# Is the tourism-economic growth nexus time-varying? Bootstrap rolling-window causality analysis for the top ten tourist destinations

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# Bootstrap rolling-window causality analysis for the top ten tourist destinations


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## Abstract

This paper explores the time-varying causal nexus between tourism development and economic growth for the top ten tourist destinations in the world, namely China, France, Germany, Italy, Mexico, the Russian Federation, Spain, Turkey, the United Kingdom and the United States of America, over the period 1990-2015. To that end, a bootstrap rolling window Granger causality approach based on the modified Granger causality test developed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996), is used. A new index for tourism activity which combines via principal component analysis the commonly used tourism indicators is also employed. The results of the bootstrap rolling window causality tests reveal that the causal relations between tourism and economic growth vary substantially over time and across countries in terms of both magnitude and direction. It is shown that the causal linkages tend to be more pronounced for a large group of countries following the global financial crisis of 2008. Additionally, Germany, France and China clearly stand out as the countries with the weakest causal nexus, while the UK, Italy and Mexico emerge as the countries that have the strongest causal links. These results have particularly important implications for policy makers.



**Keywords**: Tourism, economic growth, time-varying causality, bootstrap, rolling window causality

**JEL Code:** C15, C22, L83, O11

## 1. Introduction

Over the last years, tourism has become one of the largest and fastest growing sectors of the world economy and, consequently, it has turned into a key driver of socio-economic progress in many countries. According to data of the World Travel & Tourism Council (2015), the total contribution, including direct, indirect and induced impacts, of the travel and tourism industry to the worldwide economy in 2014 was around 9.8% of world GDP and 9.4% of world employment. Despite the challenging economic environment caused by the recent global financial crisis, the annual average growth rates of tourist arrivals and international tourism receipts worldwide over the period 2008-2014 have been 3.59% and 3.23%, respectively (World Tourism Organization, 2016), demonstrating the resilience of the tourism industry. Moreover, the United Nations World Tourism Organization (UNWTO) projects that international tourist arrivals will increase by approximately 3.3 per cent every year from 2010 to 2030 to reach 1.8 billion by 2030.

It is generally accepted that international tourism has a positive effect on long-run economic growth through various channels. First, tourism is a fundamental foreign exchange earner for many countries, allowing to import capital goods used in the production process. Second, tourism has an important role in stimulating investments in new infrastructure and competition between local firms and firms in other tourist countries. Third, tourism can boost other sectors of the economy such as construction, transportation, accommodation, food and entertainment via its direct, indirect and induced impacts. Fourth, another interesting feature of the tourism industry is its ability to generate new jobs, which causes an increase of household income and government tax revenues through multiplier effects. Fifth, tourism facilitates the exploitation of economies of scale in national firms. Finally, tourism can be regarded as an important factor in the diffusion of technical knowledge, promotion of research and improvement of human capital. This belief that tourism contributes positively to economic growth has given rise to the tourism-led economic growth (henceforth TLG) hypothesis, which has its origin in the export-led growth hypothesis and was first introduced by Balaguer and Cantavella-Jordá (2002). The TLG hypothesis states that higher economic growth of a country can be generated not only by increasing the amount of labor and capital within the economy, but also by expanding tourism exports.

A great deal of empirical research has been done to test the validity of the TLG hypothesis in a wide range of countries mostly using the notion of causality developed by Granger (1969). A common feature of the great majority of these causality-based studies is their static nature, as they implicitly assume the stability over time of the causality relationship between tourism activity and economic growth. However, the causal links between these variables may vary over time because of structural changes caused by major economic events, shifts in economic or tourism policies and/or changes in the political and social environment. Therefore, the empirical studies that examine the causality relationship between tourism activity and economic growth without taking into account the possible impact of structural changes on the causal connection are susceptible to misleading results and conclusions.

The purpose of this paper is to investigate the time-varying causal linkages between tourism development and economic growth for the world's top ten tourism destinations in terms of international tourist arrivals, namely France, the United States, Spain, China, Italy, Turkey, Germany, the United Kingdom, the Russian Federation and Mexico, using a bootstrap rolling window Granger causality approach. In particular, the rolling window estimation is incorporated into the modified Granger causality test developed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). The main advantage of using this modified causality test is that it does not require knowledge of the degree of integration and cointegration properties of the variables involved.

This article contributes to the existing literature in three ways. Firstly, to the best of our knowledge, this is the first attempt to explore the causal nexus between tourism development and economic growth in the top ten tourist countries using a time-varying framework. The rolling window Granger causality approach applied here allows capturing the time variation in the causal relations and, therefore, provides a comprehensive and detailed view of the tourism-economic growth link in the most popular tourist destinations worldwide. Secondly, a bootstrap-based causality test, which is robust to small sample size and pre-testing bias and the non-normality of the data, is adopted in this study. Thirdly, different from previous studies, a novel indicator of tourist activity, which combines in a single index the information contained in the three common measures of tourism (tourist arrivals, tourism receipts and tourism expenditures) and is constructed employing principal component analysis, is used in the present study.

Our empirical results clearly show the time-varying nature of the causal relations between tourism development and economic growth for all countries under scrutiny. Specifically, the causal linkages are more pronounced for a large group of countries in the period following the global financial crisis of 2008 and the subsequent economic downturn, reflecting the deep impact of these major financial and economic events on the tourism-economic growth link. Considerable differences are also found across countries in terms of the magnitude and direction of the causal connections between tourism activity and economic development. In particular, Germany, France and China emerge as the countries with the weakest causal linkages, possibly as a result of the limited weight of the tourism sector in the economies of these countries. In contrast, the UK, Italy and Mexico appear as the countries where the causal relations are more stable and stronger. Lastly, significant bidirectional Granger causality relationship where tourism and economic growth mutually reinforce each other are observed for most countries in the aftermath of the recent global financial crisis.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature on the relationship between tourism activity and economic growth. Section 3 presents the dataset. Section 4 introduces the econometric framework. Section 4 presents the dataset. Section 5 reports and discusses the main empirical results. Finally, Section 6 offers some concluding remarks.

## 2. Review of the literature

The relationship between tourism activity and economic growth has been the subject of a vast amount of research in the tourism economics literature, primarily from the early 2000s and for those countries in which the tourism sector plays a more prominent role.[1] Granger causality analysis is undoubtedly the most widely used technique to explore the tourism-economic growth link as the knowledge of the existence and direction of causal linkages is crucial for policy makers in order to design appropriate tourism and economic policies. Four main hypotheses regarding the causality relationship between tourism and economic development can be identified in the literature. The first and most popular interpretation of the tourism-economic growth link is the TLG hypothesis, according to tourism boosts economic growth because of the economic benefits of tourism, such as increases in foreign exchange earnings, investments in infrastructure, employment, income and tax revenues. This hypothesis implies

[1]A comprehensive survey of this literature can be found in Pablo-Romero and Molina (2013) and Brida et al. (2016).

unidirectional causality running from the tourism industry to economic growth and it has been empirically validated by the majority of studies (e.g. Bassil et al., 2015; Brida et al., 2008; Eeckels et al., 2012; Ghartey, 2013; Tang and Tan, 2015). The second view is the economic-driven tourism growth (EDTG) hypothesis, which asserts that economic growth contributes significantly to tourism expansion. Specifically, the sustained economic growth of a country facilitates the development of the tourism sector in that country as resources are available for tourism infrastructure, the positive economic climate encourages the proliferation of tourism activities and international tourists are also attracted by the country's economic vitality. The EDTG hypothesis postulates a unidirectional causality running from economic growth to tourism development and it has been empirically verified by, among others, Narayan, (2004), Oh (2005) and Payne and Mervar (2010). The third hypothesis, also called feedback hypothesis, means bidirectional causality between tourism and the economy, suggesting a mutually reinforcing effect between tourism development and economic growth. The validity of this hypothesis has been supported by, among others, Corrie et al. (2013), Dritsakis (2004), Kim et al. (2006) and Lean and Tang (2010). Finally, the neutrality hypothesis states that there is no causal relationship at all between tourism activity and economic growth. Several studies, such as those of Brida et al. (2010), Katircioglu (2009) and Ozturk and Acaravci (2009), have provided evidence in favour of the neutrality hypothesis for different countries. A summary of previous empirical studies on the tourism-economic growth relationship can be found in Table-1 in the appendix.

This conflicting evidence on the causal nexus between tourism and economic growth has been typically attributed to differences in the sample period analyzed, variables selected, frequency of observations employed, country coverage and/or version of Granger causality test applied. Nevertheless, the controversial causality results may also be due to the presence of structural changes in the time series data. Structural changes may induce shifts in the parameters, which may, in turn, lead to instability in the causal linkages over time. Thus, there may exist causal relations between tourism and economic growth in some periods and not in others. It is also possible that the nature and direction of the causality relationship differ a cross sub-samples.

A major limitation of most previous studies in this area is that they ignore possible time-varying patterns in the causal linkage between tourism and economic growth and base their causality inference on full-sample tests, which may give rise to misleading conclusions about the underlying relationship of causality. As a matter of fact, only a recent body of work has started to question the stability over time of the tourism-economic growth link. In this regard, a number of studies have demonstrated that the TLG hypothesis is generally valid and stable over time for the Malaysian economy using different causality approaches, although the tourism-economic growth link changes over time. In particular, Lean and Tang (2010) and Tang and Tan (2015) implemented the Granger causality test proposed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) on rolling sub-samples within a bivariate and a multivariate framework, respectively. Instead, Tang and Tan (2013) examined the validity and stability of the TLG hypothesis in Malaysia with disaggregated data by applying the recursive Granger causality test in an error correction model framework. In a similar vein, Arslanturk et al. (2011) utilized bootstrapped rolling window and state-space time-varying parameter estimation methods based on a vector error correction model (VECM) to analyze the time-varying Granger causality between tourism and economic growth in the case of Turkey. Their findings regarding the time-varying links reveal that tourism positively Granger causes economic growth only since 1983, while economic output has no predictive power for tourism receipts. Using a very similar methodology to Arslanturk et al. (2011), Balcilar et al. (2014) concluded that tourism receipts positively Granger cause economic growth in South Africa with the only exception of the period between 1985 and 1990. Moreover, economic growth also seems to have predictive power for tourism receipts. More recently, Tang and Abosedra (2016) have evaluated the persistency of the TLG in Lebanon in a trivariate framework by using the bootstrap causality approach of Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) with rolling estimation. The Granger causality tests confirm the validity and stability of the TLG hypothesis for the Lebanese economy, particularly after February 20008. From a different perspective, Antonakakis et al. (2015) analyzed the time-varying relationship between tourism and economic growth for ten European countries using rolling window estimations of the VAR (vector autoregressive)-based spillover index approach developed by Diebold and Yilmaz (2012). Their results have clearly shown the changing nature of the tourism-economic growth connection in terms of magnitude and direction. In particular, the tourism-economic growth link in European countries is highly sensitive to major economic events such as the great recession of 2007 and the subsequent Eurozone debt crisis that began in 2010. In any case, to our knowledge, no previous paper has dealt with the time-varying nature of the causal linkages between tourism development and economic growth for the world's principal tourist destinations.

## 3. Data description

This paper investigates the time-varying causal links between tourism development and economic growth using quarterly data over the period 1990Q1 to 2015Q4 for the top ten international tourist destinations in the world, namely China, France, Germany, Italy, Mexico, the Russian Federation, Spain, Turkey, the United Kingdom, and the United States of America. The dataset in this study consists of a novel indicator of tourism activity as a proxy for the volume of international tourism and real Gross Domestic Product (GDP) per capita in constant 2005 US dollars as a proxy for economic growth in each of the top ten tourist countries.

Three key variables have been traditionally used in the tourism economics literature to measure the volume of tourism flows: the total number of international tourist arrivals (Antonakakis et al., 2015; Katircioglu, 2009, Tang and Abosedra, 2016), international tourism receipts (Arslanturk et al., 2011; Balaguer and Cantavella-Jordá, 2002; Chen and Chiou-Wei, 2009) and international tourism expenditures (Aslan, 2015; Cárdenas-García et al., 2015; Tugcu, 2014). However, a major drawback of these indicators is that they only show a partial association with economic growth. Thus, tourist arrivals report the number of visitors, international tourism receipts reflect the income side and international tourism expenditures cover the expense side, although it is widely accepted that there is a very high positive correlation between these variables as a larger number of tourist arrivals means more receipts and more expenditures. As noted by Zaman et al. (2016), the simultaneous use of these three tourism activity indicators in a regression model might create a problem of multi-collinearity because of high correlations between them. It would therefore be advisable to use a comprehensive measure of tourism development which avoids multi-collinearity issues. To this end, a new tourism development indicator, defined as a weighted index of the three above mentioned indicators, is employed in this study. This weighted tourism index is constructed by applying Principal Component Analysis (PCA) on international tourist arrivals, international tourism receipts and international tourism expenditures for each of the ten countries under examination.[2] The main advantage of this novel indicator is that it brings together in a single index all the relevant information pertinent to the three traditional tourism variables.

[2]To conserve space, we have not reported the results of PCA and correlation analysis between tourism indicators but results are available upon request from authors.

The data on real GDP per capita come from the World Bank's World Development Indicators database (CD-ROM, 2016). The data on the number of arrivals of international tourists, international tourism receipts in current US$ and international tourism expenditures in current US$ are collected from the World Tourism Organization (2015). Moreover, all variables are transformed into natural logarithm form to ensure better distributional properties. In addition, the annual time series of real GDP per capita and weighted tourism activity indicator are transformed into quarterly data by applying a quadratic match-sum method, which is particularly suitable to avoid the small sample problem.[3] Furthermore, the quadratic match-sum approach adjusts for seasonal variations in the data while transforming data from low frequency into high frequency. In this regard, Cheng et al. (2012) note that the seasonality problem can be prevented by using a quadratic match-sum approach as this method reduces the point-to-point data variations. Therefore, the quadratic match-sum method is preferred to other interpolation alternatives due to its convenient operating procedure.

## 4. Methodology Framework: The bootstrap rolling-window Granger causality approach

According to Granger (1969), a variable is said to Granger causes another variable if including the first variable in the information set improves the forecast of the second variable over and above its own information. From a statistical perspective, the Granger causality tests are typically performed by examining the joint significance of the lagged values for the first variable in a predictive model for the second variable in the framework of a VAR model. Conventional Granger causality test statistics include the Wald, Likelihood ratio (LR) and Langrage multiplier (LM) statistics. These test statistics assume that the underlying time series are stationary and they may not have standard asymptotic distributions if the stationarity assumption does not hold. The difficulties that arise when estimating these VAR models with non-stationary data have been illustrated by Park and Phillips (1986) and Toda and Phillips (1993, 1994), among others. To overcome these problems, Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) proposed a modification to the conventional Granger causality test that allows obtaining a standard asymptotic distribution for the test statistic when the variables forming the VAR system are I(1). The modified Granger causality testing procedure developed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) (henceforth TYDL) is based on estimating a VAR($p$+1), where $p$ is the lag order, in levels of the variables. The key advantage of this test is that it remains valid irrespective of the order of integration and cointegration properties of the variables. As noted by Balcilar and Ozdemir (2013a,b), the essence of the modification is estimating a VAR($p$+1) and performing the Granger causality test on the first $p$ lags. In this way, one coefficient matrix, which relates to the ($p$+1)th lag, remains unrestricted under the null hypothesis, making the test to have a standard asymptotic distribution.

However, using Monte Carlo simulations Shukur and Mantalos (1997b) proved that the TYDL causality test does not have correct size in small- and medium-sized samples. Moreover, Shukur and Mantalos (1997a) showed that the critical values of the modified Wald causality test improve in terms of power and size properties by applying the residual-based bootstrap (RB) method. In addition, the robustness of the bootstrap approach to test for Granger causality has been recognized by numerous Monte Carlo simulation studies (e.g. Hacker and Hatemi-J, 2006; Mantalos and Shukur, 1998; Shukur and Mantalos,

[3]The quadratic match-sum method fits a local quadratic polynomial for each observation of the original annual time series, using the fitted polynomial to fill in all observations of the higher frequency (quarterly) series. The quadratic polynomial is formed by taking sets of three adjacent points from the original series and fitting a quadratic, so that the sum of the interpolated quarterly data points matches the actual annual data points.

2000). In particular, Shukur and Mantalos (2000) demonstrated that LR tests with small sample correction exhibit relatively better power and size properties, even in small samples. According to these findings and following, among others, Balcilar et al. (2010) and Tang and Abosedra (2016), this study uses the bootstrap version of the TYDL causality test to examine the Granger causality relationship between tourism and economic growth. To illustrate the bootstrap TYDL Granger causality test, we consider the following bivariate VAR(*p*) process:

$$y_t = \Phi_0 + \Phi_1 y_{t-1} + \ldots.. + \Phi_p y_{t-(p+1)} + \varepsilon_t \tag{1}$$

where $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})'$ is a white noise process with zero mean and non-singular covariance matrix Σ and *p* denotes the optimal lag length of the VAR system. To simplify the representation, the vector $y_t$ is partitioned into two sub-vectors, namely real GDP per capita ($GDP_t$) and tourism development ($TOUR_t$). Hence, Eq. (1) can be rewritten as follows:

$$\begin{pmatrix} GDP_t \\ TOUR_t \end{pmatrix} = \begin{pmatrix} \phi_{10} \\ \phi_{20} \end{pmatrix} + \begin{bmatrix} \phi_{11}(L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{bmatrix} \begin{pmatrix} GDP_t \\ TOUR_t \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix} \tag{2}$$

$\phi_{ij}(L) = \sum_{k=1}^{p+1} \phi_{ij,k} L^k$ , $i, j = 1, 2$ and *L*is the lag operator such that $L^k x_t = x_{t-k}$ .

Based on Eq. (2), the null hypothesis that tourism development does not Granger cause real GDP per capita can be tested by imposing the zero restriction $\phi_{12,k} = 0$ for $k = 1, 2, ..., p$ . Analogously, the null hypothesis that real GDP per capita does not Granger cause tourism development can be tested by imposing the restriction $\phi_{21,k} = 0$ for $k = 1, 2, ..., p$ . If the first null hypothesis $\phi_{12,k} = 0$ for $k = 1, 2, ..., p$ is rejected, there is significant unidirectional causality running from tourism development to economic growth. This means that tourism development can predict changes in economic growth. Likewise, if the second null hypothesis $\phi_{21,k} = 0$ for $k = 1, 2, ..., p$ is rejected, there is significant unidirectional causality running from economic growth to tourism development, implying that economic development contributes to tourism expansion. In the case that both hypotheses are rejected, the evidence points to bidirectional causality, which in this context implies a feedback system where tourism development and real GDP per capita reach to each other. It is also possible that neither of the two hypotheses are rejected, implying that neither of the two variables has predictive content for the other (neutrality hypothesis).

Before introducing the multivariate LR statistics for Granger causality, following Shukur and Mantalos (2000) we can define:

$$\begin{aligned}
&Y_t = (y_1, y_2, \ldots.. y_T) && (2 \times T)\ matrix, \\
&B = (\Phi_0, \Phi_1, \ldots.. \Phi_T) && (2 \times (2k+1)\ matrix, \\
&Z_t = (1, y_t, y_{t-1}, \ldots.. y_{t-p+1})' && ((2k+1) \times 1)\ matrix, \\
&Z = (Z_0, Z_t, \ldots.. Z_{t-1}) && ((2k+1) \times T)\ matrix,
\end{aligned}$$

$$\eta = (\varepsilon_1, \varepsilon_2, .... \varepsilon_T) \qquad (2\times T) \ matrix,$$

where $k = p+1$.

Using this notation, the augmented VAR($p$+1) model can be written compactly as follows:

$$Y = BZ + \eta \tag{3}$$

where $\hat{\eta}_u$ is the matrix of estimated residuals from the unrestricted regression and $\hat{\eta}_r$ denotes the matrix of estimated residuals from the restricted regression under the null hypothesis of no causality. Then, the variance-covariance matrix of these estimated residuals can be calculated as $\Sigma_u = \hat{\eta}_u^{'}\hat{\eta}_u$ and $\Sigma_r = \hat{\eta}_r^{'}\hat{\eta}_r$, respectively.

Next, the modified-LR TYDL test statistics can be computed as follows:

$$LR = (T-m)\times \ln\left(\frac{\det \Sigma_r}{\det \Sigma_u}\right) \tag{4}$$

where $T$ denotes the total number of observations, $m = 2\times(2k+1)+k$ is the small sample correction term and $k = p+1$ is the lag order of the VAR system. In addition, *det* stands for the determinant of the respective matrix and ln is the natural log.

According to Toda and Yamamoto (1995), the LR Granger causality test statistic given in Eq. (4) has a $\chi^2$ asymptotic distribution with degrees of freedom equal to the number of restrictions to be tested, which equals $p$ under the null hypothesis of no causality.

Although the applied economics literature offers several techniques for testing the existence of Granger causality in Eq. (2), this study applies the bootstrap method pioneered by Efron (1979), which utilizes critical values or $p$-values generated from the empirical distribution derived for the particular test using the sample data. In this study, the bootstrap estimates and bootstrap p-values are based on 2,000 repetitions.

The standard Granger causality tests assume that parameters of the VAR model used in testing remain constant over time. Nevertheless, this assumption is violated when the underlying full-sample data exhibit structural changes. This implies that the results derived from the causality tests based on the full sample become invalid and the causal links between the variables involved will show instability. In this respect, Granger (1996) emphasizes that the structural instability is one of the most challenging issues confronting empirical studies today as it may lead to ambiguous and biased results. It is possible to identify and incorporate the structural changes into the estimation using techniques such as sample splitting and dummy variables, but these procedures introduce pre-test bias. In order to overcome the possible parameter non-constancy and avoid pre-test bias, this paper adopts a rolling window Granger causality approach based on the bootstrap TYDL test. The rolling window estimation provides an appropriate framework for the detection of instability in the causal linkages between tourism development and economic growth across different sub-samples. Specifically, the rolling window techniques rely on fixed-size sub-samples rolling sequentially from the beginning to the end of the sample by adding one observation from ahead and dropping one from behind. Setting a fixed-size rolling window including $l$ observations, the full sample is converted into a sequence of $T$-$l$ sub-samples, that is, $t = \tau - l + 1, \tau - l, ....., \tau$ for $\tau = l, l+1, ...., T$. The bootstrap-based TYDL causality test is then applied to each sub-sample, instead of estimating a singly causality test for the entire sample. Possible changes in the causal linkages between tourism development and economic growth for each country can be intuitively identified by calculating the bootstrap $p$-values of observed LR statistics rolling through $T$-$l$ sub-samples.

Additionally, the magnitude of the effect of tourism development on economic growth as well as that of economic growth on tourism are also investigated. The cumulative effect of tourism development on real GDP per capita is calculated as the average of all bootstrap estimates, that is $N_b^{-1} \sum_{k=1}^{p} \hat{\phi}_{12,k}^{*}$, where $N_b^{-1}$ equals the number of bootstrap repetitions. Analogously, the cumulative effect of real GDP per capita on tourism development is obtained from the formula $N_b^{-1} \sum_{k=1}^{p} \hat{\phi}_{21,k}^{*}$. Both $\hat{\phi}_{12,k}^{*}$ and $\hat{\phi}_{21,k}^{*}$ are the bootstrap estimates from the VAR model in Eq. (2). The 95% confidence intervals are also computed, for which the lower and upper limits equal the 2.5th and 97.5th quantiles of each of the bootstrap estimates, respectively. These effects are measured rolling through the whole sample with a fixed window size of $l$ observations.

## 5. Empirical findings

### *5.1. Full-sample results*

To avoid the spurious regression problem that arises when statistical inferences are drawn from nonstationary time series, it is necessary to first examine the unit root properties of the data (Granger and Newbold, 1974; Phillips, 1986). Specifically, the Augmented Dickey-Fuller (ADF) unit root test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test are conducted to determine the order of integration of the variables. Based on Monte Carlo analysis, Amano and van Norden (1992) and Schlitzer (1995) showed that by using the combination of ADF and KPSS tests, the possibility of wrong conclusions on stationarity is minimized. Table 2 presents the results of ADF and KPSS tests on the levels and first differences of the novel tourism development indicator and real GDP per capita for each country. The ADF test fails to reject the null hypothesis of one unit root in the levels for all series at the usual significance levels. Further, the null hypothesis of a unit root is clearly rejected when the series are in first differences. Additionally, the KPSS test strongly rejects the null hypothesis of stationarity for all series in levels at the conventional levels, while it cannot reject the null of stationarity when the series are in their first differences. Based on this evidence, it can be concluded that the time series of weighted tourism indicator and real GDP per capita for all countries considered are I(1) processes.

**Table 1.** Results of unit root tests

| Country | Level | | First Differences | |
|---|---|---|---|---|
| | **ADF** | **KPSS** | **ADF** | **KPSS** |
| **Panel A:** Tourism development index | | | | |
| China | -1.648 (5) | 1.141 (9)*** | -4.027 (4)*** | 0.106 (8) |
| France | -1.481 (9) | 1.046 (9)*** | -3.196 (8)** | 0.368 (6) |
| Germany | -0.306 (9) | 1.249 (8)*** | -3.016 (8)** | 0.062 (4) |
| Italy | -1.136 (1) | 0.639 (8)** | -4.219 (0)*** | 0.053 (7) |
| Mexico | -1.916 (9) | 1.172 (8)*** | -3.643 (8)*** | 0.066 (1) |
| Russia | 0.496 (5) | 0.770 (9)** | -3.444 (12)** | 0.517 (8) |
| Spain | -1.921 (9) | 0.913 (9)** | -4.410 (8)*** | 0.568 (8) |
| Turkey | -1.175 (9) | 1.189 (8)*** | -3.874 (12)*** | 0.099 (1) |
| UK | -2.138 (1) | 1.039 (9)*** | -4.066 (0)*** | 0.224 (7) |
| USA | -1.543 (5) | 1.151 (8)*** | -4.373 (12)*** | 0.172 (7) |
| **Panel B:**Real GDP per capita | | | | |
| China | -1.669 (2) | 1.082 (9)*** | -3.767 (0)*** | 0.807 (5) |
| France | -1.743 (9) | 1.108 (9)*** | -4.214 (8)*** | 0.127 (6) |
| Germany | -0.444 (5) | 0.925 (9)*** | -3.232 (12)** | 0.342 (7) |
| Italy | -1.354 (9) | 0.934 (8)*** | -4.529 (8)*** | 0.120 (7) |
| Mexico | -1.166 (5) | 1.127 (8)*** | -3.010 (12)** | 0.556 (6) |
| Russia | -1.146 (5) | 0.871 (9)** | -4.962 (4)*** | 0.674 (7) |
| Spain | -1.290 (9) | 1.074 (9)*** | -3.230 (8)** | 0.214 (6) |
| Turkey | -0.271 (8) | 1.195 (8)*** | -3.114 (8)** | 0.151 (3) |
| UK | -1.629 (9) | 1.046 (8)*** | -4.242 (8)*** | 0.368 (7) |
| USA | -2.185 (5) | 1.147 (8)*** | -3.084 (4)** | 0.153 (4) |

**Note:** ADF and KPSS denote the statistics of the Augmented Dickey-Fuller (ADF) unit root test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test, respectively. The figure in the parentheses represents the optimal lag structure for the ADF test, determined by the Akaike information criterion (AIC), and the optimal bandwidth for the KPSS test, determined by Schwert's (1989) formula, $l = int\left\{4\left(T/100\right)^{1/4}\right\}$, where *int* is an integer and *T* denotes the number of observations.In addition, ***, ** and * indicate rejection of the null hypothesis of unit root at the 1%, 5% and 10% levels, respectively.

In order to shed light on the causality relationship between tourism development and real GDP per capita, the bootstrap version of the TYDL causality test is performed on the whole sample period. The optimal lag length of the VAR model for each of the top ten tourist countries is selected based on the Akaike information criterion (AIC). The full-sample bootstrap *p*-values for the TYDL causality test are obtained with 2,000 bootstrap replicates. Table 3 displays the results of this full-sample Granger causality test. As can be seen, the null hypothesis that tourism development does not Granger cause real GDP per capital is rejected at the usual levels for Italy, Mexico, the UK, the US and the Russian Federation. This finding means that causality flows from tourism development to economic growth for these five countries. In contrast, the null hypothesis that real GDP per capita does not Granger cause tourism development is rejected at the conventional levels for Italy, Mexico, Spain, the UK and the US. These results from the full-sample bootstrap Granger causality tests support the existence of bidirectional causality relationships between tourism development and economic growth for Italy, Mexico, the UK and the US. In turn, for the Russian Federation there is only Granger causality running from tourism development to real GDP, while for Spain the causality is from real GDP per capita to tourism development. Additionally, no causal link between tourism development and economic growth is found for China, France, Germany and Turkey over the entire sample period.

**Table 2.** Full-sample Granger causality tests between tourism and economic growth

| Country | *k* | $H_0$: Tourism does not cause GDP | | $H_0$: GDP does not cause Tourism | |
|---|---|---|---|---|---|
| | | ***LR*-Statistics** | **Bootstrap *p*-values** | ***LR*-Statistics** | **Bootstrap *p*-values** |
| China | 6 | 1.8855 | 0.6430 | 1.4530 | 0.5350 |
| France | 6 | 9.0140 | 0.1310 | 1.3959 | 0.5510 |
| Germany | 5 | 5.0797 | 0.3349 | 0.8431 | 0.7270 |
| Italy | 6 | 13.437** | 0.0160 | 52.027*** | 0.0000 |
| Mexico | 4 | 14.287* | 0.0812 | 38.131** | 0.0140 |
| Russia | 6 | 11.994** | 0.0400 | 1.6176 | 0.6380 |
| Spain | 7 | 8.2372 | 0.0709 | 30.149*** | 0.0000 |
| Turkey | 3 | 0.0857 | 0.9620 | 5.2304 | 0.2060 |
| UK | 5 | 11.605* | 0.0607 | 18.435*** | 0.0010 |
| USA | 6 | 10.947* | 0.0790 | 17.768** | 0.0410 |

**Note:** The optimal lag order (k) of the VAR model is determined by the AIC. The *p*-values are based on 2,000 bootstrap replicates. As usual, ***, ** and * indicate rejection of null hypothesis of no causality at the 1%, 5% and 10% significance level, respectively.

However, it is worth noting that this full-sample causal inference may be seriously biased in the presence of structural changes, which produce shifts in the parameters and may alter the pattern of causality over time. Accordingly, tests for short-run and long-run parameter stability are conducted in this study. In practice, a number of tests can be utilized to examine the temporal stability of VAR models (e.g. Andrews 1993; Andrews and Ploberger 1994). Although it is straightforward to apply these tests to stationary systems, the variables in our model are nonstationary and may be cointegrated and, therefore, this integration-cointegration property should be taken into account. In a cointegrated VAR, the variables form a VECM and the stability of the long-run and short-run parameters needs to be investigated. If the long-run or cointegration parameters are stable, the model exhibits long-run stability. Moreover, if the short-run parameters are also stable, the model has full structural stability. Since the estimators of cointegration parameters are super-consistent, stability testing can be split into two steps. In the first step, the stability of the cointegration parameters is checked. In the second step, the stability of the short-run parameters of the VAR model is tested. To evaluate the stability of long-run parameters, the $L_c$ test put forward by Nyblom (1989) and Hansen (1992) is used. The $L_c$ test is an LM test for parameter constancy against the alternative hypothesis that the parameters follow a random walk process and are, hence, time-varying. When the series are I(1), the Nyblom-Hansen $L_c$ test serves as a test of cointegration. In the second step, the Sup-LR, Mean-LR and Exp-LR tests developed by Andrews (1993) and Andrews and Ploberger (1994) are used to investigate the stability of the short-run parameters. All these three tests are computed from the sequence of LR statistics that test the null hypothesis of constant parameters against the alternative of a one-time structural change at each possible time in the sample. These tests have non-standard asymptotic distributions and the critical values are available from Andrews (1993) and Andrews and Ploberger (1994). In order to avoid the use of asymptotic distributions, the critical values and *p*-values for all stability tests are obtained from a parametric bootstrap approximation to the null distribution of the test statistics, constructed by means of Monte Carlo simulation using 2,000 samples generated from a VAR model with constant parameters.

Table 4 reports the outcome of these tests of parameter constancy for tourism development and real GDP per capita equations along with the associated *p*-values. The $L_c$ test is calculated for each equation separately using the fully modified OLS estimator of Phillips and Hansen (1990) and also for the entire VAR system. Unlike the $L_c$ test, the Sup-LR, Mean-LR, and Exp-LR tests require trimming at the ends of the sample. Following Andrews (1993), Balcilar and Ozdemir (2013a, b) and Balcilar et al. (2010), among others, we trim 15% from both ends and calculate these test statistics for the fraction of the sample in [0.15, 0.85]. The results for the $L_c$ test of stability of cointegration parameters indicate that both tourism and real GDP per capita equations do not have constant long-run parameters at the usual levels. Moreover, the system $L_c$ test statistics show that the VAR model as a whole turns out to be unstable at the 1% level for all countries. In addition, the Sup-LR, Mean-LR, and Exp-LR test statistics reject the null hypothesis of short-run parameter constancy at the conventional significance levels in tourism development and real GDP per capita equations in a large number of cases for most countries. In sum, the evidence from the parameter stability tests suggests that the estimated VAR models do not have constant long-run and short-run parameters, supporting the existence of structural changes. Consequently, any statistical inference based on the assumption of parameter constancy is likely to be invalid. Based on these findings, it can be concluded that the results of Granger causality tests between tourism development and economic growth based on the full sample for the main world's tourist destinations are not reliable.

**Table 3.** Results of short-run and long-run parameter stability tests

| | **Tourism equation** | | **Real GDP equation** | |
|---|---|---|---|---|
| | Statistics | p-values | Statistics | p-values |
| 1). China | | | | |
| Sup-LR | 5.8493 | [0.5000] | 4.9983 | [0.3920] |
| Exp-LR | 2.0682 | [0.1320] | 1.2279 | [0.2380] |
| Mean-LR | 3.1158* | [0.0840] | 4.2073* | [0.0620] |
| $L_c$ | 1.5716*** | [0.0000] | 1.2203*** | [0.0000] |
| $L_c$ for system | 4.2126*** | [0.0050] | | |
| 2). France | | | | |
| Sup-LR | 9.4697* | [0.0312] | 4.8240 | [0.2980] |
| Exp-LR | 0.5836 | [0.7150] | 1.3294 | [0.1380] |
| Mean-LR | 1.0312 | [0.7320] | 2.2431 | [0.1160] |
| $L_c$ | 0.6043** | [0.0217] | 0.6084** | [0.0211] |
| $L_c$ for system | 4.4543*** | [0.0050] | | |
| 3). Germany | | | | |
| Sup-LR | 3.9393 | [0.4940] | 9.1740* | [0.0700] |
| Exp-LR | 0.7627 | [0.6460] | 1.0166 | [0.4090] |
| Mean-LR | 1.2756 | [0.6840] | 1.3027 | [0.6650] |
| $L_c$ | 0.9486*** | [0.0000] | 0.8808*** | [0.0000] |
| $L_c$ for system | 6.0009*** | [0.0050] | | |
| 4). Italy | | | | |
| Sup-LR | 8.6038** | [0.0420] | 12.514** | [0.0210] |
| Exp-LR | 1.5227** | [0.0120] | 2.4754** | [0.0380] |
| Mean-LR | 1.9588 | [0.2730] | 1.9158 | [0.2680] |
| $L_c$ | 0.6220** | [0.0190] | 0.8754*** | [0.0000] |
| $L_c$ for system | 2.6284*** | [0.0050] | | |
| 5). Mexico | | | | |
| Sup-LR | 9.7705** | [0.0320] | 4.1565 | [0.3760] |
| Exp-LR | 0.6595 | [0.6380] | 0.9820 | [0.2760] |
| Mean-LR | 4.0351*** | [0.0072] | 1.7255 | [0.2470] |
| $L_c$ | 0.7961*** | [0.0000] | 0.7513*** | [0.0000] |

| | | | | |
|---|---|---|---|---|
| $L_c$ for system | 1.5775*** | [0.0010] | | |
| 6). Russia | | | | |
| Sup-LR | 3.9652 | [0.5540] | 5.9365 | [0.1370] |
| Exp-LR | 0.9353 | [0.4760] | 1.8761** | [0.0420] |
| Mean-LR | 1.6861 | [0.4090] | 3.3029** | [0.0310] |
| $L_c$ | 1.4104*** | [0.0000] | 0.5996** | [0.0224] |
| $L_c$ for system | 1.5485*** | [0.0050] | | |
| 7). Spain | | | | |
| Sup-LR | 7.5945* | [0.0870] | 10.394** | [0.0130] |
| Exp-LR | 1.0796 | [0.3190] | 1.9054** | [0.0440] |
| Mean-LR | 1.3071 | [0.6680] | 2.5188 | [0.1100] |
| $L_c$ | 0.6558** | [0.0134] | 0.9576*** | [0.0000] |
| $L_c$ for system | 3.7338*** | [0.0050] | | |
| 8). Turkey | | | | |
| Sup-LR | 9.2597** | [0.0570] | 2.9870 | [0.6570] |
| Exp-LR | 1.2292 | [0.2320] | 0.5556 | [0.7660] |
| Mean-LR | 1.0993 | [0.7280] | 1.0543 | [0.7350] |
| $L_c$ | 0.7503*** | [0.0000] | 0.4930** | [0.0422] |
| $L_c$ for system | 5.5192*** | [0.0000] | | |
| 9). UK | | | | |
| Sup-LR | 23.831*** | [0.0010] | 28.635*** | [0.0010] |
| Exp-LR | 7.6564*** | [0.0010] | 10.056*** | [0.0010] |
| Mean-LR | 1.5753 | [0.4480] | 2.8642* | [0.0670] |
| $L_c$ | 0.3849* | [0.0850] | 0.5719** | [0.0267] |
| $L_c$ for system | 2.0105*** | [0.0050] | | |
| 10). USA | | | | |
| Sup-LR | 10.692** | [0.0190] | 13.587*** | [0.0080] |
| Exp-LR | 2.1396** | [0.0310] | 2.9039** | [0.0100] |
| Mean-LR | 2.2818 | [0.1400] | 2.3151* | [0.0910] |
| $L_c$ | 0.4271* | [0.0641] | 0.4654* | [0.0501] |
| $L_c$ for system | 3.0960*** | [0.0001] | | |

**Note:** The null hypothesis for all tests is that the estimated parameters are constant. The *p*-values for the long-run and short-run parameter stability tests are calculated using 2000 bootstrap repetitions. The Hansen-Nyblom $L_c$ parameter stability test has been calculated for each equation separately and for the VAR system as a whole. As usual, ***, ** and * indicate rejection of null hypothesis of no causality at the 1%, 5% and 10% significance level, respectively.

### *5.2. Bootstrap rolling window causality results*

Given the results of parameter stability tests, the time-varying nature of the causal links between tourism development and economic growth is investigated applying the bootstrap-based TYDL Granger causality test in a rolling window estimation framework. Two basic reasons justify the use of the rolling window regression technique. First, the rolling window estimation allows the relationship between variables to evolve over time. Second, the rolling window causality approach accommodates potential structural breaks and regime shifts in the causal relations between tourism development and real GDP per capita. In each step of the rolling window estimation the lag length of the VAR model is chosen using the AIC and the Granger causality test is performed applying the bootstrap method on each sub-sample. A critical choice parameter in rolling estimations is the window size, which determines the number of observations covered in each sub-sample and also the total number of rolling estimates. More importantly, the window size controls the precision and representativeness of the sub-sample estimates. A large window size provides more precise estimates, but may reduce their representativeness, particularly in the presence of heterogeneity. On the contrary, a small window size reduces heterogeneity and improves representativeness of parameters, but it may increase the standard error of estimates, which reduces parameter accuracy. Consequently, the window size should be set to balance the trade-off between representativeness and accuracy. According to Balcilar et al. (2010), there is no strict criterion for selecting the window size in a rolling window estimation. Using Monte Carlo simulations, Pesaran and Timmermann (2005) demonstrated that the optimal window size depends on persistence and size of the break. Moreover, they proposed that the minimum limit of window size must be 20 when there are frequent breaks. Considering the above-mentioned trade-off between accuracy and representativeness and based on the simulation results in Pesaran and Timmermann (2005), a window of 24 quarterly observations (a time horizon of six years) is selected. This window size excludes the observations required for lags and hence is the actual number of observations in the VAR model. Given that the small window size chosen may lead to imprecise estimates, bootstrap techniques are applied to each sub-sample estimation in order to obtain parameter estimates and tests with better precision.

Figures 1-10 plot the bootstrap *p*-values of the rolling causality test statistics and the magnitude of the cumulative effect of each series on the other for each of the top ten tourist destinations under scrutiny. The horizontal axis shows the final observation in each of the 24-quarter rolling sub-samples. Panels a and b in each figure depict the bootstrap *p*-values of the rolling test statistics for the null hypothesis of no Granger causality between tourism development and economic growth and the opposite case, respectively. When the red lines, reflecting the estimated *p*-values, are above the black horizontal line, which represents the 10% significance level, the null hypothesis of no causal relationship between the weighted tourism indicator and real GDP per capita cannot be rejected at the 10% level. In turn, panels c and d report the bootstrap estimates of the sum of the rolling coefficients measuring the effect of economic growth on tourism development and vice versa, respectively.

The bootstrap rolling TYDL causality test results for China are presented in Figure 1. It can be seen that the causal linkages between tourism development and economic growth for China are rather weak throughout the study period. Specifically, the null hypothesis that tourism development does not Granger cause real GDP per capita (Panel a) is only rejected at the 10% significance level, beyond some punctual cases, during the sub-periods from early 2004 to mid-2005 and from mid-2012 to early 2014. Figure 1 panel c shows that tourism development has a significantly positive effect on Chinese real GDP only in the sub-periods from early 1995 to mid-1997 and from early 2013 to late 2014, confirming the poor impact of tourism development on economic growth in China. In addition, the null hypothesis that real GDP per capita does not Granger cause tourism (panel b) is rejected at the 10% level basically during the sub-periods from mid-2004 to early 2007 and from the beginning of 2013 to late 2014. Figure 1 panel d corroborates the limited effect of economic growth on tourism development in China as a significant positive impact of tourism, although with very low values, is only found in some short time intervals in 2002, 2007 and 2014.

The estimation results for France, displayed in Figure 2, reveal that the causal relations between tourism development and economic growth in French case are equal or even lower than in China. The null hypothesis that tourism development does not Granger cause real GDP per capita is only rejected at the 10% level during some months of 2009 and in some punctual occasions in 2013 and 2014 (Figure 2 panel a). Figure 2 panel c shows that tourism has a significant negative effect on real GDP per capita only in 2009 and from 2012-2014 and a significant positive effect, although with very low values, between 1995-1997 and 2003-2005. In turn, the null hypothesis that real GDP per capita does not cause tourism development can be rejected at the 10% level during 1999 and 2009, some months of 2004 and from 2012 to 2014 (Figure 2 panel b). Figure 2 panel d confirms the weak impact of economic growth on tourism in France as a significant positive effect of real GDP per capital is only observed during the years 2001 and 2009.

Interestingly, Germany emerges as the country with the weakest causal links between tourism and economic growth (Figure 3), especially from tourism development to economic development. Thus, the null hypothesis that tourism does not Granger cause real GDP per capita is only rejected at the 10% level in a punctual occasion at the beginning of 2003 and for some months between 2007 and 2008 (Figure 3 panel a). Figure 3 panel c corroborates this finding and a significant negative effect of tourism development on German real GDP is only observed in several months in 1997 and between 2012 and 2013. In addition, the null hypothesis that real GDP per capita does not Granger cause tourism development in Germany can be rejected at the 10% level only for the sub-period from late 2011 to late 2014 (Figure 3 panel b). Consistent with this result, Figure 3 panel d only shows a significant positive effect of real GDP on tourism development for the sub-period from late 2007 to late 2008.

The scarce evidence of Granger causality relationships between tourism development and economic growth for Germany, France and China is not surprising taking into account the limited weight of tourism in these three countries. For example, Germany and, to a lesser extent, France are the leading European economies and they are specialized in non-tourism related and technologically advanced industries such as automobiles, machinery, aerospace sector and chemicals. Moreover, the tourism sector only accounts for an insignificant share of the Chinese economy. Our findings concerning the poor tourism-economic growth link are in accordance with those previously reported by Antonakakis et al. (2015) for Germany and Chiang (2012) and Li et al. (2015) for China.

In contrast, Italy appears as one of the countries with a greater presence of Granger causality between tourism development and economic growth. The null hypothesis that tourism development does not Granger cause real GDP per capita is rejected at the 10% significance level for several sub-periods since the beginning of the 2000s, the most largest of which extends from late 2008 to mid-2014 (Figure 4 panel a). In turn, the null hypothesis that real GDP per capita does not Granger cause tourism development is rejected at the 10% level mainly during the sub-period from late 2008 to early 2015 (Figure 4 panel b). Panels c and d in Figure 4 indicate that the effect of tourism development on real GDP and vice versa in Italia is rather weak. However, a significant positive effect in both directions is observed for the sub-period from mid-2011 to mid-2013, although its magnitude is more pronounced from real GDP per capita to tourism development. These results confirm the existence of significant bidirectional causality between tourism development and economic growth for Italy from late 2008 onwards and are in line with those obtained by Massidda and Mattana (2013) using a little older sample.

Mexico is another of the countries where significant causal connections between tourism development and economic growth are detected more regularly, although the Granger causality running from tourism development to economic development is predominant. In particular, the null hypothesis that tourism development does not Granger cause real GDP per capita is rejected at the 10% significance level during the sub-periods from early 1995 to early 1997, early 2001 to mid-2003, early 2004 to early 2005 and late 2009 to early 2014 (Figure 5 panel a). For its part, the null hypothesis that real GDP per capita does not Granger cause tourism development is rejected at the 10% level for the sub-periods from early 1995 to late 1996, early 2001 to mid-2003 and late 2011 to late 2013 (Figure 5 panel b). Panels c and d in Figure 5 show that the impact of tourism development on economic growth and vice versa in Mexico is in general quite limited, but the effect of tourism development on real GDP tends to be slightly more significant in line with the results of Brida et al. (2008).

The results from the bootstrap rolling window causality estimation for the Russian Federation are plotted in Figure 6. Panels a and b in Figure 6 also show a relatively high proportion of significant causal relations between tourism development and economic growth for Russia. In turn, panels c and d in Figure 6 suggest that the effect of tourism development on economic growth and vice versa is generally low, even though an important negative effect of real GDP per capita on tourism activity is found in the sub-period from late 2012 to early 2014. Overall, the evidence in Figure 6 supports the validity of the feedback hypothesis between tourism development and the economy for the Russian Federation during a substantial part of the whole sample, particularly from early 2000 to mid-2003, late 2008 to early 2010, and late 2012 to early 2014.

For Spain, the results given in Figure 7 panel a indicate that the null hypothesis that tourism development does not Granger cause real GDP per capita is rejected at the 10% level during the sub-periods from mid-2004 to early 2005, some months in 2007 and from late 2008 to late 2012. The results in Figure 7 panel b reveal that the null hypothesis that real GDP per capita does not Granger cause tourism development is rejected at the 10% level in the sub-periods from late 1996 to late 1997, mid-2001 to mid-2002, late 2004 to late 2005 and from late 2008 to late 2013. Similarly to Italy, panels c and d in Figure 7 show significant positive effects in both directions from late 2008 onwards, although the impact of economic growth on tourism development tends to be larger than in the opposite case. These findings support the feedback hypothesis between tourism activity and economic growth in the Spanish case from the onset of the global financial crisis in September 2008. This change in the tourism- growth link for Spain from the start of the recent international financial crisis is in line with the evidence of Antonakakis et al. (2015). Furthermore, the existence of bidirectional causal links between tourism and the economy for Spain aligns with the results of Cortés-Jiménez and Pulina (2010) and Mérida and Golpe (2016).

The estimation results for Turkey given in Figure 8 show that the causal linkages between tourism development and economic growth fluctuate widely over time and the direction of causality runs mainly from tourism activity to economic development. To be more precise, the null hypothesis that tourism does not Granger cause real GDP per capita is rejected at the 10% level during the sub-periods from mid-1995 to mid-1998, a few months between 2004 and 2005, and from late 2012 to mid-2014. In contrast, the null hypothesis that real GDP per capita does not Granger cause tourism is rejected at the 10% level during some months of 2000 and 2004 and from late 2012 to early 2014. Panels c and d in Figure 8 corroborate the weak impact of tourism development on economic growth and vice versa. The unstable character of the causal tourism-growth nexus for Turkey provides an explanation for the conflicting and time-dependent findings of previous works in this field for the Turkish case (Arslanturk et al., 2011; Aslan, 2015; Ertugrul et al., 2015; Katircioglu, 2009; Ozturk and Acaravci, 2009).

Figure 9 reports the estimation results for the UK. Panels a and b show that the UK is, together Italy and Mexico, the country with the highest proportion of significant causal linkages between tourism development and economic growth in both directions and especially since 2010. Panels c and d in Figure 9 confirm the significant positive effect of tourism on real GDP per capita and vice versa mainly from the beginning of 2010. This significant bidirectional Granger causality relationship between tourism development and economic development for the UK is consistent with the feedback effect previously documented by Louca (2013a). For the US, the results of panels a and b in Figure 10 reveal a clear predominance of the causal relations from real GDP per capita on tourism, mostly since the beginning of the 2000s, over the opposite direction. The stronger positive effect of real GDP per capita on tourism is supported by panels c and d in Figure 10. This evidence in favor of the EDTG hypothesis for the US economy is in line with the findings of Hatemi-J et al. (2015) and is, however, contrary to the results obtained by Tang and Jang (2009) for several US tourism-related industries using a sample that ends in 2005.

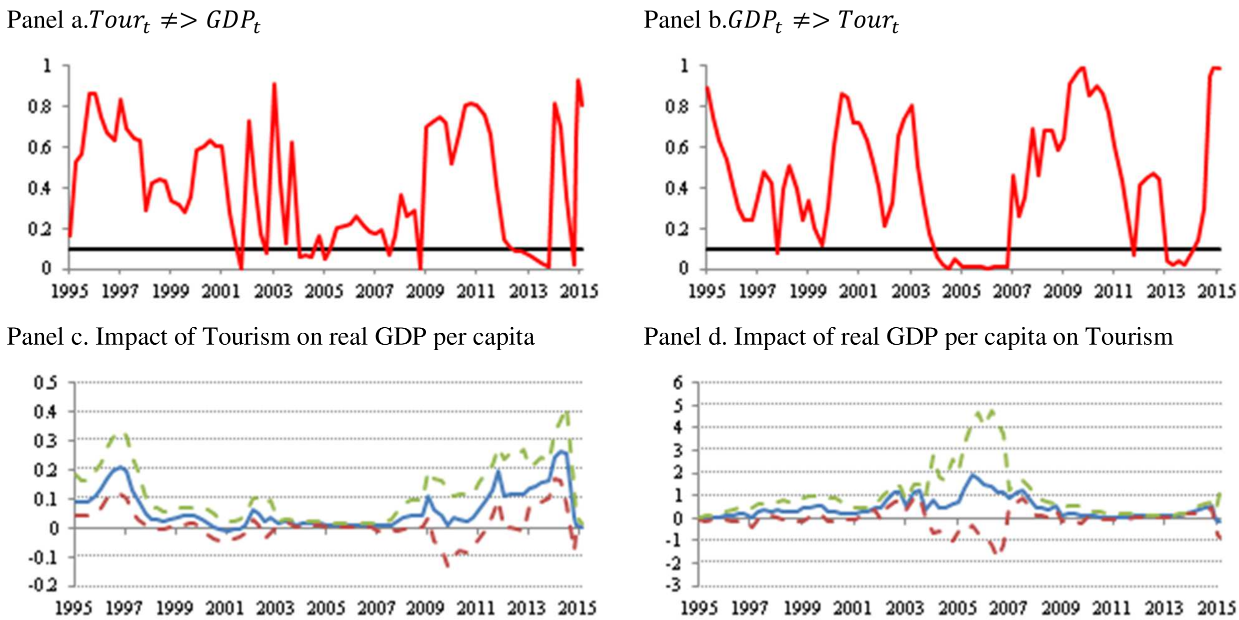
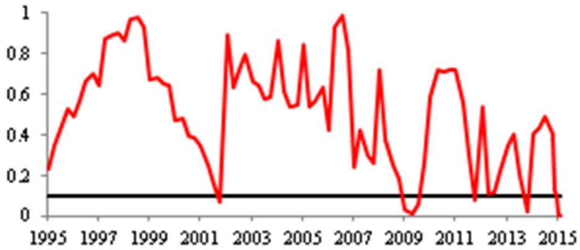
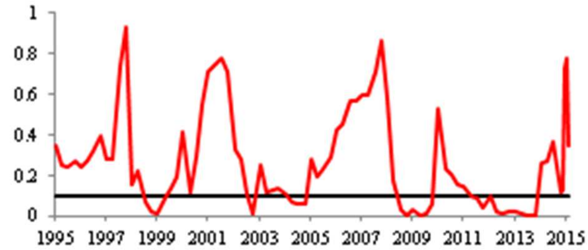



**Figure 1:** Rolling window estimates for China

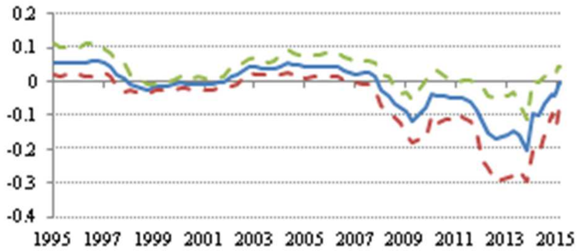
Panel a. $Tour_t \neq> GDP_t$



Panel b. $GDP_t \neq> Tour_t$



Panel c. Impact of Tourism on real GDP per capita



Panel d. Impact of real GDP per capita on Tourism

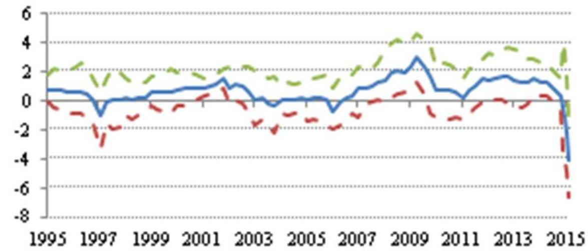
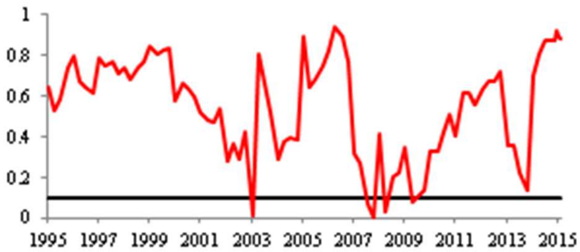
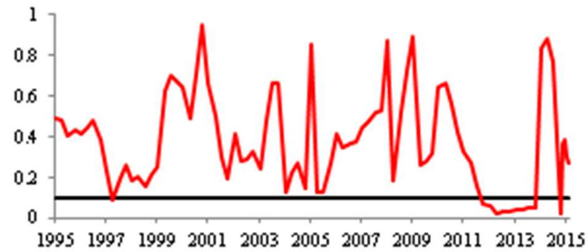


**Figure 2:** Rolling window estimates for France

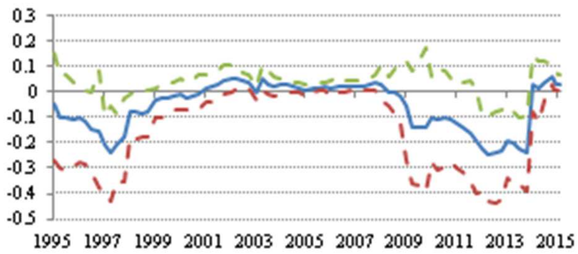
Panel a. $Tour_t \neq> GDP_t$



Panel b. $GDP_t \neq> Tour_t$



Panel c. Impact of Tourism on real GDP per capita



Panel d. Impact of real GDP per capita on Tourism

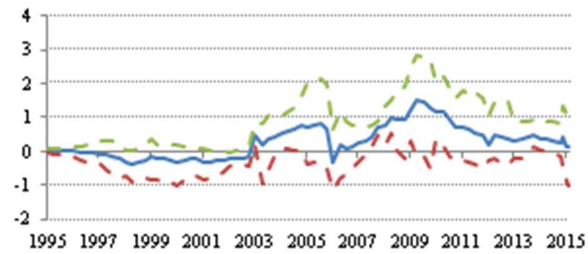
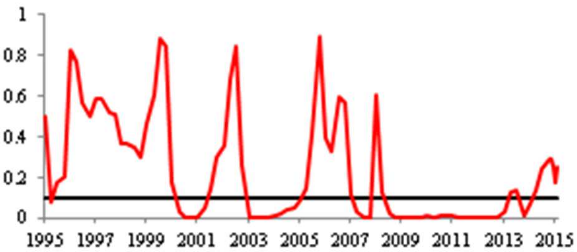
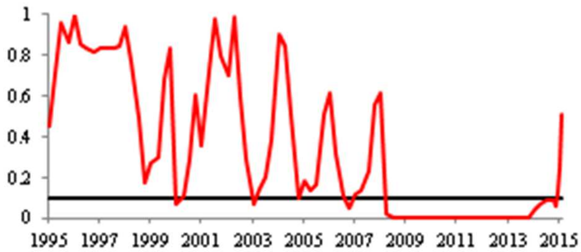


**Figure 3:** Rolling window estimates for Germany

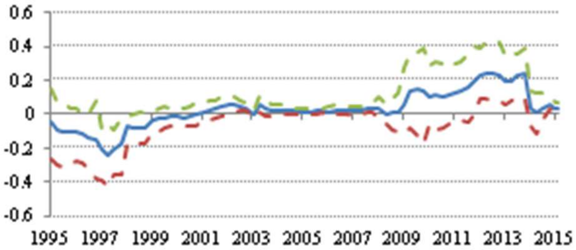
Panel a. $Tour_t \neq> GDP_t$




Panel b.$GDP_t \neq> Tour_t$




Panel c. Impact of Tourism on real GDP per capita




Panel d. Impact of real GDP per capita on Tourism

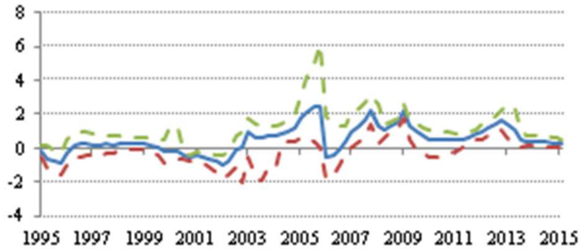
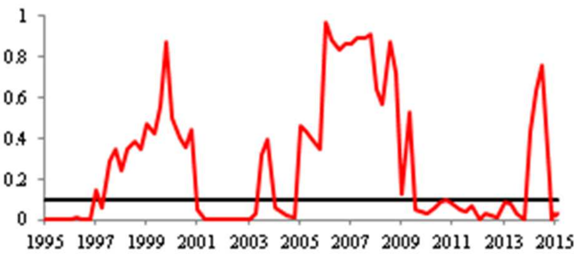
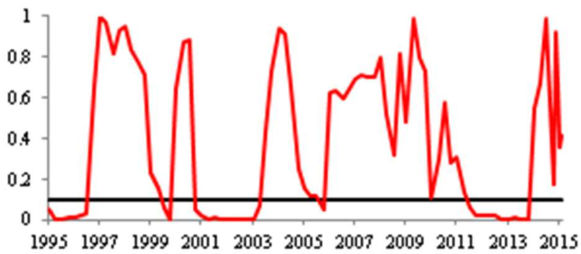



**Figure 4:** Rolling window estimates for Italy

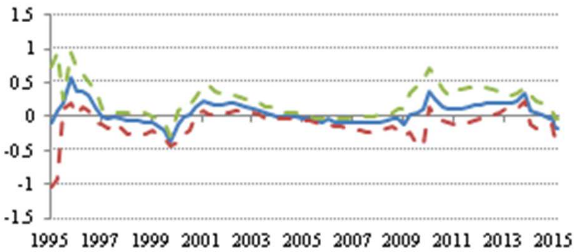
Panel a. $Tour_t \neq> GDP_t$




Panel b.$GDP_t \neq> Tour_t$




Panel c. Impact of Tourism on real GDP per capita




Panel d. Impact of real GDP per capita on Tourism

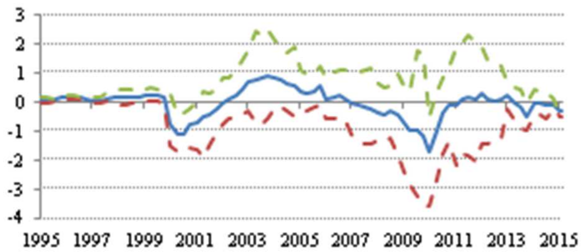
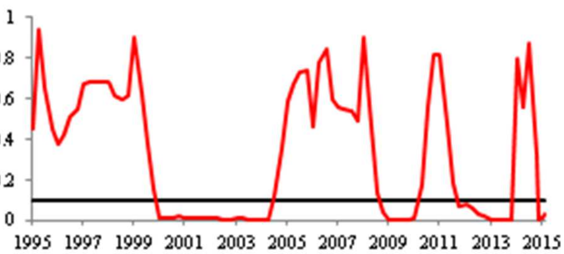
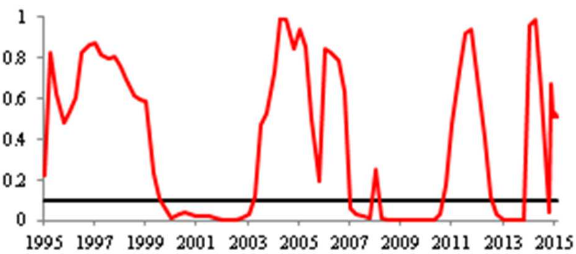



**Figure 5:** Rolling window estimates for Mexico

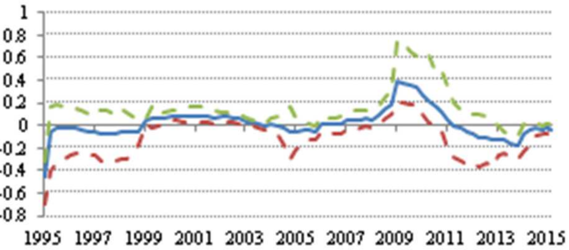
Panel a. $Tour_t \neq> GDP_t$




Panel b. $GDP_t \neq> Tour_t$




Panel c. Impact of Tourism on real GDP per capita




Panel d. Impact of real GDP per capita on Tourism

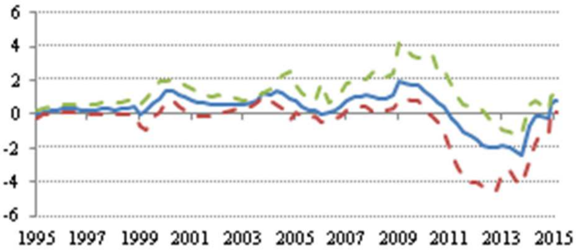
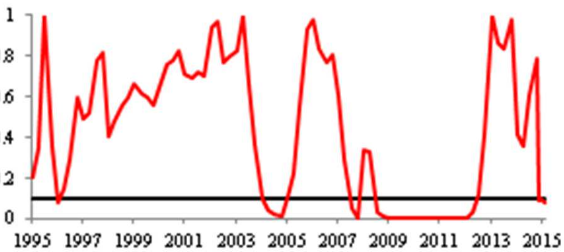
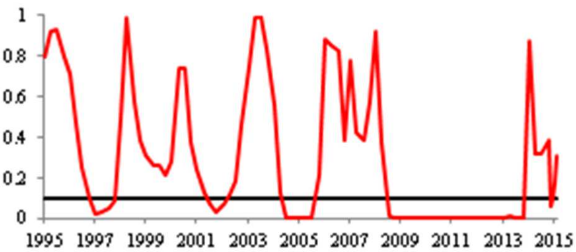



**Figure 6:** Rolling window estimates for Russia

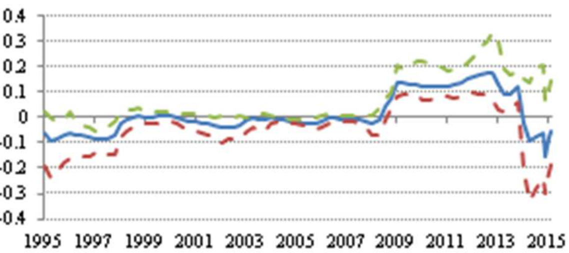
Panel a. $Tour_t \neq> GDP_t$




Panel b. $GDP_t \neq> Tour_t$




Panel c. Impact of Tourism on real GDP per capita




Panel d. Impact of real GDP per capita on Tourism

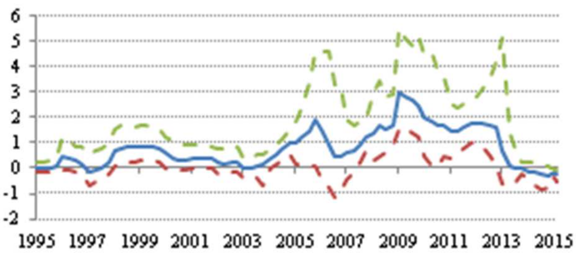
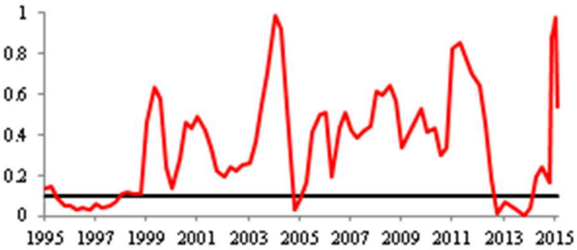
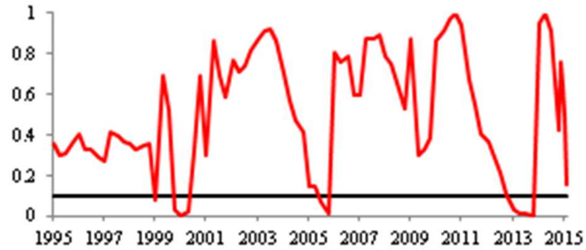



**Figure 7:** Rolling window estimates for Spain

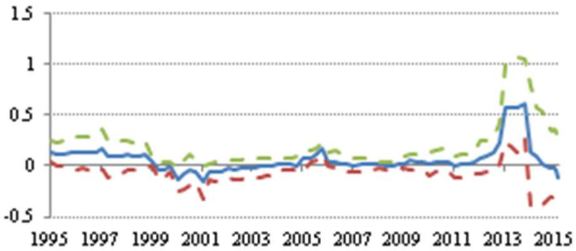
Panel a. $Tour_t \neq> GDP_t$




Panel b. $GDP_t \neq> Tour_t$




Panel c. Impact of Tourism on real GDP per capita




Panel d. Impact of real GDP per capita on Tourism

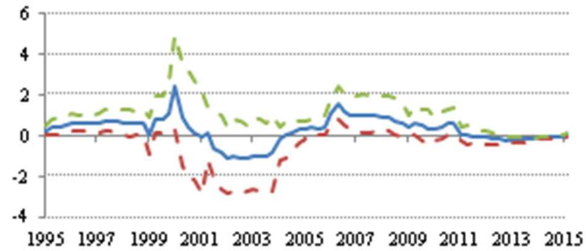
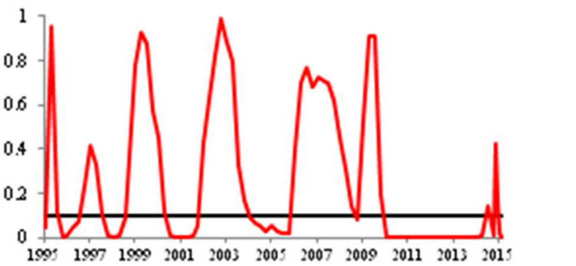
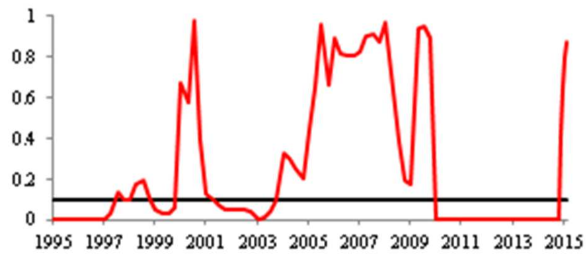



**Figure 8:** Rolling window estimates for Turkey

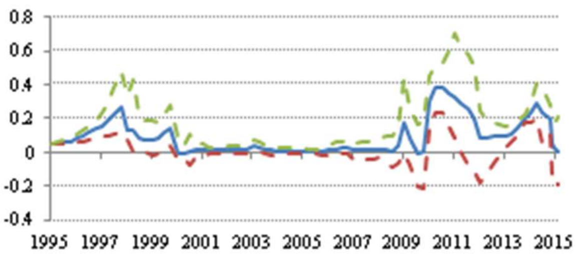
Panel a. $Tour_t \neq> GDP_t$




Panel b. $GDP_t \neq> Tour_t$




Panel c. Impact of Tourism on real GDP per capita




Panel d. Impact of real GDP per capita on Tourism

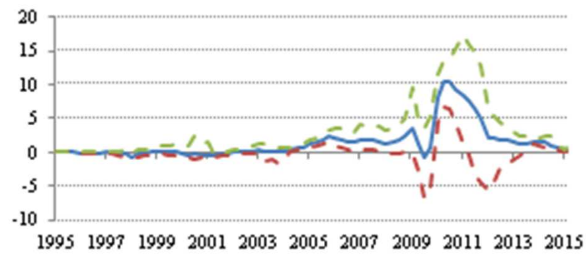
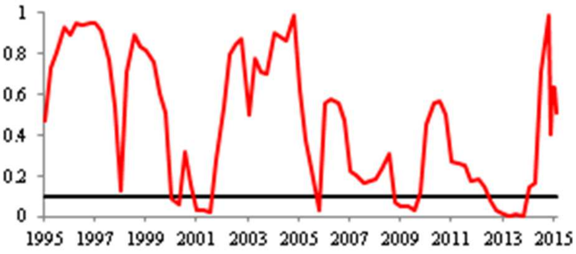
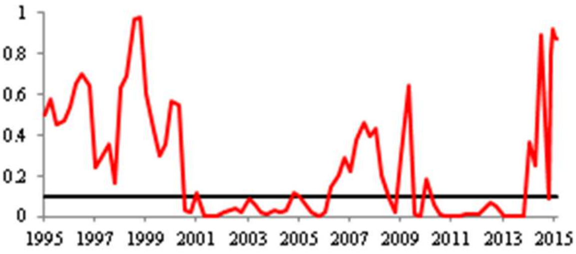



**Figure 9:** Rolling window estimates for UK

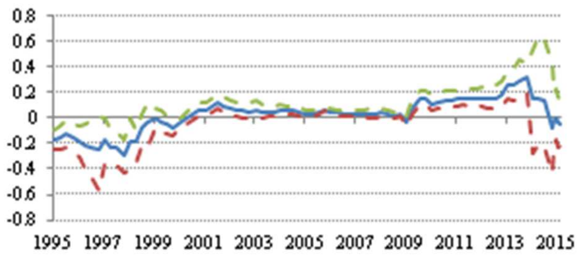
Panel a. $Tour_t \neq> GDP_t$




Panel b. $GDP_t \neq> Tour_t$




Panel c. Impact of Tourism on real GDP per capita




Panel d. Impact of real GDP per capita on Tourism

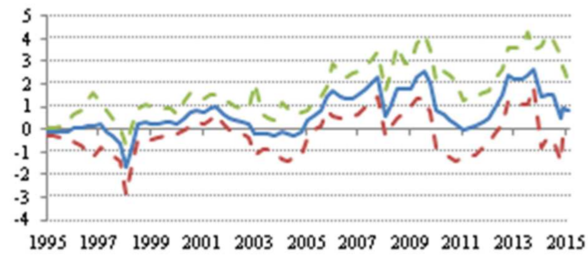



**Figure 10:** Rolling window estimates for USA

Overall, three major remarks can be derived from the results of the bootstrap rolling window Granger causality tests. Firstly, the tourism-economic growth causal nexus is clearly time-varying for the top ten world tourist destinations. This finding is in line with that obtained by Arslanturk et al. (2011) for Turkey, Lean and Tang (2010) and Tang and Tan (2013 and 2015) for Malaysia, Balcilar et al. (2014) for South Africa, Tang and Abosedra (2016) for Lebanon and Antonakakis et al. (2015) for ten European countries. More precisely, a stronger causal link between tourism development and the economy is evident for several countries in the period following the global financial crisis of 2008. Second, there are notable differences across countries in terms of the magnitude and direction of the causal relations. This heterogeneity among countries may be explained by the distinct relative importance of the tourism sector on their respective economies, the production structure and capacity restraints of each country and the relevance of local businesses in the tourism sector of each country. Thirdly, significant feedback effects, meaning that tourism expansion helps economic growth while economic growth also benefits the increase of the tourism activity, are observed for most countries in the aftermath of the recent global financial crisis. One critical implication of this result is that the severe economic downturn caused by the recent worldwide financial crisis and its associated climate of uncertainty along with the austerity measure adopted by numerous countries to decrease their fiscal deficits brought about lower investments and disposable income and, hence, reduced tourism demand and spending.

## 6. Conclusions and policy implications

This paper examines the time-varying causal nexus between tourism development and economic growth for the top ten tourist destinations worldwide over the period 1990-2015 employing a bootstrap rolling window version of the modified Granger causality test developed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). A novel tourism activity indicator, based on the application of PCA on the three usual measures of tourism (tourist arrivals, tourism receipts and tourism expenditures), is used in this study. Much of the previous literature investigating the existence of Granger causality relationships between tourism development and economic growth rests on the assumption that the causal linkage remains stable across the whole sample period. However, the inference of these full-sample causality tests is likely to be invalid when the underlying time series are subject to structural changes. In contrast, the bootstrap rolling window approach allows the causal relations to vary over time and provides, therefore, a more realistic and nuanced picture of the tourism- growth link.

Several interesting results emerge from this analysis. First, the causal linkages between tourism development and economic growth are not stable over time in terms of both magnitude and direction for all countries under consideration. In particular, for a large set of countries the aforementioned causal relations tend to be more pronounced following the intensification of the global financial crisis in September 2008 (bankruptcy of Lehman Brothers). This finding demonstrates that the recent international financial crisis and the resulting economic downturn have had a profound impact on the tourism- growth relationship. Second, the pattern of causality between tourism activity and the economy varies considerably across countries. For example, Germany, China and France stand out as the countries with the weakest causal nexus, possibly because the very low weight of the tourism sector in these economies. On the contrary, the UK, Italy and Mexico are the countries that have the strongest causal relations. Third, despite the heterogeneity among countries, significant bidirectional Granger causality relationships are found for a wide range of countries such as Italy, Russia, Spain, Turkey and the UK, mainly in the aftermath of the worldwide financial crisis of 2008.

The empirical evidence presented in this study has important implications for policy makers and business agents. Firstly, in order to maximize the beneficial effect of tourism and economic policies on the general economy and the tourism sector, respectively, policy making should be flexible and sensitive to the time-varying nature of the tourism-economic growth link rather than exhibiting a rigid and inertial behavior. Secondly, given the significant feedback effects between tourism development and economic development observed for most countries during the severe economic downturn following the global financial crisis, tourism policies aimed at alleviating the negative effects of poor economic conditions on the tourism sector should be taken especially in times of crisis. These measures would avoid the collapse of the tourism industry and would serve to pave the way for full exploiting the positive synergies between tourism and the economy when the economic conditions improve in the near future. Thirdly, the significant dynamic feedback effects between tourism and real GDP found in many countries also provide valuable information to help business actors make the best decisions taking into account the specific phase of the economic cycle.

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## Appendix

**Table 1:** Studies on Tourism Development-Economic Growth Nexus

| No. | Authors | Method | Period | Countries | Findings |
|---|---|---|---|---|---|
| 1 | Ghali (1976) | OLS | 1953-1970 | Hawaii | $T \rightarrow Y$ |
| 2 | Balaguer and Cantavella-Jorda (2002) | VECM | 1975-1997 | Spain | $T \rightarrow Y$ |
| 3 | Dritsakis (2004) | VECM | 1960-2000 | Greece | $T \leftrightarrow Y$ |
| 4 | Durbarry (2004) | VECM | 1952-1999 | Mauritius | $T \leftrightarrow Y$ |
| 5 | Narayan (2004) | VECM | 1970-2000 | Fiji | $T \leftarrow Y$ |
| 6 | Oh (2005) | GC | 1975-2001 | Korea | $T \leftarrow Y$ |
| 7 | Kim et al. (2006) | GC | 1971-2003 | Taiwan | $T \leftrightarrow Y$ |
| 8 | Lee and Chien (2008) | J-J, WE | 1959-2003 | Taiwan | $T \leftrightarrow Y$ |
| 9 | Brida et al. (2008) | J-J, WE | 1980-2007 | Mexico | $T \rightarrow Y$ |
| 10 | Tang and Jang (2009) | GC | 1981Q1-2005Q4 | USA | $T \leftarrow Y$ |
| 11 | Ozturk and Acaravci (2009) | ARDL, VECM | 1987-2007 | Turkey | $T \neq Y$ |
| 12 | Katircioglu (2009) | ARDL, J-J | 1960-2006 | Turkey | $T \neq Y$ |
| 13 | Belloumi (2010) | J-J VECM | 1970-2007 | Tunisia | $T \leftarrow Y$ |
| 14 | Cortés-Jimenez and Pulina (2010) | J-J, VECM | 1954-2004 | Spain, Italy | $T \leftrightarrow Y$ |
| 15 | Akinboade and Braimoh (2010) | J-J, VECM | 1980-2005 | South Africa | $T \rightarrow Y$ |
| 16 | Lean and Tang (2010) | TYDL | 1989-2009 | Malaysia | $T \leftrightarrow Y$ |
| 17 | Payne and Mervar (2010) | TYC | 2000-2008 | Croatia | $T \leftarrow Y$ |
| 18 | Brida et al. (2010) | J-J, VECM | 1987-2006 | Uruguay | $T \rightarrow Y$ |
| 19 | Arslanturk et al. (2011) | VECM, TVC | 1963-2006 | Turkey | $T \rightarrow Y$ |
| 20 | Mishra et al. (2011) | J-J, VECM | 1978-2009 | India | $T \rightarrow Y$ |
| 21 | Katircioglu (2011) | ARDL, VECM | 1960-2007 | Singapore | $T \rightarrow Y$ |
| 22 | Eeckels et al. (2012) | VECM, IRF | 1976-2004 | Greece | $T \rightarrow Y$ |
| 23 | Lee (2012) | ARDL, VECM | 1980-2007 | Singapore | $T \leftrightarrow Y$ |
| 24 | Tang (2012) | ARDL, VECM | 1974-2009 | Malaysia | $T \leftrightarrow Y$ |
| 25 | Tang and Tan (2013) | Recursive GC, ECM | 1995M1-2009M2 | Malaysia | $T \rightarrow Y$ |
| 26 | Massidda and Mattana (2013) | SVECM | 1987-2009 | Italy | $T \leftrightarrow Y$ |
| 27 | Hye and Khan (2013) | J-J, ARDL | 1971-2008 | Pakistan | $T \rightarrow Y$ |
| 28 | Corrie et al. (2013) | J-J, VECM | 2000-2010 | Australia | $T \leftrightarrow Y$ |
| 29 | Ghartey (2013) | J-J, VECM | 1968-2008 | Jamaica | $T \rightarrow Y$ |
| 30 | Louca (2013a) | J-J, VECM | 1980-2012 | UK | $T \leftrightarrow Y$ |
| 31 | Louca (2013b) | J-J, VECM | 1995-2012 | France | $T \rightarrow Y$ |
| 32 | Bouzahzah and Menyari (2013) | J-J, VECM | 1980-2010 | Morocco, Tunis | $T \rightarrow Y$ |
| 33 | Jalil et al. (2013) | ARDL, GC | 1972-2011 | Pakistan | $T \rightarrow Y$ |
| 34 | Surugiu (2013) | J-J, VECM | 1988-2009 | Romania | $T \rightarrow Y$ |
| 35 | Balcilar et al. (2014) | VECM | 1960-2011 | South Africa | $T \leftrightarrow Y$ |
| 36 | Tang and Abosedra (2014) | ARDL, VECM | 1995-2010 | Lebanon | $T \rightarrow Y$ |

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| 37 | Ridderstaat et al. (2014) | VECM | 1972-2011 | Aruba | $T \leftrightarrow Y$ |
| 38 | Trang et al. (2014) | J-J, VECM | 1992-2011 | Taiwan | $T \rightarrow Y$ |
| 39 | Aslan (2015) | ARDL, VECM | 2003-2012 | Turkey | $T \leftrightarrow Y$ |
| 40 | Bassil et al. (2015) | GC, IRF | 1995-2013 | Lebanon | $T \rightarrow Y$ |
| 41 | Tang and Tan (2015) | J-J, TYDL | 1991-2014 | Malaysia | $T \rightarrow Y$ |
| 42 | Ertugrul et al. (2015) | ARDL, VECM | 1998-2011 | Turkey | $T \rightarrow Y$ |
| 43 | Pavlic et al. (2015) | J-J, VECM | 1996-2013 | Croatia | $T \neq Y$ |
| 44 | Antonakakis et al. (2015) | GC, SIA | 1995–2012 | ItalyNetherlands<br>Cyprus<br>Germany<br>Greece<br>Austria<br>Portugal<br>Spain<br>Sweden<br>UK | $T \rightarrow Y$<br>$T \rightarrow Y$<br>$T \leftarrow Y$<br>$T \leftarrow Y$<br>$T \leftarrow Y$<br>$T \leftrightarrow Y$<br>$T \leftrightarrow Y$<br>$T \leftrightarrow Y$<br>$T \neq Y$<br>$T \neq Y$ |
| 45 | Tang and Abosedra (2016) | BC | 1995-2011 | Lebanon | $T \rightarrow Y$ |
| 46 | Mérida and Golpe (2016) | GC | 1980-2013 | Spain | $T \leftrightarrow Y$ |
| 47 | Hatemi-J (2016) | BCL | 1995-2014 | UAE | $T \rightarrow Y$ |

Note: T denotes Tourism and Y Economic Growth, respectively. Moreover, OLS represents Ordinary Least Squares, VECM is Vector Error Correction Method, GC is Granger Causality, J-J denotes the Johansen-Juseliuscointegration test, WE represents Weak Exogeneity, TYDLC means Toda-Yamamoto and Dolado-LütkepohlGranger Causality test, TVC is Time-varying causality, BC is Bootstrap Causality, BCL means Bootstrap Causality with Leverage Adjustments, IRF represents Impulse Response Function, SVECM is Structural Vector Error Correction Model and SIA represents Spillover Index Approach.