3 A REVISIT OF TOURISM AND GROWTH NEXUS IN THE PROVINCES OF CHINA BASED ON BOOTSTRAP PANEL CAUSALITY TEST WITH A FOURIER FUNCTION

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Abstract

In this study, we collect annual data for 30 regions in China using tourism receipts and gross domestic product over the period of 1980-2020. Empirical results from Bootstrap Toda-Yamamoto Granger Causality test with a Fourier function, which consider both cross-sectional dependence and multiple smooth breaks, support the evidence of feedback hypothesis in most of the regions except for Jilin that we find the validity of tourism-led-growth hypothesis, Shanxi, and Qinghai where we find the supportive evidence of growth-led-tourism hypothesis, and for Gansu, Ningxia, and Xinjiang where we find the strong evidence of neutrality hypothesis. These results further show the importance of incorporating cross-sectional dependence and smooth breaks in testing the Granger causality. Our empirical results have important policy implications for the regional governments in China conducting tourism policy to sustain its regional economic growth.

Keywords: Regional Analysis, Panel Data, Sustainability, Cross-Sectional Dependence, Smooth Breaks

JEL Classification: C33, Z3

Introduction

The tourism industry has witnessed tremendous growth since World War II due to increases in standards of living and in leisure time. The importance of the tourism sector can be seen in the fact that, prior to the COVID-19 pandemic, both of international tourist arrivals and tourism receipts have notably outpaced the global economy. According to the UNWTO (World Tourism Organization (hereafter WTO), 2020a, b), international tourist arrivals have grown from 25 million in 1950 to reach a record 1.46 billion mark in 2019, representing nearly 60-fold growth, despite ongoing global economic and regional political challenges during these periods. This figure

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signifies the tenth consecutive year of sustained growth, a benchmark that was reached two years ahead of the WTO's long-term forecast issued in 2010. In addition, tourism drives economic progress in developing and developed countries, creating much-needed jobs. For instance, in 2019, the tourism sector grew by 3.5% growth compared with a 2.5% increase for the global economy as a whole, marking the ninth consecutive year that tourism growth outpaced global economic growth. It represents US$8.9 trillion (10.3%) contribution to the world's gross domestic product (GDP). Additionally, the tourism sector created 25% of new jobs, and the number of people working either directly in tourism or in related sectors of the economy accounts for 1 in 10 jobs (World Travel and Tourism Council (hereafter WTTC), 2021). These statistics distinguish tourism as a critical driver of economic growth and socio-economic progress (Shahzad *et al.*, 2017). The President of the WTTC (2019) further indicates that "tourism becomes even more critical as an engine of economic development and as a vehicle for sharing cultures and building mutual understanding" (p. 2). Therefore, the tourism industry has become a primary development strategy for many countries (Songling *et al.*, 2019; Nicholas, 2021), as it is an important source of business activity, income, employment, infrastructure improvement, the balance of payments, and foreign currency earnings (Min *et al*., 2019; Liu, & Song, 2018; Zuo & Huang, 2018; Lin *et al.*, 2019; Narayan, 2010).

In recent decades, China has represented the most greatly expanded tourism market compared with other important tourist-generating countries since opening its door to the world under the leadership of Deng Xiaoping in 1978. As a result, rising standards of living, the emergence of an affluent middle class, and an easing of movement restrictions for locals and foreign visitors drive a boom in tourism and fuel the economic growth in China. Recognizing the potential of the tourism industry to revitalize local economies and improve the living standards of residents (Cárdenas-García *et al.*, 2015), Chinese government authorities and local practitioners have made many efforts to promote and invigorate regional tourism through policies such as relaxed restrictions for inbound visitors and tourism-related investments. For instance, by including the tourism industry in its national plan for social and economic development in 1986, China recognized the important role of tourism nationwide. The China National Travel Administration, which is the nation's administrative body tasked with establishing short- and long-term national tourism policies, and its provincial and municipal offices were created in order to facilitate the government policies. All of them are responsible for marketing strategies on tourism development. The reforms of currency in circulation in China in 1994, allowing international travelers to use the same currency as Chinese citizens, were also an important pull factor for the rapid growth for inbound arrivals (Lim & Pan, 2005).

In recent years, China has ranked among the world's top five destinations for international tourist arrivals, and it is the largest tourist-receiving country in terms of both international tourist arrivals and international tourism receipts within East Asia and the Pacific region. Moreover, remarkable growth in domestic tourism, led by increasing economic prosperity and growth of household incomes, has contributed to China's booming tourism markets. The tourism-economic growth thus plays an essential role in fostering both international and domestic tourism development. According to the reports of WTTC, in 2019, China was the second-ranking country worldwide in terms of the contribution to GDP of its travel and tourism sector ($943.1 billion), and it ranked first for travel and tourism's contribution to employment (66,086,000 jobs in 2019). In 2018, tourism and travel contributed 11 percent to China's gross domestic product (China Power Team, 2016). This information highlights that tourism has been recognized as a significant part of China's economy, and the relationship between tourism and economic growth rate is increasingly gaining attention by many researchers across the world. However, since the launch of the open-door policy in Mainland China, there has been a regional unbalance, with the coastal region developing much ahead of the central and western regions as a result of policy priorities (Wang *et al.*, 2011; Zhou & Chen, 2021), which is one of the most important issues which cannot be ignored when estimating the correlation between tourism and the economy as a whole.

In general, tourism has been considered to stimulate and nurture the destination economy, such as providing more consumption expenditure, employment, and tax revenue. This marks tourism as a positive contributor to economic growth, referred to as the tourism-led economic growth hypothesis (hereafter TLEGH). Some studies with a particular focus on China support the hypothesis of the unidirectional causality from tourism development to economic growth (Songling *et al.*, 2019). However, according to Zuo and Huang (2018), there is still a question as to whether tourism development is the cause of economic growth or whether, conversely, the expansion of the economy drives the growth in the tourism industry. The correlation outcomes of earlier studies are very mixed and contrary. For instance, the reverse effect, by which tourism is boosted by economic growth in China, has been identified by several studies (Wu & Wu, 2019); the cointegration relationship, bilateral causality, has also been found by Wang *et al.* (2012). In addition, mixed findings were demonstrated in examining different provinces and regions of China (Wu & Wu, 2019). These findings are consistent with the argument put forth by previous scholars (Oh, 2005; Deng, Ma & Shao, 2014; Zuo & Huang, 2018) that there is not as yet sufficient research to determine with certainty the nature of the relationship between tourism and economic growth. According to Oh (2005), this uncertainty may be due to limitations of the data and methodology. Therefore, the purpose of this study is to investigate the causal relationship between tourism activities and GDP using Bootstrap Panel Granger Causality test with Fourier function among the 30 provinces (municipalities) in China. This study contributes to the existing literature in several ways. First, unlike prior studies, we employ a panel framework that allows us to analyze 30 regions of China simultaneously, capturing the heterogeneity across provinces that is often overlooked in single-region studies. Second, we address the limitations of traditional causality tests by incorporating a Fourier function within the Toda-Yamamoto framework. This allows us to model multiple smooth structural breaks in the series, which are highly likely given China's significant economic reforms and shifts over the past few decades. Third, we account for the spatial correlation of the regional areas by using bootstrap simulations to obtain reliable test results. Finally, by using a recent panel causality test (PFTY) that combines the advantages of panel data, the Toda-Yamamoto method, and a Fourier function to allow multiple breaks with considering the cross-sectional dependence, we offer a more robust investigation than previous studies of the tourism-growth nexus in China. The findings will provide information with respect to the causal relationship between them in different regions of China, which may have important implications for government, policymakers, and local authorities/practitioners to promote tourism demand and nurture economic development more effectively and efficiently.

The paper is organized as follows. Section II presents some review of the literature. Section III and IV present the methodology and data that we used in this paper. Section V presents the empirical results, and some policy implications are discussed. Section VI wraps up the paper.

Review of Literature

China is the largest Asia-Pacific country with a unique variety of natural scenery and resources, and it is also a leading force in the development of global tourism and the global economy as a whole. Over recent decades, the country’s tourism industry has been transformed from a tool that primarily served political/economic purposes into a pillar of its socialist market economy. This transformation can be attributed to the introduction of different policies and legislation (Lim & Pan, 2005). In 2019, for instance, the number of tourist arrivals to China reached 65.7 million, an increase of 36.5-fold from 1.8 million in 1978, the year of the economic reform to welcome international tourists. In terms of international tourism receipts, the receipts increased from USD 2.6 billion in 1978 to a total of USD 35.83 billion in 2019, a growth of 13.78%, ranking five in international tourism receipts (China National Tourism Administration, 2020) in the Asia-Pacific region. Meanwhile, China has also experienced over 10% GDP average annual growth rate from the mid-1990s to 2010, which was much higher than that of developing countries at 4.5% and the world's average rate of 3.2% over the same period. Although the economic development slowed down after the mid-2010s, showing a 6-7% increase annually, it is still one of the leading countries worldwide, compared with an economic growth rate of 2.5% globally.

Undoubtedly, economic prosperity drives rising incomes in local communities and stimulates international and domestic tourism growth. Meanwhile, the rapid tourism development alleviates poverty by generating more employment and triggers overall economic growth in China. With the tremendous expansion of tourism and the overall economy, a growing body of academic literature has thus focused on tourism, the economy, and their correlations, with different methods in a perspective of qualitative or quantitative analyses.

In terms of the tourism-economic estimations of the tourism destinations, these were traced by the scholar Ghali (1976), who was the first to conduct an empirical examination of tourism and the economic growth rate in Hawaii. Balaguer and Cantavella-Jordá (2002) subsequently developed and tested the TLEGH, which provided scholars the necessary theoretical and empirical foundation for conducting more in-depth research into this topic. It is noteworthy that Brida *et al.* (2016) reviewed approximately 100 peer-reviewed published papers on TLEGH using diversification in econometric modeling. The general consensus of these studies' empirical findings, although rejected in several countries, is that international tourism tends to drive economic growth. Over time, many researchers have conducted investigations of the causal relationship between tourism activities and economic growth either in tourist destinations or regions of China. Some studies have proven that tourism demand is an important catalyst of economic growth and affects the economic activities in China, using different approaches. For instance, in Gao *et al.* (2009), considering the unbalanced spatial distribution, the relationship between the international tourist income and economic growth was investigated based on Chinese province-level data. The findings confirmed that foreign exchange income enhanced the regional economic performance, and it is particularly interesting to note that the levels of correlations from the results were varied because of its geographical location. Songling *et al.* (2019) examined the relationship between tourism and GDP in Beijing by adopting vector autoregressive (VAR), error correction model, and the Granger causality from 1994 to 2015. The empirical results support the TLEGH hypothesis that tourism impacts the economy in Beijing.

In contrast to the studies on the perspective of TLEGH, however, some studies reach different conclusions that the economy benefited from tourism development (economy-driven tourism growth, hereafter EDTG) or that bilateral causality was found between them (Zuo & Huang, 2018). Cárdenas-García *et al*. (2015) further argue that the mixed and inconclusive results of the tourism-economy relationship for different countries could be attributed to nation-specific factors such as at different development levels (see also Tang & Jang, 2009; del P. Pablo-Romero & Molina, 2013; Lin *et al*., 2019). These inconsistent empirical evidences are also drawn from several studies focusing on Chinese regional data. For instance, Lin *et al.* (2019) adopted both Bayesian probit models and the Toda – Yamamoto (TY) Granger causality test in a comparable setting of 29 provincial regions in China to examine the validity of the TLEGH, EDTG hypotheses, or different linkages during 1978 to 2013. Unlike previous studies, the study concluded that bi-directional, unidirectional, and mixed causalities exist among the 29 provincial regions. The authors also found that areas with less-developed economies, larger economies, and larger geographic areas had a higher tendency to experience TLEGH. At the same time, less-developed economies were also likely to experience EDTG. Similarly, the causal relationship between international tourism receipts and economic growth in China was explored among the 11 eastern provinces by Wu *et al.* (2018), 31 major regions by Wu and Wu (2018), and eight central provinces by Wu and Wu (2019) using panel data employing different economic techniques. The results provided evidence that the mixed causalities of TLEGH, reverse, reciprocal, and neutrality linkages occurred simultaneously in these provinces and regions.

Recognizing China's phenomenal growth in tourism and the overall economy, along with the importance of tourism-economy estimations, it is necessary to attempt to investigate the interaction of the tourism-economy relationship country-wide. Moreover, the regional developing disparities and inequalities in China, as mentioned, have been widely identified, leading to divergences on estimations of tourism-economy correlation among different provinces or regions applying different methods of economic techniques on different time frames. In particular, over forty years after the reforming and opening-up policy, China has transformed to a market economic system, and it requires reassessment country-wide on the correlation. The current study tries to fill the gap in the literature by applying the Bootstrap Panel Toda-Yamamoto Causality test with the Fourier function to examine the relationship between tourism development and economic growth in different regions. The findings will shed more light on the relationships for future research on the tourism-economic estimation and serve more directions for government and regional development on tourism and the economy.

Methodology

(1)Toda-Yamamoto and Fourier Toda-Yamamoto Causality Tests

Although the Granger causality test is one of the most employed tests in empirical papers, it has two major disadvantages. First, one can only test the causality between stationary variables, and in the case of nonstationary variables, one should make them stationary. Second, the existence of a cointegration relationship between the variables also must be tested if the variables are nonstationary. Because, in the case of cointegration relationship, the Granger causality test is performed on vector error correction models, not vector autoregressive models. However, by using Toda and Yamamoto (1995) approach to causality, one can remedy these disadvantages.

Toda and Yamamoto (1995) propose augmenting the VAR model with the maximum integration levels of the variables to maintain the asymptotic distribution of the test statistic independent of the integration of the variables and the presence of a cointegration relationship. The test statistic of Toda and Yamamoto (1995) (TY) can be obtained by estimating the following VAR models:

$$Y_t = \alpha_{10} + \sum_{i=1}^{k+d\max} \alpha_{1i} X_{t-i} + \sum_{i=1}^{k+d\max} \beta_{1i} Y_{t-i} + e_{1t}$$

$$X_t = \alpha_{20} + \sum_{i=1}^{k+d\max} \alpha_{2i} X_{t-i} + \sum_{i=1}^{k+d\max} \beta_{2i} Y_{t-i} + e_{1t}$$

Where k , and $d_{\max}$ indicate the optimal lag length and maximal order of integration, respectively. The null hypothesis X_t does not Granger cause Y_t is tested by examining the significance of the first k lags of X_t.

Some milestone studies in the literature demonstrate that neglecting structural changes in the unit root or cointegration tests could bias the test results (See Perron, 1989; and Gregory and Hansen, 1996, among others). However, structural breaks may also affect the results of the causality test as suggested by Enders and Jones (2016). Thus, recently Nazlioglu *et al.* (2016) proposed to improve the TY causality test by adding a Fourier function to the augmented VAR model to allow multiple structural breaks. Using the Fourier function, there is no need to pre-determine the number, dates, and forms of the breaks. We estimate the following VAR model to obtain the test statistic (FTY):

$$Y_t = \alpha_{10} + \sum_{i=1}^{k+d\max} \alpha_{1i} X_{t-i} + \sum_{i=1}^{k+d\max} \beta_{1i} Y_{t-i} + \theta_1 \sin(2\pi Tf/t) + \phi_1 \cos(2\pi Tf/t) + e_{1t}$$

$$X_t = \alpha_{20} + \sum_{i=1}^{k+d\max} \alpha_{2i} X_{t-i} + \sum_{i=1}^{k+d\max} \beta_{2i} Y_{t-i} + \theta_2 \sin(2\pi Tf/t) + \phi_2 \cos(2\pi Tf/t) + e_{1t}$$

Where $\pi = 3.1416$ is a constant, and T, t, and f indicate the trend term, sample size, and a particular frequency whose value is determined that produces the minimum sum of squared residuals in the related equation for each integer value in the interval [1, 5]. To test the null, the restrictions of first k lags are tested using the Wald statistics, and critical values are obtained using bootstrap simulations.

(2) Panel Toda-Yamamoto Causality test

By following the suggestion of Fisher (1932), Emirmahmutoglu and Kose (2011) introduced to the literature a new panel causality test that is based on combining the test statistics of individual TY tests. Since this causality test is based on the TY test, one can employ it without pretesting the unit root or cointegration properties of the variables. The following panel VAR model is estimated to obtain the test statistics:

$$y_{i,t} = \mu_i + \sum_{j=1}^{k_i + d_{\max_i}} A_{11} y_{i,t-j} + \sum_{j=1}^{k_i + d_{\max_i}} A_{12} x_{i,t-j} + u_{i,t}$$

$$x_{i,t} = \mu_i + \sum_{j=1}^{k_i + d_{\max_i}} A_{21} y_{i,t-j} + \sum_{j=1}^{k_i + d_{\max_i}} A_{22} x_{i,t-j} + u_{i,t}$$

where $t = 1,2,3,...,T$, and $i = 1,2,3,...,N$. $d_{\max}$, k_i are defined as before. We test the null hypothesis of non-causality from x_t to y_t for the i th cross-section by testing the first k_i coefficients of x_t in the first equation of the VAR using the Wald statistic. Panel Toda-Yamamoto test statistic can be obtained as $PTY = -2\sum_{i=1}^{N} \ln(p_i)$ where p_i shows the p-value of the Wald statistic for the i th individual. To consider the possible cross-sectional dependence, Emirmahmutoglu and Kose (2011) suggested using bootstrap simulations to obtain critical values.

(3) Panel Fourier Toda-Yamamoto Causality Test

In this study, we use a recently introduced panel causality test by Yilanci and Gorus (2020) which is called panel Fourier Toda-Yamamoto causality. Indeed, Yilanci and Gorus (2020) combined the approaches of Emirmahmutoglu and Kose (2011) and Nazlioglu *et al.* (2016). While the former is the extension of the Toda and Yamamoto (1995) causality test to the panel data, the latter can be considered the advanced version of the TY causality test to allow multiple structural breaks.

To employ the panel Fourier Toda-Yamamoto (PFTY) causality test, the following two-variable panel VAR model is estimated:

$$y_{i,t} = \mu_i + \sum_{j=1}^{k_i + d_{\max_i}} A_{11} y_{i,t-j} + \sum_{j=1}^{k_i + d_{\max_i}} A_{12} x_{i,t-j} + A_{13} \sin\left(\frac{2\pi t f_i}{T}\right) + A_{14} \cos\left(\frac{2\pi t f_i}{T}\right) + u_{i,t} \quad (1)$$

$$x_{i,t} = \mu_i + \sum_{j=1}^{k_i + d_{\max_i}} A_{21} y_{i,t-j} + \sum_{j=1}^{k_i + d_{\max_i}} A_{22} x_{i,t-j} + A_{23} \sin\left(\frac{2\pi t f_i}{T}\right) + A_{24} \cos\left(\frac{2\pi t f_i}{T}\right) + u_{i,t} \quad (2)$$

where $d_{\max}$ shows the maximal order of integration, k_i is the optimal lag order that is estimated employing the Akaike information criteria (AIC), $\pi = 3.1416$, t, T, f_i indicate the trend term, the number of observation, and a particular frequency, respectively. To find the optimum value f_i, one should estimate the related test equation for each integer value in the interval [1, 5], and select the value that produces the minimum sum of the squared residuals. By following the suggestion of Yilanci and Gorus (2020), we allow a single-frequency component of a Fourier function since it can mimic the various form of breaks.

The null hypothesis of that x_t does not Granger cause to y_t for i th individual can be investigated by testing the restriction of the first k_i coefficients of x_t in the first equation of the VAR system using a standard Wald statistic. We can obtain the PFTY test statistic by following the suggestion of Fisher (1932) by combining the p-values of the Wald test statistic for each individual as $PFTY = -2\sum_{i=1}^{N} \ln(p_i)$ where p_i is the bootstrap *p*-values corresponding to the Wald statistic for the i th individual. We follow Yilanci and Gorus (2020) and obtain the critical values employing bootstrap simulations to consider cross-sectional dependence (see Emirmahmutoglu and Kose, 2011 also). PFTY test has some advantages. First, there is no need to pre-specify the number, location, and form of the break; second cross-sectional dependence among the members of the panel is considered; third; the results of the individual Fourier Toda-Yamamoto causality test are also obtained.

Data

We apply annual data covering the period from 1990 to 2019 for China. The variables used in this study include tourism receipts (TOUR) and GDP. Both series are retrieved from the National Bureau of Statistics of China (various issues).

Empirical Results and Policy Implications

(1) Results from Unit Root Tests

As we know that many macroeconomic and financial time series data exhibit nonstationary properties, and nonstationary variables will create spurious results (Granger and Newbold, 1974); therefore, it is very important to test the stationarity of the variables before model estimation. Following most of the literature, we first apply panel unit root tests. Tables 1 reports our panel unit root test results.

Table 1. Panel unit root test results

Series	Im, Pesaran and Shin Test	MW unit root test	Panel CIPS Test
TOUR	-6.934***	143.527***	-25.453***
GDP	-9.892***	117.287***	-42.55 ***

*Notes: ***, **, and * indicate significance at the 1, 5, and 10 % levels, separately.*

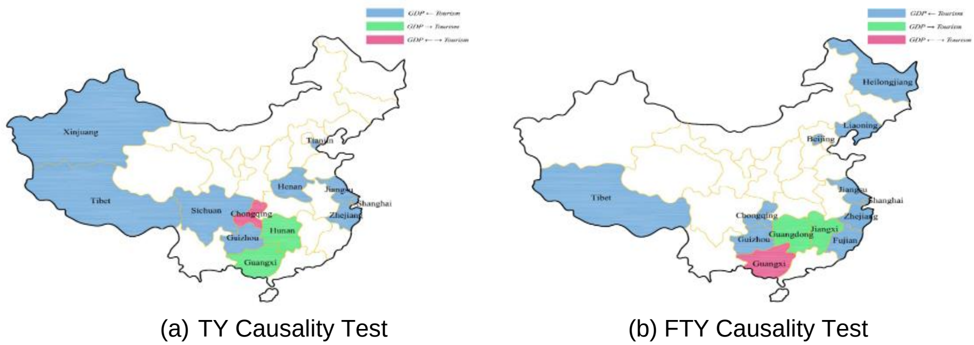
Both IPS (Im et al, 2003) and Maddala-Wu (Maddala & Wu, 1999) panel unit root test results from Table 1 show that both series are stationary in level. Table 1 also reports the results of the CIPS

(Pesaran, 2007) panel unit root test results that further confirm these findings that both the TOUR and GDP time series are stationary at level[5].

(2) Results from the Toda-Yamamoto Causality Test with and without Fourier Function

Because we find both TOUR and GDP are stationary, we first use the Toda-Yamamoto Granger causality with and without Fourier function to investigate Tourism-GDP links in the regional areas of China[6]. Empirical results are reported in Appendix A.

We divide China into six regions – Northeast, North, East, Southcentral, Southwest, and Northwest. In the first region of Northeast China that we find the TOUR Granger causes GDP in Heilongjiang and only when the Fourier function is incorporated in the Toda-Yamamoto causality (TYC) model (for both Wald and F tests). In the North region that we find that there is a causality from GDP to TOURs in Beijing and only when the Fourier function is incorporated in the TYC model (for both Wald and F tests). On the other hand, we also find that there is a causality that runs from TOUR to GDP in Tianjin under the TYC model without the Fourier function. In the East region, we find a feedback causality relationship between TOUR and GDP in Shanghai in the TYC model with the Fourier function. We also find a one-way Granger causality running from TOUR to GDP for Jiangsu, Zhejiang, and Fujian in the TYC model with and without Fourier function. TYC model with Fourier function also indicates that GDP Granger causes TOUR in Jiangxi. In the Southcentral area, we find feedback between TOUR and GDP in Guangxi under the TYC model with and without Fourier function. In this area, we also find a one-way Granger causality running from TOUR to GDP in Henan and from GDP to Tourism in Hunan. In the Southwest region, we also find feedback between TOUR and GDP in Chongqing and a one-way Granger causality running from Tourism to GDP in Sichuan, Guizhou, and Tibet under TYC model with and without Fourier function. In the last region of Northwest, we also find Tourism Granger Causes GDP in Ningxia and Xinjiang only. We further demonstrate our empirical results in Figure 2.



(a) TY Causality Test　　　(b) FTY Causality Test

Figure.2: Causality Tests

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[5] *Though some of the individual TOUR and GDP time series are not stationary according to the CADF unit root test, the whole panel is stationary in level. The results of CADF test are available upon reasonable request.*

[6] *If both variables are stationary, we apply the Granger causality test is instead of the Toda-Yamamoto causality test, since no additional lag is added to the VAR model.*

(3) Results from Bootstrap T-Y Granger Causality Tests with Fourier Function

Cross-sectional dependence is one of the most likely effects to be encountered, especially among the regions of a country because of spatial effects and ignoring the cross-sectional dependence may have serious consequences such as biasing the empirical results. Therefore, we also employ various cross-sectional dependence tests and also Delta (slope) homogeneity test and provide the results in Table 2.

Table 2. Cross-sectional Dependence and Homogeneous Tests

Cross-sectional Dependence	*Test.Stat.*	*p-value*
LM	5305.416***	0.000
CD_{LM}	46.854***	0.000
CD	165.123***	0.000
LM_{adj}	86.967***	0.000
Homogeneous Tests		
$\tilde{\Delta}$	8.9482***	0.000
$\widetilde{\Delta_{adj}}$	0.3154	0.376

*Notes: ***, ** and * indicate significance at the 1, 5 and 10 % levels, separately.*

The findings of the CD tests show that cross-sectional dependence exists in the testing model. Delta homogeneity test results also reject slope homogeneity in our testing model. Because we find most of the Granger causality test results with significant smooth breaks, we use the PFTY causality test with the Fourier function for further analysis. Appendix B reports our empirical results.

From Appendix B, we can find most of the lag length is 2, and frequency ranges from 1-3. PFTY causality test results indicate a one-way Granger causality running from TOUR to GDP Jilin (for Northeast region). Interestingly, we find significant feedback between TOUR and GDP for most areas in North, East, Southcentral, Southwest regions. Finally, in the Northwest region, we find a one-way Granger causality running from GDP to TOUR in both Shanxi and Qinghai regions. We believe these results are more reliable because the PFTY causality test considers both cross-sectional dependence and structural breaks in our testing model. We also demonstrate our empirical results in Figure 2.

Our findings line up in several important ways with other studies in the literature. For instance Su et al. (2021) highlights that local economic contexts can cause tourism's impact on growth to vary significantly by region. Likewise, Wu and Wu (2018) provides evidence that not all Chinese provinces follow the same causality pattern: some follow tourism-led paths, whereas others exhibit reciprocity or no clear linkage. Similar observations also appear in the Wu et al. (2022)'s analysis of eight central provinces, where a strong positive relationship emerges in some areas (especially during periods of economic upswing) but a weaker relationship persists in places like Shanxi. Taken together, the results from our study confirm the broader conclusion reached by these prior studies: the tourism–growth nexus in China does not follow a "one-size-fits-all" trajectory. Instead, it reflects local economic structures, the maturity of the tourism sector, and how various macro-level shocks (including public health crises) influence both arrivals and spending. This study's use of a panel approach that incorporates structural shifts (via Fourier terms) and cross-sectional dependencies provides additional support for nuanced, region-specific policy measures—such as calibrated marketing incentives in tourism-led provinces and broader, growth-focused interventions where tourism reacts more strongly to general economic expansions.

Figure 2: Panel Fourier Toda-Yamamoto Causality Test

(4) Policy Implications of our Empirical Findings

Based on our empirical findings that, we can conclude that both cross-sectional dependence and structural breaks are two important points that we need to take into account when we work on testing the TOUR-GDP nexus. Our empirical results from TYC model with Fourier function further confirm that feedback causality relationship exists between tourism and economic development in most of the regions in China, except for Jilin (TOUR → GDP), Shanxi and Qinghai (GDP → TOUR), and Gansu and Ningxia and Xinjiang (GDP ↮ TOUR). Our empirical results have very important policy implications; first, the findings show that there are different causality relationships in different regions of China; thus, region-specific policies should be implemented for the regions. For example, the results support the evidence of the tourism-led-growth hypothesis only for Jilin, which shows that the tourism sector boosts economic growth in a few channels, such as contributing to capital goods and creating new job opportunities. Thus, the tourism sector should be promoted via resources allocation, tax incentives, encouraging private investment through providing financial assistance to stimulate economic growth in Jilin. Besides, the local government can benefit from the multiplier effect of tourism to the other sectors (such as agriculture, construction, transportation, etc.).

The growth-led-tourism hypothesis, which maintains economic growth contributes to the growth in tourism earnings, is found to be valid for only Shanxi and Qinghai among the provinces. As increased economic growth will also have a positive impact on citizens' incomes, the local demand for tourism increases, which, in turn, accelerates business opportunities and leads to the entry of new investors into the tourism sector, and thus an overall increase in tourism revenues. The government should budget more tourism investment and strengthen existing infrastructure after economic expansion. Furthermore, local government should continue to encourage necessary investment in both physical and human capital. Therefore, the tourism sector reaps the benefits, as additional resources created from such growth will help to boost tourism infrastructure in the province (Wu *et al.*, 2018).

We find that the neutrality hypothesis is valid for Gansu, Ningxia, and Xinjiang that validates the economic growth and tourism influence each other. The policies for tourism development have no effect on economic growth, and tourism earnings are not affected by the economy. For the remaining provinces, we find evidence of feedback hypothesis, that is, both variables influence each other simultaneously. The feedback hypothesis indicates that the policies to promote the tourism industry also increase economic growth; in turn, the increases in economic growth tend to promote tourism. Policymakers should pay attention tourism sector when making decisions about the economy, that is, consider a holistic vision, including tourism.

Conclusions

We collect annual data for 30 regions in China using both tourism receipt and GDP two variables over the period of 1980-2020 to investigate the tourism and GDP nexus. Empirical results from panel Toda-Yamamoto Causality test with Fourier function, which take into account both cross-sectional dependence and smooth breaks, demonstrate that feedback causality relationship exists between tourism and GDP in most of the regions except for Jilin that we find tourism leads growth, Shanxi, and Qinghai that we find GDP leads tourism, and independence between tourism and growth for Gansu and Ningxia and Xinjiang. Specifically, the PFTY results showed a unidirectional causality running from tourism to GDP in Jilin. We found unidirectional causality running from GDP to tourism in Shanxi and Qinghai, and lastly, no evidence of causal relationship between tourism and growth for Gansu, Ningxia, and Xinjiang was obtained, supporting the neutrality hypothesis for these regions. For all remaining regions, we found support for the feedback hypothesis. These results further demonstrate the importance of incorporating both cross-sectional dependence and smooth breaks in the Granger causality test regression. Our empirical results have important policy implications for the government in China. We find causality relationships vary across regions; thus, policymakers should design region-specific policies. For the provinces where we find supportive evidence of tourism-led-growth, tourism supporting incentives programs should be implemented, for the provinces where growth-led-tourism is valid more tourism investment should be budgeted, for the provinces where the feedback hypothesis is not rejected, policymakers should consider a holistic economic view including tourism, and lastly, for the provinces where no evidence is found for causality relationship, policymakers should not undervalue the effect of tourism sector when designing policies that have negative influences on tourism.

Especially during the COVID-19 period, it became clear that the tourism sector is one of the most fragile sectors. The visits of international tourists to the tourism destinations abruptly cease in the case of extraordinary events. Policymakers should make regulations to protect firms and employees in the tourism sector and implement stimulus packages to mitigate the effects of shocks. This study considered provinces of China to investigate the causality relationship between tourism and economic growth by considering multiple smooth structural changes that may arise due to economic crises (such as the 1997 Asian financial crisis or the financial crisis of 2007–2008), and may affect the causality relationship. Future studies can be conducted by considering different country groups to reveal the effect of the breaks.

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Appendix

Appendix A. Toda-Yamamoto Causality Test with and without Fourier Function

	TY		FTY				TY		FTY			
	H_0: gdp does not cause tourism						H_1: tourism does not cause gdp					
Provinces	wald	p-value	wald	p-value	F-test	p-value	wald	p-value	wald	p-value	F-test	p-value
NorthEast China												
Heilongjiang	0.488	0.494	4.574	0.125	4.409	0.028	0.216	0.644	6.303*	0.070	5.596*	0.013
Liaoning	0.149	0.702	0.596	0.426	4.963	0.017	0.134	0.709	0.135	0.710	3.125	0.065
Jilin	2.305	0.314	0.709	0.715	15.675	0.000	5.318	0.118	0.466	0.781	1.150	0.339
North_China												
Beijing	1.389	0.251	4.476**	0.038	4.249	0.028	2.105	0.165	2.941	0.105	4.008	0.034
Hebei,	0.012	0.908	0.086	0.431	16.182	0.000	1.830	0.170	5.414	0.310	0.729	0.502
Shanxi	0.380	0.565	0.005	0.948	3.513	0.048	1.082	0.326	1.896	0.192	1.646	0.217
Inner Mongolia	0.086	0.782	0.614	0.416	2.724	0.089	1.053	0.338	0.000	0.987	1.359	0.278
Tianjin	1.077	0.611	7.147	0.115	8.747	0.003	8.510**	0.039	9.647	0.128	2.151	0.159
East_China												
Shanghai	0.554	0.910	6.669*	0.062	2.617	0.106	30.453***	0.000	21.83 ***	0.002	1.387	0.280
Shandong	2.040	0.362	0.978	0.582	1.746	0.203	2.827	0.290	9.083	0.207	2.536	0.134
Jiangsu	4.388	0.265	3.405	0.389	0.951	0.409	16.129***	0.005	11.536**	0.013	10.387	0.005
Zhejiang	0.943	0.624	1.726	0.449	4.739	0.022	6.400*	0.054	14.812***	0.004	6.351	0.008
Anhui	0.286	0.853	0.471	0.795	2.940	0.079	2.698	0.271	5.069	0.123	2.513	0.109
Fujian	1.905	0.396	18.063	0.0109	33.641	0.000	4.375	0.534	3.305**	0.037	4.139	0.043
Jiangxi	3.109	0.237	4.838**	0.033	6.067	0.008	1.873	0.395	0.012	0.901	0.190	0.828

South Central China												
Henan	0.840	0.119	0.840	0.118	5.472	0.014	11.241**	0.013	2.031	0.376	6.214	0.009
Hubei	2.512	0.335	0.170	0.692	1.093	0.354	0.621	0.734	0.016	0.998	9.220	0.001
Hunan	6.918*	0.050	22.399***	0.000	1.852	0.186	3.142	0.252	0.493	0.134	4.058	0.035
Guangdong	4.818	0.199	3.462	0.388	0.315	0.735	4.948	0.225	0.221	0.133	3.658	0.051
Hainan	2.596	0.429	0.559	0.894	4.356	0.032	3.363	0.368	1.889	0.575	2.859	0.089
Guangxi	15.778***	0.008	6.394**	0.021	2.077	0.154	12.306**	0.025	3.754	0.183	3.557	0.050
Southwest China												
Sichuan	13.547	0.014	0.471	0.467	3.293	0.057	11.005**	0.038	2.357	0.139	1.177	0.328
Yunnan	0.113	0.732	0.790	0.396	2.372	0.118	0.717	0.415	1.736	0.178	2.457	0.110
Guizhou	3.090	0.231	4.889	0.238	10.916	0.001	7.436*	0.049	11.331**	0.019	10.815	0.001
Chongqing	6.143*	0.072	1.895	0.609	1.925	0.180	9.147**	0.024	17.681***	0.001	4.097	0.038
Tibet	6.599	0.127	6.425	0.140	0.223	0.803	19.398***	0.002	20.695***	0.001	0.579	0.572
Northwest China Region												
Shaanxi	-4.764	0.996	-2.359	1.000	0.118	0.889	-0.406	1.000	1.630	1.000	-0.521	-1.000
Gansu	-8.446	1.000	-6.079	1.000	-0.807	-1.000	-0.179	1.000	-1.243	1.000	-1.924	-1.000
Qinghai	-10.692	1.000	-6.459	1.000	-0.747	-1.000	0.249	1.000	-0.213	1.000	-1.228	-1.000 -
Ningxia	-14.939	-1.000	-7.917	1.000	-0.723	-1.000	0.362	1.000	3.407***	0.000	-0.923	1.000
Xinjiang	14.333	1.000	-7.468	1.000	-0.685	-1.000	0.283***	0.000	-4.249	1.000	-1.214	-1.000

Notes: TY: The TY approach which does not account for structural breaks. FTY: The Fourier TY approach with cumulative frequencies. F-test is based on the null hypothesis. The VAR models include suicide and unemployment.
****,**, and * denote the statistical significance at 1, 5, and 10%, respectively*

Appendix B. Panel Fourier Toda-Yamamoto Causality Test Results

Provinces	GDP→TOUR		TOUR→GDP			
	Wald state	Bootstrap p-value	Wald state	Bootstrap p-value	lags	frequency
NorthEast Region						
Heilongjiang	329.620***	0.0000	938.845***	0.0000	2	3
Liaoning	564.8285***	0.0000	1024.873***	0.0000	2	2
Jilin	2.210	0.3350	42.861***	0.0000	2	1
North _China	Region					
Beijing	42.416***	0.000	8.353**	0.015	2	1
Hebei,	117.034***	0.0130	35.0872***	0.000	2	1
Shanxi	120.340***	0.000	8.200**	0.0350	2	1
Inner Mongolia	1500.290***	0.000	6.502*	0.059	2	1
Tianjin	362.992***	0.000	29.632***	0.001	2	1
East_China	Region					
Shanghai	35.755***	0.000	35.220***	0.000	2	1
Shandong	22.417***	0.001	55.887***	0.000	2	1
Jiangsu	21.009***	0.000	79.163***	0.000	2	1
Zhejiang	31.449***	0.000	41.022***	0.000	2	1
Anhui	20.109***	0.000	61.846***	0.002	2	1
Fujian	17.385***	0.000	119.7933***	0.000	2	1
Jiangxi	19.921***	0.000	107.512***	0.000	2	1
South Central	Region					
Henan	105.233***	0.000	23.069***	0.000	1	1
Hubei	522.333***	0.000	126.738***	0.000	2	1
Hunan	1.330***	0.000	0.108***	0.000	2	1
Guangdong	233.562***	0.000	67.513***	0.000	2	1
Hainan	1361.526***	0.000	112.242***	0.000	2	1
Guangxi	407.204***	0.000	86..079***	0.000	2	3
Southwest	Region	0.000				
Sichuan	20.584***	0.000	259.210***	0.000	2	1
Yunnan	71.393***	0.000	248.340***	0.000	2	1
Guizhou	138.384***	0.000	114.342***	0.000	2	1
Chongqing	83.627***	0.000	128.933***	0.000	2	1
Tibet	217.139***	0.000	544.981***	0.000	2	1
Northwest	Region					
Shaanxi	3.974**	0.066	-8.299	1.000	1	1
Gansu	-12.011	1.000	-16.750	1.000	1	3
Qinghai	1053.1***	0.000	-7.0673	1.000	1	3
Ningxia	-13.655	1.000	-14.998	1.000	1	2
Xinjiang	-7.852	1.000	-13.712	1.000	1	3

*Note:Maximum n and p are respectively set to 2 and optimal n and p are determined by Schwarz information criterion.p-value is based on the bootstrap distribution with 3000 replications. ***,**, and * denote the statistical significance at 1, 5, and 10%, respectively*