Article

The Impact of Informatization on the Relationship between the Tourism Industry and Regional Economic Development

Xianghong Zhou and Weiwei Chen *

School of Economics and Management, Tongji University, Shanghai 200092, China; xhz7@tongji.edu.cn

* Correspondence: 09048@tongji.edu.cn

Abstract: Modern tourism plays an increasingly important economic role in regional development. However, in the practice of regional economic development, there is often a lag in economic development where the tourism industry is prosperous. We explored the potential impact of the development level of informatization on the coupling and coordination relationship between the tourism industry and regional economic development. Using provincial panel data from 2008 to 2017, we constructed a spatial Dubin model for empirical research. We established an evaluation model for the coupling and coordination relationship between tourism and regional economic development based on the establishment of evaluation models and indicator systems for informatization, tourism, and regional economic development. The results show that improvements to informatization generally promoted the coupling and coordination of tourism and regional economic development. Informatization not only improved the coupling and coordination of tourism and economic development in the region but also had significant spatial spillover effects. In addition to the influencing factors at the information level, the advantages of tourism resources and the level of economic development on the whole also helped to improve the degree of coupling and coordination, while the widening of the income gap between urban and rural areas hindered coordinated development. Further discussion shows that informatization will affect the degree of coupling and coordination between the tourism industry and regional economic development by influencing the level of institutional environment. The findings highlight the need to focus on diversified development of the regional tourism industry and economy while improving the level of informatization and strengthening cross-regional cooperation during informatization. The conclusions contribute to improving the coordinated development of regional tourism and regional economy and provide a scientific basis for the development of informatization and the formulation of tourism and economic policies.

Citation: Zhou, X.; Chen, W. The Impact of Informatization on the Relationship between the Tourism Industry and Regional Economic Development. *Sustainability* **2021**, *13*, 9399. <https://doi.org/10.3390/su13169399>

Academic Editor: Juan Ignacio Pulido-Fernández

Received: 5 July 2021

Accepted: 18 August 2021

Published: 21 August 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Copyright: © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Keywords: regional economic development; coupling and coordination relationship; spatial Dubin model

1. Introduction

Modern tourism plays an increasingly important economic role in regional development due to its strong integration, relevance, and ability to drive radiation. It is often one of the most important ways to boost regional economic development. However, there is often no positive correlation between the abundance of tourism resources, development of the tourism industry, and development of the regional economy. The economic development of countries or regions where the tourism industry is prosperous is relatively limited. Examples around the world include Greece in Europe and the Maldives in Asia, which are all relatively economically underdeveloped regions. Even within a country, this situation also exists, such as Yunnan and Tibet in China. Although research shows that tourism development can drive economic growth, the theory and related case studies show that “Dutch disease”—a phenomenon of industrial structure imbalance caused by the discovery and large-scale development of new natural resources that inhibited the development of other industries—is a common process in global economic development. These economic

symptoms have occurred in the Netherlands, Saudi Arabia, Russia, Mexico, Australia, Norway, and other countries that are rich in natural resources. The connotation is similar to the concepts of “beach disease” and “resource curse”. The concept of “resource curse” has the largest extension, which generally refers to the inhibitory effect on other industries of various resource-rich places. “Dutch disease” is generally used in places where primary industries are developed to inhibit other industries; “beach disease” specifically refers to a restraining effect on other industries where the tourism industry is particularly developed. In view of the fact that the concept of “Dutch disease” is relatively common, and the concept of “beach disease” is rarely used and is not familiar to ordinary scholars and the public, we use the concept of “Dutch disease”. It has been shown that the effect of Dutch disease not only exists in the natural resources sector but that excessive economic dependence on tourism is also likely to produce Dutch disease (Xu, 2006 [1]; Sheng and Tsui, 2009 [2]), where the resource economic dependence formed by regional economic development highly depends on some natural resources, such as tourism resource endowment. This leads to imbalanced regional economic development, a single industrial structure, and a reduction in the quality of economic growth.

At the same time, rapid advances in information technology are driving major changes in the economy and society. The level of informatization in various regions of China is at different stages of development. Indeed, the phenomenon of the “digital divide” between regions is relatively obvious, the development of informatization is unbalanced (Zhang et al., 2017 [3]), and there are significant development levels in the four major eastern, northeastern, central, and western regions. The level of informatization in the east is far ahead of the northeast, central, and western regions, and the gap between the regions with the highest and lowest levels of informatization is widening. Informatization may provide underdeveloped regions with opportunities to catch up and surpass the developed regions. Inclusive innovation promotes the balanced development of regional innovation capabilities, but it may also widen the innovation gap between the advanced and underdeveloped regions, further exacerbating the digital divide (Cha et al., 2016 [4]). The status quo of uneven development of informatization provides a realistic background for including it as an important variable in the study of the coordinated relationship between tourism and regional economic development.

2. Literature Review

There are relatively few studies on the impact of informatization on tourism and economic development. Research to date has mainly adopted qualitative methods. For example, Simon et al. (2005) used the east coast of New Zealand’s North Island as a case study to discuss the relationship between tourism, informatization, and regional economic development from a qualitative perspective, as well as being guided by community information. They believed that regional commercial development plays a role in promoting tourism informatization [5]. There are also some recent papers that focus on this topic. For example, Kumar et al. (2019) studied the relationship between Israel’s information and communication technology (ICT) and tourism and GDP during the period 1960–2016. They used Granger causality tests to reveal a one-way causal relationship between ICT and per capita economic output, and a one-way causal relationship between tourism development and per capita economic output and ICT indicators [6]. They concluded that ICT is an important driving force for Israel’s economic growth and a major driver of key economic activities, such as tourism. Specifically, they found that technology can expand the passenger flow and tourism market, especially by letting potential visitors know about Israel as a tourist destination so that the number of tourists continues to grow. The authors believed that the impacts of ICT and Israeli tourism development on economic growth are long-term.

Literature on the relationships between informatization, tourism, and economic development is relatively limited. Zhou and Wang (2017) constructed a tourism industry–regional economy–information industry system (TRI system) coupling and coordination

evaluation index system and evaluation model and conducted research using time-series data for Sichuan Province from 2004 to 2014 [7]. As a conclusion to their findings on the TRI system, they reported that “the tourism industry is the source of vitality, the regional economy is the basic support, and the information industry is the technical guarantee.” The overall comprehensive evaluation index of Sichuan Province has been increasing steadily. Pan (2017) conducted an empirical study on time-series data for China from 1994 to 2014. Through the construction of a state-space model and a vector autoregressive model, it was found that in the long term, informatization has a positive impact on tourism development, and the tourism industry has a positive impact on economic development. The author concluded that to realize the promotion of tourism to economic growth, it is necessary to take a new type of information-based tourism upgrade path [8].

Wei (2017) used grey correlation and coupling coordination analysis methods to study the relevance and coordination of the tourism industry, economic development, and information industry in the transformation and development of Japan’s tourism industry and found that the three were strongly correlated. Based on economic development and guided by smart tourism, Japan’s tourism is changing from an imbalance to coordination [9]. Based on the literature, Wei investigated the relationship between tourism, economic development, and informatization and found that, with the development of a local economy and society, the local government must issue relevant policies and regulations for the tourism industry to support the local tourism industry and guide tourism consumption. At the same time, through the creation of a good social environment and other means, this provides many guarantees for the development of local tourism; the tourism industry can promote the development of the information industry from the aspects of a technology application and development environment, and the development of tourism can improve the economic effect. This leads to increased labor and employment opportunities, improves infrastructure, and promotes related industries by either directly or indirectly promoting the sustainable development of the local economy and society. The information industry drives tourism through smart tourism construction, marketing innovation, information display, and the fast dissemination of information.

Luo (2017) studied the coordinated development of the “three modernizations” of tourism, informatization, and new urbanization in Guangdong Province. The study found that the three modernizations are coupled in terms of space, economy, culture, and environment, both promoting and restricting each other [10]. Through the measurement of the comprehensive development level of the three modernizations subsystem in Guangdong Province from 2006 to 2015, it was found that there are differences between cities, but the overall trend displayed slow development. The coupling development level was relatively high and the development between regions was relatively balanced. While the coupling index was relatively concentrated, the level of coordinated development of the three modernizations was close to being imbalanced, as the areas with a high level of coordinated development were concentrated in areas with more developed economies. Yang et al. (2018) used the AHP model and established an evaluation model to study the relationship between rural tourism informatization and the regional tourism economy in Jiangsu Province; they found that the two have a benign positive relationship of interdependence and integrated development and that the level of informatization promoted the development of tourism [11]. Wang et al. (2016) used a comprehensive evaluation function, coupling coordination degree, an efficacy function, and other methods to evaluate the coordination level of tourism and informatization in various provinces in China. The study found that provinces with a higher informatization level are more concentrated on the economy. Developed regions, such as the Bohai Rim, Yangtze River Delta, and Pearl River Delta provinces have a higher degree of coupling between informatization and tourism. At the same time, it was emphasized that the degree of coupling and coordination also depends on the influence of factors such as the economy, technology, resources, and population of each province [12].

There is limited research on the impact of informatization on the coupling relationship between tourism and regional economic development. In this study, we considered whether the coordinated development of tourism and regional economy is affected by the level of informatization development, what role the various subsystems of informatization play, and whether there is a spatial spillover effect. We conducted our research using the panel data model in econometrics to identify effects and quantitatively analyze them to reveal the reasons for their internal changes. The empirical test found that the improvement of the comprehensive level of informatization generally promoted the degree of coupling and coordination between tourism and regional economic development, and had significant spatial spillover effects.

As the largest developing country in the world, China is in the transitional period of its economic system. The depth and breadth of institutional changes are unmatched by any country in transitional systems today. China's tourism industry, which is in the transitional period of the economic system and is sensitive to the macro environment, is greatly affected by the institutional structure and industrial policies. The development of China's tourism is actually accompanied by the evolution and innovation of many related systems, and its rapid growth after the reform and opening up especially is obviously related to the institutional changes. Moreover, the energy released by it has deeply affected the level of regional tourism development and the degree of difference in tourism economy.

Tourism development-related policies have an impact on the coupling relationship between tourism and regional economy. The main purpose of this type of research is to analyze relevant policies that affect tourism development and economic development, so as to give relevant macro-system recommendations. Shen (1996) argued that tourism policy research has a relatively short time on a global scale. Pioneering leadership, innovative research and academic exploration, industry cooperation, and government recognition can be used to find the location of tourism policy in world economic and social policies. He also introduced two important foreign tourism policy research works in the early 1990s [13]. Against the background that foreign tourism policy research lacks sufficient attention, Hall et al. (1995) and Elliott et al. (1997) emphasized the combination of cases, expounding the relationship among tourism, public policy, and government from both theoretical and practical aspects [14,15]. Meethan (1998) took Cornwall and Devon, two regions of the United Kingdom, as examples. He pointed out that the long-formed tourism policy needs to be reconstructed when facing a competitive market, and pointed out that instead of aiming at pursuing economic benefits only, tourism policies and systems should be formulated to promote regional comprehensive development in social, cultural, and other fields. Fayos-Sola (1996), Douglas et al. (1998), and Vernon et al. (2005) discussed the government's important role from different angles in constructing a reasonable system model, formulating relevant policies, and cooperating with enterprises. The government's tourism administration policies should change along with changes in the tourism market [16–18]. Jaakson (1996) studied the impact of institutional changes on tourism development in the new independent countries formed after the disintegration of the Soviet Union from a planned economic system to a market economic system, and took Estonia in the Soviet Union as an example to indicate that similar regions should complete the transition from a planned economy to a market economy as soon as possible to eliminate the negative effects of institutional changes on tourism development [19]. Alipour et al. (2005) analyzed the role of basic system and national organizations in tourism development, and explored how, after Cyprus was divided into two independent political and economic entities, Northern Cyprus and Southern Cyprus, the internal factors such as the system are the primary reasons why the development of North Cyprus is lagging behind South Cyprus. In all, he tried to explain those problems of underdeveloped countries from an institutional perspective, and he hoped his analysis of the system would make contributions to the economic revival and promote the development of island countries like Cyprus [20].

The system changes in developing countries represented by China are typical. Therefore, the impact of system changes in developing countries on tourism development has

aroused the interest of scholars. The research on tourism policies and related systems is a hot spot for foreign scholars to conduct research on China's tourism. Chow (1988) analyzed the new situation and policy driving factors of the tourism development of Guangdong and Hong Kong since the implementation of China's reform and opening policy. Many problems are inseparable from the general background of China's institutional transition from the planned economy to the market economy [21]. Zhang et al. (1999) used Hall's (1994) evolution model of tourism policy formulation to demonstrate the important role played by the Chinese government in the development of inbound tourism from the four aspects of demand, decision, output, and impact after 1978. It was the main driving force of tourism development [22]. From the perspective of Western scholars, Sofield et al. (1998) and others systematically analyzed the contextual correlation between Chinese cultural policies and the development of tourism [23]. Lew et al. (2003) reviewed the development process of China's tourism from the perspectives of politics, economy, and geography, involving the impact of system and policy changes before and after the reform and opening up in 1978 on the development of China's tourism industry [24]. Qu et al. (2005) studied the influence of government management and ownership structure on the market orientation of China's tourism industry, and his study revealed that the influence of government regulation on the formation of market orientation is crucial [25]. Zuo (2011) found that under the government-led development model, the performance of tourism development in various places has nothing to do with the quality of the system, and the relationship between entry barriers and tourism development needs to be analyzed in combination with specific situations [26]. Yu et al. (2010) found that institutional changes are an important factor in promoting the rapid development of my country's tourism industry. Under the effect of path dependence, regional tourism differences have arisen and expanded. However, institutional innovation can be used to promote regional tourism development and narrow the regional tourism gap [27].

3. Materials and Methods

3.1. Hypothesis and Index

3.1.1. Hypothesis

The impact of informatization on the coupling and coordination relationship between tourism and regional economic development is mainly determined by the level of informatization and its development sub-items regarding the allocation ratio, allocation method, allocation efficiency, and other aspects of the internal subsystems of tourism and regional economic development. In addition, there may be a spatial spillover effect. In addition, the influence of informatization on the coupling and coordination relationship between tourism and regional economic development is mainly manifested in two perspectives: first, from a structural point of view, informatization can help to promote the optimization and improvement of the industrial structure; second, from the perspective of endogenous growth, information technology can help to promote the coordinated development of the two systems and has obvious endogenous characteristics. Based on this, the following hypothesis was proposed:

Hypothesis 1. *The improvement of the level of informatization will help to promote the coordinated development of the tourism industry and the regional economy and has a spatial spillover effect.*

3.1.2. Index Calculation

The data used in this study were from the 2009–2018 China Tourism Statistical Yearbook [28], China Statistical Yearbook [29], China Population and Employment Statistical Yearbook [30], and China Statistical Yearbook for Regional Economy [31]. Taking the panel data of 31 provinces, autonomous regions, and municipalities in the country (except for Hong Kong, Macau Special Administrative Region, and Taiwan Province) as the research object, China's provincial space was divided into western, central, and eastern regions. The western region included 12 regions: Guangxi, Ningxia, Qinghai, Gansu, Shaanxi, Xinjiang,

Yunnan, Guizhou, Tibet, Chongqing, Sichuan, and Inner Mongolia. The central region included 8 regions: Shanxi, Jiangxi, Anhui, Hunan, Hubei, Henan, Jilin, and Heilongjiang. The eastern region included 11 regions: Tianjin, Beijing, Shanghai, Zhejiang, Shandong, Liaoning, Hebei, Jiangsu, Guangdong, Fujian, and Hainan.

1. The level of informatization development

The level of informatization development is an important factor in measuring the level of a country's economic development and is an organic part of promoting China's economic development. The informatization development system is a comprehensive and complex system that covers a range of indicators. This study was based on the indicator system set out in the *Annual Report on Statistical Monitoring of China Informatization Development Index*, with reference to Cha and Zuo (2016), who categorized indicators in terms of dimensions regarding Internet resources, and finally formed six categories with a total of 16 indicators (Table 1): infrastructure (TV ownership rate, telephone ownership rate, computer ownership rate, mobile phone users, and mobile phone exchange capacity machine), industrial technology (per capita revenue from main telecom business, invention patent applications per million people), application consumption (Internet penetration rate, per capita telecom business volume), knowledge support (proportion of the number of employees in the information industry, education index: adult literacy rate $\times 2/3$ + average years of education $\times 1/3$), development effects (technology market turnover, research and development expenditure as a proportion of GDP), and Internet resources (number of websites, Internet broadband access ports, broadband access users).

Table 1. Informatization development system index system.

System	Level-I Index	Secondary Indicators
Information development system	Infrastructure facilities	TV ownership Phone ownership rate Computer ownership rate Mobile phone users Mobile phone switch capacity
	Industrial technology	Per capita telecom main business income Application patent applications per million
	Application consumption	Internet penetration rate Per capita of telecommunication volume
	Knowledge Support	Number of employees in the information industry relative to total employees Education index
	Development effect	Technology market turnover R&D expenses relative to GDP
	Internet resources	Number of websites Number of Internet broadband access ports Number of broadband access users

2. Coupling degree calculation

From the perspective of synergy, the coupling effect and the degree of coordination determine the order and structure of a system when it reaches the critical region, that is, the trend of the system from disorder to order. The key to the mechanism of the system from disorder to order lies in the synergy between the order parameters within the system, which influences the characteristics and laws of the phase transition of the system, where the degree of coupling is a measure of this synergy. Therefore, the degree of mutual influence between two systems through their respective coupling elements can be defined as the degree of coupling, which reflects the degree of interaction and mutual influence between the two systems. To deeply analyze the coupling and coordination relationship between the

two systems, an evaluation model reflecting the overall efficacy and coupling coordination relationship of the two systems was constructed based on the principle of coupling and coordination with the aid of the evaluation index system of information development, tourism development, and regional economic development, and through comprehensive references to Diane and Reyniers (1989) [32], Prideaux (2000) [33], Liu and Ma (2008) [34], Saenz and Rossello (2012) [35], Dong (2012) [36], and Zhang et al. (2013) [37].

(1) Weight of the index system

To establish an evaluation model for the coupling and coordination between the two systems, it is also necessary to clarify the weights of various indicators in the system. We used an improved entropy method to measure the weights of the indicators. As an objective variable, information entropy can be used to measure the degree of variation of indicators. A system consists of multiple indicators, where for the indicators that make up the system, the higher the information entropy, the greater the amount of information it carries, the higher the degree of variation, and the greater its impact on the overall system. Similarly, the correlation between indicators also leads to differences in the degree of their influence on the system, where the differences can be measured using information entropy. Compared with the principal component analysis method, the entropy method can objectively display the degree of influence of the indicators on the system.

Since the magnitude of each indicator is different, it is easy for this to unfairly influence the effect, and the measured result may not reflect the real situation; therefore, the original data for the indicator cannot be used directly. The raw data in different units need to be processed and comprehensively evaluated through certain mathematical transformations.

The dimensionless treatment methods of indicators include extremal, standardization, and averaging methods. Due to the large amount of information and the huge number of indicators, the range standard method was adopted for dimensionless processing. With the original data matrix of the evaluation index for every year, we studied the 31 provinces and cities of the Chinese mainland, and hence the total number of secondary indices of the research system in the formula.

The extreme deviation standardization data were $M = (x_{ij})_{m \times n}$, in which $m = 31$ and n was the total number of the index of the second level of the system. The index of the line i was $(x_{i1}, x_{i2}, \dots, x_{in})$. $\max(x_{ij})$ and $\min(x_{ij})$ were the maximum and minimum, respectively:

$$u_{ij} = \begin{cases} (x_{ij} - \min(x_{ij})) / (\max(x_{ij}) - \min(x_{ij})) \\ (\max(x_{ij}) - x_{ij}) / (\max(x_{ij}) - \min(x_{ij})) \end{cases} \quad (1)$$

After the dimensionless transformation and type transformation, a zero value appeared. To avoid having meaningless data in the subsequent data processing, the value was shifted, where this shift amplitude took a value of $r = 0.1$. Then,

$$u_{ij}' = u_{ij} + r \quad (2)$$

First, the weight of the index was calculated. After the standardization and translation transformations, the following transformations were performed on the data:

The proportion of the index j of region i was

$$\omega_{ij} = \frac{u_{ij}'}{\sum_{i=1}^m u_{ij}'} \quad (3)$$

The entropy value of the first indicator j was

$$r_j = -\frac{1}{\ln m} \sum_{i=1}^m \omega_{ij} \ln \omega_{ij} \quad (4)$$

The degree of difference of index j was

$$s_j = 1 - r_j \quad (5)$$

The weight of indicator j was

$$\lambda_{ij} = \frac{s_j}{\sum_{j=1}^n s_j} \quad (6)$$

Through the calculation of the above formulae, the index weights of the two research systems in different years were obtained. At the same time, due to the long time span of the research period, in order to improve the accuracy of the data, the weight data averaged over the years were used as the weight value of the two research system evaluation indicators.

(2) Efficacy function

u_i was the order parameter. u_{ij} was the first i order parameter of index j , where i represents the primary index of the research system and j represents the secondary index of the research system. u_{ij} was a function of x_{ij} . The $\max(x_{ij})$ and $\min(x_{ij})$ were the maximum and minimum values corresponding to the order parameter, respectively. The efficacy function was as follows:

$$u_{ij} = \begin{cases} (x_{ij} - \min(x_{ij})) / (\max(x_{ij}) - \min(x_{ij})) & x_{ij} \text{ is positive} \\ (\max(x_{ij}) - x_{ij}) / (\max(x_{ij}) - \min(x_{ij})) & x_{ij} \text{ is negative} \end{cases} \quad (7)$$

The value range of u_{ij} was $[0, 1]$, where a smaller u_{ij} means the rate of the index contributes less, while a larger u_{ij} means that the index rate contributes more and the index was closer to reaching the target.

The two variables in the two-variable coupled coordination model included two interacting systems that obtained the contribution of various order parameters within the system via geometric averaging, which was calculated using

$$u_i = \sum_{j=1}^n \lambda_{ij} u_{ij}, \quad \sum_{j=1}^n \lambda_{ij} = 1 \quad (8)$$

where u_i is the comprehensive evaluation index of year j , and λ_{ij} is the weight.

(3) Coupling degree function

The coupling function of n variables was as follows:

$$C_n = n \left\{ \frac{u_1 \times u_2 \times \dots \times u_n}{\prod (u_i + u_j)} \right\}^{1/n} \quad (9)$$

The generalized coupling model of the two-variable system was as follows:

$$C_2 = 2 \left(\frac{u_1 \times u_2}{u_1 + u_2} \right)^{1/2} \quad (10)$$

where u_1 and u_2 are the comprehensive evaluation indexes of two systems, and C_2 is the coupling degree of each system. The value range of the coupling degree was from 0 to 1. When C_2 was closer to 1, the system tended toward order (benign coupling), while when C_2 was closer to 0, the system tended toward disorder (loose coupling).

(4) Coupled Coordination Evaluation Model

The connection between different system components makes it possible for the two systems to interact. Coupling coordination was used to clarify the positive interaction between the systems from the perspective of nonlinear interactions between the system under test or the subsystems of the system under investigation. The degree of dependence

on the coordination relationship can be measured; in this study, the coupling coordination degree model was introduced as

$$D = (C_2 \cdot T)^{1/2} T = \alpha u_1 + \beta u_2 \quad (11)$$

In these formulae, the coupling coordination and the comprehensive evaluation index of the two systems reflect the contribution of the two systems to the degree of coordination and the comprehensive evaluation index of the two systems, respectively.

In Formula (11), D is the degree of coupling coordination; T is the comprehensive evaluation index of the two systems or elements, reflecting the degree of contribution of the two systems to the degree of coordination; u_1 and u_2 are the comprehensive evaluation indexes of the two systems; and α and β are the weights of the two systems.

Since the selected indicators involve different fields, the range of values differed. In order to ensure the accuracy of the analysis, the data were standardized according to Formulae (1) and (2) to eliminate the difference in dimensions between indicators. At the same time, to avoid meaningless data being included in subsequent data processing, the values were shifted by an amplitude of 0.1. After completing the data standardization process, the index weights were determined according to the entropy method of Formulae (3)–(11). Since we aimed to explore the coupling and coordination relationships between the parent system and other subsystems, in addition to considering the informatization, tourism, and regional economic development systems as a complete system for the weight calculations, it was necessary to calculate the weight of each system. For the index weights of the subsystems, the two sets of index weight calculation methods used the same principle. Given that each system was based on panel data for 10 years in 31 provinces, in order to eliminate the difference in year weights under the influence of special events and facilitate subsequent horizontal comparison and analysis, the final weight values obtained here were the average of the 10-year weights (Table 2).

Table 2. Index weights used in this study.

System	Level-I Index	Weight	Secondary Indicators	Weight
Tourism development system	Resource endowment	0.0371	Number of tourist attractions	0.0177
			Number of tourist attractions at level 3A or above	0.0195
	Location conditions	0.0782	Total annual passenger transport per capita	0.0185
			Source turnover volume of the whole society	0.0179
			Railway operating mileage	0.0230
			per capita of mail and electricity volume	0.0187
	Natural environment	0.0270	Greening coverage rate of the built-up area	0.0042
			Park area coverage rate	0.0148
			SO ₂ emissions per square meter	0.0079
	Reception capacity	0.1311	Number of travel agencies	0.0274
			Number of tourist hotels	0.0262
			Fixed asset investment of the travel agency	0.0369
			Investment asset investment in tourist hotels	0.0406
	Tourism public service capacity	0.0413	Total revenue/tourist population in the general fiscal budget	0.0413
	Travel requirements	0.0902	Total tourist times	0.0447
			Average visitor stay time	0.0236
			Visitors per capita	0.0219

Table 2. Cont.

System	Level-I Index	Weight	Secondary Indicators	Weight
Regional economic development system	Tourism industry scale	0.1768	Total tourism revenue	0.0414
			Operating revenue of the travel agency	0.0494
			Hotel operating revenue	0.0454
			Total accommodation facilities	0.0289
			Hotel room rental rate	0.0029
			Operating income from tourism enterprises/number of tourism enterprises	0.0088
	Tourism industry structure	0.1579	Share of travel agencies in total travel revenue	0.0359
			Part of total tourism revenue	0.0474
			Total tourism revenue equivalent to the added value of the tertiary industry	0.0364
			Total tourism revenue equivalent to the GDP proportion	0.0382
	Tourism speed	0.0245	Growth rate of total tourism revenue	0.0047
			Growth tourism of growth rate	0.0046
			Growth rate of the number of travel agencies	0.0050
			Growth rate of the number of hotels	0.0041
			Travel agency operating revenue growth rate	0.0060
	Tourism industry employment function	0.1290	Number of tourism practitioners	0.0296
			Number of tourism practitioners/population	0.0209
			Original value of fixed assets of tourism enterprises/urban fixed-asset investments	0.0291
			Number of tourist institutions	0.0269
			Students/population	0.0225
	Tourism and culture communication function	0.1068	Travel search index/overall search index	0.0272
			Travel information search volume/population	0.0429
			Travel search index	0.0367
	Funding effect	0.1371	GDP	0.0411
			Production value of the tertiary industry	0.0395
			Income within the local finance general budget	0.0357
			Expenditure within the local finance general budget	0.0208
	Structural effect	0.1641	Part of the primary industry in GDP	0.0285
			Part of the tertiary industry in GDP	0.0292
			Town population/total population	0.0207
			Total per capita social retail goods	0.0289
			Agricultural population	0.0569
	Income effect	0.0810	GDP per capita	0.0292
			Average annual salary of the staff	0.0153
			Per capita net income of urban residents	0.0364
	Image effect	0.1088	Accommodation and catering practitioners as legal entities above the limit	0.0555
			Legal entity of wholesale and retail practitioners above the limit	0.0533
	Open effect	0.1274	Actual utilization of foreign capital	0.0423
			Total import and export amount	0.0851
	Social development effect	0.0504	Per capita disposable income of urban residents	0.0174
			Town residents' Engel coefficient	0.0105
			Rural residents' Engel coefficient	0.0226

Table 2. Cont.

System	Level-I Index	Weight	Secondary Indicators	Weight
	Sustainable development effect	0.0813	GDP growth rate	0.0030
			Total fixed assets investment in the whole society	0.0337
			Total energy consumption	0.0445
	Urban development effect	0.1791	Landscape spatial area	0.0530
			Road traffic mileage	0.0389
			New fixed assets	0.0550
			Total mail and telecommunications service	0.0322
	Innovative and development effect	0.0708	Number of units of high-tech enterprises	0.0340
			Number of Internet users	0.0367

Data Sources: Calculated by authors.

Based on the system evaluation index, the coupling degree and coordination degree were obtained using the coupling coordination model, and the obtained coupling coordination degree between the tourism industry and regional economic development is listed in Table 3.

Table 3. Coordination of China's tourism and regional economic development system.

Province	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Beijing	0.8984	0.8840	0.8995	0.9066	0.9154	0.9180	0.9268	0.9318	0.9397	0.9515
Tianjin	0.6530	0.6590	0.6662	0.6846	0.7045	0.7164	0.7264	0.7428	0.7437	0.7461
Hebei	0.7017	0.7131	0.6931	0.7353	0.7449	0.7574	0.7585	0.7751	0.7847	0.7896
Shanxi	0.6590	0.6653	0.6661	0.6722	0.6906	0.6867	0.6807	0.6877	0.7087	0.7011
Neimenggu	0.6540	0.6604	0.6671	0.6770	0.6909	0.6997	0.7046	0.7150	0.7185	0.7368
Liaoning	0.7505	0.7613	0.7570	0.7696	0.7914	0.7921	0.7752	0.7792	0.7695	0.7704
Jilin	0.6202	0.6200	0.6278	0.6303	0.6388	0.6398	0.6390	0.6538	0.6577	0.6606
Heilongjiang	0.6616	0.6554	0.6589	0.6713	0.6769	0.6677	0.6732	0.6774	0.6823	0.6916
Shanghai	0.8426	0.8361	0.8559	0.8539	0.8619	0.8642	0.8848	0.9095	0.9422	0.9236
Jiangsu	0.8676	0.8772	0.8789	0.9107	0.9277	0.9236	0.9415	0.9514	0.9936	0.9709
Zhejiang	0.8445	0.8490	0.8495	0.8784	0.8973	0.9064	0.9234	0.9412	0.9151	0.9570
Anhui	0.6861	0.6910	0.7032	0.7288	0.7441	0.7477	0.7565	0.7722	0.7877	0.7956
Fujian	0.7246	0.7299	0.7432	0.7569	0.7734	0.7822	0.7966	0.8133	0.8425	0.8453
Jiangxi	0.6599	0.6634	0.6606	0.6738	0.6743	0.6804	0.6844	0.6979	0.7134	0.7265
Shandong	0.8513	0.8628	0.8730	0.8883	0.9064	0.9011	0.9139	0.9300	0.9363	0.9592
Henan	0.7270	0.7332	0.7429	0.7382	0.7541	0.7562	0.7542	0.7911	0.7955	0.8016
Hubei	0.7027	0.7118	0.7186	0.7285	0.7601	0.7593	0.7678	0.7797	0.7862	0.7961
Hunan	0.7143	0.7221	0.7310	0.7453	0.7594	0.7561	0.7576	0.7672	0.7823	0.8003
Guangdong	0.9762	0.9855	1.0139	1.0412	1.0503	1.0637	1.0868	1.0953	1.1252	1.1240
Guangxi	0.6792	0.6859	0.6833	0.6929	0.7021	0.7056	0.7105	0.7281	0.7421	0.7559
Hainan	0.6935	0.6894	0.6762	0.7019	0.6975	0.6788	0.6741	0.6749	0.6826	0.6836
Chongqing	0.6632	0.6750	0.6880	0.7006	0.7111	0.7145	0.7289	0.7401	0.7528	0.7608
Sichuan	0.7524	0.7548	0.7649	0.7792	0.7874	0.7868	0.7856	0.7957	0.8261	0.8149
Guizhou	0.6303	0.6496	0.6406	0.6402	0.6489	0.6602	0.6655	0.6793	0.7035	0.7169
Yunnan	0.7487	0.7436	0.7446	0.7547	0.7663	0.7729	0.7744	0.8002	0.8114	0.8292
Tibet	0.6202	0.6458	0.6476	0.6212	0.6287	0.6347	0.6372	0.6681	0.6594	0.6468
Shaanxi	0.6559	0.6703	0.6790	0.6948	0.7064	0.7154	0.7248	0.7491	0.7554	0.7668
Gansu	0.6254	0.6398	0.6560	0.6535	0.6574	0.6666	0.7079	0.7018	0.7019	0.7096
Qinghai	0.5697	0.5699	0.5717	0.5875	0.5901	0.5966	0.6014	0.6034	0.6010	0.6172
Ningxia	0.6127	0.6118	0.6141	0.6279	0.6458	0.6244	0.6124	0.6121	0.6080	0.6125
Xinjiang	0.6410	0.6491	0.6507	0.6703	0.6797	0.6772	0.6826	0.6980	0.7092	0.7136

Data Sources: Calculated by authors.

3.2. Empirical Model Setting

The degree of coupling and coordination between China's provincial tourism industry and regional economic development is not randomly distributed in space, i.e., it is accompanied by a certain spatial correlation. At this time, if an ordinary least squares (OLS) estimation model was used, an estimate may be generated. In contrast, the spatial measurement method further incorporates spatial correlation into the regression model, which can solve the possible errors of traditional measurement models in processing spatial data, and

is more suitable for the empirical research in this study. Therefore, we constructed a spatial Dubin regression model (SDM) to examine the influence of the level of informatization on the degree of coupling and coordination between tourism and the economy. This was calculated as follows:

$$TE_{it} = \rho W \cdot TE_{it} + \beta_0 + \beta_1 Inford_{jit} + \beta_2 Touradv_{it} + \beta_3 Tourcen_{it} + \beta_4 Tourenv_{it} + \beta_5 Eco_{it} + \beta_6 Asset_{it} + \beta_7 Open_{it} + \beta_8 Gap_{it} + WX_{it}\gamma + \tau_{it} + \alpha_{it} + u_{it} \quad (12)$$

where i represents the region, t represents time, α_i represents the regional fixed effect, τ_t represents the time fixed effect, u_{it} represents the random error term, ρ represents the space lag coefficient of the dependent variable, γ represents the space lag coefficient of the independent variable, and W is the spatial weight matrix. We used the adjacency matrix. To introduce the information technology infrastructure, information technology industry technology, information application consumption, information knowledge support, information development effect, information Internet resources, and other secondary indicators into the regression model, the data were sourced from the China Information Statistics Yearbooks. The variables are shown in Table 4.

Table 4. Variable used and their definitions.

Name	Symbol	Measurement Method
Dependent Variables		
Regional tourism–economic development Coupling coordination degree	TE	Measurement using a coupling coordination model
Independent Variables		
Information development evaluation index	$Infor$	Informatization development level
	$Inford_1$	Information technology infrastructure
	$Inford_2$	Information industry technology
	$Inford_3$	Information technology application consumption
	$Inford_4$	Information knowledge support
	$Inford_5$	Information development effect
	$Inford_6$	Information technology in Internet resources
Control Variables		
Tourism resource advantages	$Touradv$	Number of areas that were level 3A and above (%)
Tourism industry agglomeration	$Tourcen$	Regional tourism industry location entropy
Tourism environment quality	$Tourenv$	Regional environmental protection investment ratio (%)
Economic development level	Eco	Regional GDP per capita (100 million yuan/person)
Fixed asset investment	$Asset$	Regional whole social fixed asset investment ratio (%)
Opening degree	$Open$	Regional FDI ratio (%)
Urban and rural income gap	Gap	Taylor coefficient of disposable income of regional urban and rural residents

The calculation results of the global Moran's I index value are shown in Table 5. From the one-tailed test results, it can be seen that the spatial correlation of the coupling coordination degree of China's inter-provincial tourism industry and economic development during the sample period gradually increased, showing an overall trend of agglomeration. Specifically, the global Moran's I index of the coupling coordination degree of China's inter-provincial tourism–economic development in 2008 was positive (0.2320), and the global Moran's I index of the coupling coordination degree of China's inter-provincial tourism–economic development in 2017 was positive (0.3160). Over the sample period, the global Moran's I index had an increasing trend year by year, and this was significant at the 5% level. It should be noted that, regardless of the results of one-tailed or two-tailed tests, the degree of coupling coordination between China's inter-provincial tourism industry and the economic development showed a significant positive correlation throughout the sample period.

Table 5. Spatial correlation test results.

Year	One-Tailed Test			Year	Two-Tailed Test		
	Moran's I	Z	p-Value		Moran's I	Z	p-Value
2008	0.2320	2.2727	0.0115	2008	0.2320	2.2727	0.0230
2009	0.2326	2.2890	0.0110	2009	0.2326	2.2890	0.0221
2010	0.2157	2.1591	0.0154	2010	0.2157	2.1591	0.0308
2011	0.2469	2.4334	0.0075	2011	0.2469	2.4334	0.0150
2012	0.2590	2.5267	0.0058	2012	0.2590	2.5267	0.0115
2013	0.2686	2.6185	0.0044	2013	0.2686	2.6185	0.0088
2014	0.2668	2.6101	0.0045	2014	0.2668	2.6101	0.0091
2015	0.2918	2.8146	0.0024	2015	0.2918	2.8146	0.0049
2016	0.3263	3.1277	0.0009	2016	0.3263	3.1277	0.0018
2017	0.3160	3.0317	0.0012	2017	0.3160	3.0317	0.0024

Note: The spatial weight matrix is the spatial neighboring matrix.

4. Results

4.1. Degree of Coupling between Informatization and Tourism-Related Economic Development

The overall impact of informatization on the coordination degree of regional tourism–economic development coupling was investigated, and the results are shown in Table 6.

Table 6. Coupled coordination degree between informatization and tourism-related economic development.

Variables	TE						
	SDM (1)	SDM (2)	SDM (3)	SDM (4)	SDM (5)	SDM (6)	SDM (7)
<i>Infor</i>	0.5290 *** (4.20)						
<i>Inford₁</i>		−0.0628 (−0.81)					
<i>Inford₂</i>			0.1137 *** (2.67)				
<i>Inford₃</i>				0.0183 (0.55)			
<i>Inford₄</i>					0.3115 *** (6.29)		
<i>Inford₅</i>						0.1140 ** (2.48)	
<i>Inford₆</i>							0.2746 ** (2.38)
<i>Touradv</i>	0.0114 *** (2.86)	0.0171 *** (3.89)	0.0146 *** (3.51)	0.0162 *** (3.77)	0.0109 *** (3.09)	0.0100 ** (2.18)	0.0143 *** (3.43)
<i>Tourcen</i>	0.0078 (0.59)	0.0201 (1.27)	0.0173 (1.23)	0.0177 (1.19)	0.0083 (0.70)	0.0361 ** (2.42)	0.0064 (0.45)
<i>Tourenv</i>	0.1953 * (1.68)	0.2584 * (1.90)	0.1878 (1.50)	0.1760 (1.33)	0.2095 ** (2.00)	0.2336 * (1.87)	0.2365 * (1.88)
<i>Eco</i>	0.0222 *** (12.39)	0.0257 *** (13.75)	0.0245 *** (14.00)	0.0244 *** (11.59)	0.0189 *** (10.56)	0.0245 *** (13.91)	0.0260 *** (14.93)
<i>Asset</i>	0.0001 (0.46)	0.0002 (1.03)	0.0000 (0.31)	0.0001 (0.81)	0.0002 (1.37)	0.0001 (0.69)	0.0001 (0.65)

Table 6. Cont.

Variables	TE						
	SDM (1)	SDM (2)	SDM (3)	SDM (4)	SDM (5)	SDM (6)	SDM (7)
<i>Open</i>	0.0001 (1.02)	0.0003 ** (2.12)	0.0002 * (1.95)	0.0003 ** (2.25)	0.0003 *** (3.59)	0.0003 ** (2.14)	0.0003 ** (2.23)
<i>Gap</i>	−0.0058 ** (−2.49)	−0.0085 *** (−3.25)	−0.0062 ** (−2.53)	−0.0078 *** (−3.03)	−0.0051 ** (−2.46)	−0.0057 ** (−2.26)	−0.0076 *** (−3.11)
Obs	310	310	310	310	310	310	310
R ²	0.745	0.630	0.640	0.631	0.693	0.558	0.783
LR _{spatial}	42.57 *	48.39 **	49.40 **	45.31 **	40.68 *	46.14 **	57.26 ***
LR _{time}	27.48	27.19	16.42	22.82	27.92	23.17	25.93
Log-likelihood	940.42	937.53	928.78	926.80	949.08	935.84	941.46
VIF	[1.10, 4.13]	[1.14, 3.80]	[1.11, 3.21]	[1.11, 3.65]	[1.11, 3.11]	[1.13, 3.23]	[1.11, 3.88]

Note: ***, **, and * identify significance at the levels of 1%, 5%, and 10%, respectively; the heteroscedasticity robust t statistic of each estimated coefficient is in parentheses.

The regression results of the spatial Dubin model (model 1) show that the estimated coefficient of the information development level variable was positive (0.5290) and significant at the 1% level, which means that the overall improvement of the information level promoted the coordinated development of regional tourism and the economy. This result indicates that if the level of informatization development increased by 1 percentage point, the degree of coupling and coordination of tourism and economic development would increase by 0.529%. Based on this analysis, it can be seen that informatization may have had a certain impact on the factor allocation ratio method, as well as the efficiency of the internal system of tourism and economic development, by promoting industrial structures and technological transformation upgrades, thereby improving the relationship between tourism and regional economic development.

The regression results of models (2–7) show the following:

(1) The estimated coefficient of information infrastructure variables was negative (−0.0628), but this was not a statistically significant association. It can be seen that the information infrastructure level was generally correct. The coordinated development of regional tourism and the economy had no obvious impact. The reason for this may be that there was a threshold effect regarding the effectiveness of infrastructure. The information infrastructure in different regions of China was responsible for the three major operators, and the differences between these regions were not obvious.

(2) The estimated coefficient of the technical variables of the chemical industry was positive (0.1137) and significant at the 1% level. This shows that the technological progress of the information industry generally helped to improve the coordination of regional tourism and economic development. This also confirms the influence channel of informatization on the coordinated development of regional tourism and economy from the side.

(3) The estimated coefficient of the consumption variables of informatization application was also positive (0.0183), but this was not statistically significant, indicating that the increase in the level of informatization consumption had no obvious impact on the coordinated development of regional tourism and the economy. This may have been because the national Internet penetration rate was high, and the difference between regions was therefore not obvious.

(4) The estimated coefficient of the informatization knowledge support variable was positive (0.3115) and significant at the 1% level, which shows that the overall improvement of the informatization knowledge support level affected the coordinated development of regional tourism and the economy and enhanced the effectiveness of tourism through the process of upgrading the industrial structure and promoting regional economic development.

(5) The estimated coefficient of the informatization development effect variable was positive (0.1140) and significant at the level of 5%, indicating that the informatization

development effect also had a positive impact on the coordinated development of regional tourism and the economy, where this positive effect likely came from the economic effects of information technology R&D investment and the transformation of technological achievements.

(6) The estimated coefficient of the informatization Internet resources variable was positive (0.2746) and significant at the 5% level, indicating that the increase in informatization Internet resources generally helped to improve the coordination of regional tourism and economic development.

The following results were obtained by assessing the coefficients of the control variables:

(1) The estimated coefficient of the tourism resource advantage variable was positive and significant at the 5% level, which shows that the tourism resource advantage was generally beneficial to the coordinated development of regional tourism and the economy. That is, to a certain extent, informatization determined the initial form and trend of tourism development, which in turn affected the coupling and coordination of tourism and regional economic development.

(2) The estimated coefficients of the tourism industry agglomeration variables were all positive, but most were not statistically significant, indicating that the current increase in the degree of tourism industry agglomeration had no obvious impact on the coordinated development of regional tourism and the economy as a whole.

(3) The estimated coefficient of tourism environmental quality variables was positive, and most were significant at the 10% level. It can be seen that the ecological environment was not only the basis of tourism economic activities but also improved the regional economic development quality and the associated benefits. Therefore, environmental quality generally helped to improve the coordinated development of regional tourism and the economy.

(4) The estimated coefficient of the economic development level was positive and significant at the 1% level, which shows that the development of the regional economy brought about the expansion of the tourism industry chain, and the upgrade of the tourism industry in turn stimulated economic development. Eventually, this had a positive impact on regional tourism and economic coordination.

(5) Although the estimated coefficients for fixed asset investment indicators were all positive, they were not statistically significant and therefore had no obvious impact on the coordinated development of regional tourism and the economy. Opening to the outside world could significantly improve the coordination level of regional tourism and economic development.

(6) The estimated coefficient for the urban–rural income gap was negative and significant at least at the 10% level, indicating that the expansion of the urban–rural income gap was not conducive to the coordinated development of regional tourism and the economy. The reason for this was that, as the income gap between urban and rural residents widened, the optimization and upgrade of the industrial structure was restricted, which had a negative impact on the coordinated development of regional tourism and the economy.

4.2. Coupling Degree of Informatization and Tourism–Economic Development: Direct and Spillover Effects

To further explore the role of informatization on the coordination degree of regional tourism and economic development, we divided the total effect into direct and spillover effects. The direct effects represented the impact of informatization on the coordination degree of tourism and economic development coupling in the region, while the spillover effects represented the spatial externality of informatization, that is, the potential impact on the coupling coordination degree of tourism and economic development in the neighboring regions. The results of direct and spillover effects are shown in Tables 7 and 8, respectively.

Table 7. Coupling degree of informatization and tourism and economic development: direct effects.

Variables	TE						
	SDM (1)	SDM (2)	SDM (3)	SDM (4)	SDM (5)	SDM (6)	SDM (7)
<i>Infor</i>	0.3124 *** (5.35)						
<i>Inford₁</i>		0.1121 *** (3.69)					
<i>Inford₂</i>			0.0693 *** (3.23)				
<i>Inford₃</i>				0.0485 *** (2.76)			
<i>Inford₄</i>					0.1283 *** (5.51)		
<i>Inford₅</i>						0.0867 *** (3.29)	
<i>Inford₆</i>							0.3042 *** (5.95)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	310	310	310	310	310	310	310
R ²	0.754	0.628	0.616	0.547	0.642	0.547	0.781

Note: *** identify significance at the level of 1%; the heteroscedasticity robust t statistic of each estimated coefficient is in parentheses.

Table 8. Coordination degree of informatization and tourism and economic development: spillover effects.

Variables	TE						
	SDM (1)	SDM (2)	SDM (3)	SDM (4)	SDM (5)	SDM (6)	SDM (7)
<i>Infor</i>	0.2166 ** (2.00)						
<i>Inford₁</i>		−0.1750 *** (−2.74)					
<i>Inford₂</i>			0.0443 (1.12)				
<i>Inford₃</i>				−0.0302 (−1.05)			
<i>Inford₄</i>					0.1831 *** (3.77)		
<i>Inford₅</i>						0.0273 (0.59)	
<i>Inford₆</i>							−0.0296 (−0.26)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	310	310	310	310	310	310	310
R ²	0.745	0.63	0.64	0.604	0.693	0.558	0.783

Note: *** and ** indicate significance at the levels of 1% and 5%, respectively; the heteroscedasticity robust t statistic of each estimated coefficient is in parentheses.

As shown in the model (1) results in Tables 7 and 8, the direct and spillover effect coefficients of the development level variables of informatization were 0.3124 and 0.2166, respectively, and both were significant at the 1% level. This shows that informatization could enhance the degree of coupling and coordination of tourism and economic development in the region, and that it also had significant spatial externalities, which had a positive

impact on the degree of coupling and coordination of tourism and economic development in neighboring regions.

From the perspective of informatization subdivision dimensions, observing other variables in the model, we obtained the results as follow:

(1) The direct effect coefficient of the informatization infrastructure variables was positive (0.1121) and its spillover effect coefficient was negative (−0.1750); both were significant at the 1% level. This shows that, although informatization infrastructure helped to improve the degree of coupling and coordination between tourism and economic development in the region, it reduced the degree of coupling and coordination between tourism and economic development in neighboring areas.

(2) The direct effect coefficient of the information technology industry technology variable was positive (0.0693) and its spillover effect coefficient was negative (0.0443), but only the direct spillover effect was statistically significant at the 1% level. This shows that the development of informatization industry technology helped to improve the degree of coupling and coordination of tourism and economic development in the region, but it had no influence in any form on the degree of coupling and coordination of tourism and economic development in neighboring regions.

(3) The direct effect coefficient of the consumption variables of information application was positive (0.0485) and its spillover effect coefficient was negative (−0.0302), and only the former was significant at the 1% level. This shows that the consumption of information application could improve the degree of coupling and coordination of tourism and economic development in the region of interest, but that it had no impact on neighboring regions.

(4) The direct effect coefficient of the information-based knowledge support variable was positive (0.1283) and its spillover effect coefficient was also positive (0.1831), and both were significant at the 1% level. This shows that informatization knowledge support not only helped to improve the degree of coupling and coordination of tourism and economic development in the region of study but also had a positive impact on the degree of coupling and coordination of tourism and economic development in neighboring regions.

(5) The direct effect coefficient of the informatization development effect variable was positive (0.0867) and its spillover effect coefficient was also positive (0.0273), but only the former was significant at the 1% level, indicating that informatization development improved the degree of coupling and coordination of tourism and economic development in the region of study but did not have a similar effect in neighboring areas.

(6) The direct and spillover effect coefficients of informatization Internet resource variables were 0.3042 and −0.0296, respectively, but only the former was significant at the 1% level, indicating that informatization Internet resources could improve tourism and economic development coupling in the region, but that this effect did not spillover to neighboring areas.

4.3. Robustness

For the endogenous problems that may be caused by missing variables or reverse causality in the model, in this study, we drew on the research of Yu et al. (2008) [38] and used dynamic panel QML to re-estimate and further test the robustness of the regression results. As shown in Table 9, after controlling for the endogenous problem of the model, most of the estimated coefficients and their significance did not change significantly, indicating that the regression results of the model were robust overall.

Table 9. Robustness test.

Variables	Model	Equation	TE		
			Total Effect	Direct Effect	Overflow Effect
<i>Infor</i>	SDM	(1)	0.5687 *** (3.36)	0.3345 *** (5.69)	0.2341 ** (2.58)
<i>Inford₁</i>	SDM	(2)	−0.0754 (−0.69)	0.1170 *** (3.71)	−0.1924 ** (−2.11)
<i>Inford₂</i>	SDM	(3)	0.1404 ** (2.33)	0.0899 *** (4.36)	0.0505 (0.94)
<i>Inford₃</i>	SDM	(4)	0.0201 (0.46)	0.0422 ** (2.44)	−0.0221 (−0.59)
<i>Inford₄</i>	SDM	(5)	0.3112 *** (4.74)	0.1122 *** (4.80)	0.1990 *** (3.23)
<i>Inford₅</i>	SDM	(6)	0.0936 (1.56)	0.0839 *** (3.42)	0.0097 (0.17)
<i>Inford₆</i>	SDM	(7)	0.3112 * (1.83)	0.3070 *** (6.02)	0.0042 (0.03)

Note: ***, **, and * identify significance at the levels of 1%, 5%, and 10%, respectively; the heteroscedasticity robust t statistic of each estimated coefficient is in parentheses.

5. Discussion

The empirical research verifies that informatization has a significant impact on the coupling and coordination of tourism and regional economic development by constructing a spatial model, and the impact presents a certain degree of heterogeneity and spatial spillover effects. Next, this article further explores possible mechanisms through which informatization affects the coupling of tourism and regional economic development.

5.1. Hypothesis

Informatization has had a profound impact on the institutional environment. China's tourism industry, which is in the transitional period of the economic system and is sensitive to the macro environment, is greatly affected by the institutional structure and industrial policies. The development of China's tourism is obviously related to institutional changes. The energy released by evolution and innovation of many related systems affects the level of regional tourism development and the degree of difference in tourism economy. Given that the coordinated relationship between tourism and regional economy is affected by institutional factors, this article believes that those institutional factors are an important mechanism for informatization to influence the coordinated development of tourism and regional economy. Based on this, the following hypothesis was proposed:

Hypothesis 2. *Informatization affects the coupling and coordination relationship between tourism and regional economic development through changes in the institutional environment.*

5.2. Method

This paper uses the method of stepwise testing of regression coefficients to test the intermediary variables, and uses the following equation to describe the relationship between the variables:

$$Y = cX + e_1 \quad (13)$$

$$M = aX + e_2 \quad (14)$$

$$Y = c'X + bM + e_3 \quad (15)$$

The coefficient *a* represents the effect of the independent variable acting on the intermediate variable, and the coefficient *b* represents the effect of the intermediate variable acting on the dependent variable. The two constitute the indirect effect of the relationship between the variables. The coefficient *c'* represents the direct effect between the independent variable and the dependent variable after controlling the intermediate variable.

Then the total effect between variables is equal to the direct effect plus the indirect effect ($ab + c'$). The intermediary variable in this chapter is the institutional environment, which is represented by marketization index data, which come from the “Report on China’s Provincial Marketization Index (2018)”.

5.3. Result

In order to verify the impact of changes in the institutional environment on the informatization’s impact on the coupling and coordination of the tourism industry and the regional economy, this section uses the marketization index as intermediary variables for testing. We referred to Formulas (13–15) to add institutional environmental variables as intermediary variables, from the perspective of informatization variables, and used the SDM model to perform regression analysis to obtain the following results (Tables 10 and 11).

Table 10. Result of direct effect.

Variables	SDM (1)	SDM (2)	SDM (3)	SDM (4)	SDM (5)	SDM (6)	SDM (7)
Industry	0.0034 * (1.69)	0.0037 * (1.86)	0.0026 (1.23)	0.0043 ** (2.10)	0.0040 ** (2.03)	0.0005 (0.27)	0.0013 (0.63)
Infor	0.3178 *** (5.70)						
Inford ₁		0.1060 *** (3.12)					
Inford ₂			0.0587 *** (2.73)				
Inford ₃				0.0456 *** (2.71)			
Inford ₄					0.1310 ** (2.03)		
Inford ₅						0.1092 *** (4.34)	
Inford ₆							0.2820 *** (5.63)
Touradv	0.0029 (1.61)	0.0040 ** (2.20)	0.0037 ** (1.96)	0.0041 ** (2.17)	0.0023 (1.34)	0.0005 (0.27)	0.0030 * (1.69)
Tourcen	0.0192 *** (4.31)	0.0210 *** (4.37)	0.0172 *** (3.60)	0.0191 *** (4.05)	0.0178 *** (4.13)	0.0235 *** (5.17)	0.0165 *** (3.59)
Tourenv	−0.0025 ** (−2.11)	−0.0023 ** (−1.98)	−0.0026 ** (−2.10)	−0.0024 * (−1.99)	−0.0018 (−1.52)	−0.0021 (−1.77)	−0.0023 ** (−1.97)
Eco	0.0113 *** (6.07)	0.0117 *** (6.25)	0.0100 *** (5.26)	0.0099 *** (5.23)	0.0114 *** (6.25)	0.0078 *** (4.09)	0.0073 *** (3.66)
Asset	0.0000 (0.10)	0.0001 (0.77)	0.0000 (0.30)	0.0000 (0.21)	0.0000 (0.39)	0.0001 (0.85)	−0.0001 (−1.07)
Open	0.0001 ** (2.23)	0.0001 * (1.72)	0.0001 ** (2.14)	0.0001 (2.61)	0.0001 ** (2.49)	0.0001 * (1.86)	0.0001 (2.41)
Gap	0.0398 (0.40)	−0.2236 ** (−2.23)	−0.0526 (−0.52)	−0.0295 (−0.29)	0.0102 (0.10)	−0.1251 (−1.22)	0.0857 (0.85)

Note: ***, **, and * identify significance at the levels of 1%, 5%, and 10%, respectively; the heteroscedasticity robust t statistic of each estimated coefficient is in parentheses.

Table 11. Result of spillover effect.

Variables	SDM (1)	SDM (2)	SDM (3)	SDM (4)	SDM (5)	SDM (6)	SDM (7)
Industry	0.0030 (0.79)	0.0056 (1.33)	0.0050 (1.22)	0.0057 (1.38)	−0.0002 (−0.05)	0.0035 (0.93)	0.0022 (0.52)
<i>Infor</i>	0.2736 *** (2.32)						
<i>Inford₁</i>		−0.2059 ** (−2.36)					
<i>Inford₂</i>			0.0285 (0.68)				
<i>Inford₃</i>				−0.0397 (−1.24)			
<i>Inford₄</i>					0.1494 *** (3.15)		
<i>Inford₅</i>						0.1178 ** (2.36)	
<i>Inford₆</i>							−0.0171 (−0.13)
<i>Touradv</i>	0.0075 ** (2.33)	0.0125 *** (3.55)	0.0106 *** (3.06)	0.0102 *** (3.00)	0.0078 *** (2.66)	0.0039 (0.93)	0.0113 *** (3.38)
<i>Tourcen</i>	−0.0120 (−1.17)	−0.0161 (−1.40)	−0.0133 (−1.20)	−0.0124 (−1.10)	−0.0109 (−1.19)	0.0043 (0.42)	−0.0142 (−1.29)
<i>Tourenv</i>	−0.0025 (−1.03)	−0.0046 * (−1.73)	−0.0026 (−1.02)	−0.0030 (−1.13)	−0.0017 (−0.78)	−0.0016 (−0.67)	−0.0035 (−1.40)
<i>Eco</i>	0.0170 * (1.82)	0.0039 (0.92)	0.0071 * (1.72)	0.0083 ** (1.97)	0.0059 (1.64)	0.0067 * (1.75)	0.0135 *** (3.19)
<i>Asset</i>	−0.0001 (−0.40)	0.0001 (0.68)	−0.0000 (−0.08)	0.0000 (0.15)	0.0001 (0.47)	0.0000 (−0.01)	0.0000 (0.21)
<i>Open</i>	0.0001 (0.44)	0.0001 (1.07)	0.0001 (1.10)	0.0001 (1.00)	0.0001 (1.22)	0.0001 (1.08)	0.0001 (0.60)
<i>Gap</i>	0.1591 (0.93)	0.5119 *** (2.72)	0.1984 (1.09)	0.1364 (0.74)	0.1748 (1.07)	0.3016 * (1.75)	0.1142 (0.62)

Note: ***, **, and * identify significance at the levels of 1%, 5%, and 10%, respectively; the heteroscedasticity robust t statistic of each estimated coefficient is in parentheses.

(1) The results of models (1) and (2) in Table 10 show that the regression coefficient of the institutional environment was significant at the level of 10%. The results of the models (4) and (5) show that the regression coefficient of the institutional environment was significant at the 5% level. Combining the results of the previous part, we can see that informatization will indeed have an impact on the coupling and coordination of tourism-economic development through the institutional environment, that is, the mediating effect of the institutional environment exists.

(2) In the results of all models in Table 11, the regression coefficients of the institutional environment were not significant, so the role of the institutional environment in the mechanism of spillover effects was not obvious.

(3) The results in Table 10 show that after adding institutional environmental factors, the regression coefficients of informatization indicators of models (1) and (5) had increased, while the regression coefficients of informatization indicators of models (2) and (4) had decreased. It showed that the institutional environment had different effects on the degree of informatization measured by different informatization sub-category indicators, but informatization did have a certain impact on the degree of coupling and coordination through the institutional environment.

The empirical chapter of this article not only examines the impact of informatization on the coupling relationship between the tourism industry and the regional economy, but also explores the impact mechanism of the institutional environment, which is unique compared to other researchers' studies. Independently examining the impact of the institu-

tional environment on tourism performance, even if the influencing factors of the regional economy are controlled, insignificant conclusions may be obtained (Zuo, 2011). Related researches also suggest that specific circumstances need to be considered (Jaakson, 1996). The literature examining the impact of the institutional environment on the differences in tourism between regions has yielded a conclusion that the improvement of the institutional environment can promote the development of tourism and reduce the regional tourism gap (Yu et al., 2010). In the research on informatization on the development of tourism, quite a lot of studies not only failed to consider the correlation between independent variables and the causal relationship between independent variables and dependent variables, but also did not discuss the impact mechanism clearly. We considered the tourism industry and regional economy, and studied the coupling relationship as a dependent variable, which makes up for the deficiencies of previous studies to a certain extent.

6. Conclusions

In this study, we examined the influence of the level of informatization on the degree of coupling and coordination of tourism and regional economic development at the regional scale. We separately constructed evaluation models and indicator systems for informatization, tourism, and regional economic development and used these to establish a model to evaluate the coupling and coordination relationship between tourism and regional economic development using spatial econometrics methods. Our analysis found that an improvement in the level of informatization generally helped to promote the coupling and coordination of tourism and regional economic development. Informatization development not only improved the coupling and coordination of tourism and economic development in the region but also had significant spatial spillover effects for neighboring regions. Of the subdivisions we studied, the spatial spillover effects of informatization industry technology, informatization knowledge support, and informatization development were significant. In addition to the influencing factors at the information level, the advantages of tourism resources and the overall level of economic development helped to improve the degree of coupling and coordination, while the expansion of the urban–rural income gap hindered coordinated development. Informatization will affect the degree of coupling and coordination between the tourism industry and regional economic development by influencing the level of institutional environment. When examining the impact mechanism of the institutional environment, the estimated coefficient of the proxy variable marketization index is positive and highly significant, which means that informatization will affect the coupling and coordination of tourism and economic development through the improvement of the institutional environment.

In conclusion, it is clear that in a regional development system composed of three systems—informatization, tourism, and regional economic development—the level of informatization had a significant effect on the coupling and coordination relationship between tourism and economic development in a region. However, although the coupling and coordination relationship between tourism and economic development at the regional level in China maintained an upward trend, the level of coordination was not high, and stability was limited, with obvious differences between regions, highlighting certain imbalances. At the same time, informatization still had a lot of room for improvement in promoting the coordinated development of tourism and regional economic development. Therefore, we should pay attention to the diversified development of tourism and the regional economy, adopt differentiated development strategies for the coupling and coordination of tourism and regional economic development, improve the level of informatization construction, and strengthen cross-regional cooperation in informatization construction. It is important that informatization is fully integrated with the tourism industry, and that the overall focus is on regional economic development. Furthermore, it is necessary to break down the policy barriers of informatization, tourism, and regional development, and improve the institutional environment for regional development.

Limited by the availability of data, the construction and evaluation of relevant indicators need to be improved. Informatization indicators involve numerous and scattered data, coupled with changes in statistical calibers and the lack of content of relevant documents, which are subject to certain restrictions in the construction of the indicator system. Next, we will further use big data mining methods to find breakthroughs in data collection, data management, and data processing. From a more diversified perspective, we will use clustering and association analysis to collect more complete data. Thus, the in-depth integration of data and improvement of data's use value and efficiency will be promoted.

In the future, we will also add intermediary variables to explore how informatization affects the coupling and coordination relationship between tourism and regional economic development using the gradual regression test method. This will deepen our understanding of the relationship between regional informatization, tourism, and economic development.

Author Contributions: Conceptualization, X.Z. and W.C.; methodology, W.C.; formal analysis, W.C.; investigation, W.C. and X.Z.; resources, X.Z. and W.C.; data curation, W.C.; writing—original draft, W.C. and X.Z., writing—review and editing, X.Z. and W.C.; visualization, W.C.; supervision, X.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author. The data are not publicly available due to a conditional request from the source.

Acknowledgments: The authors are thankful to the School of Economics and Management, Tongji University, for supporting W.C. for her study.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Xu, H.G. The limit of growth of resource dependent tourism destination. *China Popul. Resour. Environ.* **2006**, *16*, 35–39.
2. Sheng, L.; Tsui, Y. Taxing tourism: Enhancing or reducing welfare? *J. Sustain. Tour.* **2009**, *17*, 627–635. [[CrossRef](#)]
3. Zhang, X.L.; Shi, P.C.; Li, X.D. The mechanism and effect of the internet on regional innovation in China. *Econ. Geogr.* **2017**, *37*, 129–137.
4. Cha, H.W.; Zuo, P.F. A study on the development level of Chinese regional informatization—Based on the empirical research of dynamic multiple attribute. *Financ. Econ.* **2016**, *9*, 53–63.
5. Milne, S.; Speidel, U.; Goodman, T. Tourism, ICT and regional economic development: The case of kiwitrails. In Proceedings of the Information & Communication Technologies in Tourism Enter, International Conference, Innsbruck, Austria, 22–25 January 2005.
6. Kumar, R.R.; Stauvermann, P.J.; Kumar, N.; Shahzad, S.J.H. Exploring the effect of ICT and tourism on economic growth: A study of Israel. *Econ. Chang. Restruct.* **2019**, *52*, 221–254. [[CrossRef](#)]
7. Zhou, L.; Wang, C. Research on the coupling and coordinative development of tourism industry-regional economy-information industry system. *Stat. Decis.* **2017**, *18*, 103–107.
8. Pan, L. Empirical study of information and tourism development to economic growth. *Sci. Technol. Manag.* **2017**, *19*, 16–22.
9. Wei, H.J. Research on the transformation and development of Japan's tourism industry—Based on the coupling analysis of economic development and information industry. *World Surv. Res.* **2017**, *6*, 57–64.
10. Luo, C.L. Study on the Coupling and Coordination Development of Guangdong's Touristization, Informatization and New Urbanization. Ph.D. Thesis, Guangzhou University, Guangzhou, China, June 2017.
11. Yang, Y.; Ding, Z.S.; Ge, J.L.; Wu, Y.L.; Wang, Y. Coupling coordination between rural tourism informatization and regional tourism economy in Jiangsu province. *Econ. Geogr.* **2018**, *38*, 220–225.
12. Wang, G.X.; Liang, L.K.; Li, F.; Jiang, S.Y.; Duan, X.W. An empirical research on the coupling coordinative relationship between regional tourism and informatization. *J. Nat. Resour.* **2016**, *31*, 1339–1350.
13. Shen, J.B. Progress in foreign tourism research. *Tour. Trib.* **1996**, *3*, 48–54.
14. Hall, C.M.; Jenkins, J.M. *Tourism and Public Policy*; Routledge: London, UK, 1995.
15. Elliott, J. *Tourism: Politics and Public Sector Management*; Routledge: London, UK, 1997.
16. Fayos-Sola, E. Tourism policy: A midsummer night's dream. *Tour. Manag.* **1996**, *6*, 405–410. [[CrossRef](#)]
17. Douglas, G. Pearce. Tourism development in Paris: Public intervention. *Ann. Tour. Res.* **1998**, *2*, 457–476.
18. Vernon, J.; Essex, S.; Pinder, D. Collaborative policy making local sustainable projects. *Ann. Tour.* **2005**, *2*, 325–345. [[CrossRef](#)]

19. Jaakson, R. Tourism in transition in Post-Soviet Estonia. *Ann. Oftourism Res.* **1996**, *3*, 617–634. [[CrossRef](#)]
20. Alipour, H.; Kilic, H. An institutional appraisal of tourism development and planning: The case of the Turkish Republic of NorthCyprus (TRNC). *Tour. Manag.* **2005**, *1*, 79–94. [[CrossRef](#)]
21. Chow, W.S. Open policy and tourism between Guangdong and HongKong. *Ann. Tour. Res.* **1988**, *2*, 205–218. [[CrossRef](#)]
22. Zhang, Q.H.; Chong, K.; Ap, J. An analysis of tourism policy development in modern China. *Tour. Manag.* **1999**, *4*, 471–485. [[CrossRef](#)]
23. Sofield, T.H.B.; Mei, F.; Li, S. Tourism management development and cultural policies in China. *Ann. Tour.* **1996**, *2*, 362–392.
24. Xie, P.F. Tourism in China. *Ann. Tour. Res.* **2004**, *1*, 241–243. [[CrossRef](#)]
25. Qu, R.; Ennew, C.; Sinclair, M.T. The impact of regulation and ownership structure on market orientation in the tourism industry in China. *Tour. Manag.* **2005**, *6*, 939–950. [[CrossRef](#)]
26. Zuo, B. An empirical study of the factors influencing the tourism economic growth of China. *J. Bus. Econ.* **2011**, *10*, 82–90.
27. Yu, F.L.; Lu, L. A study on regional tourism development and differences in China with the influence of institutional change. *Hum. Geogr.* **2010**, *3*, 124–127.
28. National Tourism Administration of the People's Republic of China. *China Tourism Statistical Yearbook*; China Tourism Publishing House: Beijing, China, 2009–2018.
29. National Bureau of Statistics of the People's Republic of China. *China Statistical Yearbook*; China Statistics Press: Beijing, China, 2009–2018.
30. Population and Employment Statistics Department, National Bureau of Statistics of the People's Republic of China. *China Population and Employment Statistics Yearbook*; China Statistics Press: Beijing, China, 2009–2018.
31. Department of National Economic Comprehensive Statistics, National Bureau of Statistics; Department of Rural Social and Economic Investigation, National Bureau of Statistics. *China Statistical Yearbook for Regional Economy*; China Statistics Press: Beijing, China, 2009–2018.
32. Reyniers, D.J. Supply decisions for unknown linearly increasing demand. *Eng. Costs Prod. Econ.* **1989**, *17*, 389–393. [[CrossRef](#)]
33. Prideaux, B. The role of the transport system in destination development. *Tour. Manag.* **2000**, *21*, 53–63. [[CrossRef](#)]
34. Liu, H.Y.; Ma, Y.F. Coupling analysis of the linkages between inbound tourism flows and tourism economy: A case study of the westward diffusion of tourists through Shanghai. *Resour. Sci.* **2008**, *30*, 1162–1168.
35. Saenz-De-Miera, O.; Rossello, J. The responsibility of tourism in traffic congestion and hyper-congestion: A case study from Mallorca, Spain. *Tour. Manag.* **2012**, *33*, 466–479. [[CrossRef](#)]
36. Dong, Y.J. A Study on the Coupling Relationship between Inbound Tourism Flow Drive and Urban Destination Response from the Perspective of Supply and Demand. Ph.D. Thesis, Shaanxi Normal University, Xian, China, 2012.
37. Zhang, C.H.; Ma, Y.F.; Wu, J. Coupling coordination degree between inbound tourist flows and destinations and its spatio-temporal differences in the western region of China: A study from the perspective of supply-demand relationship. *Econ. Geogr.* **2013**, *33*, 174–181.
38. Yu, J.; Jong, R.D.; Lee, L.F. Estimation for spatial dynamic panel data with fixed effects: The case of spatial cointegration. *J. Econom.* **2012**, *167*, 16–37. [[CrossRef](#)]