Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

Why and how tourism affects green development: evidence for China

Yan Zhang & Jiekuan Zhang

To cite this article: Yan Zhang & Jiekuan Zhang (2023) Why and how tourism affects green development: evidence for China, Economic Research-Ekonomska Istraživanja, 36:1, 2181841, DOI: 10.1080/1331677X.2023.2181841

To link to this article: https://doi.org/10.1080/1331677X.2023.2181841

Published online: 09 Mar 2023.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2023, VOL. 36, NO. 1, 2181841
https://doi.org/10.1080/1331677X.2023.2181841

Why and how tourism affects green development: evidence for China

Yan Zhang[a] and Jiekuan Zhang[b]

[a]School of Tourism Management, Guilin Tourism University, Guilin, Guangxi, China; [b]World-class Tourism City Institute of China Tourism Academy, Guilin Tourism University, Guilin, Guangxi, China

ABSTRACT

Green development, considering economic and environmental performance, has received increased attention globally. Moreover, the significant economic and environmental impacts of tourism are widely accepted by scholars. However, the nexus of tourism and green development is still unclear. To fill this gap, this study examines the effects of tourism on green development performance measured as green total factor productivity and the influence mechanisms. China's 308 cities' panel data between 2005 and 2019 provide empirical evidence. The results demonstrate an inverted U-shaped relationship between tourism and green total factor productivity, which is substantiated via various rigorous robustness tests. The key drivers of green total factor productivity change in cities include tourism-induced technological innovation, industrial structure optimisation, and environmental enhancement. Besides, the nexus of tourism and GTFP varies significantly across different socio-economic development regions. The positive relationship exists in relatively developed areas, while less-developed western China still keeps inverted U-shaped links between tourism and GTFP. The U-shaped relationship exists in central and northeastern China. The article is the first to systematically explore the impact of tourism on green development while revealing several potential mechanisms, thus significantly contributing to the literature on green development and sustainable tourism.

ARTICLE HISTORY
Received 13 November 2022
Accepted 12 February 2023

KEYWORDS
tourism specialisation; tourism revenue; green development; green total factor productivity; influence mechanism; heterogeneity

JEL CODES
A10; D01; Q57

1. Introduction

Economic development has long been the most important goal pursued globally, especially in developing countries, even at the cost of environmental degradation. However, the effects of environmental pollution are cumulative and amplified and may become irreversibly worse over time, ultimately affecting the sustainability of the economy. Therefore, the tension between economic growth and environmental protection constrains sustainable global growth (Grossman & Krueger, 1995; Cordero et al., 2005). As a result, green total factor productivity (hereafter GTFP), which integrates economic

CONTACT Yan Zhang zhangyan140701@126.com

and environmental performance, has received increasing attention in different countries and regions (e.g., Xie et al., 2021; Wu et al., 2020). Also, GTFP has become an essential indicator of green and sustainable development (Zhang et al., 2021). A GTFP-oriented development model can effectively reduce the impulse of local governments to pursue pure economic growth (often measured by GDP), increase the endogenous motivation to reduce energy and resource consumption, save energy and reduce emissions, and promote healthy competition between different countries and regions.

The significant economic impact of tourism has been well documented in the extensive literature (e.g., Nunkoo et al., 2020; Tang, 2021; Zhang & Zhang, 2021). Similarly, tourism-induced environmental change has also been supported (e.g., Lv & Xu, 2021; Sun et al., 2020; Peng et al., 2022). Since GTFP combines increased economic output and reduced environmental pollution, both influenced by tourism growth, tourism theoretically also significantly affects GTFP. However, to our best knowledge, few studies have focused on the nexus of tourism and GTFP and explained the underlying influence mechanism. In order to gain a deeper understanding of the relationship between tourism and green growth, two fundamental theoretical issues should be addressed. One is to clarify the effects of tourism on GTFP; the second is to explain how tourism affects GTFP. However, the two theoretical issues mentioned above have not been well explored. Not only is the impact of tourism on GTFP unknown, but how this impact occurs is also a black box. Therefore, as of now, we can still not link tourism and green development theoretically.

For a long time, China has led the world in economic growth. Since China's reform and opening up in 1978, China's GDP has grown by about 41.97 times by 2021, with an average annual growth rate of approximately 6.11%.[1] However, rapid economic growth has led to excessive consumption of natural resources and environmental pollution; a purely GDP-driven growth model has seriously undermined the basis for China's sustainable economic development (Song et al., 2018). In the 21st century, China's environmental pollution problems have attracted great attention from the government, which launched the 'Green GDP Accounting' project in 2004. Green GDP is obtained by deducting resource consumption and environmental losses from GDP; however, due to the high correlation between resources, energy and capital and the difficulty of measuring environmental costs, an accurate and authoritative technical accounting system for green GDP in China has not yet been established.

Another concept that has been gaining attention in recent years to integrate economic growth and environmental protection is the GTFP (Xia & Xu, 2020; Li & Chen, 2021; Lee & Lee, 2022). GTFP measures take into account not only the inputs of labour, capital and energy consumption in economic growth, but also ecological and environmental issues. It is estimated that China's GTFP fluctuates significantly, and after considering environmental factors, the GTFP growth was even negative in many cases (Xia & Xu, 2020). China's rapid economic growth is accompanied by fast-growing tourism industry. Before the COVID-19 pandemic, tourism's combined contribution to GDP exceeded 11% in 2019.[2] The environmental effects of increased tourism consumption are also considerable (Tang et al., 2022). For example, Tang et al. (2021) argued that China's tourism is emitting increasingly more carbon dioxide; Zhang and Zhang (2021) found that tourism Granger causes carbon emissions.

In summary, the development practice in China provides excellent empirical evidence to explore the link between tourism and GTFP. Consequently, we cite China as the case to empirically discuss the above-mentioned theoretical issues. Concretely, we develop the theoretical hypotheses of tourism and GTFP. Methodologically, we apply econometric methods to explore the nonlinear effect of tourism on GTFP and its influence mechanism as well as further explore the regional heterogeneity of such effects.

In contrast to prior studies, this article has the following unique contributions. This study establishes a theoretical association between tourism and GTFP and is the first to systematically explore the impact of tourism on regional GTFP focusing on both the economic and environmental aspects on the basis of the existing isolated studies of tourism's economic or environmental impact. Therefore, this study expands the scope of tourism effects and enriches the understanding of the relationship between tourism and sustainability. The article also provides a theoretical and decision-making reference for determining and regulating tourism development in the context of quality development. Conversely, the article offers a new perspective on tourism to enhance the regional GTFP. In addition, the study reveals several potential mechanisms by which tourism affects GTFP, contributing to the theoretical knowledge of GTFP and the influence of tourism. Examining the regional heterogeneity also contributes to deepening the understanding of the relationship between tourism and GTFP and helps build an organic and coordinated development mechanism that encompasses tourism growth and GTFP enhancement in a localised manner.

We organise this paper as follows. In Section 2 we provide the theoretical basis and summarise the research hypotheses. Then we introduce the research method, variable determination and data sources in Section 3. Next, we report the empirical results and perform a series of robustness tests in Section 4 as well as extend this study by discussing the influence mechanism and regional heterogeneity. Finally, we highlight the theoretical and practical implications of this study in Section 5.

2. Theoretical background and hypothesis

Total factor productivity (TFP) is the output efficiency of the combined inputs of labour, capital, and other production factors (Van Beveren, 2012); GTFP, on the other hand, is an improvement of TFP by additionally introducing the factor of energy resources, taking into account both the production factor inputs and energy and resources consumption. Therefore, GTFP is a new sustainable development indicator that integrates factors of production such as labour, capital and consumption of energy and resources into a single analytical framework (Xia & Xu, 2020). Furthermore, the GTFP-oriented development model considers the rational consumption of energy and resources and the reduction of environmental pollution while guiding economic growth. Accordingly, GTFP has become an important concept in modern economics and an essential tool for analysing sustainable economic development, as well as an important basis for governments to formulate long-term growth policies.

Industrial structure optimisation and technological innovation are important drivers of GTFP improvement. As an important basis for economic growth, industrial structure optimisation is also considered a pollutant controller (Zhou et al., 2013), which largely determines the direction of economic development and the quality of environmental protection and thus constitutes a critical way to enhance GTFP (Li & Lin, 2017). Industrial structure optimisation is also often accompanied by the continuous release of the industrial structure dividend. Concretely, the continuous turnover between the old and new industries has led to the gradual emergence of clean and efficient sectors, which has led to the continuous optimisation of resource allocation and improvement of production efficiency of the whole economy, thus effectively improving GTFP (Sun et al., 2022).

Technological innovation as a means to enhance resource allocation efficiency can effectively reduce energy consumption per unit of output, thereby increasing GTFP in the long run (Liu & Dong, 2021; Wang et al., 2021). In particular, after limiting strict environmental red lines and emission standards, a more effective incentive mechanism for green technology innovation will be formed, further generating continuous positive support for GTFP (Ai et al., 2020). But, of course, the productivity paradox also argues that unsuitable technological innovation is difficult to match with the development stage and factor endowment structure of the economy, which will weaken the intrinsic motivation of technological innovation and thus is not conducive to improving GTFP (Jacobs & Nahuis, 2002). Also, the environmental paradox suggests that technological innovation oriented exclusively towards economic growth may negatively impact the environment and thus further hinder the improvement of GTFP.

With its traditional reputation as a green and smoke-free industry, tourism plays an important role in global sustainable development. Therefore, extensive prior studies have examined the effects of tourism on various aspects of sustainability, especially with a broader focus on the economic and environmental impacts. For example, Faber and Gaubert (2019), Li et al. (2018) and Zhang and Zhang (2021) found the positive effects of tourism on economic development; Balli et al. (2019) supported the positive environmental effects of tourism. In contrast, tourism also exerts adverse effects on the economy and environment in some cases, such as Antonakakis et al. (2015), Lee and Brahmasrene (2013), Yıldırım et al. (2021), and Tian et al. (2021). Notably, these tourism impacts are often fragmented; scholars do not organically integrate economic and environmental impacts, even within the same tourism analytical framework. Given the integrated consideration of GTFP for economic and environmental development, exploring the impact of tourism on regional GTFP would undoubtedly lead to a better understanding of the role of tourism in regional sustainable development, yet this has not received sufficient scientific attention. Because of the significant impact of tourism on the economy and environment, we hypothesise that tourism also significantly impacts GTFP.

The continued growth of tourism may lead to a shift in its economic and environmental impact. For example, continued tourism growth will lead to a shift of resources to the non-tradable sector, which may jeopardise productivity and thus negatively affect economic development, namely the so-called Dutch Disease (Inchausti-Sintes,

2015). Similarly, the continued growth of tourism will also lead to a shift in the direction of its impact on the environment due to the increased demand for quality tourism products, the willingness of tourists to pay for quality eco-environment and the increasingly stringent environmental regulations. In other words, there may be nonlinear relationships between tourism and economic growth or environmental performance (e.g., Chiu & Yeh, 2017; Zuo & Huang, 2018; Ehigiamusoe, 2020; Bella, 2018). Hence, we also hypothesise that a nonlinear association exists between tourism and GTFP and obtain the first hypothesis of the article:

Hypothesis 1 *There is an inverted U-shaped relationship between tourism and GTFP.*

In terms of the mechanisms by which tourism affects GTFP, we first discuss the possible effects of tourism on technological innovation and industrial structure and thus GTFP. Tourism exerts innovative effects in terms of talent clustering, investment factor clustering, and technology exchange or spillover. First, tourism development can enhance the brand image and destination's attractiveness and promote the development of destination services, especially high-end services and consumer centres. The resulting quality employment and living environment will further increase the concentration of talent, thus increasing regional innovation. Second, tourism growth increases the transparency of the destination, making it easier to attract investors' attention and reducing the cost of their visits, thus increasing the success rate of offsite investments and providing sufficient financial support for regional innovation. Third, tourism development strengthens the level of destinations' openness and communication and thus contributes to the exchange of scientific and technological innovations, promoting the overall level of regional innovation.

Some studies provide empirical evidence for the above theoretical analysis. For instance, Richards (2020) found that cities increase their attractiveness to creative talent by developing 'creative cities' to leverage the positive role of creativity in placemaking in tourism destinations. Ong and Liu (2022) confirmed that urbanisation driven by large-scale tourism development enhances its attractiveness to capital and thus regional innovation capacity. Ruhanen et al. (2021) argued that new tourism-related knowledge can be generated and shared through tourism talent assistance and that this function can be better enhanced to contribute to regional innovation. Weidenfeld (2013) suggested that intensive mobility of people promotes knowledge transfer and innovation diffusion between tourist destinations. Besides, as an important service industry, tourism has a great demand for technology development and applications in order to meet the high-quality experience of tourists, thus contributing to regional technological innovation to a certain extent (Aldebert et al., 2011). Consequently, we summarise the second hypothesis as follows:

Hypothesis 2 *Tourism affects GTFP through changing regional innovation capacity.*

The tourism elements are involved in almost all service sectors. Therefore, tourism growth can enhance the development of the service sectors and give rise to new tourism services, thus optimising the industrial and factor structure. Specifically, the increase in tourist arrivals promotes the development of tourism-related services, reduces the proportion of traditional agriculture and secondary industries, and increases the proportion of tertiary industries such as services in the national

economy, thus promoting industrial structure optimisation and green transformation. In addition, tourism and its related services are mostly labour-intensive and have a significant advantage in absorbing employment. The increase in tourism is bound to increase the employment rate and promote the transfer of production factors to services, thus optimising the factor structure. For example, Wang et al. (2022) found that tourism can effectively promote the optimisation of industrial structure. Furthermore, Inchausti-Sintes (2015) contended that tourism helps to reduce unemployment by improving terms of trade and enhancing capital accumulation. Thus, we sum up the third hypothesis:

Hypothesis 3 *Tourism affects GTFP through changing the share of the tertiary industry.*

Apart from the technological innovation and industrial structure effects, we also consider tourism's possible environmental enhancement effects to influence GTFP. Since green development and low carbon are often accompanied by each other, the change in carbon intensity measures the environmental enhancement effect in this study. Carbon intensity is measured by carbon emissions per unit of economic output, which is consistent with the connotation of GTFP in accommodating economic growth and environmental protection. At the same time, energy input, a factor closely related to carbon intensity, is also considered in the GTFP calculation; therefore, changes in carbon intensity largely determine the level of green development. According to the definition of carbon intensity, the impact of tourism on carbon intensity includes two aspects, namely the effects on economic growth and carbon emissions, as indicated previously. As a result, theoretically, tourism also significantly affects carbon intensity. In sum, we hypothesise:

Hypothesis 4 *Tourism affects GTFP through changing regional carbon intensity.*

3. Methods for this study

We develop the following econometric model with two-way fixed effects to estimate the nonlinear effects of tourism on GTFP. Usually, control variables are observable and time-varying and regionally heterogeneous, so to consider unobservables and time-fixed factors, we control time fixed effects and region fixed effects to increase the robustness of the model.

$$GTFP_{it} = \alpha + \beta_1 tourism_{it} + \beta_2 tourism_{it}^2 + \sum_{k=1}^{n} \varphi_k con_{k,it} + \gamma_i + \lambda_t + \varepsilon_{it}, \qquad (1)$$

where *GTFP* represents green total factor productivity, tourism is indicated by tourism specialisation. The coefficients β_1 and β_2 are the effects of tourism on GTFP to be examined. *con* denotes control variables, γ_i denotes city fixed effects, λ_t denotes time fixed effects. Referring to the model of Song et al. (2018), the control variables contain foreign investment (FOI), industrial structure (IND), population density (POPD), and population quality (POPQ). To prevent possible omitted variables, we add economic development as an additional control variable.

We measure GTFP referring to Oh and Heshmati (2010). The conventional Malmquist-Luenberger Productivity Index cannot address the bias in productivity calculations caused by technological progress; for this reason, Oh and Heshmati (2010) proposed the Global Malmquist-Luenberger Productivity Index calculated using the SBM directional distance function to yield a more accurate productivity index. Output indicators for measuring GTFP include desired and undesired ones. The desired output indicator is GDP (Unit: ¥10,000), obtained by using the constant price of the year 2005. The undesired output indicators include the volume of industrial waste water discharged (Unit: ton), the volume of industrial soot(dust) emission (Unit: ton), and the volume of industrial sulphur dioxide emission (Unit: ton). A composite pollution index is calculated using the entropy method based on the above three pollutants as the undesired output. Input indicators include capital, labour, and energy. The capital input is expressed as fixed capital stock (Unit: ¥10,000), the annual capital increment is defined as fixed asset investment, and the capital depreciation rate is set at 9.6%. The initial capital stock is determined by dividing the actual total fixed asset investment in the city in 2005 by 10%. The fixed capital stock is also converted to constant price based on the GDP price index by using the constant price of the year 2005. Labour input is expressed as total employment (Unit: 10,000 persons), equal to the sum of persons employed in urban units and private enterprises and self-employed individuals at year-end. The energy input is expressed as electricity consumption, equal to annual electricity consumption (Unit: 10,000 kWh).

Tourism specialisation reflects the relative economic position of tourism and highlights the willingness of local governments to use tourism as a key decision-making tool to achieve green growth objectives, often measured by the ratio of tourism revenue to GDP (Croes et al., 2021; Zhao, 2021), compared to per capita or overall tourism revenue, which is the proxy for tourism in the existing literature. Foreign investment is measured as the ratio of total foreign investment to GDP. According to the Petty-Clark law, industrial optimisation involves gradually reducing the proportion of primary industries while increasing the proportion of tertiary sectors; therefore, the industrial structure is measured as the share of tertiary industries' value added to GDP. Population density is calculated as the number of people per square kilometre. Population quality is measured as the ratio of financial expenditure on education to GDP. Finally, economic development is measured as the real GDP per capita by using the constant price of the year 2005.

Data on GDP and GDP per capita were collected from the *China City Statistical Yearbook* or provincial statistical yearbooks. Data on industrial waste water discharged, industrial soot(dust) emission, industrial sulphur dioxide emission, fixed asset investment, total employment, the added value of the tertiary industry, and electricity consumption were derived from *China City Statistical Yearbook*, provincial statistical yearbooks, and city-level statistical yearbooks. Data on tourism revenue were obtained from the city's annual national economic and social development statistical bulletins. Data on foreign investment were obtained from the *China City Statistical Yearbook*, and the missing data were supplemented by collecting the city's annual national economic and social development statistical bulletins, provincial statistical yearbooks, as well as government reports. Data on financial expenditures on

education were obtained from the *China City Statistical Yearbook* and the city's annual national economic and social development statistical bulletins, and individual regions' data were obtained from public reports of local finance departments or estimates made from them.

After the above data collection, there were still some missing data in some years supplemented by the linear interpolation method. Even so, there were some cities with serious missing data for several variables. Therefore, we removed these cities from the study sample. Thus we obtained panel data for 308 prefecture-level administrative regions from 2005 to 2019. Notably, our sample does not include the four provincial-level municipalities, namely Beijing, Tianjin, Shanghai, and Chongqing. We obtained the GTFP of each city from 2005 to 2019 by cumulative multiplication year by year using the GTFP of 2004 as the base period value of 1. The descriptive statistics for the data of all variables are shown in Table 1.

4. Results

4.1. Benchmark regressions

Classical Ordinary Least Squares (OLS) is used to estimate model (1). Table 2 reports the estimations results. Column 1 reports the regression results when only controlling city and time fixed effects. The coefficients of tourism and its quadratic term are positive and negative, respectively, and both are statistically significant. This suggests that tourism will raise regional GTFP and then decrease it, thus supporting *Hypothesis 1*. Columns 2 to 5 introduce POPQ and other control variables successively, whilst the regression results do not change essentially compared with column 1. Therefore, there exists an inverted U-shaped relationship between tourism and GTFP. Taking column 6 as an example, the inflection point of tourism specialisation is 0.0717/(0.0252*2)=1.4226. The economic implication of this result is that tourism specialisation starts to have a negative impact on regional GTFP when it deviates upward from the actual tourism growth by 42.26%, while it has a positive effect on regional GTFP until tourism specialisation approaches 1.4226 times the actual tourism growth from below.

4.2. Robustness test

To verify the reliability of the benchmark regression results, we perform the following robustness tests. First, we change the explanatory variable by replacing the ratio of total tourism revenue to GDP with the ratio of total tourist arrivals to the resident

Table 1. Descriptive statistics for the whole sample.

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
GTFP	1.0815	1.0667	1.5344	0.8148	0.0982	4620
Tourism	0.1601	0.1044	3.0686	0.0007	0.1904	4620
$Tourism^2$	0.0619	0.0109	9.4166	0.0000	0.3028	4620
POPQ	0.0373	0.0289	0.7646	0.0012	0.0334	4620
FOI	0.0162	0.0100	0.2002	0.0000	0.0188	4620
Tertiary	0.3867	0.3785	0.7920	0.0342	0.0950	4620
GDP	30482	23770	198005	2730	22856	4620
POPD	400	271	6729	1	478	4620

Source: Authors own calculations.

Table 2. The effects of tourism on green total factor productivity.

Variable	Dependent variable: Green total factor productivity					
Tourism	0.0771***	0.0774***	0.0779***	0.0766***	0.0744***	0.0717***
	(0.0150)	(0.0150)	(0.0151)	(0.0152)	(0.0152)	(0.0153)
Tourism^2	−0.0292**	−0.0283***	−0.0285**	−0.0279***	−0.0259***	−0.0252***
	(0.0062)	(0.0063)	(0.0063)	(0.0063)	(0.0063)	(0.0064)
POPQ		−0.086*	−0.0859*	−0.0875*	−0.0662	−0.0661
		(0.0484)	(0.0484)	(0.0484)	(0.0493)	(0.0493)
FOI			−0.0210***	−0.0166	−0.0300**	−0.0421
			(0.0670)	(0.0671)	(0.0673)	(0.0679)
Industrial structure				−0.0334***	0.0515**	0.0500**
				(0.0212)	(0.0227)	(0.0227)
lnGDP per capita					0.0121**	0.0103*
					(0.0054)	(0.0055)
lnPOPD						−0.0198
						(0.0141)
Constant	1.0709***	1.0741***	1.0743***	1.0615***	0.9320***	1.0576***
	(0.0022)	(0.0028)	(0.0029)	(0.0086)	(0.0587)	(0.1073)
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4620	4620	4620	4620	4620	4620
R-squared	0.7457	0.7459	0.7459	0.7460	0.7463	0.7464

Robust standard errors are in brackets. *, **, *** respectively indicate the 10%, 5%, and 1% significance level.
Source: Authors own calculations.

Table 3. The effects of tourism on green total factor productivity: Alternative independent variable.

Variable	Dependent variable: Green total factor productivity					
Tourism	0.0003***	0.0004***	0.0003***	0.0003***	0.0003***	0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Tourism^2	−4.68E-06***	−4.55E-06***	−4.51E-06**	−4.35E-06***	−3.87E-06**	−4.00E-06***
	(1.47E-06)	(1.47E-06)	(1.48E-06)	(1.38E-06)	(1.38E-06)	(1.38E-06)
POPQ		−0.0824*	−0.0827*	−0.0844*	−0.0585	−0.0594
		(0.0477)	(0.0478)	(0.0478)	(0.0489)	(0.0489)
FOI			0.0114	0.0157	0.0021**	−0.0177
			(0.0671)	(0.0671)	(0.0673)	(0.0680)
Industrial structure				0.0388*	0.0578**	0.0553**
				(0.0213)	(0.0227)	(0.0227)
lnGDP per capita					0.0129**	0.0104*
					(0.0054)	(0.0055)
lnPOPD						−0.0286**
						(0.0141)
Constant	1.0796***	1.0828***	1.0826***	1.0676***	0.9290***	1.1108***
	(0.0019)	(0.0026)	(0.0027)	(0.0087)	(0.0583)	(0.1066)
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4620	4620	4620	4620	4620	4620
R-squared	0.7443	0.7445	0.7446	0.7448	0.7451	0.7454

Robust standard errors are in brackets. *, **, *** respectively indicate the 10%, 5%, and 1% significance level.
Source: Authors own calculations.

population to indicate tourism specialisation (De Vita & Kyaw, 2017). Table 3 reports the regression results for replacing the explanatory variable. Although there is a significant change in the magnitude of the regression coefficients (mainly due to the different magnitudes of the explanatory variables), there is no essential change in the direction of influence. Here, the tourism and its quadratic term coefficients are still significantly positive and negative, respectively. Hence, although the explanatory variable tourism revenue/GDP is replaced with tourist arrivals/population, there is still a significant inverted U-shaped association between tourism and GTFP.

Second, we examine the sensitivity of the relationship between tourism and GTFP to the sample. For this purpose, we set different samples to re-estimate the model (1), and the results are shown in Table 4. The new samples cover 2005–2018 and 2006–2019, respectively. When the 2005 or 2019 data are removed, the coefficients of tourism and its quadratic term remain significantly positive and negative, with only a slight change in their magnitude relative to the whole sample. Accordingly, the inverted U-shaped relationship between tourism and GTFP still exists. Furthermore, Table 4 indicates that the change in the sample does not essentially change the nonlinear association between tourism and GTFP.

Finally, we use the instrumental variables approach to address the possible endogeneity of the explanatory variable. In general, the endogeneity of the explanatory variable arises from two aspects. One is the possible omitted variables in the model because it is impossible to control all the factors potentially affecting GTFP. The other is a potential reverse causality, i.e., GTFP may conversely affect tourism. For this reason, we seek suitable instrumental variables for tourism specialisation. Following the principle that the instrumental variables should be correlated with the explanatory variables but not with the residuals, we use provincial tourism and its squared term as the instrumental variables for the city's tourism and its squared term. Generally speaking, local tourism and its related policies are influenced by the development of tourism at the higher level (e.g., the provincial level), while provincial tourism does not have a direct impact on the city's GTFP. Also, we choose the mean of tourism in other cities in the province and its squared term as the instrumental variable for tourism in that city and its squared term. Because there is often horizontal competition among local governments, when the level of tourism development in other cities in the province increases, the local government also tends to develop higher tourism. Moreover, no direct relationship exists between tourism in other cities in the province and the GTFP of the city.

Table 4. The effects of tourism on green total factor productivity: Alternative samples.

	Dependent variable: Green total factor productivity			
Variable	2005–2018		2006–2019	
Tourism	0.0755***	0.0705***	0.0795***	0.0749**
	(0.0170)	(0.0172)	(0.0153)	(0.0155)
Tourism^2	−0.0301***	−0.0257***	−0.0305***	−0.0268***
	(0.0066)	(0.0068)	(0.0063)	(0.0064)
POPQ		0.0533		−0.0781***
		(0.0490)		(0.0500)
FOI		−0.0272		−0.0552
		(0.0676)		(0.0723)
Industrial structure		0.0732***		0.0391*
		(0.0242)		(.0235)
ln(GDP per capita)		0.0130**		0.0085
		(0.0061)		(0.0056)
lnPOPD		−0.0089		−0.0265*
		(0.0146)		(0.0150)
Constant	1.0668***	0.9593***	1.0754***	1.1218***
	(0.0023)	(0.1162)	(0.0023)	(0.1112)
City fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	4620	4620	4620	4620
R-squared	0.7441	0.7450	0.7660	0.7667

Robust standard errors are in brackets. *, **, *** respectively indicate the 10%, 5%, and 1% significance level.
Source: Authors own calculations.

Table 5. Endogeneity test.

	Dependent variable					
Variable	GTFP (Second stage)	Tourism (First stage)	Tourism^2 (First stage)	GTFP (Second stage)	Tourism (First stage)	Tourism^2 (First stage)
Tourism	1.0102***			0.7531***		
	(0.1327)			(0.0935)		
Tourism^2	−0.7389***			−0.5604***		
	(0.1016)			(0.0753)		
IV: Provincial tourism		1.0006***	0.3039**			
		(0.0814)	(0.1163)			
IV: Provincial tourism^2		0.3068***	1.8247***			
		(0.1152)	(0.3061)			
IV: Other cities' tourism					0.6404***	0.0691***
					(0.0642)	(0.0071)
IV: Other cities' tourism^2					0.1781**	1.1496***
					(0.0701)	(0.1824)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.1309***	2.4454***	5.1009***	1.9103***	2.4744***	5.2252***
	(0.0651)	(0.1824)	(0.4847)	(0.2456)	(0.1893)	(0.4928)
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4620	4620	4620	4620	4620	4620
R-squared	0.2577	0.8069	0.4608	0.1639	0.7943	0.4490

Robust standard errors are in brackets. *, **, *** respectively indicate the 10%, 5%, and 1% significance level.
Source: Authors own calculations.

We employ the Two-Stage Least Squares for the instrumental variable test, and the results are shown in Table 5. Columns 2 and 3 indicate the effect of provincial tourism specialisation and its squared term on the city's tourism specialisation and its squared term. The results show the positive effect of the former on the latter, which validates the above theoretical analysis. Columns 5 and 6 also indicate that tourism in the city is positively influenced by the tourism in other cities in the province. Therefore, our choice of instrumental variables is reasonable. Furthermore, column 1 shows that when provincial tourism and its squared term are chosen as the instrumental variables, there is also an inverted U-shaped relationship between tourism and GTFP. Such an inverted U-shaped relationship also exists when the mean of tourism in other cities in the province and its squared term are chosen as the instrumental variables (see column 4).

4.3. Further analysis

4.3.1. Influence mechanism analysis

We continue to explore the previous hypothetical paths by which tourism affects regional GTFP: the technological innovation effect, the industrial structure optimisation effect, and the environmental enhancement effect. We respectively introduce technological innovation and carbon intensity as control variables in model (1), where technological innovation is measured as the number of patents granted, and carbon intensity is expressed as the carbon emissions per 10,000 Yuan of GDP. Data on the number of patents granted were collected from *China City Statistical Yearbook* and the city's annual national economic and social development statistical bulletins. Data on carbon emissions were derived from Chen et al. (2020). Since the carbon emission data provided by Chen et al. (2020) are only available up to 2017, our sample data

Table 6. Influence mechanism of the nexus of tourism and green total factor productivity.

	Dependent variable					
Variable	GTFP	TEC	GTFP	IND	GTFP	CAR
Tourism	0.0738***	15.8638***	0.0717***	2.58E-14***	0.0758***	−0.3688***
	(0.0155)	(1.5632)	(0.0153)	(2.37E-15)	(0.0204)	(0.1074)
$Tourism^2$	−0.0258**	−4.3673***	−0.0252***	−6.86E-15***	−0.0267***	0.4481***
	(0.0064)	(0.6534)	(0.0064)	(7.92E-16)	(0.0087)	(0.0882)
Technological innovation	0.0001***					
	(0.0000)					
Industrial structure			0.0500**			
			(0.0227)			
Carbon intensity					−0.0005***	
					(0.0002)	
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.0717***	−108.0213***	1.0576***	9.96E-13***	0.9440***	40.0556***
	(0.1085)	(10.9367)	(0.1073)	(1.66E-14)	(0.1389)	(1.2463)
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4620	4620	4620	4620	4004	4004
R-squared	0.7465	0.7592	0.7464	1.0000	0.7446	0.9469

Robust standard errors are in brackets. *, **, *** respectively indicate the 10%, 5%, and 1% significance level.
Source: Authors own calculations.

only between 2005 and 2017 are used to examine the environmental enhancement effect. The test results for *Hypotheses 2* to *4* are shown in Table 6.

Column 1 shows that the coefficient of technological innovation is significantly positive, so technological innovation effectively increases GTFP. Meanwhile, tourism is significantly positive, and its squared term is significantly negative, while the inflection point of tourism specialisation is 1.4302. In other words, tourism contributes to GTFP when the ratio of tourism revenue to GDP does not exceed 1.4302 times the actual tourism specialisation; otherwise, tourism reduces GTFP., When considering technological innovation, the inflection point of tourism specialisation shifts to the right somewhat, relative to the baseline inflection point of 1.4226. We further examine whether regional innovation capacity is affected by tourism, and the results are shown in column 2 in Table 6.

The results show that the coefficients of tourism and its squared term are significantly positive and negative, respectively. That is, there is also an inverted U-shaped relationship between tourism and technological innovation, thus confirming *Hypothesis 2*. Consequently, the impact of tourism on technological innovation constitutes a channel through which tourism ultimately influences GTFP. As mentioned earlier, the increase in tourism contributes to the concentration of regional talent and investment as well as the technology exchange, thus contributing to improving the regional technological innovation and hence the GTFP. However, when tourism specialisation is too high, various resources flow to the tourism industry with relatively weak technical barriers, which in turn reduces regional attractiveness to talent, capital, and technology, thus reducing innovation performance and ultimately negatively affecting GTFP.

Column 3 in Table 6 replicates the results of column 6 in Table 2 and shows that tertiary sector development can significantly increase GTFP. We further examine whether tourism affects the tertiary industry, and the results are shown in column 4 in Table 6. We found that there is also an inverted U-shaped relationship between tourism and the tertiary industry, thereby substantiating *Hypothesis 3*. Thus, the nexus of tourism and industrial structure constitutes another influence mechanism by which tourism affects GTFP.

We have previously explained that the increase in tourism specialisation helps promote the development of tourism-related services and attract more employment to these industries, thus optimising the industrial structure and ultimately increasing GTFP. However, when tourism specialisation is too high, resources are overly concentrated in tourism and its related industries, leading to an increasingly distorted industrial structure, making the whole economy less productive, which eventually negatively impacts GTFP.

Column 5 indicates that the coefficient of carbon intensity is significantly negative, suggesting that the increase in carbon intensity reduces GTFP. At the same time, tourism and its squared term are significantly positive and negative, respectively, and the inflection point of tourism specialisation is 1.4195. Therefore, when considering the carbon intensity, the inflection point of tourism specialisation will shift to the left to some extent, relative to the baseline case. We also analyse the effects of tourism on carbon intensity. Column 6 shows that the coefficients of tourism and its quadratic term are significantly negative and positive. That is, there exists a U-shaped relationship between tourism and carbon intensity. Therefore, our results support *Hypothesis 4*. The impact of tourism on carbon intensity also constitutes an intermediate channel by which tourism ultimately influences GTFP. As widely recognised relatively low-carbon sectors, the enhancement of tourism and its related services can effectively reduce the regional carbon intensity, thus improving the regional environmental quality and GTFP. However, as the tourism economy continues to grow, the energy consumption of the tourism industry is increasing, but its contribution to economic development is gradually bottlenecked, which in turn increases the carbon intensity, thus reducing the GTFP.

4.3.2. Regional heterogeneity analysis

Up to now, we have confirmed an inverted U-shaped relationship between tourism and GTFP. We further investigate whether this association differs across different regions. We customarily divide the overall Chinese sample into four subsamples: eastern, central, western, and northeastern. Table 7 reports the results of the regional heterogeneity analysis. Column 1 shows that the coefficients of tourism and its squared term are both significantly positive in eastern China, implying that tourism significantly increases GTFP. This result differs considerably from the inverted U-shaped relationship for the whole sample. Column 2 indicates that in middle China, the coefficients of tourism and its squared term are significantly negative and positive, respectively, suggesting the U-shaped relationship between tourism and GTFP. This finding is also inconsistent with the results for the national sample. Column 3 shows that in western China, there is an inverted U-shaped relationship between tourism and GTFP, which is similar to the conclusion for the whole sample. The difference is that the inflection point of tourism specialisation has shifted to the left compared to the national sample (1.3091 versus 1.4226). In the Northeast, tourism and GTFP are linked in a similar way compared to the Middle.

The results demonstrate the positive linear impact of tourism on GTFP in eastern China which is relatively socio-economically developed with outstanding advantages over the other regions in terms of economic development level, technology level, and ability to attract foreign investment. These benefits are more conducive to exerting the positive role of tourism in talent pooling, innovation, and industrial structure optimisation, thus contributing to green development. In addition, the advantages can effectively offset the positive

Table 7. Heterogeneity of the effects of tourism on green total factor productivity.

Variable	Dependent variable: Green total factor productivity			
	East	Middle	West	Northeast
Tourism	0.0464***	−0.0317***	0.0665**	−0.2547**
	(0.0081)	(0.0057)	(0.0233)	(0.1035)
Tourism^2	0.0107**	0.1080***	−0.0254***	0.3136***
	(0.0050)	(0.0372)	(0.0085)	(0.1197)
POPQ	−0.8633*	−0.8992**	−0.0379	0.7703
	(0.4787)	(0.3628)	(0.0523)	(0.4816)
FOI	−0.3058**	0.5023***	0.0104	−0.0719
	(0.1341)	(0.1526)	(0.1800)	(0.1362)
Industrial structure	0.0657	0.2025***	0.0229	−0.1008
	(0.0469)	(0.0589)	(0.0367)	(0.0650)
ln(GDP per capita)	−0.0363**	−0.0032	0.0184**	0.0039
	(0.0158)	(0.0178)	(0.0089)	(0.0200)
lnPOPD	0.0241	−0.0384	−0.0699***	−0.0488
	(0.0402)	(0.0255)	(0.0245)	(0.0915)
Constant	1.3018***	1.2817***	1.2001***	1.3223**
	(0.3749)	(0.2992)	(0.1642)	(0.5402)
City fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Observations	1230	1215	1680	495
R-squared	0.7471	0.7581	0.7570	0.7392

Robust standard errors are in brackets. *, **, *** respectively indicate the 10%, 5%, and 1% significance level.
Source: Authors own calculations.

or negative impact of tourism on the three influence mechanisms, thereby maintaining the positive effect of tourism on GTFP. In general, China's central and northeastern regions have relatively similar socioeconomic development levels and are therefore sometimes classified as one region, such as Zhang and Zhang (2022) and Zhang (2023). Thus our results show similar linkages between tourism and GTFP in these two regions. In these regions, as tourism specialisation increases, its role in technological innovation, industrial structure optimisation, and environmental enhancement gradually emerges and then begins to affect GTEP positively. The curve for the western region is similar to that of the whole country. Tourism initially also contributes to technological innovation, industrial structure optimisation, and environmental enhancement. However, the negative impact of tourism on GTFP in Western China is presented earlier than the whole sample.

5. Conclusions and discussion

This paper theoretically links tourism and regional green total factor productivity, for which we propose four theoretical hypotheses and test them to address the two basic questions posed in the paper. We theorised that the impact of tourism may not be linear but rather that a decline follows an increase. We tested this theoretical hypothesis based on panel data for 308 prefecture-level cities in China from 2005 to 2019. Consistent with theoretical expectations, the results demonstrate an inverted U-shaped relationship between tourism (measured as the ratio of tourism revenue to GDP) and GTFP. We confirmed the reliability of this linkage through various rigorous robustness tests. This addresses the first theoretical question. Our findings also suggest that tourism affects GTFP through the technological innovation effect, the industrial structure optimisation effect, and the environmental enhancement effect, which reveals the mechanism of the effect of tourism on green total factor productivity and provides a theoretical basis for

promoting green growth through tourism development. Besides, the nexus of tourism and GTFP varies significantly across China's regions. The inverted U-shaped relationship exists only in western China, while the U-shaped relationship exists in central and northeastern China and a positive relationship exists in eastern China. These results indicate that economically developed regions with higher-level economic development, technology and ability to attract foreign investment are more conducive to the positive effects of tourism on green development. Therefore, the second theoretical question is addressed.

The research design and findings of the article contribute to the existing literature and suggest the following theoretical implications. Firstly, for the first time, the article examines the impact of tourism economic activities on regional green development performance. GTFP is a good indicator of regional green development performance. Although tourism is difficult to be included as a production factor in general economic growth models, the article confirms the objective role of tourism activities for sustainable regional growth (e.g., green growth). We found the nonlinear effect of tourism on regional green development performance. In the moderate interval, tourism specialisation can increase GTFP, but after exceeding a certain threshold, it has a suppressive effect on GTFP. Therefore, tourism growth is not always green, and dependence on tourism must be kept within a reasonable range. We also encourage more researchers to explore the nonlinear role of tourism on GTFP, thus providing more substantial evidence on the link between the two.

Secondly, the mechanism of tourism's impact on GTFP needs to be widely discussed. We validate several potential channels through which tourism affects GTFP. Tourism growth is conducive to the regional concentration of talent, investment, and technology exchange, as well as the development of the tertiary industries, thus enhancing innovation capacity and optimising industrial structure, but such effects are also nonlinear. Excessive tourism growth can in turn reduce innovation dynamics and capacity. Meanwhile, the overconcentration of resources in tourism and related industries will lead to an increasingly distorted industrial structure, and the crude growth of the relatively low-end tourism service industry will cause a decrease in productivity and the increase in environmental pressure. Accordingly, the tourism-only development concept is not always conducive to the sustainable development of the economy and the environment, and a better coordination between tourism and other industries is needed. Furthermore, in addition to the innovation, structural optimisation, and environmental effects, given the comprehensive nature of tourism and the wide range of its impacts (e.g., the relationship between tourism and the 17 Sustainable Development Goals), more impact mechanisms could be further explored.

Thirdly, our study deepens the understanding of the link between tourism and green development in a developing country with significant internal differences like China. We compared the nexus of tourism with GTFP in the more socio-economically developed eastern region, the less developed western region, and the moderately developed central and northeastern regions. Extensive research has confirmed that tourism impacts are related to the socio-economic characteristics of the destinations (e.g., Zhang & Zhang, 2022; Ehigiamusoe, 2020). We also demonstrate the regional heterogeneity of the impact of tourism on GTFP. In socio-economically developed regions, we only found a linear positive effect of tourism on GTFP, suggesting that tourism increases regional green development performance almost unrestrictedly in a relatively developed socio-economic system. This result is logical because these regions often have their own traditional

industrial structures and technological endowments, and tourism development is more of an icing on the cake than a significant driver for the overall regional socio-economic system. However, the inverted U-shaped association between tourism and GTFP still exists in less socio-economically developed regions, and the turning point of tourism specialisation is more to the left than in the overall sample. This suggests that establishing a less tourism-dependent economic system is even more important in these regions.

Finally, an important concern is a precipitous decline in tourism during the COVID-19 pandemic. Although our sample pre-dates the COVID-19 pandemic, our findings suggest that a significant reduction in regional green development performance is implied in COVID-19. During the pandemic or post-pandemic period, in the face of greater economic recovery and growth pressures, it is highly likely that tourism will not be expected for some time due to travel restrictions, but rather that some carbon-intensive manufacturing or other high-emission sectors (even those that were once restricted) will re-emerge. In the foreseeable short term, tourism specialisation will remain at a low level, and its positive impact on GTFP may be significantly reduced, warranting future attention.

Our findings also highlight some key policy implications. At the present stage, the proportion of tourism in the national economy could be continuously increased, so as to give more play to the positive role of tourism in green development, which is particularly important in developed areas. In the central and western areas, there is a need to consider the inflection point of tourism specialisation in promoting green urban development in a context-specific manner. It is recommended to facilitate or delay the inflection point as much as possible through technological innovation, the development of high-end services, and environmental management. In addition, tourism should play a positive role in the flow of talent, capital and technology, and the transfer of innovation factors from developed to less developed regions. At the same time, the quality of tourism should be improved, the traditional model of large-scale growth should be changed, the coordination between tourism and high-end services should be strengthened, the proportion of clean energy in tourism should be increased, and the low-carbon transition of tourism should be promoted. Conclusively, it is proposed to establish an economic and management system that can organically link high-quality tourism, innovation, industrial structure optimisation, and environmental protection.

The article can be enhanced in the following ways. Due to limited data availability, we apply the ratio of tourism revenue to GDP to indicate tourism specialisation. This is also a common current practice, such as Croes et al. (2021) and Zhao (2021); however, strictly speaking, such a comparison is statistically incorrect. In the future, more artificial calculations could be made to obtain data on the value-added of tourism to better capture tourism specialisation in order to assess its impact on GTFP more accurately. Also, other complex theoretical mechanisms may affect the nexus of tourism and GTFP, such as regional development policies and resource endowments. Thus, an integrated analysis of impact mechanisms will yield richer theoretical and practical insights that deserve future attention. Finally, the huge differences in socio-economic development within China mean that a rough division of China into four regions may not be a good way of highlighting regional differences. Therefore, future enhancements could focus on forming more divisions based on strict criteria to enrich the understanding of the regional heterogeneity of tourism's association with GTFP.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Improvement Project of Young and Middle-aged Teachers' Research Ability in Guangxi's Colleges under Grant 2020KY22018; the National Natural Science Foundation of China under Grant 71764027.

Notes

1. https://data.stats.gov.cn/easyquery.htm?cn=C01.
2. https://www.mct.gov.cn/whzx/whyw/202003/t20200310_851786.htm

ORCID

Jiekuan Zhang http://orcid.org/0000-0002-0598-0584

References

Ai, H., Hu, S., Li, K., & Shao, S. (2020). Environmental regulation, total factor productivity, and enterprise duration: Evidence from China. *Business Strategy and the Environment*, *29*(6), 2284–2296. https://doi.org/10.1002/bse.2502

Aldebert, B., Dang, R. J., & Longhi, C. (2011). Innovation in the tourism industry: The case of Tourism@. *Tourism Management*, *32*(5), 1204–1213. https://doi.org/10.1016/j.tourman.2010.08.010

Antonakakis, N., Dragouni, M., & Filis, G. (2015). How strong is the linkage between tourism and economic growth in Europe? *Economic Modelling*, *44*, 142–155. https://doi.org/10.1016/j.econmod.2014.10.018

Balli, E., Sigeze, C., Manga, M., Birdir, S., & Birdir, K. (2019). The relationship between tourism, CO_2 emissions and economic growth: A case of Mediterranean countries. *Asia Pacific Journal of Tourism Research*, *24*(3), 219–232. https://doi.org/10.1080/10941665.2018.1557717

Bella, G. (2018). Estimating the tourism induced environmental Kuznets curve in France. *Journal of Sustainable Tourism*, *26*(12), 2043–2052. https://doi.org/10.1080/09669582.2018.1529768

Chen, J., Gao, M., Cheng, S., Hou, W., Song, M., Liu, X., et al. (2020). County-level CO_2 emissions in China. *Scientific Data*, *7*, 391. https://doi.org/10.6084/m9.figshare.12887213.v3

Chiu, Y. B., & Yeh, L. T. (2017). The threshold effects of the tourism-led growth hypothesis: Evidence from a cross-sectional model. *Journal of Travel Research*, *56*(5), 625–637. https://doi.org/10.1177/0047287516650938

Cordero, R. R., Roth, P., & Da Silva, L. (2005). Economic growth or environmental protection? The false dilemma of the Latin-American countries. *Environmental Science & Policy*, *8*(4), 392–398. https://doi.org/10.1016/j.envsci.2005.04.005

Croes, R., Ridderstaat, J., Bąk, M., & Zientara, P. (2021). Tourism specialization, economic growth, human development and transition economies: The case of Poland. *Tourism Management*, *82*, 104181. https://doi.org/10.1016/j.tourman.2020.104181

De Vita, G., & Kyaw, K. S. (2017). Tourism specialization, absorptive capacity, and economic growth. *Journal of Travel Research*, *56*(4), 423–435. https://doi.org/10.1177/0047287516650042

Ehigiamusoe, K. U. (2020). Tourism, growth and environment: Analysis of non-linear and moderating effects. *Journal of Sustainable Tourism*, *28*(8), 1174–1192. https://doi.org/10.1080/09669582.2020.1729164

Faber, B., & Gaubert, C. (2019). Tourism and economic development: Evidence from Mexico's coastline. *American Economic Review*, *109*(6), 2245–2293. https://doi.org/10.1257/aer.20161434

Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *The Quarterly Journal of Economics*, *110*(2), 353–377. https://doi.org/10.2307/2118443

Inchausti-Sintes, F. (2015). Tourism: Economic growth, employment and Dutch disease. *Annals of Tourism Research*, *54*, 172–189. https://doi.org/10.1016/j.annals.2015.07.007

Jacobs, B., & Nahuis, R. (2002). A general purpose technology explains the Solow paradox and wage inequality. *Economics Letters*, *74*(2), 243–250. https://doi.org/10.1016/S0165-1765(01)00551-1

Lee, C. C., & Lee, C. C. (2022). How does green finance affect green total factor productivity? Evidence from China. *Energy Economics*, *107*, 105863. https://doi.org/10.1016/j.eneco.2022.105863

Lee, J. W., & Brahmasrene, T. (2013). Investigating the influence of tourism on economic growth and carbon emissions: Evidence from panel analysis of the European Union. *Tourism Management*, *38*, 69–76. https://doi.org/10.1016/j.tourman.2013.02.016

Li, K. X., Jin, M., & Shi, W. (2018). Tourism as an important impetus to promoting economic growth: A critical review. *Tourism Management Perspectives*, *26*, 135–142. https://doi.org/10.1016/j.tmp.2017.10.002

Li, K., & Lin, B. (2017). Economic growth model, structural transformation, and green productivity in China. *Applied Energy*, *187*, 489–500. https://doi.org/10.1016/j.apenergy.2016.11.075

Li, Y., & Chen, Y. (2021). Development of an SBM-ML model for the measurement of green total factor productivity: The case of Pearl River Delta urban agglomeration. *Renewable and Sustainable Energy Reviews*, *145*, 111131. https://doi.org/10.1016/j.rser.2021.111131

Liu, Y., & Dong, F. (2021). How technological innovation impacts urban green economy efficiency in emerging economies: A case study of 278 Chinese cities. *Resources, Conservation and Recycling*, *169*, 105534. https://doi.org/10.1016/j.resconrec.2021.105534

Lv, Z., & Xu, T. (2021). Tourism and environmental performance: New evidence using a threshold regression analysis. *Tourism Economics*, *29*(1), 194–209. https://doi.org/10.1177/13548166211042450

Nunkoo, R., Seetanah, B., Jaffur, Z. R. K., Moraghen, P. G. W., & Sannassee, R. V. (2020). Tourism and economic growth: A meta-regression analysis. *Journal of Travel Research*, *59*(3), 404–423. https://doi.org/10.1177/0047287519844833

Oh, D. H., & Heshmati, A. (2010). A sequential Malmquist–Luenberger productivity index: Environmentally sensitive productivity growth considering the progressive nature of technology. *Energy Economics*, *32*(6), 1345–1355. https://doi.org/10.1016/j.eneco.2010.09.003

Ong, C. E., & Liu, Y. (2022). State-directed tourism urbanisation in China's Hengqin. *Annals of Tourism Research*, *94*, 103379. https://doi.org/10.1016/j.annals.2022.103379

Peng, Y. T., Saboori, B., Ranjbar, O., & Can, M. (2022). The effects of tourism market diversification on CO_2 emissions: Evidence from Australia. *Current Issues in Tourism*, *26*(4), 518–525. https://doi.org/10.1080/13683500.2022.2071683

Richards, G. (2020). Designing creative places: The role of creative tourism. *Annals of Tourism Research*, *85*, 102922. https://doi.org/10.1016/j.annals.2020.102922

Ruhanen, L., Saito, N., & Axelsen, M. (2021). Knowledge co-creation: The role of tourism consultants. *Annals of Tourism Research*, *87*, 103148. https://doi.org/10.1016/j.annals.2021.103148

Song, M., Du, J., & Tan, K. H. (2018). Impact of fiscal decentralization on green total factor productivity. *International Journal of Production Economics*, *205*, 359–367. https://doi.org/10.1016/j.ijpe.2018.09.019

Sun, J., Tang, D., Kong, H., & Boamah, V. (2022). Impact of industrial structure upgrading on green total factor productivity in the Yangtze River economic belt. *International Journal of Environmental Research and Public Health*, *19*(6), 3718. https://doi.org/10.3390/ijerph19063718

Sun, Y. Y., Cadarso, M. A., & Driml, S. (2020). Tourism carbon footprint inventories: A review of the environmentally extended input-output approach. *Annals of Tourism Research*, *82*, 102928. https://doi.org/10.1016/j.annals.2020.102928

Tang, C. F. (2021). The threshold effects of educational tourism on economic growth. *Current Issues in Tourism*, *24*(1), 33–48. https://doi.org/10.1080/13683500.2019.1694869

Tang, C., Han, Y., & Ng, P. (2022). Green consumption intention and behavior of tourists in urban and rural destinations. *Journal of Environmental Planning and Management*, 1–25. https://doi.org/10.1080/09640568.2022.2061927

Tang, C., Zha, J., Zhang, J., Tao, Y., Wang, L., Wang, L., et al. (2021). The goal of China's tourism industry carbon peak and neutrality (dual-carbon) in the context of high-quality development: Evaluation and prediction, major challenges, and approach. *Journal of Chinese Ecotourism*, *11*(4), 471–497 (in Chinese).

Tian, X. L., Bélaïd, F., & Ahmad, N. (2021). Exploring the nexus between tourism development and environmental quality: Role of renewable energy consumption and income. *Structural Change and Economic Dynamics*, *56*, 53–63. https://doi.org/10.1016/j.strueco.2020.10.003

Van Beveren, I. (2012). Total factor productivity estimation: A practical review. *Journal of Economic Surveys*, *26*(1), 98–128. https://doi.org/10.1111/j.1467-6419.2010.00631.x

Wang, H., Cui, H., & Zhao, Q. (2021). Effect of green technology innovation on green total factor productivity in China: Evidence from spatial Durbin model analysis. *Journal of Cleaner Production*, *288*, 125624. https://doi.org/10.1016/j.jclepro.2020.125624

Wang, Y., Han, L., & Ma, X. (2022). International tourism and economic vulnerability. *Annals of Tourism Research*, *94*, 103388. https://doi.org/10.1016/j.annals.2022.103388

Weidenfeld, A. (2013). Tourism and cross border regional innovation systems. *Annals of Tourism Research*, *42*, 191–213. https://doi.org/10.1016/j.annals.2013.01.003

Wu, H., Ren, S., Yan, G., & Hao, Y. (2020). Does China's outward direct investment improve green total factor productivity in the "Belt and Road" countries? Evidence from dynamic threshold panel model analysis. *Journal of Environmental Management*, *275*, 111295. https://doi.org/10.1016/j.jenvman.2020.111295

Xia, F., & Xu, J. (2020). Green total factor productivity: A re-examination of quality of growth for provinces in China. *China Economic Review*, *62*, 101454. https://doi.org/10.1016/j.chieco.2020.101454

Xie, F., Zhang, B., & Wang, N. (2021). Non-linear relationship between energy consumption transition and green total factor productivity: A perspective on different technology paths. *Sustainable Production and Consumption*, *28*, 91–104. https://doi.org/10.1016/j.spc.2021.03.036

Yıldırım, S., Yıldırım, D. Ç., Aydın, K., & Erdoğan, F. (2021). Regime-dependent effect of tourism on carbon emissions in the Mediterranean countries. *Environmental Science and Pollution Research*, *28*(39), 54766–54780. https://doi.org/10.1007/s11356-021-14391-7

Zhang, J. (2023). The nonlinear effects of tourism on rural income inequality and urban–rural income inequality: Evidence from China. *Tourism Economics*, *29*(1), 172–193. https://doi.org/10.1177/13548166211041802

Zhang, J., & Zhang, Y. (2021). Tourism, economic growth, energy consumption, and CO_2 emissions in China. *Tourism Economics*, *27*(5), 1060–1080. https://doi.org/10.1177/1354816620918458

Zhang, J., & Zhang, Y. (2022). Does tourism contribute to the nighttime economy? Evidence from China. *Current Issues in Tourism*, 1–16. https://doi.org/10.1080/13683500.2022.2053073

Zhang, J., Lu, G., Skitmore, M., & Ballesteros-Pérez, P. (2021). A critical review of the current research mainstreams and the influencing factors of green total factor productivity. *Environmental Science and Pollution Research*, *28*(27), 35392–35405. https://doi.org/10.1007/s11356-021-14467-4

Zhao, L. (2021). Tourism, institutions, and poverty alleviation: Empirical evidence from China. *Journal of Travel Research*, *60*(7), 1543–1565. https://doi.org/10.1177/0047287520947792

Zhou, X., Zhang, J., & Li, J. (2013). Industrial structural transformation and carbon dioxide emissions in China. *Energy Policy*, *57*, 43–51. https://doi.org/10.1016/j.enpol.2012.07.017

Zuo, B., & Huang, S. (2018). Revisiting the tourism-led economic growth hypothesis: The case of China. *Journal of Travel Research*, *57*(2), 151–163. https://doi.org/10.1177/0047287516686725