Article

Tourism, industrialization, and sustainable economic growth

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Abstract: The coordination between tourism and other industries contributes to the tourism sustainability as well as the sustainable economic growth. This study comprehensively examines the effect of the relationship between tourism development and industrialization on sustainable economic growth based on provincial data of China. By using the coupling coordination degree model and instrumental variable regression method, we found the following: (1) Tourism-industrialization coordination exerts positive and significant effects on sustainable economic growth. Additional robustness checks show that the results are reliable. (2) Economic development, tourism development, and manufacturing innovation moderate the effect of tourism-industrialization coordination on sustainable economic growth. (3) The sustainable economic growth effect of tourism is nonlinear and affected by tourism-industrialization coordination, and industrialization is important for tourism-led sustainable growth. The findings broaden the understanding of the relationship between tourism and economic sustainability from the perspective of industrial coordination. It may contribute to building a sustainable economic development path in developing countries.

Keywords: tourism; industrialization; economic sustainability; sustainable development; China

1. Introduction

The United Nations Sustainable Development Goals (SDGs) point out that regional development should aim at economic, social, and environmental sustainability [1]. Sustainable economic growth is the integration of economic development and ecological environment, which is the unified development of economy, environment, and society. Sustainable tourism has attracted extensive attention as an important tool for sustainable economic growth [2], mainly focusing on the relationship between tourism and environmental development. However, tourism development needs to consider the coordination of economic growth and ecological environment. Under the background of the global COVID-19, the regional economic development with tourism as the pillar industry has been seriously impacted. Thus, how tourism development can enhance sustainable economic growth has become an important issue for regional development in the post-epidemic era.

The impact of tourism on sustainable economic growth does not involve a direct, linear, and single mechanism [3,4], but rather occurs through multiple channels that affect economic development [5]. Among these channels, the relationship between tourism and other industries is an important mechanism that affects the role of tourism in economic development [6]. When considering the Kuznets hypothesis [7], industrialization plays an important role in the evolution of the industrial structure and

long-term economic development, so the relationship between tourism and industrialization is bound to affect economic development. In practice, the development of tourism may not only promote the development of manufacturing but also lead to de-industrialization [8,9]. Therefore, the measurement of the degree of coordination between tourism and industrialization and its impact on sustainable economic growth have become important issues [10,11]. This involves the green development and economic sustainability, which is consistent with the realization of the sustainable development goals of the United Nations [12]. However, few studies have shown how the relationship between tourism and industrialization affects economic growth [13].

China is an emerging economy with rapid industrialization and tourism development [14,15]. To bridge the research gap, this study explores how the interaction between tourism and industrialization affects sustainable economic development in China. Based on China's provincial-level data, it measures the coordination degree between tourism development and industrialization and verifies its impact on sustainable economic growth. Various robustness analysis methods are used to prove the research hypothesis. Heterogeneity analysis and threshold analysis were used to deepen the conclusions. The results indicate that the sustainable economic development should coordinate the relationship between tourism and industrialization. This is especially true in areas where tourism is a pillar industry.

The paper is organized as follows: Section 2 provides a literature review in order to theoretically identify the relationship between tourism–industrialization coordination and sustainable economic growth. Then, the next section provides a descriptive analysis of China's coordinated development of tourism and industrialization. The following section presents the model specification for empirical estimation and research findings. Section 5 is the further discussion of the results. Finally, conclusions and contribution are discussed in the last section.

2. Literature review

2.1. Tourism and economic growth

The relationship between tourism and economic growth is the core proposition of tourism economics [6]. The impact of tourism on economic growth, that is, the tourism-led growth hypothesis, has been examined in a number of studies through cross-sectional data, time-series data, and panel data [16]. In literature, the tourism-led growth hypothesis presents three types of views. First, tourism development promotes economic growth. Balaguer and Cantavella-Jorda (2002) first proposed and verified the tourism-led growth hypothesis [17]. The argument goes that tourism may increase foreign exchange, create job opportunities, attract investment, and increase taxation [18–21], which further promote economic growth. Second, tourism development inhibits economic growth. A resource curse effect, investment leakage effect, and welfare loss effect may restrain economic growth [22–24]. Third, tourism development does not have a significant impact on economic growth, and tourism has only a horizontal effect and no growth effect on economic development.

A lot of research has been conducted on the impact of tourism on economic growth, with different research objects, theoretical mechanisms, and research methods,

but most studies show that tourism promotes economic growth. In particular, an increasing number of studies in this field have involved in-depth discussions on theoretical mechanisms, such as the relationship between tourism and other industries [10]. The impact of the relationship between tourism and industrialization on economic growth, however, remains to be further studied [6]. Existing studies have mainly discussed the impact of tourism on economic growth, while few have discussed the impact on sustainable economic growth incorporating the ecological environment.

2.2. The tourism-industrialization coordination and sustainable economic growth

Sustainable economic growth requires not only rapid growth, but also sustainable development. Sustainable economic growth depends on a sound industrial structure. Giving full play to the strengths of different sectors is the key to sustainable economic growth [25]. To promote sustainable economic growth, tourism is not only to improve environmentally friendly economic development, but also to achieve resilient economic development through coordination with other industries [26]. Therefore, the coordinated development of tourism and other industries is the process of promoting sustainable economic growth.

The coordinated development of tourism and industrialization has an impact on sustainable economic growth. The innovative development of tourism and industrialization has given rise to new integrated formats directly related to tourism and industry, such as the manufacturing industries of tourism equipment, tourist commodities, and industrial tourism [27], which directly promote the economic growth. Moreover, there are input–output linkages between industrialization and tourism. Industrialization provides manufactured goods for tourism and results in its low cost, whereas tourism provides huge application scenarios for industrialization, drives the development of numerous industrial categories and businesses, and then promotes industrialization [28]. Regional economy realizes industrial structure optimization in the mutual promotion of the two sides. A high-level of coordination between tourism and industrialization contributes to high-quality economic development because of the effect of industrial structure rationalization. Tourism is an important part of the tertiary industry. The high level of coordination between tourism and industrialization reflects the rationalization of the structure of secondary and tertiary industries, which is conducive to economic development.

In addition, high-level coordination between tourism and industrialization also leads to the flow effect of factor resources. The high level of coordination between tourism and industrialization reflects the efficient flow of factor resources between different sectors of the regional economy. In particular, many communities depend on tourism for economic growth to compensate for declines in manufacturing [29,30]. Both the rationalization of the industrial structure and the efficient flow of factor resources contribute to the sustainable development of the economy.

The low-level coordination between tourism and industrialization, however, restricts the sustainable development of economy. Low-level coordination between tourism and industry is often due to the overdevelopment of one side and the underdevelopment of the other. Economic development cannot be separated from the

input of labor, capital, land, and other factors [31]. Excessive emphasis on the development of tourism or manufacturing will reduce the resource input of another industry [32,33]. Tourism is a labor-intensive industry, and some tourism forms are capital-intensive industries. Tourism development will lead to a shortage in the labor force and capital for industrial development [34]. Furthermore, once land is used for the purpose of tourism or manufacturing, the land and its surrounding land may become difficult to use for other purposes. The environmental destructiveness of some heavy industries, like steel industry, inhibits the development of tourism. Tourism is environmentally demanding and inhibits industrialization [35]. As a result, in a region, especially a small one, only one industry can be the leading industry.

In the process of economic development, excessive reliance on tourism will lead to the resource curse and Dutch disease [36]. These also may induce the deterioration of human capital [37]. Another example is the overdevelopment of industrialization. Excessive development of a certain industrial sector may lead to overcapacity and disordered competition [38]. In short, the excessive development of tourism or industrialization leads to low-level coordination between tourism and industrialization, which is detrimental to the sustainability of economic development.

3. Method and data

3.1. Research method

To analyze the coordinated development level of tourism and industrialization at the provincial level in China, we calculate the coupling coordination degree by referring to the capacity coupling coefficient model in physics [39]. First, the entropy method is adopted to determine the weight of the indicators. By determining the weight through the variation degree of each indicator value, deviation can be avoided, and the results can be rendered more reliable. The coupling coordination degree model integrates the coordination degree, development degree, and coupling coordination degree by measuring the comprehensive development level of tourism and industrialization. The specific steps are as follows:

(1) Entropy method

We selected the entropy method to assign the weight to the system indexes to avoid the influence of subjective factors. There are m evaluation objects and n evaluation indicators, and X_{ij} is the attribute value of the jth index of the ith evaluation object. The basic calculation steps are as follows:

Under index j, the characteristic proportion of the subject i is p_{ij}, so:

$$p_{ij} = X_{ij} / \sum_{i=1}^{m} X_{ij}$$

Calculate the entropy value of the jth index e_j:

$$e_j = -1/ln(m) \sum_{i=1}^{m} p_{ij} \cdot ln\, p_{ij}$$

Determine the weight of each index W_j:

$$W_j = (1 - e_j) / \sum_{j=1}^{n} (1 - e_j)$$

(2) Comprehensive development level:

$$U_1 = \sum_{i=1}^{m} a_i x_i, U_2 = \sum_{j=1}^{n} b_j y_j$$

where U_1 and U_2 are the comprehensive development level of tourism and industrialization, respectively; a_i and b_j are the weights of the two systems; x_i and y_j are dimensionless values in the two systems; and m and n are the number of indicators of the two systems.

(3) Coupling coordination degree:

$$C = \left[\frac{U_1 \cdot U_2}{\left(\frac{U_1 + U_2}{2} \right)^2} \right]^{1/2}, T = \alpha U_1 + \beta U_2, D = \sqrt{C \cdot T}$$

where C represents the coordination degree; T represents the development degree, namely the comprehensive development level of the two systems; and α, β represent the weight of the importance degree of the two systems. The role of tourism and industrialization in economic growth is not symmetrical. Thus, the values of α and β are determined according to the ratio of tourism's comprehensive contribution to the GDP and the ratio of industrial added value to the GDP, respectively, and finally $\alpha = 0.26$, $\beta = 0.74$. D is the coupling coordination degree between 0 and 1; the larger the value of D, the higher the degree of coordinated development of tourism and industrialization. When D is greater than 0.5, it is considered to be at the coordination level.

3.2. Indicator system

According to the principles of comprehensiveness, scientificity, and operability, and facing a modern economic system with high-quality development [40], we constructed a comprehensive development level of tourism and industrialization [41,42]. Considering the interaction between tourism and industrialization, green development indicators are added into the indicator system of industrialization, so as to measure the relationship between tourism and green industrialization more accurately. The tourism data come from The Yearbook of China Tourism and The Yearbook of China Tourism Statistics, while the industrialization indicators come from the National Bureau of Statistics of the People's Republic of China, China Industry Statistical Yearbook, China Statistical Yearbook on High-technology Industry, and China Statistical Yearbook on Science and Technology. With China's provinces taken as the evaluation spatial unit, the starting and ending years range from 2000 to 2017. This is because some data (i.e., main business income of travel agencies) has not been published since 2017, and the statistical caliber of some data changed after 2017 (i.e., export delivery value of industrial enterprises above designated scale). In order to maintain the consistency of the statistical caliber of industrialization indicators and the consistency of the years of all indicators, the research period of this paper is up to 2017.

The indicator system is shown in **Tables 1** and **2**.

Table 1. Indicator system of tourism.

| Category	First-level indicators	Second-level indicators	Influential direction
Tourism	Development scale	Total number of tourists	positive
		Total tourism income	positive
		Proportion of total tourism revenue in GDP	positive
		Main business income of star-rated hotels	positive
		Main business income of travel agencies	positive
	Industrial structure	Number of National Scenic Spots	positive
		Number of world heritages	positive
		Number of high-star-rated hotels	positive
		Capital–labor ratio of travel agencies	positive
		Capital–labor ratio of star-rated hotels	positive
	Quality benefit	Total labor productivity of travel agencies	positive
		Total labor productivity of star-rated hotels	positive
		Foreign exchange earnings from inbound tourism	positive
		Number of days of inbound tourists	positive

Table 2. Indicator system of industrialization.

Category	First-level indicators	Second-level indicators	Influential direction
Industrialization	Development scale	Number of industrial enterprises above designated scale	positive
		Main business income of industrial enterprises above designated scale	positive
		Industrial added value	positive
	Industrial structure	Proportion of main income of non-state-owned industrial enterprises	positive
		Main business income of high-tech manufacturing industry	positive
	Quality benefit	Main business profit rate of industrial enterprises above designated scale	positive
		Asset–liability ratio of industrial enterprises above designated scale	appropriate
		Contribution rate of total assets of industrial enterprises designated above scale	positive
	Innovation capacity	Number of patents of industrial enterprises above designated scale	positive
		Full-time equivalent jobs of R&D personnel in industrial enterprises above designated scale	positive
		R&D funds for industrial enterprises above designated scale	positive
	Green development	Water consumption of per-unit industrial added value	negative
		Electricity consumption of per-unit industrial added value	negative
		Sulfur dioxide emissions of per-unit industrial added value	negative
	International competition	Export delivery value of industrial enterprises above designated scale	positive
		Proportion of export delivery value to export	positive

3.3. Temporal and spatial characteristics

To evaluate the coordinated development degree of tourism and industrialization, we calculated the coupling coordination degree of provincial tourism and industrialization in China from 2000 to 2017 based on the previous method. **Figure 1**

shows the trends of U1 (tourism) and U2 (industrialization), the C (coupling degree), the T (development degree), and the D (coordination degree).
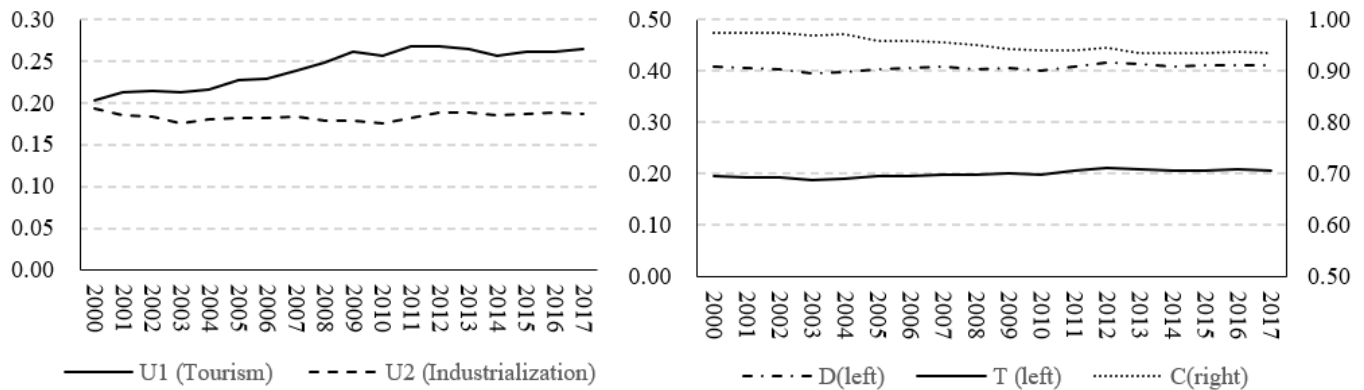
Figure 1. Comprehensive development level of tourism and industrialization and their coordination.

During the evaluation period, the mean of the coupling coordination degree of tourism and industrialization followed a fluctuating upward trend, and the coordination relationship between tourism and industrialization tended to remain consistent and orderly. As shown in **Table 3**, the mean coupling coordination degree was only 0.412 in 2017, indicating that there is still room for their coordination. From 2000 to 2010, China's industrial economy developed rapidly, and its industrial structure was transformed into a heavy industry. The development of tourism was relatively lagging behind, and the degree of tourism–industrialization coordination was low. In 2011, China became the second-largest economy globally and the largest industrial country in the world, with the economic development entering a shift [15]. Because of the increasingly prominent contradiction between economic growth and environmental constraints, the central government has begun to take the initiative to reduce the economic growth target, emphasize connotative and high-quality development, and accelerate the transformation of driving forces of economic development. This is reflected in the strong consumption expenditure of cultural entertainment, transportation, and communication. This resulted in the proportion of the tertiary industry in the economic structure increasing.

Table 3. Coupled coordination degree between tourism and industrialization in China from 2000 to 2017.

Province	2000	2002	2004	2006	2008	2010	2012	2014	2016	2017	Mean
Guangdong	0.907	0.915	0.912	0.894	0.911	0.923	0.923	0.928	0.937	0.935	0.918
Jiangsu	0.702	0.700	0.750	0.764	0.817	0.813	0.862	0.817	0.826	0.817	0.787
Zhejiang	0.634	0.660	0.651	0.685	0.693	0.699	0.681	0.675	0.665	0.657	0.673
Shandong	0.565	0.574	0.571	0.596	0.615	0.614	0.641	0.638	0.638	0.634	0.610
Shanghai	0.638	0.620	0.656	0.627	0.631	0.617	0.581	0.553	0.538	0.535	0.605
Fujian	0.485	0.484	0.465	0.445	0.453	0.46	0.491	0.495	0.518	0.523	0.481
Beijing	0.557	0.531	0.508	0.499	0.463	0.441	0.451	0.433	0.421	0.417	0.473
Liaoning	0.506	0.486	0.455	0.437	0.450	0.464	0.461	0.439	0.366	0.367	0.447
Henan	0.426	0.416	0.401	0.421	0.435	0.430	0.454	0.470	0.489	0.486	0.439
Tianjin	0.453	0.441	0.425	0.410	0.390	0.375	0.406	0.415	0.403	0.385	0.410

Table 3. (*Continued*).

Province	2000	2002	2004	2006	2008	2010	2012	2014	2016	2017	Mean
Sichuan	0.406	0.400	0.390	0.375	0.379	0.394	0.429	0.432	0.441	0.443	0.406
Hebei	0.428	0.422	0.398	0.391	0.379	0.369	0.399	0.405	0.415	0.412	0.400
Hunan	0.376	0.362	0.350	0.353	0.370	0.393	0.428	0.429	0.442	0.444	0.391
Hubei	0.393	0.383	0.345	0.350	0.364	0.388	0.415	0.424	0.442	0.435	0.390
Anhui	0.337	0.343	0.319	0.325	0.347	0.371	0.424	0.445	0.463	0.460	0.379
Heilongjiang	0.400	0.381	0.383	0.411	0.401	0.333	0.332	0.306	0.290	0.278	0.358
Chungking	0.339	0.351	0.345	0.306	0.324	0.329	0.365	0.378	0.402	0.397	0.350
Shaanxi	0.348	0.347	0.339	0.348	0.356	0.329	0.355	0.339	0.355	0.365	0.347
Jiangxi	0.291	0.288	0.299	0.310	0.325	0.341	0.361	0.372	0.394	0.401	0.334
Tibet	0.336	0.313	0.305	0.340	0.288	0.332	0.316	0.277	0.277	0.297	0.314
Shanxi	0.323	0.335	0.329	0.330	0.317	0.301	0.304	0.289	0.285	0.312	0.311
Guangxi	0.319	0.298	0.293	0.288	0.290	0.306	0.320	0.328	0.356	0.342	0.310
Sinkiang	0.324	0.302	0.327	0.384	0.353	0.304	0.302	0.249	0.235	0.253	0.309
Jilin	0.295	0.304	0.304	0.299	0.290	0.305	0.321	0.326	0.331	0.334	0.308
Yunnan	0.354	0.32	0.327	0.320	0.288	0.287	0.291	0.285	0.300	0.313	0.308
Inner Mongolia	0.286	0.290	0.289	0.302	0.306	0.305	0.317	0.298	0.307	0.289	0.300
Hainan	0.292	0.309	0.302	0.321	0.294	0.291	0.301	0.285	0.284	0.286	0.297
Guizhou	0.251	0.231	0.232	0.241	0.257	0.256	0.306	0.286	0.321	0.328	0.266
Qinghai	0.199	0.212	0.227	0.311	0.333	0.220	0.252	0.209	0.217	0.204	0.244
Gansu	0.260	0.253	0.233	0.239	0.213	0.217	0.217	0.221	0.216	0.212	0.227
Ningxia	0.251	0.248	0.245	0.238	0.204	0.201	0.197	0.191	0.204	0.200	0.218
Mean	0.409	0.404	0.399	0.405	0.404	0.401	0.416	0.408	0.412	0.412	0.407

A few regions, such as Beijing and Shanghai, have begun to enter the postindustrial stage. Against the backdrop of strong domestic demand, new industry development, and tertiary industry domination, the coupling coordination degree between tourism and industrialization has been rising in varying degrees. During the initial stage of coordination, tourism and industrialization compete with each other as different sectors in different provinces because of their different resource endowments and development conditions [13]. In this stage, tourism and industrialization are more competitive and substitutive for development resources and growth opportunities. This is consistent with the theoretical research of Zeng and Zhu (2011), which has a solid empirical explanation [43]. As the industrial structure becomes more advanced and service-oriented, however, the manufacturing industry becomes more eco-friendly, and the tourism industry chain grows. A positive correlation of the productivity between tourism and manufacturing can be found in this stage [44]. Thus, tourism and industrialization tend to be cooperative and complementary. This evolutionary process shows the improvement of tourism–industrialization coordination.

From the spatial perspective, the coupling coordination degree of tourism and industrialization decreases from the provinces in east China to the provinces in west China. The average level of Guangdong, Jiangsu, Zhejiang, Shandong, and Shanghai is greater than 0.5. These provinces are at the coordination level, indicating that the

tourism and industrialization of the eastern coastal provinces are in a positive interactive development state. Tourism, as the consumption scene of industrialization, promotes industrial scale production. The standardized and characteristic commodities provided by industrialization support the development of tourism. For instance, based on the equipment manufacturing industry, Guangdong province focuses on the development of tourism equipment manufacturing industries, such as the cruise ship and other entertainment equipment industries. This will help not only to promote the development of industrialization to specialization and characteristics, but also to develop coastal tourism, theme parks, and other tourism products, which will in turn boost economic development. Tourism and industrialization in central provinces are developing rapidly, but a certain gap exists compared with the eastern coastal provinces. In the rapid development stage, a certain competitive effect and crowding-out effect exist, resulting in a certain degree of disorder. The western and northeastern provinces and Beijing are in minor or medium states of disorder, whereas Qinghai and Gansu are in serious states of disorder. Most western provinces belong to ecologically fragile areas, and their industrial development has been severely restricted. Northeast and Beijing are in a state of passive or active de-industrialization, which has led to a decline in industrial status and is resulting in a serious imbalance between tourism and industrial development.

4. Empirical analysis

4.1. Model specification

To investigate the sustainable economic growth effect of the coordinated development of tourism and industrialization, we formulate the following econometric model:

$$gtfp_{it} = \alpha + \rho lncoor_{it} + \beta lnX_{it} + \mu_i + \theta_t + \varepsilon_{it},$$

where the dependent variable $gtfp_{it}$ indicates the sustainable economic growth in province i in year t, represented by green total factor productivity; and $lncoor_{it}$, the core explanatory variable, is the logarithm of the coordinated development of tourism and industrialization. For comparison, the effect of tourism specialization and tourism composite index is also considered. X_{it} is the control variable sets, and β represents their coefficients; μ_i is the individual effect and θ_t is the time effect; and ε_{it} is the disturbance term.

Sustainable economic growth is the coordinated development of economic growth and ecological environment. In order to examine the sustainable economic growth, green total factor productivity was used to measure the level of sustainable development of the economy as well as environment. A super-efficient SBM model with non-expected output was adopted by combining the advantages of super-efficiency DEA model and SBM model [45]. This method considers the loss to the environment in the process of economic development so as to accurately measure the efficiency of economic development. Global Malmquist-Luenberger (GML) index was selected to avoid non-transmissibility and potential unsolvable problem of linear programming [46]. GML index is expressed as follows:

$$\text{GML}_t^{t+1}(x^t, y^t, b^t, x^{t+1}, y^{t+1}, b^{t+1}) = \frac{1 + D^G(x^t, y^t, b^t)}{1 + D^G(x^{t+1}, y^{t+1}, b^{t+1})} = \frac{1 + D^t(x^t, y^t, b^t)}{1 + D^{t+1}(x^{t+1}, y^{t+1}, b^{t+1})} \times$$

$$\left[\frac{\dfrac{1 + D^G(x^t, y^t, b^t)}{1 + D^t(x^t, y^t, b^t)}}{\dfrac{1 + D^G(x^{t+1}, y^{t+1}, b^{t+1}}{1 + D^{t+1}(x^{t+1}, y^{t+1}, b^{t+1})}} \right]$$

The direction distance function $D^G(x^t, y^t, b^t) = \max\{\beta \mid (y + \beta y, b - \beta b) \in P^G(x)\}$, when the desirble output increases (decreases) and the undesirable output decreases (increases) in a production activity, $\text{GML}_{t,t+1} > (<)1$, indicating economic efficiency increased (decreased). GTFP is assumed to be 1 in the base period, and then multiplied by the corresponding index year by year. The input-output variables are shown in **Table 4** [47]. The data was from the website of China's National Bureau of Statistics.

Table 4. Selected input and output factors.

Type	Variable	Definition
Inputs	Labor force	The number of employees at the end of a year
	Capital stock	Total investment in fixed assets
	Energy consumption	Electricity consumption of the whole society
Desirable output	Economic output	Real gross domestic product
Undesirable output	Environmental pollution	Discharge of industrial wastewater
		Sulfur dioxide emissions

It has been suggested that some variables should be controlled to explore the causal relationship between target variables in tourism economics [48]. To further capture the relevant omitted variables and ensure the robustness of the estimated model, some control variables were included [49]. Control variables are selected from literature and also based on a multicollinearity test. Therefore, control variables did not include variables with variance inflation factor values greater than 10, such as industrialization variables. Industry-related variables (industrial structure, real estate industry, and financial industry), innovation-related variables (patent application), governance-related variables (fiscal expenditure), and infrastructure-related variables (physical infrastructure) are included. **Table 5** lists the definition of variables used in the empirical analysis.

Table 5. Variable definitions.

Variable name	Symbol	Definition	Literature
Sustainable economic growth	gtfp	Green total factor productivity	[45,46]
Tourism composite index	tci	Comprehensive tourism level calculated by systematic evaluation indicators	The authors
Tourism–industrialization coordination	coor	The coupling coordination development of tourism and industrialization	The authors
Industrialization composite index	indci	Comprehensive industrialization level calculated by systematic evaluation indicators	The authors
Industrial structure	gdppro	The proportion of nonagricultural industries	[50]

Table 5. (*Continued*).

Variable name	Symbol	Definition	Literature
Financial industry	finan	Added value of financial industry per capita	[51]
Patent application	patapp	Number of patent application	[52]
Fiscal expenditure	fisexp	The ratio of fiscal expenditure to GDP	[53]
International trade	trade	Per capital trade level	[32]
Urbanization	urban	The intensity of nighttime light	[54]

Table 6 summarizes the observed variables. Because the data set included balanced panel data from 2000 to 2017 in China's mainland, the sample size is 540. The standard deviations of most variables are around 1. In contrast, the standard deviation of gtfp is greater than that of tourism-related variables, and that of lntci is larger than that of lncoor, which indicates that the spatial differences of tourism–industrialization coordination are even less than those of tourism composite index. To decrease the variability and reduce heteroskedasticity, all of the independent variables in the table are given in logarithmic form. The data sources are the same as given previously.

Table 6. Summary of observed variables.

Variable	N	Mean	Median	Standard deviation	Minimum	Maximum
gtfp	540	2.496	1.786	2.219	0.881	20.995
lntci	540	−1.612	−1.658	0.617	−3.414	−0.249
lncoor	540	−0.965	−1.030	0.350	−1.692	−0.065
lngdppro	540	−0.135	−0.129	0.077	−0.453	−0.004
lnfinan	540	−2.393	−2.403	1.258	−5.403	0.790
lnpatapp	540	8.589	8.619	1.837	1.946	12.715
lnfisexp	540	−1.660	−1.716	0.511	−2.672	0.322
lntrade	540	8.584	8.479	1.653	5.203	12.606
lnurban	540	−1.743	−1.685	1.794	−7.698	2.529

4.2. Empirical results

The endogeneity problem caused by the interaction between tourism–industrialization coordination and sustainable economic growth may lead to biased estimation [55], which will affect the direction and significance of parameter estimation. Therefore, we introduce instrumental variables to overcome this problem. In this study, we selected the first- and second-order lag term of tourism-related variables as the instrumental variables. We used the instrumental variable-generalized moment estimation (IV-GMM) method to estimate the parameters and used the heteroscedasticity robust standard error to test the hypothesis. The instrumental variables meet the requirement of the under identification test, weak identification test, and overidentification test.

Table 7 shows the main estimation results. To examine the impact of the tourism industry on sustainable economic growth, we added the tourism-related variables to the models. In Model (1), we introduced the tourism composite index to the equation,

which shows a significantly positive effect, with a coefficient of 2.674 ($p < 0.05$). This result indicates the significant role of tourism development on sustainable economic development, which is consistent with the existing research conclusions [56].

Table 7. Regression results.

	(1)	**(2)**	**(3)**	**(4)**
lntci	2.674**	0.851	0.424	−0.218
	(2.188)	(1.382)	(1.313)	(−0.278)
lncoor		2.044*	−1.435**	9.736***
		(1.951)	(−2.285)	(3.735)
lngdppro	−2.982	−4.452	12.039**	−20.401**
	(−0.673)	(−0.993)	(2.419)	(−2.402)
lnfinan	−0.393	−0.298	0.151	−1.642**
	(−1.615)	(−1.355)	(1.256)	(−2.294)
lnpatapp	0.303	0.266	0.096	−0.237
	(1.247)	(1.032)	(0.465)	(−0.641)
lnfisexp	−1.370	−0.923	−2.203**	4.203**
	(−1.460)	(−0.860)	(−2.444)	(2.085)
lntrade	0.739***	0.789***	0.517***	0.585
	(3.154)	(3.438)	(3.625)	(1.330)
lnurban	−0.727***	−0.723***	0.358*	−0.724*
	(−2.767)	(−2.819)	(1.925)	(−1.788)
N	480	480	210	240
Adj. R^2	0.318	0.329	0.405	0.193

Notes: *t* value in the parentheses; both individual effect and time effect were considered in all models; *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

The coordination between tourism and industrialization in Model (2) positively and significantly affected the sustainable economic growth, after adding other control variables. Its coefficient was 2.044 ($p < 0.10$), which shows that the tourism–industrialization coordination is conducive not only to economic growth, but also to green and sustainable development. In comparison, the coefficient of lncoor is significantly larger than that of lntci. This result indicates that the coordination between tourism and industrialization has a greater effect on sustainable economic growth than tourism alone.

Models (3) and (4) show the regression results from 2000-2008 and 2009–2017, respectively. The results show that lncoor has a greater impact on sustainable economic growth in 2009–2017. This is because the low level of tourism-industrialization coordination in the early stage of economic development. The results indicate that the coordination relationship with other industries is particularly important in the process of tourism promoting sustainable economic growth. The sustainable development of tourism needs the support of other industries.

4.3. Robustness check

To further test the robustness of the findings, we employed different variables,

data structure, and estimation methods in **Table 8**. First, we chose the co-agglomeration index of tourism and industrialization as the alternative variable of coordination between tourism and industrialization. According to Ellison et al. (2007) [57], the location quotient index of tourism and the manufacturing industry (LQ_{tour} and LQ_{manu}) is constructed to analyze the comparative advantages and agglomeration degree of tourism and industrialization. On this basis, the co-agglomeration index is counted as follows:

$$\text{coagg} = \left(1 - \frac{|LQ_{manu} - LQ_{tour}|}{LQ_{manu} + LQ_{tour}}\right) + (LQ_{manu} + LQ_{tour}).$$

The first item on the right of the formula can reflect the synergy quality. The closer the agglomeration level of tourism and manufacturing industry, the higher the value. The second item can reflect the agglomeration scale, representing the agglomeration level of tourism and manufacturing. Therefore, the co-agglomeration index can reflect the tourism–industrialization coordination. In Model (5), the core dependent variable was the co-agglomeration index of tourism and industrialization, which had a significantly positive effect on sustainable economic growth.

Table 8. Robustness checks.

	(5)	(6)	(7)	(8)	(9)
lncoor	0.256***	0.588***	2.038**	2.593***	2.159*
	(6.106)	(3.077)	(1.971)	(4.285)	(1.768)
lntci	0.031	−0.133	0.853	−0.371	0.665
	(0.819)	(−1.403)	(1.391)	(−0.795)	(1.001)
lngdppro	1.042***	−1.593**	−4.448	−6.723**	−3.624
	(3.268)	(−2.064)	(−0.992)	(−2.177)	(−0.759)
lnfinan	0.097***	−0.080*	−0.298	−0.557***	−0.316
	(6.207)	(−1.926)	(−1.355)	(−3.229)	(−1.308)
lnpatapp	0.020	0.086**	0.267	0.038	0.312
	(1.001)	(2.168)	(1.033)	(0.266)	(1.093)
lnfisexp	−0.274***	−0.195	−0.918	0.527	−1.030
	(−4.704)	(−1.295)	(−0.862)	(0.984)	(−0.815)
lntrade	0.002	0.080*	0.790***	0.316*	1.012***
	(0.098)	(1.741)	(3.509)	(1.676)	(4.065)
lnurban	0.125***	−0.055	−0.721***	−0.073	−0.814***
	(6.941)	(−1.438)	(−2.865)	(−0.506)	(−2.910)
N	496	450	480	432	432
Adj. R^2	0.984	0.658	0.329	0.428	0.356

Notes: t value in the parentheses; both individual effect and time effect were considered in all models; *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Second, considering the possible hysteresis effect of the impact of tourism development and other control variables on sustainable economic growth [58], we replaced the current term of all of the explanatory variables in the model with a lagging one in Model (6). The coefficient of the lag term of lncoor is not only significantly positive (0.588, $p < 0.01$). This result confirms the lagging effect of tourism impact.

Third, we used the two-step generalized method of moments (GMM) as the estimation method in the regression, which is more efficient when the instrumental variable was greater than the endogenous variable [59]. This result agrees with the main conclusions.

In addition, a typical feature of the China's tourism economy is the imbalance layout in the region [60], which may lead to the outliers in these observations. In the sample, Tianjin, Hunan, and Inner Mongolia were the top three provinces with the highest degree of green total factor productivity, whereas Guangdong, Guangxi, and Ningxia were the top provinces with the lowest degree of green total factor productivity. To test whether the main conclusion was affected by the outliers, these six regions in the two groups were excluded from Models (8) and (9), respectively. The empirical outcomes were similar to previous results.

Based on the theoretical mechanism, we employed different variables, methods, and samples, and the obtained results are robust. Therefore, the positive effect of tourism–industrialization coordination on economic growth appears to be plausible.

4.4. Heterogenous analysis

The level of economic development, tourism industry, and manufacturing industry are different in different regions, which may lead to differences in research conclusions. Therefore, we further employed the regression of the subsamples to examine the moderating effects of different regions.

China could be geographically divided into three parts (i.e., east, middle, and west) to capture differences caused by economic development [61]. In terms of development level, the eastern part is the most developed, followed by the central and the western region. Accordingly, the empirical results are shown in Models (10)–(12) in **Table 9**. For all regions, lncoor was a significant predictor. In the eastern region, the coefficient of tourism-industrialization coordination is negative. This is because the high level of tourism-industrialization coordination but low level of sustainable economic growth. The coordination between tourism and industry in the eastern region has not been well transformed into a driving force for sustainable economic growth. This requires the eastern region to further improve its efficiency in environmental protection and resource consumption in the process of economic development. In contrast, the coordination level in the middle and western region played a positive role. For the middle and western regions, compared with their economic stage, their tourism–industrialization coordination was beneficial to their economic development.

Table 9. Heterogenous regression results.

	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	East	Middle	West	Tourism developing	Tourism developed	High-tech developing	High-tech developed
lncoor	−14.407***	6.476***	1.832**	3.014***	2.416	2.487***	−12.509***
	(−3.442)	(2.692)	(2.423)	(3.780)	(0.645)	(3.162)	(−3.003)
lntci	8.895***	−2.262***	−0.365	0.665	0.793	−0.230	6.698***
	(4.301)	(−2.646)	(−1.149)	(0.925)	(0.590)	(−0.570)	(3.996)
lngdppro	−11.792	−15.238**	20.700***	−11.765***	−8.792	2.518	−6.612
	(−1.000)	(−1.976)	(4.055)	(−2.620)	(−0.693)	(0.544)	(−0.626)

Table 9. (*Continued*).

	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	East	**Middle**	**West**	**Tourism developing**	**Tourism developed**	**High-tech developing**	**High-tech developed**
lnfinan	0.164	−0.112	0.966***	−0.371*	−0.196	0.676***	0.100
	(0.247)	(−0.486)	(3.322)	(−1.958)	(−0.493)	(3.113)	(0.261)
lnpatapp	2.792***	−0.356	−0.795***	−0.163	0.890*	−0.886***	1.045**
	(3.970)	(−1.343)	(−3.303)	(−0.761)	(1.689)	(−3.318)	(2.053)
lnfisexp	−0.920	1.632	−0.972	0.266	−1.544	−1.497	3.642*
	(−0.411)	(1.062)	(−1.079)	(0.323)	(−0.641)	(−1.535)	(1.722)
lntrade	−0.270	0.401	0.785***	0.350	1.411***	0.887***	1.522***
	(−0.368)	(1.609)	(2.911)	(1.472)	(3.130)	(2.926)	(3.611)
lnurban	−1.099*	0.435**	−0.527**	0.573**	−1.469***	−0.525***	−0.446
	(−1.795)	(1.987)	(−2.439)	(2.268)	(−3.501)	(−2.593)	(−1.092)
N	192	128	160	240	240	224	256
Adj. R^2	0.439	0.701	0.618	0.382	0.327	0.483	0.466

Notes: *t* value in the parentheses; both individual effect and time effect were considered in all models; *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

In terms of tourism development reflected by the proportion of total tourism revenue in GDP, Models (13) and (14) present the estimation results of provinces with low and high tourism development, respectively. For provinces with high tourism development, the coefficient of tourism–industrialization coordination was statistically insignificant, whereas for provinces with low tourism development, the coefficient of tourism–industrialization coordination is positively significant. This result shows that the effect of tourism–industrialization coordination on sustainable economic growth is influenced by the development level of the tourism industry. The coefficient of provinces with low tourism development is larger and more significant than that of provinces with high tourism development, which is smaller and less significant. In the stage of rapid development of tourism, its coordination with industrialization exert the effect of sustainable economic growth.

With regard to the manufacturing industry, we divided the sample into two groups: low high-tech manufacturing regions and high high-tech manufacturing regions. The manufacturing industry is reflected in the high-tech manufacturing industry revenue in the GDP. The empirical estimation results are shown in Models (15) and (16). The coefficient of tourism–industrialization coordination in Model (15) is positively significant, but the latter is negatively significant. In provinces with high manufacturing innovation, the role of industrialization is more prominent; thus, the tourism industry and tourism–industrialization coordination tend to be neglected.

In provinces with high economic development and manufacturing development, the effect of tourism–industrialization coordination on economic growth is limited. However, in the midwest, tourism developing, and high-tech developing regions, tourism–industrialization coordination had a significant effect. This might be because of differences in the nature of the industries in these regions [13]. These results indicate that industrialization plays a more prominent role in economically developed areas than tourism development. However, for areas where tourism is more important, the

sustainable development of tourism also needs to be coordinated with industrialization.

4.5. Threshold effect

Theoretical analysis shows that the sustainable economic growth effect of tourism is affected by the degree of tourism–industrialization coordination. In other words, we find significant differences in the sustainable economic growth effects of tourism at different levels of tourism–industrialization coordination. Regional differences also exist between tourism–industrialization coordination, which suggests the effect of tourism–industrialization coordination may have a nonlinear relationship. Therefore, we introduce Hansen's threshold regression method [62]. First, tourism–industrialization coordination are defined as threshold variables, and only a single threshold is identified in Models (17). Furthermore, the provinces are divided into regions with low industrialization and high industrialization. We used the median industrialization composite index in 2017 as the reference value. For the samples of industrialization developed and less developed regions in Models (18) and (19), there is a no threshold and single threshold for tourism–industrialization coordination. **Table 10** shows the identification of the threshold number.

Table 10. Threshold number identification.

Model	Threshold variable	Threshold number	RSS	MSE	*F*	*P*	Crit10	Crit5	Crit1
(17)	lncoor	Single	652.603	1.250	188.26	0.000	41.434	56.001	81.209
(18)	lncoor	Single	130.528	0.518	11.51	0.720	42.319	56.075	105.973
(19)	lncoor	Single	383.300	1.521	139.67	0.000	34.205	42.694	59.874

The threshold regression results are shown in **Table 11**. Model (17) takes the tourism–industrialization coordination as the threshold variable. The results show that the sustainable economic growth effect of tourism is positively significant. When the tourism–industrialization coordination is higher, the sustainable economic growth effect of tourism is more significant. These results show that in the process of tourism economic development, the coordination with industrialization is essential.

In addition, the results of Models (18) and (19) show that for less industrialization developed regions, the sustainable economic growth effect of tourism did not depend on tourism–industrialization coordination ($p = 0.720 > 0.1$; **Table 10**). For industrialization developed regions, the sustainable economic growth effect of tourism depended on tourism–industrialization coordination. This indicates that in the initial stage of industrialization, the destination not only can rely on tourism industry, but also needs to build a sound and reasonable industrial system. At this stage, the sustainable economic development of tourism needs the support of industrialization. In the mature stage of industrialization, the tourism industry should become an independent variable to promote sustainable economic growth.

Table 11. Threshold regression results.

	(17)	**(18)**	**(19)**
lntci ($q < r1$)	1.359***	−0.563	5.084***
	(3.066)	(−1.607)	(5.194)
lntci ($q > r1$)	4.886***	−0.810**	8.721***
	(9.192)	(−2.300)	(8.456)
lngdppro	7.174**	5.840**	1.598
	(2.342)	(2.437)	(0.221)
lnfinan	0.096	0.473**	0.227
	(0.441)	(2.503)	(0.498)
lnpatapp	0.492**	−0.239	0.536
	(2.341)	(−0.953)	(1.366)
lnfisexp	−1.849***	−2.926***	−0.013
	(−2.798)	(−5.383)	(−0.009)
lntrade	0.635***	0.691***	1.168***
	(2.728)	(3.094)	(2.698)
lnurban	−0.394*	−1.090***	−0.172
	(−1.893)	(−5.557)	(−0.460)
Constant	−9.203***	−10.965***	−6.097
	(−2.793)	(−3.280)	(−1.073)
N	540	270	270
Adj. R^2	0.535	0.535	0.633

Notes: t value in the parentheses; both individual effect and time effect were considered in all models; *p < 0.10; **p < 0.05; ***p < 0.01.

5. Discussion

Economic sustainability is an important part of the United Nations SDGs. Sustainable economic growth not only requires both economic growth and ecological environment, but also requires a resilient industrial structure. For tourism destinations, more attention should be paid to the coordination between tourism and other industries, so as to achieve sustainable development. China is a typical example of sustainable economic growth. Since China's reform and opening up, it has made world-renowned economic achievements. The comprehensive contribution of the tourism industry has gradually increased, with numerous research studies analyzing the role of tourism in China's economic growth [63]. China continues to optimize its industrial structure, emphasizing the sustainability of economic development and putting forward the developing concept that clear waters and green mountains are as good as mountains of gold and silver. Tourism is an important tool for transforming ecological resources into industrial advantages and realizing sustainable economic growth. The results of this study indicate that in the process of China's rapid growth, tourism and industrialization interact deeply and jointly affect China's sustainable economic growth over the evaluation period. This study has important implications for the sustainable economic development of the destination.

First, this study shows that the tourism-industrialization coordination provides

support for their respective sustainable development. The coordination between tourism and industrialization in China over the evaluation period tend to be orderly and effective, but the potential for growth is great. Industrial structure always evolves dynamically [64], which affects the degree of coordinated development between tourism and industrialization. Therefore, it is necessary to avoid the unitary and imbalanced development of the industrial structure. The tourist destination can optimize the industrial structure through the coordinated development of tourism and industrialization. In regions with developed tourism, we should avoid the curse of tourism resources and Dutch disease by appropriately developing green manufacturing, improving local finance and taxation, extending the regional industrial chain, and strengthening economic resilience. For regions with developed industrialization, the ability to continuously improve the technological level of the industrial system is most important, so as to achieve sustainable industrial development (SDG 9). Moreover, tourism should be actively developed to improve the region's image, enhance the welfare level and quality of workers, and achieve sustainable development (SDG 8).

Second, the study shows that the tourism-industrialization coordination provides impetus for sustainable economic development. The tourism-industrialization coordination is conducive not only to economic growth, but also to environmental sustainability. Although the tourism composite index affect economic development, its coordinated development with industrialization has a greater impact. Hence, the comprehensive contribution of tourism needs to be measured by a combination of indicators rather than a single one. The contribution of tourism on economic development should be investigated from the perspective of industrial structure and industrial coordination. Additionally, tourism not only needs industrialization to promote the consumption capability of residents and the quality of special equipment, but also needs to prevent the deterioration of the environment because of tourism development and the reduction of development space caused by excessive industrialization.

Third, this study shows that economic development and tourism development moderated the effect of tourism-industrialization coordination on sustainable economic growth. The role of industrial coordination in economic developing regions as well as tourism developing regions was prominent. This is consistent with the Faber and Gaubert study (2018), which finds that tourism regions could obtain significant positive spillovers from manufacturing [10]. Both developed and developing regions, however, should coordinate the development of the tourism and manufacturing industries to implement industrial policies. Economically developed regions have a high degree of agglomeration of various factors and a high degree of coordinated development between tourism and industrialization. Excessive deindustrialization should be avoided, which may lead to abnormal and unsustainable economic structure. For economically developing areas, to realize coordinated development among different economic sectors, the regions need to seek their comparative advantages, concentrate their resources to promote the development of industrialization or tourism, and adjust their economic structure and resource allocation to expand economic scale.

Finally, industrial innovation also affected the sustainable economic growth effect of tourism-industrialization coordination. Thus, it is necessary to promote scientific and technological innovation to achieve high-quality coordinated

development between tourism and industrialization (SDG 9). Both tourism and industrialization need to enhance total factor productivity through technological empowerment. In particular, for those regions with tourism as the pillar industry, the low threshold for employment in tourism may restrict the accumulation of regional human capital, thus affecting the long-term economic growth of the region [65]. Encouraging innovation in tourism products, technologies, and business models will enhance the competitiveness of the industry and promote sustainable development of the region. Additionally, the government should give full play to the role of scientific and technological innovation in the integrated development of tourism and industrialization and should promote the development of highly integrated business forms, such as the tourism equipment manufacturing industry.

6. Conclusion and contribution

The United Nations SDGs emphasize economic, social and environmental sustainability. The coordinated development of tourism and industrialization contributes to the realization of multiple SDG objectives, especially for SDG 8 and 9. This paper discusses the impact of their relationship on sustainable economic growth. Taking China as an example, this study constructed panel data to measure the coupling coordination between tourism and industrialization and to investigate its impact on sustainable economic growth. The coupling coordination degree of tourism and industrialization tend to be orderly and effective over the evaluation period. This degree of coordination, however, verge on an imbalance. More provinces have a slight imbalance between tourism and industrialization, and fewer provinces are in the coordination range. Additionally, tourism-industrialization coordination exerts a significant positive effect on sustainable economic growth. Additional robustness checks show that the results are reliable. It shows that the tourism–industrialization coordination is conducive not only to economic growth, but also to green and sustainable development of the economy. We also found that economic development, tourism development, and manufacturing innovation moderate this effect. The threshold analysis also shows that the sustainable economic growth effect of tourism is nonlinear and affected by tourism-industrialization coordination, and industrialization is important for tourism-led sustainable growth.

These research findings provide theoretical contributions. Sustainable economic development requires not only coordination between sectors and industries, but also a good deal of benefits between economic development and the environmental sustainability.

First, compared with previous studies focusing on sustainable tourism from the perspective of environment, this paper investigates the relationship between tourism and sustainable economic development from the perspective of industrial coordination. This is consistent not only with the nature of sustainable tourism, but also with the SDGs of the United Nations. By verifying the impact of the coordination between tourism and industrialization on economic growth in China, this study provides an industrial coordination approach for the sustainable economic growth of tourism destination. This contributes to balance the benefits of economic development, environmental protection and people's well-being.

Second, this paper examines tourism promoting sustainable economic growth from the perspective of industrial structure. Based on the data and analysis about China, the influence of environment sustainability on industrialization and economic growth is fully considered. The variables of green development have been incorporated into the industrialization indicator system, and the sustainable economic growth is measured by green total factor productivity. This study verifies the economic effect of tourism by using instrumental variable method. It provides an empirical sample under the transition of the developing economy and innovative methods for the research topic, as well as references for other economies to promote economic growth from the perspective of industrial coordination.

Third, compared with the literature on tourism economics, this paper deeply discusses the relationship between tourism and industrialization and its economic effects. Tourism and industrialization are crucial to the sustainable development of regional economy. Their relationship, however, has always been neglected in the study of tourism economics. This study contributes to the research topic by using a representative case of China. It has the largest industrial scale and domestic tourism scale in the world. The empirical study of the sustainable economic growth effect of tourism-industrialization coordination in China has implications for emerging economies. The excessive development of either tourism or industrialization will limit the sustainable development of the economy. Their coordinated development is more conducive to economic growth.

The relationship between tourism and sustainable development is a long-term topic. This paper explores the influence of tourism on sustainable economic growth from the perspective of industrial coordination, which takes into account both economic growth and environmental sustainability. Although the coupling mechanism of tourism and industrialization is proposed herein, different mechanisms were not directly verified in the empirical test. In the future, the theoretical mechanism used in this study can be further investigated. Due to the lack of the latest data, the paper did not analyze the situation during the Covid-19. Case study can be selected to analyze in detail the differences of economic recovery and tourism development in regions with different tourism-industrialization coordination under the influence of the epidemic and in the post epidemic era.

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