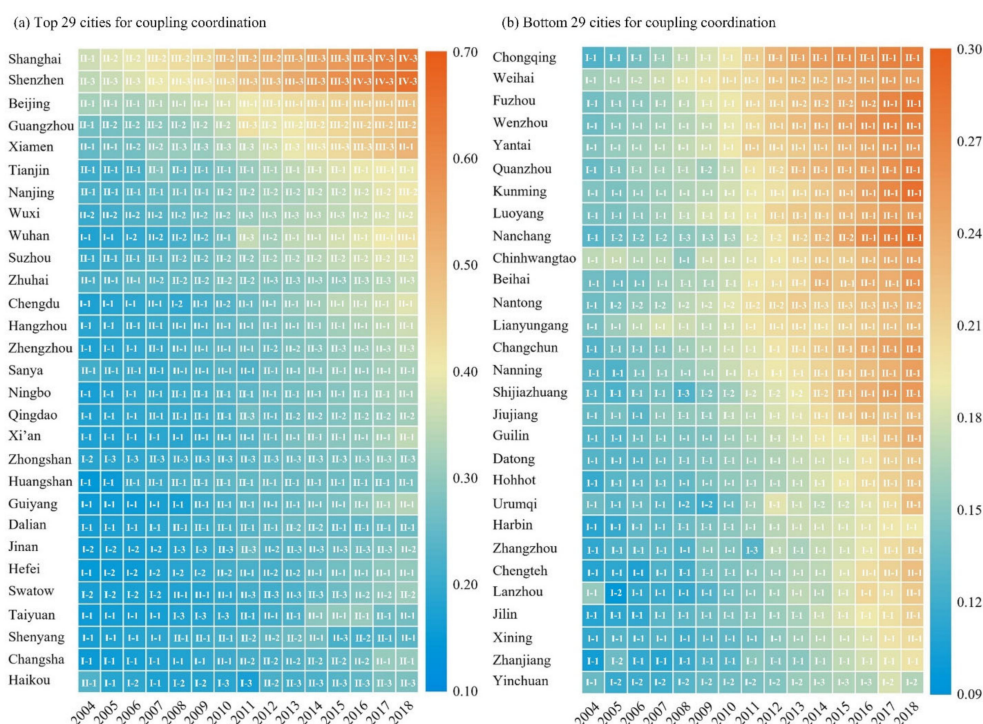


**Figure 6.** Variation in coupling coordination types of ILU and TID from 2004 to 2018.



**Figure 7.** Variation in relative development types of ILU and TID from 2004 to 2018.

From the perspective of the type of differentiation of coupling coordination degree and relative development degree among different cities (Figure 8), the evolution process can be roughly divided into three stages. In the first stage (2004–2006), the major tourist cities in China were in a state of serious imbalance, and most of the cities belonged to type I-1. TID was ahead of the ILU, the two were highly antagonistic, and the system tended to decline. The second stage (2008–2016) was in a state of moderate imbalance, mainly consisting of type II-1 and type II-2. TID and ILU tended to be synchronized. The third stage (2017–2018) was still in a state of moderate imbalance. However, the coupling coordination degree between the two systems of several cities tended to be optimized and reached the state of moderate coordination. Therefore, this stage was a transition period from imbalance to coordination, the level of ILU was constantly optimized, and more types of II-2 and II-3 emerged. TID tends to synchronize with the intensive use of land.



**Figure 8.** Variation in coupling coordination type and relative development type between ILU and TID in 58 major tourist cities.

### 3.3. Analysis of Interaction Mechanism

#### 3.3.1. PVAR Model Test

In view of the problem that unit root may cause false regression in panel data, IPS, LLC, and Breitung methods should be adopted to test the stability of data. The results show that the original sequences of ILU and TID could not reject the null hypothesis of the existence of a unit root of the variable, whereas the first order difference sequences of dILU and dTID rejected the null hypothesis of the existence of a unit root of the variable. dILU and dTID are stationary sequences, which can be estimated by using the PVAR model. On this basis, according to AIC, BIC, and HQIC criteria, the optimal lag order was determined as order 1, and a GMM estimation of panel data was carried out. As shown in Figure 9, the reciprocal values of the root module of the PVAR model established in this study were all located in the unit circle, indicating that the PVAR model system was stable and could be analyzed in the next step.

#### 3.3.2. Impulse Response

An impulse response function was used to study the dynamic impact of a variable on each variable in the system. To intuitively depict the dynamic lag relationship between ILU and TID, this study carried out a standard deviation impact on each variable, set the duration of the impact effect as 10 periods, conducted 300 random simulations using the Monte Carlo method, and obtained the results of the orthogonal impulse response function (Figure 10). Figure 10 shows that the impact of TID on ILU, ILU on TID, and TID on itself, presenting a positive and negative alternating iterative trend on the whole. All functions gradually flattened out after the fifth phase. This result indicates that the interaction between ILU and the TID is not the influence of a single trend, but will constantly change with the change in the development level between the two. The main reason for this may be related to the complex relationship between land use and industrial structure. The adjustment of the industrial structure will lead to a change in land use structure and mode, and a reasonable land use mode will also promote the optimization of industrial structure. However, the impact of ILU on the TID iteration range was greater. In addition, Figure 10

shows that the impact of TID on itself was significantly different from that of the other three shocks. At the beginning of the impact, TID rapidly decreased to induce a negative effect, but then it quickly returned to a positive effect and gradually flattened out. This result indicates that in the early stage of TID, due to the lack of supporting measures, the problems of land and environment caused by rapid development will hinder TID. Nonetheless, with the implementation of solutions, it will return to a positive impact.

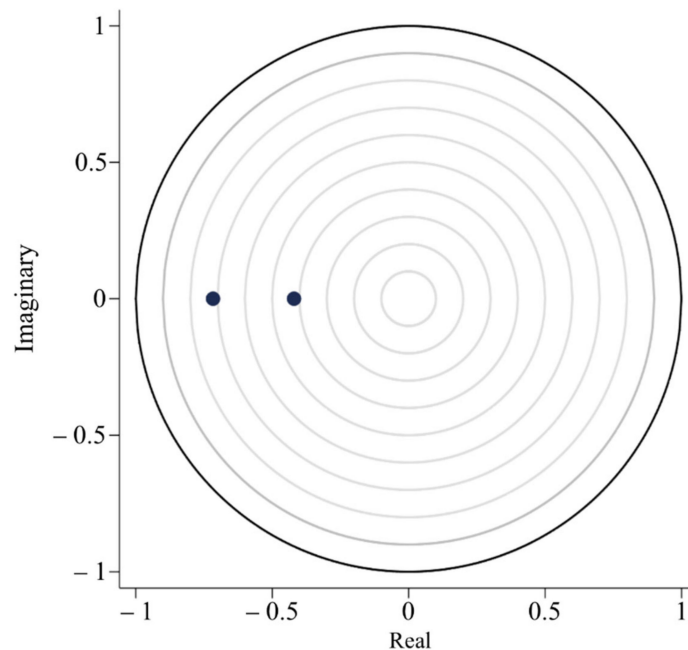


Figure 9. Reciprocal value of the root module of the PVAR model.

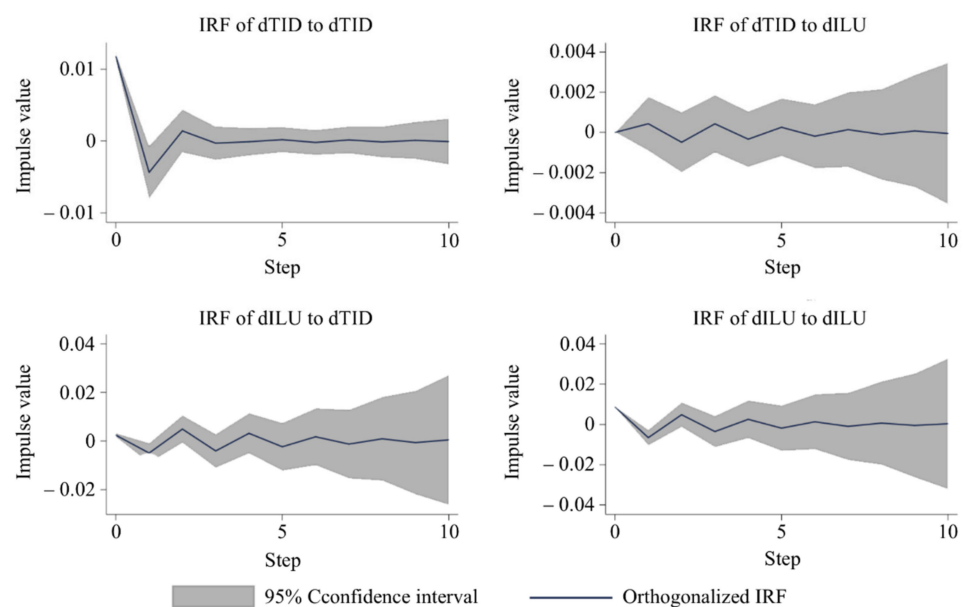


Figure 10. Impulse response function.

### 3.3.3. Variance Decomposition

To further investigate the degree of mutual influence between knowledge elements and entrepreneurial performance, variance decomposition was used to quantify the contribution of the impact of one variable to the fluctuation of another. From the perspective of the variance decomposition of ILU, its variance contribution rate mainly depends on its

own development inertia in the whole period. The contribution rate of TID to ILU showed a gradually decreasing trend from 4.04% in the first period, and gradually flattened out after the contribution rate reached 2.6% in the fifth period. From the perspective of variance decomposition of TID, although the variance contribution rate of the whole period was mainly from the TID itself, the ILU made an important contribution to TID. The rate of contribution of ILU to the TID increased from 0% in the first phase to 25.57% in the fifth phase, and then further increased to 28.95% in the tenth phase. The overall contribution rate was relatively large and showed an upward trend. A possible explanation for this is that the change in urban land intensive utilization degree, to an extent, will guide industrial land use, especially as the tourism industry is a pillar industry in tourist cities.

## 4. Discussion

### 4.1. Coupling Relationship between ILU and TID

From the perspective of geography, the spatial carrier of tourism industry is land, and its evolution law is closely related to land use pattern [38]. Therefore, it is necessary to monitor and regulate ILU, TID, and their mutual relations on a regular basis. For this reason, a coupling coordination degree model was introduced in this study to measure the degree of harmony between the internal elements of the system in the development process [39]. The research results show that in the process of the temporal evolution of ILU and TID subsystems, the present space–time structure was consistent, with existing scholars highlighting the “the spatial evolution of industry and land use change is temporal consistency” viewpoint [40], which further confirmed the existence of a correlation and regularity between the ILU and TID. Specifically, under the macrocontrol of national policies, ILU and TID showed a steady growth trend, and were affected by the microcontrol of the tourism market and major events, such as the financial crisis, resulting in fluctuating changes, thus showing certain stage characteristics [41,42]. In addition, the spatial and temporal variation in the coupling coordination degree between ILU and TID showed a distribution characteristic of “high in the eastern China and low in the western China, high in the southern China and low in the northern China”, which is highly consistent with China’s “Hu Huanyong Line”, indicating that the coupling coordination degree between ILU and TID was influenced by the cross effects of population, economy, nature, and other compound factors [38]. It is worth noting that the Yangtze River Delta region, the Pearl River Delta region, and the Beijing-Tianjin-Hebei region all held dominant positions during the 15 years of evolution and continue to radiate to the surrounding areas. This undoubtedly indicates that these regions formed a certain scale effect, and there were positive externalities, such as resource and knowledge sharing and technology spillover, among cities, which weakened the regional imbalance [43]. Therefore, it is highly important for the adjustment and optimization of the coupling and coordination relationship between ILU and TID to further encourage the synergy of tourism industries among cities, form a joint force in space, and build a comprehensive system of high-quality development.

### 4.2. Interaction between ILU and TID

Land is the basic input factor for regional industrial development, and the optimization of industrial structure can maximize the value of production factors, thereby driving the orderly, efficient, and sustainable use of land [44,45]. The tourism industry is an important development direction of regional industrial optimization and upgrading [6]; there is no doubt that the direct or indirect impact of tourism can be found in almost all the land use changes in most tourist destinations [15,46,47]. This is also an important reason for most current studies regarding tourism development as the driving factor of land use change [48]. However, in fact, several scholars highlight that the relationship between urban land use and tourism development is not simply one way, but two way [10,49]. The research results of this paper also further support this research view. It was found that there is a significant interaction relationship between urban ILU and TID, and the intensity of the interaction will constantly change with the change in the development level between

them. In addition, it is particularly noteworthy in the results that the impact of ILU on TID is significantly greater than the impact of TID on ILU. The main reason for this is that the direction and goal of urban land use will create desirable infrastructure conditions and public service environments and objectively promote the development of the tourism industry [10].

#### 4.3. Limitations and Future Research

Although the results of this study contribute to clarifying the functional relationship between ILU and TID in China's major tourist cities, they are not without limitations. Owing to the large number of cities selected in this study and the length of the study period, collecting data and unifying the caliber of data indicators among different cities were difficult and complicated. Therefore, the index data used in this paper are statistical commonalities of cities in different years. Whether this approach ignores the particularity of development between specific regions and cities may require a microscopic empirical test in the future. In addition, the research results show that the coupling and coordination degree of ILU and TID in China's 58 major tourist cities is on the rise. However, a gap remains between China's current level of urbanization and that of western countries. The existing literature shows that, in some Western and Asian developed cities, the influx of a large number of tourists and excessive tourism development may exceed the carrying capacity of urban land space [50]. Therefore, in future research, the influencing factor model of the coupling coordination degree between ILU and the TID can be built, and the relevant factors that have an important influence on its development and change can be effectively explored. Moreover, the evolution trend of ILU and TID in different cities can be identified with the help of model simulation to identify possible development problems in the future, so as to explore the optimal development path between the two systems.

#### 5. Conclusions

Tourism land is the carrier of tourism development. Research on the relationship between urban ILU and TID has an important theoretical value and practical significance for optimizing land use pattern and improving the comprehensive benefits of TID. By using the entropy weight method, coupling coordination degree model, and panel vector autoregressive model, this study analyzes the coupling and interaction relationship between ILU and TID in major tourist cities in China. The results show the following:

- (1) The indices of ILU and TID in China's major tourist cities show an increasing trend, and the development statuses of both are generally acceptable.
- (2) During the study period, the coupling and coordination degree of ILU and TID in major tourist cities in China was optimized year by year. The coupling coordination degree from 2004 to 2008 was less than 0.2, which belonged to the severe disorder recession stage. The coupling coordination degree from 2009 to 2018 was between 0.2 and 0.4, which belonged to the moderate maladjustment recession stage. In terms of spatial distribution, the coupling coordination degree of tourist cities in the Beijing–Tianjin–Hebei region, Yangtze River Delta region, and Pearl River Delta region was at a high level, whereas tourist cities in the western region were always in a serious imbalance state.
- (3) The interaction between ILU and TID is not the influence of a single trend but will constantly change with the change in the development level between them. The intensity of ILU on TID is significantly higher than that of TID on ILU.

The conclusion of the study has reference significance for how cities develop tourism, and it can provide ideas and a basis for major tourist cities to formulate new land development and utilization measures and promote high-level development of the tourism industry.

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and editing, C.H., F.L., D.C. and J.W.; visualization, C.H. and F.L.; supervision, D.C. and J.W.; project administration, D.C. and J.W.; funding acquisition, D.C. All authors have read and agreed to the published version of the manuscript.

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