Tourism and GDP short-run causality revisited: a Symbolic Transfer Entropy approach. [*]

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Abstract

We employ a symbolic transfer entropy panel data test in a large-scale data set to provide new insights on the worldwide short-term causality relations between growth and inbound tourists. Using a large data set on 145 countries from the World Bank Open Data website, we show that, despite the evidently strong correlation between these two magnitudes, claiming that the increases in inbound tourists Granger-cause positive shocks in GDP is not supported by the data. By contrast, the data seem to point out in the direction of a reverse causality in that it is GDP growth what drives international inbound tourists in the short run.

Keywords: Transfer entropy causality test, Tourism-led growth hypothesis, Longitudinal data.
JEL classification: C12, C14, C33, C55.

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1 Introduction

One of the most outstanding features of the modern global economy is the increase in the demand of touristic services (Scott, Hall and Gössling, 2019; Gössling, Scott and Hall, 2013). Based on data from the 2020 World Tourism Organization (UNWTO) barometer, the international tourist arrivals increased at an almost a constant rate of 4.6% per year between 2000 and 2019, the fastest growing rate being that of the Asia & Pacific with almost 7.8%. In fact, tourism is being a key component of GDP not only in small countries such as Maldives, Seychelles and Cape Verde where it accounts for more than one third of the total domestic product, but also in the well-developed economies of Italy, France or Spain, where it reached double percentage digits in this period.

This paper is a proposal to give a unique and robust answer to the question of the short-term causal link between inbound tourism and economic growth at the worldwide level. From an empirical point of view, the analysis of the nature of this relationship has been the source of a vast amount of research (Brida, Cortes-Jimenez and Pulina, 2016) in the last decades. In this paper, we aim to deal with a twofold issue often discussed in the literature on tourism economics: the direction of causality and the choice of an appropriate methodological approach to detect the potential complexity of the relationship between tourism and economic growth.

On the one hand, the causal relationship between inbound tourism and growth, if any, can flow either from the inbound tourism to economic growth, from economic growth to inbound tourism, or bidirectionally. In this sense, tourism can have leading influences on economic growth in several ways. Tourism spending provides direct revenues for the national tourism industry, for example on hotels, restaurants and shops. In addition, the recipients of the direct expenditures spend the money in intermediate goods, hiring employees and maintenance of equipment. Finally, the beneficiaries of these revenues spend them in goods and services, which clearly promotes growth. Among others, Khan, Phang and Toh (1995), Lee and Kwon (1995), Khalil, Kakar and Malik (2007), and Narayan et al. (2010) have examined this multiplier effect of tourism on national income, investment, job creation and the balance of payment around the world.

Besides, the economic-driven tourism growth hypothesis states that economic growth may also drive tourism. In particular, the development of a touristic industry requires building a previous stock of physical (Borodako and Rudnicki, 2014), human and social capital (Khan et al., 2020) or natural and cultural development (Dugulan et al., 2010) being accumulated in a previous process of growth. Furthermore, export promotion and economic growth are reinforced each other (Bahmani-Oskooee and Alse, 1993), which agrees with the view that export-driven economic growth can be a causal component of tourism growth.

Empirically, the actual direction of causality is still under debate and the empirical results seem to be region-dependent. Some authors, such as Cortés-Jiménez and Pulina (2010) and Nowak et al. (2007) for Spain or Po and Huang (2008) and Tang (2011) for some world regions, find that tourism leads economic growth. Others, like Chen and Chiuo-Wei (2009) or Demiroz and Ongan (2005) find bidirectional causality for South Korea and Turkey, respectively. Yet others, such as Lee and Chang (2008), Lorde, Francis and Drakes (2011) and Oh (2005) find a unidirectional causality running from economic growth to tourism for African Countries, Barbados and Korea, respectively.

On the other hand, the standard methodological approach to check for short-run relationships between tourism and economic growth relies on Granger causality tests, as in the examples of Akinboade and Braimoh (2010), Tang and Abosedra (2012) or Nayaran et al. (2010).[1] Notably, most of the causal analyses performed in the literature are based on linear, parametric models, where an autoregressive representation of the time series is required. However, these approaches ignore the complexity and non-linearities that characterize the time series related to tourism, where turning points and structural breaks are likely to be present, as documented in Baggio and Sainaghi (2016) and Sainaghi and Baggio (2017, 2019).

In the context of causal analysis, Camacho, Romeu and Ruiz (2021) show that the size and power of causality tests based on linear representations are seriously deteriorated when the data generating process displays non-linearity, cross-section heterogeneity, structural breaks, outliers or higher order moment dependence. These problems arise frequently in longitudinal data and therefore must be taken into consideration particularly in the context of panel touristic demand data analysis.

To avoid all of these drawbacks, we adapt the Symbolic Transfer Entropy (STE) causality test proposed by Camacho, Romeu and Ruiz (2021) to revisit the short-run relationship between GDP and tourist arrivals using a large panel of 145 countries over 20 years. The STE test maps the information set of the series dynamics into the space of symbols formed with the ordinal patterns of a number of consecutive values (or "histories"). Then, the transfer entropy measure associated with the symbol data is used to build a causality test in the spirit of Granger. When the data at hand suffer from some of the problems listed above, this test is proved to yield the proper size and greater power than the linear alternatives used in the literature.

According to our results, asserting that increases in inbound tourists Granger-cause positive shocks in GDP is not supported by the data. Conversely, the data seem to point out in the direction of a reverse causality in that it is GDP shocks what drives international tourism development. It is worth emphasizing that this reverse causality is found only in the short-run.

The rest of the article is structured as follows. Section 2 introduces a brief review of the most recent literature on empirical research of the relationship between tourism and economic growth. Section 3 introduces a causality test for panels that is robust to many of the data problems that are common to data on tourism. Section 4 presents the main results and section 5 concludes.

2 Literature Review

The empirical analysis of the relationship between tourism and economic development has important policy implications. Governments, authorities and institutions around the world use the results as a guideline and often recommend to promote tourism as a way to improve the eco-

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[1] The analysis of long-run relationships typically relies on cointegration tests as in Othman et al., (2012) or Lee and Kwag (2013), among many others. Our paper does not pursue this issue.

nomic growth and development in an economy. As stated in the UNWTO web site " [Tourism growth and diversification] have turned tourism into a key driver for socioeconomic progress". Yet, the recent contributions point out that this assertion should be deemphasized once we take a worldwide look to the causality of tourism on growth as a global empirical law, particularly if the focus is on the short-run relationship as we do.

In the literature on tourism economics, some analyses focus on samples of countries that are limited to a few destinations. Among others, examples are Dritsakis, 2004 for Greece, Kim, Chen, and Jang, 2006 for Taiwan, and Akinboade and Braimoh, 2010 for South Africa. This precludes their empirical results from being used as universally valid recipe for growth. Some exceptions to this reduced scope are Tang and Abosedra (2014), who use a dynamic panel data specification on 24 countries of Middle East and North Africa or Chou (2013), who uses a panel of 10 countries.

Enlarging the cross-section dimension, Sequeira and Nunes (2008) use data for more than 90 countries from 1980 to 2002. They specify a dynamic equation for the log of per capita GDP and tourism specialization which is estimated using two methods, GMM and a Fixed Effects corrected model alternatively. Their findings suggest a very modest impact of tourism exports shares on GDP ranging below 0.1%. Moreover, they find that the significance of the estimated elasticity coefficient is very sensitive to the choice of the conditioning set of variables and, in particular, to how institutional stability is measured.

An even weaker result is obtained in Arezki, Chrerif and Piotrowski (2009), who use data for 127 countries and the same sample period. Using the number of cultural heritage sites as an instrument for tourism specialization, they find that the impact of tourism on per capita GDP growth is below 0.02%. In a recent paper, Chen and Ioannides (2020) build a dedicated instrument and obtain an estimate of the effect of tourism specialization of around 0.1%. The coefficient is found to be significant for a sample of OECD countries alone and not on the wider panel. In addition, the work of Enilov and Wang (2021) considers 23 developing and developed countries in the 1981-2017 period and uses a rolling-window to investigate the stability of the relationship between tourism and growth along the sample. They find differences on the strength of the tourism-growth link along the period, and differences between developed and developing countries as well. Interestingly, these authors find that the link is stronger at the very short-run, with just one lead period, than in the case of longer leads.

The lack of a clear-cut result on the short-term causality of tourism to economic growth compels us to examine the tourism-growth relationship under a framework that should be as much robust as possible to three potentially disruptive problems. First, we should choose testing causality rather than estimating contemporaneous correlations in growth equations. Eilat and Einav (2004) pointed out the role of unobserved shocks, such as global conflicts or the perception of political risk, which may lead to potential endogeneity problems. Instead, we focus on Granger causality tests, which amount to test the significance of lags of the potentially cause variable altogether in an specification with other covariates and lags of the endogenous variables.

Second, we should be aware of the existence and extent of unobservable heterogeneity in longitudinal panels. The different units in the panel should be treated differently because, for example, a policy recommendation for Barbados may not work for Poland. Thus, analyzing panels of a big number of countries must handle this feature. Kónya (2006) propose a SUR estimation method with country-specific bootstrap critical values for the Wald test. Dumitrescu and Hurlin (2012) go a step beyond and develop a corrected Wald test statistic and a testing procedure for heterogeneous panels, where bootstrap is not required, although the same authors rely on bootstrapping in the case of cross-section dependence.

Last but not less important, virtually all of the contributions on Granger causality tests in tourism economics commit to linear specifications. However, as shown in Camacho, Romeu and Ruiz (2021), the results of testing causality in linear panel models are highly sensitive to the presence of structural breaks, extreme observations or non-linearity in the parameters and by design, they are only able to detect causality in the first order moments of the data generating process. To avoid this drawback, these authors use multiple-unit symbolic dynamics and the concept of transfer entropy to develop a non-parametric Granger causality test procedure for longitudinal data, extending the previous work of Matilla-Garcia, Ruiz-Marin and Dore (2014) to a panel of units. In the case of tourism economics, Baggio and Sainaghi (2016) and Sainaghi and Baggio (2017, 2019) documented the complex nature of tourism systems for several tourism destinations. Thus, with a large panel, the presence of data problems in tourism time series are expected to be the norm rather than the exception.

Thus, we aim to tackle these issues simultaneously by adopting the symbolic transfer entropy causality test developed by Camacho, Romeu and Ruiz-Marin (2021) so as to examine the role of tourism in economic growth and vice versa since, as shown in the next section, this framework allows us to analyze the predominant direction of information transfer between these two macroeconomic aggregates in an easy way.

3 Symbolic Transfer Entropy and Causality Test

3.1 Symbolization of univariate time series

Symbolization is basically a mapping procedure from a real-valued time series into a discrete symbol space S_m where m indicates the embedding dimension. Consider the case of a panel data variable $\{y_{it}\}$, for cross-sections $i = 1, \ldots, N$ and dates $t = 1, \ldots, T$. The mapping starts by slicing the original data into a sequence of consecutive observations or m-histories with window size m, i.e.,

$$\mathbf{y}_m^{i,t} = (y_{it}, y_{i(t+1)}, \ldots, y_{i(t+m-1)}), \tag{1}$$

where now t runs from $t = 1$ to $T^* = T - m + 1$.

An increasing ordinal pattern is applied to these data. Each of the m-histories is now sorted in increasing order and each observation is replaced by their corresponding index positions. Thus, if the result of the sorting operation applied to (1) is

$$y_{i(t+s_1)} \leq y_{i(t+s_2)} \leq \cdots \leq y_{i(t+s_m)}, \tag{2}$$

the associated ordinal pattern is the m-tuple $\mathbf{s}(\mathbf{y}_m^{it}) = (s_1, \ldots, s_m)$. Ties can be solved using the norm that $s_{j-1} < s_j$ if $y_{i(t+s_{j-1})} = y_{i(t+s_j)}$.

Each of these m-tuples is a symbol $\mathbf{s}^m$ that belongs to the symbol space S_m with $m!$ as the number of elements. Repeating this procedures for the whole sequence of m-histories we obtain the symbolized series.[2]

The symbolized series keeps most of the time dynamics of the original series in that it replicates the patterns of evolution of groups of observations but reduces the sampling space to a discrete one for which it is relatively simple to compute the empirical frequencies of the different symbols:

$$p_y(\mathbf{s}_m) = \frac{\sum_{i,t} \mathbf{I}\{\mathbf{s}_m = \mathbf{s}(\mathbf{y}_m^{it})\}}{N(T-m+1)}, \tag{3}$$

for any $\mathbf{s}_m \in S_m$ with $\mathbf{I}(\cdot)$ being the indicator function. The information content in the sample as defined in Shannon (1948), can be naturally measured using the Shannon entropy of the symbolization of the series y as:

$$h_m^y = -\sum_{\mathbf{s}_m \in \mathbf{S}_m} p_y(\mathbf{s}_m) \ln(p_y(\mathbf{s}_m)). \tag{4}$$

The Shannon entropy computes the sample average of the expected value of the amount of information in every symbolized $m$history, or equivalently, the degree of uncertainty of the data, given by the term $\ln(p_y(\mathbf{s}_m))$ in (4). Thus, the lower bound of this measure is zero and would be the one obtained, for instance, when the original series y is monotonically increasing or decreasing. Conversely, if the series is a random white-noise, the quantity in (4) is bounded from above by $\ln(m!)$.

3.2 Symbolization of bivariate time series

The previous approach can be extended to the bivariate case. Say $\{y_{it}, x_{it}\}$ the two panel series and $S_m^2 = S_m \times S_m$ the Cartesian product of the space of symbols with typical element $\mathbf{s}_m^2$. Say $\mathbf{s}(\mathbf{y}_m^{it})$ and $\mathbf{s}(\mathbf{x}_m^{it})$ the symbols obtained from the symbolization procedure of y and x respectively. The sample frequency of each symbol in $\mathbf{s}_m^2 \in S_m^2$ is now the result of

$$p_{yx}(\mathbf{s}_m^2) = \frac{\sum_{i,t} \mathbf{I}\{\mathbf{s}_m^2 = \left(\mathbf{s}(\mathbf{y}_m^{it}), \mathbf{s}(\mathbf{x}_m^{it})\right)\}}{N(T-m+1)}. \tag{5}$$

The bivariate Shannon entropy can be now obtained as

$$h_m^{y,x} = -\sum_{s \in \mathbf{S}_m^2} p_{yx}(\mathbf{s}_m^2) \ln\left(p_{yx}(\mathbf{s}_m^2)\right), \tag{6}$$

which measures the joint entropy common to both time series. The joint and the marginal entropy measures, define the entropy of y conditional on x and vice versa, conceived as the

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[2] As a quick example, consider the series {45, 23, 36, 21, 28, 19, 30, 42, 34,27}. Taking $m = 3$ we obtain the eight m-histories {(45,23,36),(23,36,21),(36,21,28),(21,28,19),(28,19,30),(19,30,42),(30,42,34),(42,34,27)}. Now, using the integers $0, 1, 2$ to construct the symbols, we obtain the symbolized series as {(1,2,0),(2,0,1),(1,2,0),(2,0,1),(1,0,2),(0,1,2),(0,2,1),(2,1,0)}.

amount of information of the conditioned variable unexplained by the conditioning variable. These quantities are obtained as

$$\begin{aligned} h_m^{y|x} &= h_m^{y,x} - h_m(x), \text{ or} \\ h_m^{x|y} &= h_m^{y,x} - h_m(y). \end{aligned}$$

Notice that the $h_m^{y|x}$ boils down to zero when $\{y_{it}\}$ is completely determined by $\{x_{it}\}$ since the joint entropy measure and the marginal entropy of x will be close each other. Conversely, the conditional entropy is equal to the marginal entropy of y when both y and x are independent.

3.3 The transfer entropy test

The Transfer Entropy test (TE) from x to y computes the reduction in y entropy when we condition on the x variable. Following Schreiber (2000), we define the Symbolic Transfer Entropy (STE) of y conditional on r lags as

$$\mathrm{STE}_{x\to y}(m,r) = h_m^{y|y^{(-r)}} - h_m^{y|y^{(-r)},x^{(-r)}}, \tag{7}$$

where $y^{(-r)}$ and $x^{(-r)}$ are the r-periods lagged variables. The expression in (7) is interpreted as a measure of how much does the lagged $x^{(-r)}$ reduce the uncertainty in predicting y beyond the contribution of $y^{(-r)}$. If such a reduction is large, it will point out in the direction of a relatively high effect of $x^{(-r)}$ on y. Thus, the $\mathrm{STE}_{x\to y}(m,r)$ will be zero if the null hypothesis that x does not cause y holds. However, when x does cause y, the true $\mathrm{STE}_{x\to y}(m,r)$ will be strictly positive.

Obtaining the distribution of the statistic $\mathrm{STE}_{x\to y}(m,r)$ or its asymptotic approximation is not viable because the distribution of the symbols and then, the distribution of the entropy statistic, may be changed by the dynamic structure of $y_{i,t}$ and $x_{i,t}$. Therefore, the use of a bootstrap method is the solution suggested in Camacho, Romeu and Ruiz-Marin (2021). In stationary bootstrap, the original data are resampled a large number of times and for each iteration, the empirical $\mathrm{STE}_{x\to y}(m,r)$ is computed. A bootstrap critical value or p-value is obtained from the empirical distribution in the end.

Indeed, simultaneous significance of the $STE_{x\to y}$ and $STE_{y\to x}$ would be an indicator of a two-way causal relationship. In that case, we can compute the net permutation transfer entropy (NTE) as the simple difference between the two STE's for each direction:

$$\mathrm{NTE}_{xy}(m,r) = \mathrm{STE}_{y\to x}(m,r) - \mathrm{STE}_{x\to y}(m,r). \tag{8}$$

The sign of the $\mathrm{NTE}_{xy}(m,r)$ indicates the direction of the transfer, from y to x or vice versa. A value close to zero could indicate that the variables do not have a causal relationship if both $\mathrm{STE}_{y\to x}(m,r)$ and $\mathrm{STE}_{x\to y}(m,r)$ have been found non-significant. But it could also be the case that the directional transfers were found to be significant and therefore, a value of zero for the net transfer would indicate that the causal relationship is similarly strong in both directions.

Using the bootstrap resampling a two-sided p-value for the test statistic null that NTE is zero would help to determine if we are in such a case. Once the two-sided test is rejected, a one-sided test of the significance of the positive or negative NTE would follow.

4 Empirical results

To examine the short-run causal relationship between tourism and growth, we use the World Bank Open Data as a source. In particular, annual data of GDP and inbound tourism was obtained for a set of 145 countries from 1996 to 2015.[3]

Our measure of growth is the growth rate of per capita GDP (Gross Domestic Product divided by the midyear population). Note that the measure of GDP is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources that are often associated with the touristic activity.

To measure tourism, we use international inbound tourists (overnight visitors), which are the number of tourists who travel to a country other than that in which they have their usual residence, but outside their usual environment, for a period not exceeding 12 months and whose main purpose in visiting is other than an activity remunerated from within the country visited.[4] We deal with unit root problems by using growth rates of the number of arrivals when estimating.

4.1 Data problems

Camacho, Romeu and Ruiz-Marin (2021) showed that standard causality tests proposed in the context of pooling time series data from different units in the context of linear models display an incorrect size and low power in some particular contexts such as non-linearity, higher-order moment dependence, cross-section heterogeneity, structural breaks or outliers.

The data obtained from international panels such as the World Bank Open Data and others is potentially affected by these problems. The reason is that, as the same institution acknowledges, the quality of the data obtained from the national statistical systems in some developing countries might be poor. Figure 1 enables us to assess whether our dataset suffers from the aforementioned data problems. Panel A displays the scatter plot for GDP (horizontal axis) growth rates and arrivals (vertical axis) growth rates for Spain. The chart includes a polynomial trend line, which shows that the relationship between output and tourism is curvilinear, oscillating from positive trends (left-hand values) to flat trends (middle values) or even negative trends (right-hand values).

To follow with the visual inspection of the potential data problems of this longitudinal data set, Panel B shows the scatter plot of the rate of growth of arrivals versus the rate of growth of GDP in the case of Poland. The first half of the data (time series up to 2004) are plotted in blue whereas the second half of the data (time series since 2005) are plotted in red. The chart also displays a linear trend line for each of these two subsets of data. According to the chart,

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[3] Regional areas and countries with less than one third of observations available were omitted from the analysis.

[4] The data on inbound tourists refer to the number of arrivals, not to the number of people travelling. Thus a person who makes several trips to a country during a given period is counted each time as a new arrival.

there is a positive relationship between GDP and tourism in the data up to 2004 but it turns to negative with data afterwards, which is consistent with the presence of a structural break in the output-tourism relationship.

The scatter plot of the rate of growth of arrivals versus the rate of growth of GDP in Grenada displayed in Panel C shows that the red point in the bottom-right quadrant lies outside the overall distribution of the dataset. The data here appear to come from a linear model with a positive slope except for the outlier which appears to have been generated from some other model. This case should be addressed with caution because Camacho Romeu and Ruiz-Marin (2021) show that the presence of these outliers has dramatic effects on the size and power of causality tests based on linear approaches.

Finally, although the standard Granger tests are routinely applied to test for causality in the mean, they are not able to detect Granger causality in higher moments. Panel D illustrates the issue of second-moment causality by displaying the scatter plot of the demeaned squared of arrivals versus the rate of growth of GDP in the US. According to the figure, it seems that there is a negative correlation between growth and the variance of arrivals.

4.2 Testing causality

To determine if there exists a short-run causal relationship between tourism and growth, we perform the symbolic transfer entropy test for causality in longitudinal data with embedding parameter $m = 3$. The top row of Table 1 displays the symbolic transfer entropy test that tourism does not cause growth (columns 2 to 4) and that growth does not cause tourism (columns 5 to 7) for lag length specifications r from one to three years. Regardless of the lag length, the large p-values reported in parentheses below the statistics unequivocally exceed the standard critical values. Thus, the tests fail to reject the null hypothesis of short-run non-causality of tourism to growth.

The results of testing the short-run causality from growth to tourism are shown in the last three columns of the top row of Table 1. We can observe that the non causality hypothesis is strongly rejected for a one-year lag, with p-value of 0.01. For a lag of two years, the evidence of growth causing tourism diminishes considerably (p-value of 0.155) and it vanishes for a lag of three years (p-value of 0.475). This is in line with the findings of Enilov and Wang (2012) who find a strong growth-tourism link for one lag and much weaker for lags 2 and beyond.

The bottom row of Table 1 examines the predominant direction of information transfer between tourism and growth, i.e., if there is simultaneous (two-way) causality or if there is a one-way causality between these two macroeconomic aggregates. A positive value of this net effect implies prevalence of tourism causing GDP growth while a negative value of the net effect implies prevalence of GDP growth driving tourism. Regardless of the lag that we consider, the sign of the net transfer is negative, indicating that growth influences more to tourism rather than the other way around.

The magnitude of the net transfer, is key to analyze the causal direction of causality between growth and tourism. If the net transfer is close to zero, then we speak of a balanced influence between growth and tourism and none of them has a greater influence on the other. To evaluate the statistical significance of the next transfer, one tailed (in parentheses) and two tailed (in brackets) p-values of the null hypothesis that the net transfer is equal to zero are reported below the statistics. According to these p-values, for one-year lag (p-value of 0.010) and two-year lags (p-value of 0.075) we conclude that the short-run causality direction runs from growth to tourism because the degree of asymmetry in the interaction is statistically significant.

Our finding is consistent with that attained by Lee and Chang (2008), who find unidirectional temporal relationship running from economic growth to tourism in African countries. Lorde, Francis and Drakes (2011), also find a short-run causal relationship running from real GDP to tourism in Barbados and fail to detect a causal relationship from tourism to real GDP. Narayan et al. (2010) document that real GDP Granger causes tourism exports and do not find evidence of short-run Granger causality running from tourism exports to GDP in Fiji Islands, the Solomon Islands, Papua New Guinea and Tonga. In this context, Oh (2005) also finds that economic development in the Korean economy leads to an short-run increase in tourism growth while tourism growth does not influence increases in the economy.

5 Conclusions

In the literature on the causal relationship between tourism and economic growth, the results are inconclusive and sometimes contradictory, raising questions about the nature of the complex link between these two magnitudes. In this paper, we seek to contribute to this literature by revisiting the short-run causality between tourism and economic growth. For this purpose, we use a symbolic transfer entropy causality test that is robust to the data problems that characterize empirical analyses with large panels, such as outliers, structural breaks and non-linearities. Using a large cross section of up to 145 countries for the period 1996-2015 obtained from the World Bank Open Data, our results indicate the existence of unidirectional causality running from economic growth to tourism. Such a result is stronger in the very short-run and significant in net terms, while the hypothesis that tourism leads growth in the short run is not significant for any of the lag specifications considered.

It is worth recalling here that our results only consider the short-run effects and do not test whether a significant touristic activity sustained in the long-run could have positive effects on GDP, which would require a different methodological approach to that used in this paper. Also, in this paper we do not characterize the underlying specific mechanisms that link growth to tourism expansion. However, we postulate some factors of economic development that could have a positive effect on a particular country's attractiveness as a tourist destination. In particular, economic development improves infrastructure, Internet access, events, gastronomy, shopping and social media presence, which are crucial aspects of the destinations and have a profound influence to attract tourists. The extent to which all these economic infrastructures stand as a plausible explanation of the causality detected is a topic to be listed in our tourism economics research agenda.

The results that we have found with pre-pandemic data may contain important implications and guidelines for both policy makers and investors in the future. In 2020, the world faced an unprecedented global health, social and economic emergency with the COVID-19 pandemic. Travel and tourism have been among the most affected sectors with airplanes on the ground, hotels closed and travel restrictions put in place in virtually all countries around the world. To mitigate the adverse effects of the coronavirus crisis, countries are considering several developing recovery measures to support the touristic sector. For instance, in a recent communication, the European Economic and Social Committee urged the member states to take "measures that provides reassurances and clarity for people and a pathway to recovery for tourism and transport." (European Economic and Social Committee, 2020).

In the past, during crises that were of a different nature to the pandemic slowdown, such as the 2007-2008 global financial crisis, some authors as, for example, Enilov and Wang (2021) recommended a range of strategies such as strategic planning and financial aid to touristic business for developing countries. As documented in this paper, our results stress the causal importance of economic growth as a first step in tourism development or recovery. Therefore, aggregate demand policies oriented to reconstruct the economic infrastructure of goods and services, the chain of supply, and the basic services seem to be recommendable strategies, accelerating the worldwide economic recovery of touristic sector as a complement to those other measures more specifically focused on direct help to the sector agents.

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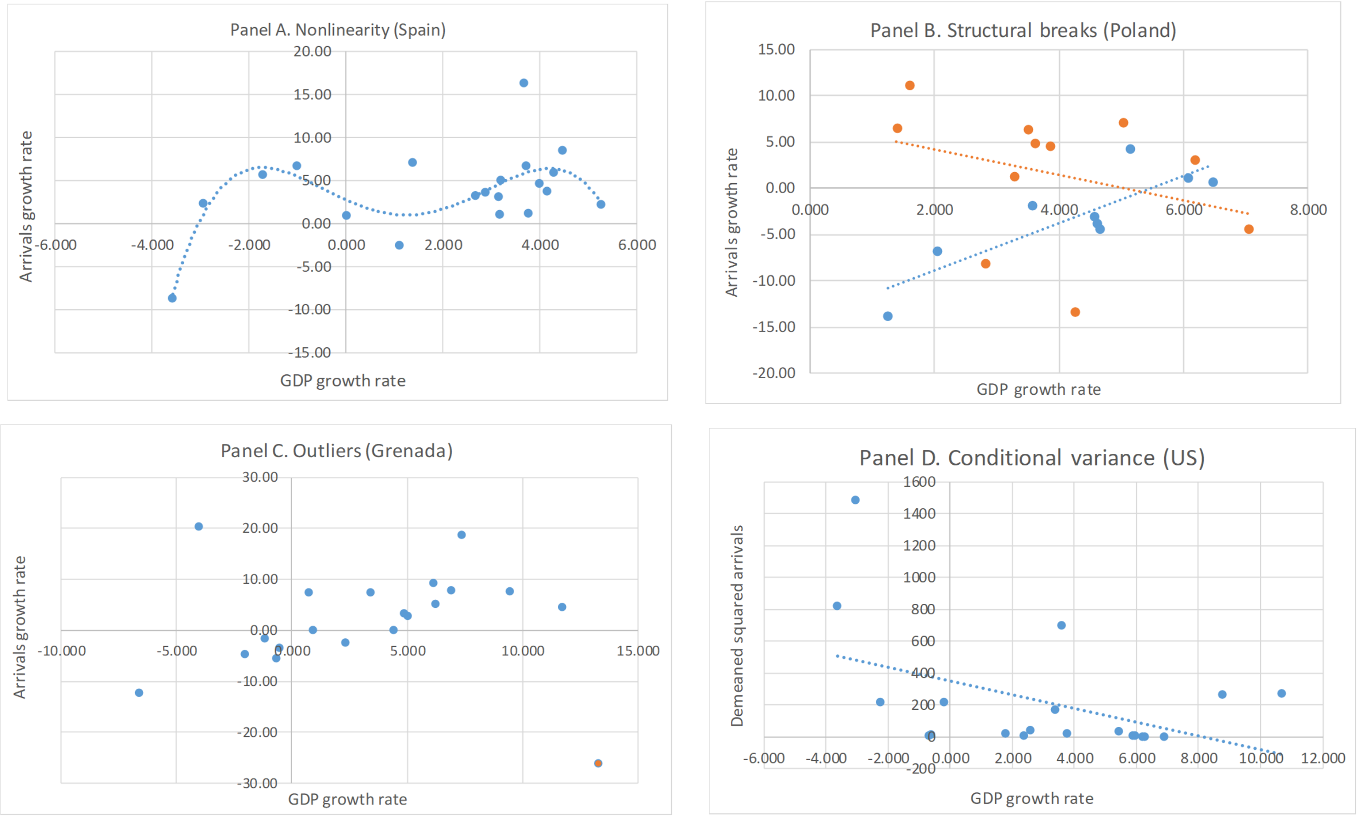
Table 1: Symbolic transfer entropy test

	Tourism → GDP			GDP → Tourism		
Number of lags	1	2	3	1	2	3
Transfer entropy	0.012 (0.580)	0.028 (0.910)	0.032 (0.800)	0.019 (0.010)	0.038 (0.155)	0.036 (0.475)
Net Transfer	-0.007 (0.010) [0.010]	-0.007 (0.075) [0.130]	-0.004 (0.230) [0.465]			

Notes: Entries show the result of transfer entropy tests (p-values in parentheses) and transfer entropy tests (one-tailed p-values in parentheses and two-tailed p-values in brackets) for 145 countries and 20 years of data. In all cases, we take the embedding dimension $m = 3$.

Figure 1: Data problems



Notes. Panels A to C display the scatter plot for the rates of growth of GDP and arrivals for different countries. The vertical axis of Panel D refers to demeaned squared growth rates of arrivals.