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Energy insecurity and tourism sustainability in China: Challenges and policy responses

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ABSTRACT

Tourism has become an essential industry due to its significant contribution to the growth of the destination economies. Energy is considered, inter alia, a major promoter of tourism, whereas energy insecurity (EIS) is believed to be a severe threat to sustainable tourism. This paper employs the fully modified ordinary least squares (FMOLS), the dynamic ordinary least squares (DOLS), and the Canonical cointegration regression techniques to examine the impact of economic growth (EG) and EIS on tourism in China for the period 2001 to 2017. The result demonstrates that economic growth is a significant promoter of tourism in the long run, as it supports the growth-led tourism hypothesis for China. The paper also finds that energy insecurity is a serious threat to sustainable tourism, as revealed by the significant negative relationship between EIS and tourism in the long run. Therefore, by reducing EIS, China can achieve sustainable tourism. The findings are robust to various estimation methods, including fully modified ordinary least squares, DOLS, and Canonical cointegration regression. Further, Juodis, Karavias, and Sarafidis's Granger non-causality test shows that a unidirectional causal relationship exists between EG, EIS, and tourism. By developing strategies that can boost EG and reduce EIS, policymakers will ensure foreign currency earnings and also promote sustainable tourism.

Contribution/Originality: This paper is the first, to the best of our knowledge, to explore the impact of EG and EIS on tourism in China by employing a comprehensive measure of EIS as aggregate energy supply minus aggregate energy demand. We converted all sources of energy supply & demand into British thermal units.

1. INTRODUCTION

As the economy of China adjusts to its new normal, some industries are booming while others are slowing down, but the tourism industry is flourishing (Xu, 2022). China's tourism sector has undergone significant changes since the initiation of reforms to expose its economy in 1978 and is now the world's third most visited country (Campa, López-Lambas, & Guirao, 2016; Sofield & Li, 2011). As per "The 2017 Travel & Tourism Competitiveness Report" of the World Economic Forum (2017), China's tourism sector improved from 71st to 13th in worldwide tourism competitiveness during 2007-2019 (Zhao & Liu, 2020), making China an essential player in the global tourism landscape. After establishing the biggest domestic tourism market, it has become the top source of international

visitors at world level (Costa, 2020). Additionally, inbound tourism continues to be at the forefront of the world (Li, Chen, Huang, Wanichwasin, & Cui, 2021).

The World Travel & Tourism Council (WTTC) has reported that before the pandemic struck in 2019, China's tourism and travel sector contributed 11.5 trillion CNY to GDP (or 11.6% of the country's economy). However, in 2020, as a result of the pandemic's negative effects on this sector, the tourism sector's contribution to China's economy decreased by 59.9% to 4.6 trillion CNY (Škare, Soriano, & Porada-Rochoń, 2021; World Travel & Tourism Council, 2021). According to the WTTC, if China, with more than 87% of its residents already fully immunized, begins relaxing restrictions year-round, the tourism sector's contribution to GDP of the economy during 2022 could reach 11 trillion CNY, only 5.2% below pre-pandemic levels (Aronica, Pizzuto, & Sciortino, 2022; World Travel & Tourism Council, 2022).

Energy is considered, inter alia, a major promoter of tourism, whereas EIS constitutes a real threat to sustainable tourism. Moreover, sustainable tourism requires a thorough examination of the role of EIS in the tourism industry. The global tourism business requires a significant amount of energy to provide goods and services and improve visitor experiences. Moreover, providing visitors with transportation and other services at their destinations also requires energy (Becken, Simmons, & Frampton, 2003; Bode, Hapke, & Zisler, 2003; Gössling, Hansson, Hörstmeier, & Saggel, 2002). EIS constitutes the greatest hurdle to tourism development. However, there is a lack of literature on the tourism-energy insecurity nexus, so this research aims to fill this gap by investigating the effects of EIS on the tourism industry in China. Alola, Eluwole, Alola, Lasisi, and Avci (2020) used energy imports to manage energy security in the economies of 9 Coastline Mediterranean countries (CMCs) for the 1995 to 2013 period. The influence of electricity consumption (as a measure for energy security) on tourists in NIS city during 2011-2016 (Dimitrijević & Petrović, 2019). The effect of increasing oil prices on energy security on Scottish tourism (Yeoman et al., 2007). Huang et al. (2021) anticipated that, from the tourism perspective, oil consumption will handle the energy security problem in China. This highlights the need to focus research on the energy insecurity-tourism nexus as the current issue of EIS increases tourism's vulnerability (UNGA, 2022).

This paper contributes to prevailing research in the following ways: First, we inspect the EG and EIS impact on tourism in China using data from 2001 to 2017. One of the objectives of the national tourism policy in China is to increase the number of tourist arrivals through the development of the tourism sector (Liu, Dou, Li, & Cai, 2020; Zhao & Liu, 2020). The studies of Li et al. (2021); Luo, Moyle, Moyle, Zhong, and Shi (2020); Ma, Liu, and Xi (2022); Xiong and Sun (2023); Zha, Dai, Ma, Chen, and Wang (2021) and Zhang and Zhang (2021) examined the nexus between tourism, energy consumption (EC), EG, policy variables and CO2, and Guo and Cai (2023) investigated the impact of renewable and nonrenewable EC, tourism, and transportation on EG for China. However, to the best of our knowledge, at least in the case of China, no existing research has explored the impact of EG and EIS on tourism in China. Second, our study measures EIS using the proxy of aggregate energy supply minus aggregate energy demand. No study has investigated the impact of EIS on tourism in China. This study fills this gap in the energy insecurity-tourism nexus literature in China. The role of EIS is found to be a significant moderator, thus contributing to hindering tourism.

The paper is arranged as follows: the theoretical framework on the association between tourists, EIS, and EG in China is described in Section 2. Data and methodology are presented in Section 3. The empirical results are discussed in Section 4, and the study conclusion is given in Section 5.

2. THEORETICAL FRAMEWORK

The relationship between energy, EG, and tourism is conceptualized through different channels such as energy as a tourism driver, EG as a tourism promoter, and as a source of tourist attraction (Amin & Rahman, 2019; Frantál & Urbánková, 2017).

2.1. Energy as a Source of Tourism Driver

Energy is important in the tourism industry because it provides the fuels and electricity needed for basic infrastructure, travel, catering, cooling, heating, and related services. The availability and cost of energy have a direct impact on the development of tourism (particularly in terms of transportation costs) and other related activities (Lennox, 2012; Selvanathan, Jayasinghe, & Selvanathan, 2021). Tourism, being one of the largest sources of tourist attraction in the global industry, consumes a significant amount of energy and has an impact on the environment by increasing a country's carbon emissions (Becken et al., 2003; Moore, 2010).

Moreover, energy is also a source of attraction for tourists, as some tourists may be attracted to the landscape and facilities associated with energy. It has been argued that tourists' preferences differ greatly from residents' preferences as they enjoy visiting different townscapes and landscapes that are imaginary to them (Britton, 1992). Therefore, objects (articles or things) such as desolate open-pit coal mines and revolving wind turbines, which inhabitants typically find irritating, become fascinating and appealing to tourists. Thus, it can be argued that energy is one of the sources of tourism attractions (Frantál & Urbánková, 2017).

2.2. Economic Growth as a Source of Tourism Promotion

Theoretically, it has been acknowledged that the growth of an economy can affect the tourism industry, which in turn influences EG (Dwyer, Forsyth, & Spurr, 2004). A growing economy promotes the tourism industry by investing in tourism actions such as hoteling, transportation facilities, infrastructure, and tourism destinations (Bano, Alam, Khan, & Liu, 2021). In turn, the tourism industry plays a pivotal role in promoting EG. The rise of tourism inflow can have a positive influence on the economy, especially in job opportunities and an increase in GDP. Tourism is an engine for GDP growth and economic development in emerging economies (Manzoor, Wei, Asif, Haq, & Rehman, 2019).

A thought-provoking question by Rasool, Maqbool, and Tarique (2021) is whether EG leads to tourism development or is it that tourism development leads to EG? In the EG-driven tourism growth hypothesis, government interventions focused on strengthening property rights, political stability in institutions, and investment in human and physical capital will enhance an economy's likelihood of growth (Manzoor et al., 2019). By increasing the availability of resources for tourism infrastructure and sending a message of safety to potential foreign visitors, this expansion will help the tourism sector to expand. The tourism-led growth hypothesis, on the other hand, is based on the assumption that the tourism sector acts as a device of EG (Pérez-Rodríguez, Rachinger, & Santana-Gallego, 2022), resulting in positive externalities and spillovers in the economy (Payne & Mervar, 2010). The study of Pablo-Romero and Molina (2013) outlines a systematic review on the tourism-growth nexus and indicates that there is an inconclusive association between economy-driven tourism growth (Oh, 2005; Tang & Jang, 2009) and tourism-led EG (Durbarry, 2004; Gunduz & Hatemi, 2005). As a result, the lack of consensus regarding this association indicates that the empirical debate is still ongoing.

Existing literature reveals that the majority of prior studies have focused on EC, urbanization, tourism, trade openness, and EG in the context of China, with CO2 emissions as the dependent variable. No previous studies of China have exhaustively investigated the effect of EIS and EG on tourism. This paper intends to address this deficiency by adding new information about the Chinese sample to the existing body of literature. In addition, our study is the first attempt to combine EIS and tourism. The goal of this research is to fill this knowledge gap by developing the following hypotheses about China.

H_1: Increase in EG increases tourism.

H_2: Increase in EIS hinders tourism.

3. DATA AND METHODOLOGY

3.1. Data Description

To examine the relationship of EG, EIS, and tourism in China, we used panel data of China from 2001 to 2017. Concerning variable measurement, tourism (TR) is measured using the number of arrivals of international tourists (in million person-times). Log of GDPPC (in thousand yuan) is used to measure EG, and for EIS, we used the energy supply minus energy demand and converted it into a unified unit of BTU. The variables' descriptions and codes are given in Table 1. The data for the study are taken from CNBS (2010). The study's descriptive statistics are presented in Table 2.

Table 1. Variables Description.

Variables	Definition	Unit
Dependent		
TR	Reception of international tourists	Million person-times
Independents		
EG	Log of GDP-PC	Thousand yuan
EIS	Energy supply minus energy demand	BTU

Note: GDP-PC denotes gross domestic product per capita.

Table 2. China Descriptive Statistics.

Variables	N	Average	SD	Min.	Max.
TR	527	2.4937	4.8959	0	36.55
EIS	526	-2.1627	1.9113	-12.8105	0.6174
EG	527	10.4138	1.2315	7.8299	13.1444

3.2. Methodology

To begin our empirical analysis of the central question of this study, we build a panel model in which tourism is the explained variable and EIS and EG are the explanatory variables. Following Amin, Kabir, and Khan (2020), we considered the following model in this study.

$$TR_{pt} = \beta_0 + \beta_1 EG_{pt} + \beta_2 EIS_{pt} + \beta_3 X_{pt} + \varepsilon_{pt} \quad (1)$$

TR is the reception of international tourists (dependent variable) in p province at t time. The focus of this study is China, as tourism is becoming its burgeoning industry (Zhou, 2019). The Chinese tourism industry has developed into one of the world's leading outbound and inbound tourist destinations. The tourism industry is a focal point in the policy as a central driver of economic and social development (Luo, Qiu, Goh, & Wang, 2016; Sofield & Li, 1998; Zhao & Liu, 2020). EG denotes economic growth (GDP PC) and is the explanatory variable. The study of Lee and Chang (2008) supports the growth-led tourism hypothesis on this association. EIS is energy insecurity, and the expected sign is negative. ε is an error term that captures the effect of variables not included in the model.

3.3. Estimation Methods

Before estimation, the Modified Wald, BPLM, and Pesaran Cross-Sectional Dependence (CD) tests were performed to identify the presence of heteroscedasticity and cross-sectional dependence (Pesaran, 2007). Tables 3 and 4 reveal the presence of heteroscedasticity and cross-sectional dependence in the panel data.

3.3.1. Panel Unit Root Test

In general, panel data studies often suffer from the problem of cross-sectional dependence (CSD). Traditional tests do not adequately address CSD. Consequently, the most recent second-generation panel unit root tests are more suitable for resolving the CSD issue (Danish, Zhang, Hassan, & Iqbal, 2020; Wang & Dong, 2019). Thus, our study uses the first-generation (Im, Pesaran, & Shin, 2003) as well as cross-sectionally Augmented (Im et al., 2003) (CIPS)

second-generation panel unit root test, which is presented by Pesaran (2007). This test offers more consistent results even in the case of CSD (Pesaran, 2007; Yang, Ali, Hashmi, & Shabir, 2020). The CIPS test is estimated as follows:

$$CIPS = N^{-1}\hat{A}_{i=1}^{N} t_i(N,T) \quad (2)$$

3.3.2. Panel Co-integration Test

In the presence of CSD, the first-generation co-integration methods are unreliable for evaluating co-integration among the study variables (Latif et al., 2018). In this regard, the second-generation co-integration performs more efficiently and provides consistent results. Considering the importance of advanced second-generation tests, we use the Westerlund panel co-integration test, proposed by Westerlund (2007). This technique is followed because it provides more efficient results than its alternatives (Meo, Sabir, Arain, & Nazar, 2020). Moreover, Westerlund and Edgerton (2008) contend that this approach permits CSD, serially correlated errors, and heteroscedasticity, as well as unit-specific time trends in a co-integrated regression's intercepts and the slope. In addition, following Le and Ozturk (2020), the error correction specification is specified as:

$$DY_{it} = d_i d_t + e_i\left(Y_{i(t-1)} - b_i' X_{i(t-1)}\right) + \sum_{j=1}^{R} J_{ij} Y_{i(t-j)} + \sum_{j=0}^{R} J_{ij} X_{i(t-j)} + m_{it} \quad (3)$$

Where e_i is the coefficient showing the correction speed toward equilibrium.

In the co-integration test of Westerlund (2007), Gt and Ga are the group mean statistics, and Pt and Pa are the panel statistics. These statistics are computed using the following formulae.

$$G_t = \frac{1}{N}\hat{A}_{i=1}^{N} \frac{e_i}{\text{Se}(\grave{a}_i)} \quad (4)$$

$$G_T = \frac{\grave{a}_i}{\text{Se}(\grave{a}_i)} \quad (5)$$

$$G_a = \frac{1}{N}\hat{A}_{i=1}^{N} \frac{Te_i}{e_i'(1)} \quad (6)$$

$$G_a = T\grave{a}_i \quad (7)$$

Further, Gt and Ga are utilized to decide whether the co-integration exists at least in one of the cross-sectional units or not, and Pa enables us to decide whether the co-integration happens in the whole of the panel (Le & Ozturk, 2020).

3.3.3. Estimation of Long Run Coefficients

If the variables are co-integrated, the study variables' long-run coefficients must be estimated. To achieve this, Kao and Chiang (2001) employ DOLS, FMOLS, and CRR. In fact, co-integration tests can confirm the presence of co-integration but not provide an estimate of the underlying long-run relationship. Banerjee, Dolado, Galbraith, and Hendry (1993) present the fundamental connection between co-integration and the respective long-run equilibrium equation. Indeed, the exploration of the co-integration relationship is the pursuit of statistical equilibrium between variables that are likely to increase over time. FMOLS and DOLS allow for more flexibility if there is heterogeneity in the tested co-integrated vectors (Pedroni, 2004). Our study investigates the long-run association utilizing the DOLS within-dimension estimator recommended by Kao and Chiang (2001). Our analysis resorts to this estimator because it provides asymptotically efficient and unbiased estimates of the long-run relationship, even in the presence of endogenous regressors, thus allowing us to deal with possible endogeneity. Our study baseline specification expects the following cointegrated system;

$$y_{it} = \alpha_i + \beta x_{it} + \mu_{it} \quad (8)$$

$$x_{it} = x_{it-1} + \varepsilon_{it} \quad (9)$$

Whereas y_{it} is the regressand variable (tourism), β is the K*1 vector of slope parameters, x_{it} is the vector that has as the elements of independent variables (EIS, EG), and the remaining idiosyncratic error μ_{it} is regressors among i however possible regressand among t, whereas vector error process $\xi = (\mu_{it}, \varepsilon_{it})'$ is a stationary along with asymptotic covariance matrix Ω_i. So, the variable set x_i, y_i is thought to be co-integrated for every panel member, along with a co-integrating β vector if the y_{it} is order one integrated. In addition, the y_{it}-βx_{it} composite equilibrium error may possibly cover an individual particular impact α_i. Thus, the α_i term permits a cointegrating relation to involve the member-specific fixed effects. By inspecting a limiting distribution of FMOLS and DOLS estimators, Kao and Chiang (2001) demonstrate that they are asymptotically normal. Further, the FMOLS estimator is illustrated as:

$$\beta_F^* = [\sum_{i=1}^{N}\sum_{t=1}^{T}(x_{it} - \bar{x}_i)']^{-1}\left[\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)\bar{y}_{it} + T\Delta_{c\mu}\right)\right] \quad (10)$$

Whereas the $\Delta_{\varepsilon\mu}$ term for serial correlation $\bar{y}_{it}$ for a transformed variable of the y_{it} to obtain an endogeneity correction. In addition, the endogeneity and serial correlation can be modified with the DOLS estimator, which involves the differenced (I) value of past as well as future, i.e., regressor first differenced lag and lead coefficient. DOLS is presented as:

$$\beta_D^* = \sum_{i=1}^{N}(\sum_{t=1}^{T} z_{it}z_{it}')(\sum_{t=1}^{T} z_{it}\bar{y}_{it}) \quad (11)$$

Whereas, $z_{it} = [x_{it} - \bar{x}_i, \Delta x_{i,t-q},.., \Delta x_{i,t+q}]$ is 2(q+1) vector of independents. Although FMOLS considers endogeneity and serial correlation influences in independents resultant from the presence of a co-integration relation. Both are efficient and asymptotically equivalent. Mark and Sul (2003) are in support of DOLS, which is entirely parametric and provides a suitable alternative to the FMOLS panel estimator as suggested by Pedroni (2004) and Phillips and Moon (1999).

3.3.4. Granger Causality

After confirming the long-run relationship between the study variables, it is essential to demonstrate the causality direction among variables to forward accurate policy recommendations. Our study used the most applicable and improved Granger non-causality test, which is the JKS, established by Juodis, Karavias, and Sarafidis (2021). The JKS test is better and outperforms (Dumitrescu & Hurlin, 2012) (DH) test. Firstly, it utilizes the Split Panel Jackknife (SPJ) approach to control "Nickell bias." Secondly, the JKS method is equally appropriate for both homogeneous and heterogeneous panels. Thirdly, the JKS approach has better finite-sample properties than the DH test (Juodis et al., 2021).

Following Juodis et al. (2021), our study specified the JKS method to the panel Granger non-causality equation for the simplest linear dynamic panel data with independent variables as follows:

$$y_{i,t} = f_{0,i} + \hat{\hat{A}}_{p=1}^{P} f_{p,i} y_{i,t-p} + \hat{A}_{q=1} b_{q,i} x_{i,t-q} + e_{i,t}; t = 1, \dots, T \quad (12)$$

Further, the following hypothesis is tested.

$H_0: b_{q,i} = 0$ for all i and q, against $H_a: b_{q,i} \pi 0$ for some i and q.

4. RESULTS AND DISCUSSIONS

4.1. Diagnostics Results

Tables 3 and 4 reveal the existence of cross-sectional dependence in the panel data, as the associations between cross-sectional residuals are significant when utilizing both test statistics (Breusch & Pagan, 1980) and the Pesaran (2007) CD test. In addition, the Modified Wald test is significant at the 1% significance level, confirming the presence of heteroscedasticity. Thus, our data suffer from heteroscedasticity and cross-sectional dependence, which can lead to misleading conclusions. Therefore, we employ both the first-generation and second-generation panel unit root tests to determine the static properties of our series of interest.

Table 3. Diagnostics tests.

Test	Statistic
Modified Wald test	67264.66***
BPLM test	2440.909***
Pesaran CSD	18.805***

Note: *** indicates the 1% significance level.

Table 4. Pesaran (2004) CD test.

Variables	CD-test
TR	56.58***
EG	74.96***
EIS	66.65***

Note: *** indicates the 1% significance level.

4.2. Panel Unit Root Results

Table 5 shows that the existence of a unit root cannot be ignored at level, but they are stationary at first difference. Therefore, all the variables are integrated of order one (I(1)).

Table 5. Unit root tests.

First generation: Im-Pesaran-Shin (IPS) test				
	At level		First-difference	
	Const.	Const. & trend	Const.	Const. & trend
TR	1.945	0.833	-4.133***	-1.651**
EG	1.561	3.954	-3.887***	-1.591**
EIS	-1.096	3.344	-5.436***	-4.361***
Second generation: Pesaran panel unit root (CIPS) test				
TR	-1.669	-1.983	-3.565***	-3.843***
EG	-1.062	-0.765	-2.12**	-2.986**
EIS	-1.929	-2.680	-4.068***	-4.598***

Note: The critical values at 1% & 5% are -2.25 & -2.11, with constant and -2.76, -2.62, & -2.54 with constant and trend for the second-generation unit root test. ** and *** are the 5% and the 1% levels of significance.

4.3. Co-Integration Results

We have used both the first generation and second generation of Westerlund's panel co-integration test, which accounts for CSD. In Table 6, the variance ratio statistic is statistically significant at the 1% level, whereas in Table 7, the Gt and Pt statistics are statistically significant at the 1% level, and the Pa statistic is significant at the 5% level. Thus, the results presented in Tables 6 and 7 provide evidence of a long-run relationship between the variables under consideration. Since the variables are co-integrated, the long-run coefficients are estimated using the Kao and Chiang (2001) DOLS, FMOLS, DOLS, and the CRR techniques.

Table 6. First Generation Westerlund test.

Statistic	Value	P-value
Variance ratio	-3.2553	0.0006

Note: H0: no co-integration and Ha: some panels are co-integrated. Number of panels = 31, and Number of periods = 17.

Table 7. Second Generation Westerlund panel co-integration tests.

Statistic	Value	Z-value	P-value
Gt	-3.520	-8.981	0.000
Ga	-4.423	4.173	1.000
Pt	-13.230	-3.575	0.000
Pa	-7.755	-1.882	0.030

4.4. Long Run Results

The Kao and Chiang (2001) DOLS estimation presented in Table 8 shows the long-run results. The positive and statistically significant coefficient of EG suggests that tourism is largely determined by EG, and that EG promotes the tourism sector. In column 1 of Table 8, a 1% increase in EG increases China's tourism by 1.6018 percent. In addition, using the FMOLS, DOLS, and CRR techniques, our study reaches the same conclusions about the relationship between EG and tourism as indicated in columns 2-4. However, the magnitude of the coefficient of EG is smaller for each of these methods compared to that of the DOLS proposed by Kao and Chiang (2001).

Concerning EIS, the result in column 1 shows a negative relationship between EIS and tourism in China. A 1% increase in EIS leads to a 0.248% decrease in tourism, according to the findings. This finding is supported by the FMOLS, DOLS, and CRR techniques, which demonstrate a greater negative impact of EIS on Chinese tourism. Our results are consistent with. This shows that the number of tourists or tourism is strongly linked with EIS, as its coefficients in all of the specifications are statistically significant. The findings show the importance of EIS as it plays a key role in impeding tourism. Therefore, the country's government should take measures to preserve energy security. As the level of energy security improves, it promotes the tourism sector of the economy. Any type of uncertainty, like EIS and other issues related to safety, depresses tourism. EIS leads to uncertainty and a decline in tourism, according to existing empirical studies (Manrique-de-Lara-Peñate, Gallego, & Valle, 2022). Thus, EIS is a significant issue in tourism development, and it is safe to conclude that the entire tourism industry relies on energy security.

Table 8. Long-run results:

Variables	Kao and Chiang (2001) Approach	FMOLS	DOLS	CCR
EG	1.6018***	0.48***	0.56***	0.48***
	(7.99)	(78.68)	(35.97)	(61.81)
EIS	-0.247543*	-1.56***	-2.05***	-1.69***
	(-1.80)	(-39.92)	(-21.15)	(-35.99)

Note: t values are presented in parentheses and asterisks show the significance level. * and *** are the 10% and the 1% levels of significance, respectively.

4.5. Dumitrescu Hurlin (D-H) panel Granger Causality Estimates

The Granger causality approach developed by Dumitrescu and Hurlin (2012) is used to determine the causal relationships between the model variables. Table 9 summarizes the results of the causal relationship. A unidirectional causal relationship exists between EG and EIS and tourism. The Juodis et al. (2021) Granger non-causality test has also been used to confirm that causality runs from the predictor variables to tourism, both collectively and individually. The outcomes are shown in Table 10. Granger causality is indicated by the significance of the p-values of all half-panel jackknife (HPJ) Wald statistics at the 1% level. The implication is that EG and EIS must be considered when implementing China's tourism policies.

Table 9. Dumitrescu Hurlin panel causality test results.

Variables	Statistic	Tourist
EG	(W-stat.)	3.4710
	(Z-bar)	9.7282***
EIS	(W-stat.)	2.6721
	(Z-bar)	6.5832***

Note: *** indicates the 1% level of significance.

Table 10. Juodis et al. (2021) Granger non-causality Test.

Null Hypothesis	HPJ Wald test	P-value
Selected covariates do not Granger-cause tourist	330.12	0.000
EG does not Granger-cause TR	656.5397	0.000
EIS does not Granger-cause TR	45.9226	0.000

Our finding on causality is in line with the studies of Paramati, Alam, and Lau (2018) for the EU, for BRICS, and Tang and Jang (2009) for the USA, which supported the economic growth-driven tourism hypothesis. However, this finding contrasts with those of Balaguer and Cantavella-Jordá (2002) for Spain, Durbarry (2004) for Mauritius, Gunduz and Hatemi (2005) for Turkey, and Lee and Chang (2008) for the OECD that supported the tourism-led growth hypothesis. Bidirectional causality has also been found between EG and tourism in the studies of Dritsakis (2004) for Greece, Kim, Chen, and Jang (2006) for Taiwan, and Lee and Chang (2008) for non-OECD.

5. CONCLUSION

Over the last decade, the tourism sector has been growing fast in the world. It contributes to job opportunities and creates earnings in terms of foreign currencies. The tourism sector requires more energy to boost tourist activities. Therefore, energy EIS plays a major role in promoting the tourism sector. Using the Kao and Chiang (2001) DOLS method, our study investigated the impact of EIS and EG on tourism in China using Chinese province-level panel data from 2001 to 2017. The results of the DOLS estimate show a positive and significant effect of EG on tourism, and EIS reveals a negative effect on tourism. The FMOLS, DOLS, and CRR results validate the main findings, which also show a positive and significant impact of EG on tourism, suggesting that China's tourism industry has become more robust as a result of the country's reduced EIS. Increasing EG and investing in tourism infrastructure, destinations, and transportation facilities will benefit the travel and tourism industry. According to the findings of this study, China's EIS and EG should be maintained indefinitely. As the first study to examine the effect of EG and EIS on tourism in China, this research makes a significant contribution to the extensive empirical literature in the stream of energy-growth and tourism nexus. Further, the Granger causality DH and JKS test results show a unidirectional causal relationship exists between EG, EIS, and tourism.

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