Research Article

Brian Garrod*, António Almeida, Luiz Machado

Modelling of nonlinear asymmetric effects of changes in tourism on economic growth in an autonomous small-island economy

https://doi.org/10.2478/ejthr-2023-0013
received July 21, 2023; accepted October 3, 2023

Abstract: While a substantial body of empirical evidence exists supporting the tourism-led growth hypothesis, more limited evidence exists regarding the dynamics of the relationship between tourism and economic growth in the island context, with important questions remaining to be answered regarding the linearity and symmetry of the relationship. Policymakers would benefit greatly from such knowledge as they attempt to harness inbound tourism as an engine of economic growth. This study contributes to bridging this important gap in knowledge by investigating the dynamics of the relationship between tourism and GDP in Madeira, a small-island autonomous region of Portugal. The analysis employs an asymmetric nonlinear autoregressive distributed lag model, using data from 1976 to 2019. The results confirm unidirectional causality between tourism and GDP, thus corroborating the tourism-led growth hypothesis. The relationship is also found to be asymmetrical, where the retarding effect of falling tourism receipts is significantly stronger than the stimulus effect associated with increasing tourism receipts. Significant non-linear effects are also found in each adjustment pathway. In terms of policymaking, while this study confirms that investing in tourism can be an effective way of promoting economic growth, efforts should also be made to diversify both the tourism sector and the wider economy to reduce exposure to downside risks.

Keywords: NARDL model; Granger causality tests; economic growth; time series; Madeira

***Corresponding author: Brian Garrod,** Swansea University, School of Management, Centre for Visitor Economy Research (CVER), Bay Campus, Fabian Way, Swansea, SA1 8EN, UK, Email: brian.garrod@swansea.ac.uk
António Almeida, University of Madeira & CiTUR Madeira, Department of Management and Economics, Faculty of Social Sciences, Campus Universitário da Penteada, Funchal, Portugal
Luiz Machado, University of Madeira, Department of Management and Economics, Faculty of Social Sciences, Campus Universitário da Penteada, Funchal, Portugal

1 Introduction

One of the most widely-researched, yet persistently elusive, subjects of tourism research over the last two decades has been the tourism-led growth hypothesis (TLGH). Beginning with a seminal study by Balaguer and Cantavella-Jordá (2002), a substantial literature has developed around establishing a theoretical basis for the TLGH, which envisages a causal relationship between the growth of tourism and economic growth in the destination's economy (Brida et al., 2016; Marrocu & Paci, 2014, Nunkoo et al., 2020). This effect is considered to be especially important in the case of small-island economies, which often rely upon tourism as a source of foreign currency to fund the purchase of raw materials and technology from overseas (Apergis & Payne, 2012; Archer, 1995; Narayan, 2004; Roudi et al., 2019). Indeed, empirical studies attempting to verify the TLGH have concentrated disproportionately on island economies, with studies focusing on, *inter alia*, Antigua (Schubert et al., 2011); Bahamas (Singh et al., 2010); Barbados (Schubert et al., 2011; Singh et al., 2010); Cook Islands (Kumar et al, 2020); Fiji (Kumar & Patel, 2022; Narayan, 2004); Hong Kong (Jin, 2011); Jamaica (Singh et al., 2010); Malta (Katircioglu, 2009b); Mauritius (Solarin, 2018), Papua New Guinea (Kumar et al., 2022b); São Tomé and Principe (Da Costa Ribeiro & Wang, 2019); Taiwan (Kim & Chen, 2006); Tonga (Kumar & Patel, 2022; Kumar et al., 2021, 2022a); and Vanuatu (Kumar & Patel, 2022). Akadiri and Akadiri (2021), Apergis and Payne (2012), Fahimi et al., (2018) and Seetanah (2011), meanwhile, all have conducted studies using panel data from multiple island destinations.

The empirical literature on the TLGH has been reviewed by Pablo-Romero and Molina (2013). They found that the studies initially tended to employ the autoregressive distributed lag (ARDL) model in an attempt to establish and measure a relationship between the growth of tourism receipts and economic growth in destination economies (e.g., Adnan Hye et al., 2013; Kyophilavong et al., 2018; Lawal et al., 2018; Othman et al., 2012; Suryandaru, 2020). The traditional ARDL model suffers, however, from two major limitations. First, it does not distinguish between the stimulating effect of tourism growth and the retarding effect of tourism recession, which are assumed to be symmetrical. Second, such models assume a linear relationship between tourism growth and economic growth. This means they are unable to capture short-run volatility in the variables of concern that may be associated with, for example, an external shock (or a structural break).

The asymmetric nonlinear autoregressive distributed lag model (NARDL) model, as proposed by Shin et al. (2014) can, however, investigate asymmetries both in the short term and in the long run. The NARDL approach allows the researcher to highlight differences both in terms of coefficient size and causality effects. It has therefore begun to be adopted by researchers interested in the TLGH (e.g., Bastidas-Manzano et al., 2020; Charfeddine & Dawd, 2022; Husein & Kara, 2020; Kumar & Patel, 2022; Kumar et al., 2020, 2022a, 2022b). Such studies have, however, tended to produce inconsistent results, with some suggesting strong asymmetry in the relationship between tourism receipts and growth in the destination economy and others not. The nature of the asymmetry also varies substantially in the findings of such studies. Some of these studies have been applied in contexts where only annual data, often with a relatively short range, have been available. The effect of this has been to overlook short-term effects, which can be particularly important when tourism exhibits a substantial degree of seasonality.

This study aims, therefore, to evaluate the TLGH using a NARDL model populated with quarterly data from 1976 to 2019. The data are from Madeira, an island economy located in the Atlantic Ocean, where tourism accounts for a major proportion of GDP and has a substantial degree of seasonality. Madeira's major specialisation in the tourism sector, and its exposure to an increasing array of internal and external risks, provides a strong rationale for examining the TLGH using data from Madeira. It is also relevant to note that while Madeira is an island economy, it is also one of two autonomous regions of Portugal. NARDL has yet to be applied to test the TLGH in such a context, with previous studies tending to have been focused on independent island states.

2 Literature Review

2.1 The basis of the TLGH

The relationship between the growth of tourism arrivals (and, by extension, tourism receipts) and the growth of the destination economy have long been issues of interest to scholars (Pablo-Romero & Molina, 2013). It is possible to group extant studies into four categories. The first and largest category consists of studies that corroborate the TLGH, which argues that an increase in arrivals (and thus tourism receipts) will stimulate economic growth (e.g., Akadiri & Akadiri, 2021; Li et al., 2018; Perles-Ribes et al., 2017; Suryandaru, 2020). The corollary of this is that a fall in tourism receipts following a decrease in the number of arrivals will retard or even halt economic growth, perhaps even causing the economy to shrink. From a policy point of view, this means that higher levels of economic growth follow from the expansion of tourism expenditure (Balaguer & Cantavella-Jordá, 2002; Zuo & Huang, 2018), based either on more tourist arrivals or higher average daily levels of tourism expenditure. Governments would then be best advised to adhere to a tourism-friendly approach, i.e., to adopt economic policies and political initiatives that support further public and private investment in the tourism sector (Brida & Risso, 2009; Brida et al., 2015; Sokhanvar et al., 2018).

The second group comprises studies that suggest a reverse hypothesis (Aslan, 2014; Kyara et al., 2021), which proposes that economic growth causes growth in tourism. This is sometimes termed the "growth-led tourism hypothesis" (GLTH). In practice, this means that the government can indirectly induce tourism growth by pursuing an economic-growth agenda based on public investment (by investing in infrastructure and related social areas) and on the development of a diversified export-based economy, leading to higher levels of economic growth, household income, and tourism-related amenities that increase the overall attractiveness of the destination and the volume of domestic tourists.

The third group of studies support a "feedback hypothesis," which assumes a bidirectional causality between tourism growth and economic growth (Brida et al., 2016; Katircioglu, 2009b; Kim & Chen, 2006; Kyara et al., 2021). This assumes that tourism drives economic growth and vice-versa (Bilen et al., 2017; Lawal et al., 2018; Wu & Wu, 2018). Kyara et al. (2021) argue that the feedback hypothesis can be also termed as "reciprocal hypothesis" because any policy intended to further develop the tourism sector will be likewise conducive to further economic growth, while any initiative that leads to economic growth tends to promote the growth of tourism (Brida & Risso, 2009; Brida et al., 2016; Sokhanvar et al., 2018; Tugcu, 2014).

The fourth group comprises a small number of studies that adopt a neutral stance, suggesting that tourism does not have a significant, substantial and positive impact on economic growth (Brida et al., 2016; Comerio & Strozzi, 2019; Ekanayake & Long, 2012; Jin, 2011; Katircioglu, 2009a; Othman et al., 2012; Tugcu, 2014). This should not be confused with empirical studies that are unable to detect any such relationship, which could be due to weaknesses in the methodology resulting in a Type II error. Indeed, Kumar et al. (2022b) suggest that very few studies have in fact been able to identify a neutral relationship between the growth of tourism and economic growth.

A meta-analysis produced by Nunkoo et al. (2020) on the relationship between the growth of tourism and economic growth corroborated that there had been publication biases in favour of the TLGH. The investigation confirmed, however, that the effect of tourism growth on economic growth is substantially positive, as corroborated by Bilen et al. (2017), Brida et al. (2016) and Shahzad et al. (2017).

The theoretical basis for the TLGH has been widely studied. The central precept is that tourism growth drives economic growth in a number of ways, including not only through the direct, indirect and induced creation and support of incomes and employment (Apergis & Payne, 2012; Archer & Fletcher, 1996; Dogru & Bulut, 2018; Kyara et al., 2021; Lanza et al., 2003; Roudi et al., 2019), but also by harnessing economies of scale and scope (Brida et al., 2016; Kumar et al., 2022a; Kyara et al., 2021; Schubert et al., 2011); promoting the development of traditional sectors such as agriculture and fisheries; introducing new business models and sponsoring an entrepreneurial spirit in the business community (Fonseca & Sánchez-Rivero, 2020a, 2020b); and through other positive externalities that will impact the rest of the economy (Archer & Fletcher, 1996; García-Falcón & Medina-Muñoz, 1999; Hospers, 2003; Sharpley, 2003; Nowak et al., 2007; Apergis & Payne, 2012; Brida et al., 2016; Kumar et al., 2021; Kyara et al., 2021; Roudi et al., 2019; Cannonier & Burke, 2019; Comerio & Strozzi, 2019; Seetanah, 2011; Fonseca & Sánchez-Rivero, 2020a, 2020b; Akadiri & Akadiri, 2021; Kumar et al., 2021; Kumar et al., 2022b).

2.2 Econometric approaches to investigating the TLGH

A wide range of empirical models have been used to try to investigate the TLGH (Brida et al., 2016). Some studies have used bivariate models to assess the relationship between tourism receipts and GDP growth (e.g., Bilen et al., 2017; Kumar et al., 2022b). Kumar et al. (2022b) suggest this approach as the best way to avoid potential endogeneity bias from, for example, close correlations between exchange rates and tourism receipts.

Other studies have used a variety of control variables within a multivariate model, including, *inter alia*, exchange rates (Brida & Risso, 2009; Brida et al., 2015; Da Costa Ribeiro & Wang, 2019; Mérida & Golpe, 2016; Schubert et al., 2011; Trang et al., 2014); labour force (Adedoyin et al., 2021), capital investment (Adedoyin et al., 2021; Da Costa Ribeiro & Wang, 2019; De Vita & Kyaw, 2016, 2017; Pulido-Fernández & Cárdenas-García, 2021); government spending (De Vita & Kyaw, 2016, 2017; Pulido-Fernández & Cárdenas-García, 2021); inflation (De Vita & Kyaw, 2016, 2017); population growth (De Vita & Kyaw, 2016, 2017); and the human development index (Pulido-Fernández & Cárdenas-García, 2021). Some studies also include various proxy measures to reflect variables such as trade openness, rule of law, government effectiveness and financial development (Adedoyin et al., 2021; De Vita & Kyaw, 2016). Other studies have emphasised the importance of including provisions for structural breaks (Mérida & Golpe, 2016; Tang & Tan, 2015). In terms of measuring tourism flows, tourism arrivals have sometimes been used rather than tourism receipts (e.g., Brida et al., 2015), while some studies have instead used tourism nights (e.g., Mérida and Golpe, 2016).

Kumar et al. (2022b) consider that the ARDL-bounds procedure is able to avoid the endogeneity bias problem found out in bivariate specifications (Pesaran & Smith, 2014), being also valid in small samples (Nunkoo et al. 2020; Pesaran et al., 2001). The ARDL approach accepts both I(0) and I(1) regressors, while the Johansen cointegration approach requires I(1) variables. Another advantage of the ARDL is that it allows for the estimation of long- and short-run parameters, avoiding the endogeneity bias and serial correlation due to its dynamic structure, which includes both lagged and first-difference terms (Kyara et al., 2021).

Evidence from macroeconomic studies suggests, meanwhile, that the most important variables tend to have both asymmetric and non-linear effects on the dependent variable. For example, Long and Zhang (2022) found this to be true of the relationship between oil prices and several macroeconomic variables (e.g., consumption, GDP, inflation). This suggests that asymmetric nonlinear models are needed to gain a better understanding of the relationship between tourism variables (such as tourism receipts) and economic growth (Balsalobre-Lorente et al., 2021; Tang & Tan, 2013).

The asymmetric NARDL model of Shin et al. (2014) is useful in this regard. This is because it can differentiate between periods of tourism expansion and contraction. This distinction helps the researcher determine whether the short-run and long-run coefficients of positive and negative shocks are similar. This is especially important in regions that depend heavily upon tourism. The NARDL approach also offers further advantages, such as the correction of serial correlation and endogeneity problems based on the introduction of an appropriate number of lags, and the incorporation of variables with different orders of integration, including both I(0), I(1) and a mixture of the two.

Orzeszko (2021) illustrates the concept of "nonlinearity" and the relevance of examining nonlinear causality in the case of the relationship between oil prices and exchange rates. The study highlights real-world features such as asymmetric responses – differentiated impacts on the level of economic activity depending on whether the oil-price shock is positive (suddenly falling oil prices) or negative (suddenly increasing oil prices) – and technical effects such as structural breaks, persistence and discontinuity in adjustment. These features prevent researchers from adopting a perfectly linear (i.e., predictable) view of world.

In a similar vein, Bildirici and Turkmen (2015) explore nonlinear causality between the price of oil and the prices of precious metals. They characterise this as an example of complex behaviour, in contrast to the linear and predictable behaviour expected by assumption in much research. The authors argue that nonlinearity based on the instability of macroeconomic variables can lead to the temporary or permanent interruption of extant trends. Economic crises, major political upheavals (such as wars and financial crises), crises in key international markets, and oligopolistic behaviour in markets may all, therefore, result in asymmetric responses from markets. Data on macroeconomic variables tend to be plagued by discontinuities and structural breaks (Chiou-Wei et al., 2008; Smeral, 2018), which can also create such asymmetries.

Assuming asymmetric models in the field of tourism therefore allows for the research to differentiate between expansions and contractions when it comes to estimating the magnitude of an economic impact. This is of utmost importance to territories dependent on tourism.

Studies have begun to investigate the relationship between the growth of the tourism sector and economic growth using the asymmetric NARDL model (e.g., Bastidas-Manzano et al., 2020; Charfeddine & Dawd, 2022; Husein & Kara, 2020). Nunkoo et al. (2020) note that dynamic models such as NARDL provide a relatively strong basis for inter-country comparisons. Three studies of different countries by a team led by Kumar (Kumar et al. 2020, 2022a, 2022b) will therefore be used to demonstrate the inconsistency of the findings of studies of the TLGH using the NARDL technique. The first (Kumar et al., 2020) investigated the TLGH in the case of the Cook Islands using quarterly data from Q1 2010 to Q3 2016. Their findings suggested bidirectional causality between tourism arrivals and economic growth. While the short-run effects of positive and negative changes in arrivals were almost symmetrical, the long-run effect of a positive change in arrivals were nearly three times that of an equivalent fall in arrivals.

The second study (Kumar et al., 2022b) used a NARDL model to investigate the TLGH for Papua New Guinea. As they only had annual data for 2008 to 2019, the researchers used a quarterly match sum technique to convert their dataset into quarterly data. Contrary to their study of the Cook Islands (Kumar et al., 2020), their findings suggested a unidirectional relationship from tourism to economic growth, supporting the TLGH. Their study found that while a positive trend in tourism arrivals lead to economic growth, there was no evidence that a negative movement had any significant effect.

The third study (Kumar et al., 2022a) used annual data from Tonga from 1981 to 2018. The relationship between tourism and economic growth in this case was found to be bidirectional. In this case, however, economic growth was found to be more sensitive to downward changes in tourism than upward ones. This finding is directly contrary to those in both of their studies of the Cook Islands (Kumar et al., 2020) and Papua New Guinea (Kumar et al., 2022b). The authors conclude that the long-run asymmetric effects and asymmetric causality patterns appear to be country-specific, and thus recommend further research in this respect (De Vita & Kyaw, 2016; Kumar et al., 2022b).

This paper helps address this research gap by investigating the TLGH using a NARDL model and a relatively long data series. Annual data from 1976 to 2019 were firstly used to investigate possible asymmetries in the short- and long-run relationship between tourism receipts and economic growth in Madeira. No short-run asymmetry was found, which is counter-intuitive from a practical point of view based on the usual functioning of the tourism sector, but in line with expectations because of the nature of annual data. This study also increased the available data range artificially through interpolative methods.

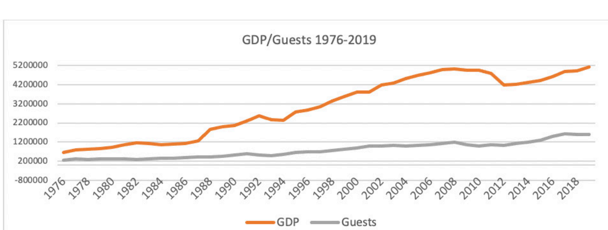
Like many previous studies using the NARDL method, Madeira is an island economy. It is, however, an autonomous region of Portugal, while previous studies have focused on independent island states. This is, therefore, the first study, to the authors' knowledge, to employ NARDL to explore the TLGH in the context of a semi-autonomous region. It is also unusual in that the analysis uses a very long run of quarterly data.

3 Methodology

The context of this study is the non-independent but autonomous island region of Madeira. As is the case with many other small-island economies (Bardolet & Sheldon, 2008), the tourism sector occupies a large share of the Madeiran economy (16.2% of GVA in 2019). Based on its direct and indirect contributions to the labour market, the sector accounted for 17% of total employment in Madeira's economy (Direção Regional de Estatística da Madeira, 2022). Based on the tourism satellite account, meanwhile, the ratio of tourism expenditure to the GDP was 28.8% in 2019 (Direção Regional de Estatística da Madeira, 2022).

The sector is also believed to play a significant role in stimulating public investment in new infrastructure in the peripheral and rural hinterland areas by supporting (indirectly through taxation) business investment through strategic spatial development and promoting competition in locations outside the main capital city that have been characterised by low entrepreneurship (ISMERI Europa 2011; Majdak & de Almeida, 2022). As is true elsewhere, the region is trying to develop niche markets based on high-spending visitors who are attracted by the region's natural and cultural resources. To this end, it uses a diversified cultural agenda of high-quality events spread over the tourist season (Almeida & Garrod, 2021).

In this study, the analysis of the relationship between tourism and economic growth is based on two annual series – tourism arrivals and GDP – which is in line with the practices of Kyara et al. (2021), Husein and Kara (2020), and Song et al. (2019). Annual data for the real GDP (measured in constant 2019 euros) was available for 1976 to 2019. Arrival data was also available from 1976



Source: Direção Regional de Estatística da Madeira (2022)

Figure 1: GDP (constant prices; 103€) and Arrivals 1976-2019

to 2019. The Madeira Statistics Office provided the datasets. Figure 1 illustrates these time series. As can be seen, tourism arrivals alone cannot provide an adequate explanation of trends in GDP, especially since 1986.

Several tests were therefore carried out to identify the best proxy for tourism activity. On an annual basis, the variable "tourism receipts" presented itself as a potential proxy. In line with expectations, preliminary analysis of the data in logarithmic form produced an OLS estimate with a positive and significant coefficient. Moreover, the Johansen cointegration test, widely used to determine the number of independent linear combinations, indicated that both variables were integrated of order 1. However, because the range is relatively small for the annual data (1976-2019), it comes as no surprise that the NARDL approach fails to detect asymmetry in the short term. For this reason, frequency conversion techniques were applied to define a sub-annual periodicity more suitable to examining short-term impacts. Quarterly data were also compatible with an increase in the number of degrees of freedom. Trimestral data were already available for the arrivals variable; this was not the case for either GDP or tourism receipts.

Several methods were adopted to convert the annual data to a quarterly frequency, including the quadratic match sum (QMS) technique, known for its seasonality-adjustment proprieties, and the Denton method (Shahzad et al., 2017, 2018; Nadeem et al., 2020; Kumar et al., 2021a; Kumar et al., 2022). Unlike Kumar et al. (2022), this study opted for the Denton method in order to avoid potential problems related to either stable or moving seasonality (Shahzad et al., 2017; Shahbaz et al. 2018; Kumar et al., 2021; Kumar et al, 2022). Of course, other cointegration methods, not applied in this study, such as those developed by Granger (1988), Hylleberg et al. (1990) and Engle et al. (1993), are also of interest in this regard. The quarterly frequency conversion resulted in a 176-period database. When quarterly data are used, "arrivals" becomes a better proxy for studying the impact of the tourism dynamics on GDP, rather than "tourism receipts."

This study employs both ARDL bounds testing and causality testing based on an error correction model (ECM) to confirm the hypothesis of unidirectional causality from tourism arrivals to economic growth (Liu & Song, 2018). In line with past studies, the empirical calculation of the impact of tourism uses the following linear equation:

$$GDP_t = \mu + \beta * G_t + \varepsilon_t \quad (1)$$

where G stands for the explanatory variable (arrivals), GDP stands for the dependent variable, β is the elasticity coefficient of arrivals, μ stands for the intercept, and εt stands for the error term.

Equation (1), based on Hu et al. (2022), identifies the long-run coefficients, whereas the error correction approach, defined below in general terms, includes both long-run and short-run effects. The standard representation of a symmetric linear ECM, with both the long- and short-run dynamic relationship, is as follows:

$$\Delta y_t = u + \rho_y * y_{t-1} + \rho_x * x_{t-1} + \sum_{i=0}^{p-1} \alpha_i \Delta y_{t.i} + \sum_{i=1}^{q-1} \beta_i * \Delta x_{t-i} + \varepsilon_t \quad (2)$$

Equation (2), in the ARDL format (error correction approach), considers the following:

$$\Delta GDP_t = \nu + \sum_{i=0}^{p-1n} \nu_i \Delta GDP_{t-j} + \sum_{i=0}^{p-1n} \nu_i \Delta x_{t-j} + \gamma_1 GDP_{t-1} + \gamma_2 x_{t-1} \varepsilon_t \quad (3)$$

The short-run parameters (identified by the symbol Δ) in both variables result from changes, while the symbols γ_1 and γ_2 identify long-term parameters. In the NARDL approach, the explanatory variables must disaggregate into positive and negative sub-variables to investigate both the occurrence of a nonlinear relationship between variables and the existence of asymmetric effects in the long and short run. It is noteworthy that the volume of arrivals generated by global tourism demand has been increasingly volatile and prone to unpredictable abrupt falls in external demand, as the COVID experience fully demonstrated. Since this study aims to identify occurrences of nonlinear relationships among variables, we define the equation that splits the explanatory variable into positive and negative accordingly:

$$G_t = G0 + G_t^+ + G_t^- \quad (4)$$

Equation (1) is thus re-defined as follows:

$$GDP_t = \beta_0 + \beta_1 * G_t^+ + \beta_2 * G_t^- + \varepsilon_t \quad (5)$$

The β coefficients represent the long term. The following equations define the partial sum of the positive changes in the T_r variable:

$$G_t^+ = \sum_{j=1}^{t} \Delta G_j^+ = \sum_{j=1}^{t} \max(\Delta G_j, 0) \quad (6)$$

$$G_t^- = \sum_{j=1}^{t} \Delta G_j^- = \sum_{j=1}^{t} \min(\Delta G, 0) \quad (7)$$

The nonlinear formula of the NARDL approach is as follows:

$$\Delta GDP_t = \nu + \sum_{i=0}^{p-1} \nu_i \Delta GDP_{t-j} + \sum_{i=0}^{q-1} \nu_i \Delta G_{t-j} + \gamma_1 GDP_{t-1} + \gamma_2 G_{t-1} + \varepsilon_t \quad (8)$$

The terms np and no represent the lag order. The terms G_t^+ and G_t^- signify the positive and negative shocks in terms of the number of arrivals. The symbol αi represents the long-run coefficients, γi the short-run coefficients (Long & Zhang, 2022). This dynamic error correction approach is commonly used to evaluate the relationship among integrated variables of order I(1) (Kumar et al., 2022).

Previous researchers have tended to employ control variables, such as the real exchange rate, because the rate of real exchange proxies the evolution of tourism prices and the impact on the volume of tourism demand of countries with cheaper currencies (Katircioglu, 2009a; Kumar et al., 2021; Oh, 2005; Song et al., 2019; Tang, 2018; Kumar et al, 2021). Nowadays, as more than 80% of tourists arriving in Madeira come from the Eurozone (DREM, 2022), the topic of exchange rates is not a major issue except for the British market. Portugal joined the eurozone in 2001. Nevertheless, the impact of changes in the exchange rate were explored in this study, given that the British market corresponds to one-fifth of the total number of arrivals. The impact of real exchange rate and inflation were investigated, and both were found to be determinants of tourism demand. In some instances of high inflation rates, the decision of not travelling may be the most rational one, as Madeira may be not economically very attractive due to high air-transport costs. For that reason, this study also considers the impact of gains in purchasing power proxied by the evolution of GDP per capita across the European countries as a whole.

In an EU funds-dependent economy such as Madeira, it is also important to study the impact of the volume of financial support from the EU. This study therefore tested the impact of several variables and dummies reflecting the impact of the accession to the EC in 1986, including total (current and capital) government expenditures, a dummy variable representing the pre- and post-accession period, and dummies for the multiannual financial frameworks. The most statistically significant variables were found to be the dummies representing the various multiannual financial frameworks.

Annual data for the variable “Europe GDP” measured in constant 2015 US dollars for the period spanning 1976-2019 was retrieved from the World Bank database. Annual data on the inflation rate for Portugal was sourced from the PORDATA database, and quarterly data on tourist arrivals, tourism receipts and overnights were retrieved from the Madeira Statistical Office. Quarterly data for the inflation rate and exchange rate were retrieved from the World Bank database. Substantial preparatory work was carried out to identify the relationship between the economic dynamics and the ups and downs of the tourism market. As mentioned above, while the analysis based on annual data led to positive and significant results, it failed to identify short-term asymmetries.

Before checking for a long-run relationship between tourism-related variables and a proxy for economic growth, several traditional unit root tests were conducted to examine the degree of stationarity of the variables under the null hypothesis of a series having a unit root. It is advisable to check for structural breaks due to events such as economic shocks and methodological changes in the compilation of the datasets. Tests developed by Bai and Perron (1998, 2002), Clemente et al. (1998) and Zivot and Andrews (1992) were used to achieve this. Such tests identify the number and location of more than one breakpoint. It is for the researcher, then, to determine whether such breaks can be readily connected to real-world events. Break dummies were not retained in the present study, as they were found not to be significant in the final estimation.

Once the diagnosis of unit roots and structural breaks was completed, the study continued to estimate the long-run and short-run parameters and the cointegration equation based on the ARDL bounds testing technique proposed by Pesaran et al. (2001). The asymmetrical NARDL approach was then employed to analyse the occurrence and form of any asymmetric effects. Granger causality tests were then used to confirm the existence and direction of causality, if any, between the variables under analysis.

4 Results

Several models were tested with different proxies and formats of variables to detect the most statistically suitable model. To avoid spurious results when using time-based data, unit root tests needed to be performed before employing any cointegration techniques (e.g., NARDL) to estimate the long-run and short-run parameters. Another reason for pre-testing is to establish the stationarity or otherwise of the variables. The augmented Dickey-Fuller (ADF) unit root test and the Phillips and Perron (PP) test (Phillips & Perron, 1988) were used for this purpose. One of the limitations of the NARDL approach is its ineffectiveness in handling the I(2) series because, in such cases, F-statistics are invalid (Hu et al., 2021; Ibrahim, 2015; Meo et al., 2018). Table 2 shows the results of the unit root tests. The variables are stationary at the first difference and non-stationary in levels, and none are stationary at I(2). Therefore, there is no cause for concern.

Owing to lack of space, the discussion here is limited to presenting the results of the unit roots test. Further details on the augmented Dickey-Fuller (ADF) unit root test, the Phillips and Perron (PP) test and unit root tests with structural breaks can be found in Zivot and Andrew (1992), Tang and Tan (2015), Mérida and Golpe (2016) and STATA (2023).

Three tests were used to consider the likely presence of structural breaks (Tables 3a, 3b and 3c). The results confirm that all the variables integrate in order one. The different tests pointed to a wide range of potential structural breaks with either positive or negative effects. A number of events (which could be potentially introduced into model using dummies) had an effect on the economy as a whole and on tourist arrivals: increases or decreases following the entry into force of several multiannual financing programmes adopted by the EU; the rise and decline of the construction sector; the 2010 natural disaster followed by recovery in 2012, and then by the worst forest fires in a century in 2016; the 2011 financial crisis, and the IMF interventions in Portugal and indirectly in Madeira, with their long-lasting effects; the Arab Spring, a favourable event for drawing a significant number of tourist arrivals to the region; and other minor events. A change in the calculation methodology of the GDP could also potentially account for some of the breaks identified below. Such a long period of time is bound to be affected by a number of such events, so what matters is to focus attention on the long-term relationship between tourism and economic growth, while acknowledging the occurrence of short-term upward or downward deviations.

Table 4 shows the results of the ARDL model. Given that the break dummies are essential for a cointegration relationship, they are included in the initial estimation. However, based on multiple preliminary tests, the conclusion was reached that only the dummies covering the multiannual financing programmes starting in 2007 and 2014 were statistically significant. It is also worth mentioning that the model was tested using preliminary tests both on levels and logs. The data interpreted in the following paragraph, uses the model with logs.

The bounds test was then performed using the null hypothesis (H_0) of no cointegration, which proposes that the coefficients of the lagged level variables in Equation 5

Table 2: Traditional unit root tests

ADF test						
	Test statistic	1%	5%	10%	p-value	Conclusion
GDPram	-1.025	-3.486	-2.885	-2.575	0,7939	Unit root
lnGDPram	-4.490	-3.486	-2.885	-2.575	0.0002	No unit root
ΔlnGDP	-4.321	-3.486	-2.885	-2.575	0.0006	No unit root
Guests	-2.451	-3.486	-2.885	-2.575	0.9990	Unit root
lnGuests	-0.951	-3.486	-2.885	-2.575	0.7708	Unit root
ΔlnGDP	-3.923	-3.486	-2.885	-2.575	.00019	No unit root

PP test							
	p.value			1%	5%	10%	Conclusion
GDPram	0.8162	Z(rho)	-0.590	-20.040	-13.844	-11.096	Unit root
		Z(t)	-0.810	-3.486	-2.885	-2.575	
lnGDPram	0.0696	Z(rho)	-1.926	-20.040	-13.844	-11.096	Unit root
		Z(t)	-2.726	-3.486	-2.885	-2.575	
ΔlnGDPram	0.0001	Z(rho)	-38.697	-20.037	-13.842	-11.095	I(0)
		Z(t)	-4.722	-3.486	-2.885	-2.575	
Arrivals	0.9941	Z(rho)	0.880	-20.040	-13.844	-11.096	Unit root
		Z(t)	0.984	-3.486	-2.885	-2.575	
lnArrivals	0.8172	Z(rho)	-0.635	-20.040	-13.844	-11.096	Unit root
		Z(t)	-0.807	-3.486	-2.885	-2.575	
ΔlnArrivals	0.000	Z(rho)	-46.117	-20.037	-13.842	-11.095	I(0)
(0)		Z(t)	-5.269	-3.486	-2.885	-2.575	

DF-GLS	**Tau (1 lag)**	**1%**	**5%**	**10%**	**Conclusion**
lnTourismReceipts	-1.967	-3.492	-2.953	-2.663	Unit root
lnGDP	-2.707	-3.492	-2.953	-2.663	Unit root

	Test statistic									
KPSS	(0)	(1)	(2)	(3)	M. lags	1%	2,5%	5%	10%	Conclusion
GDPramd	2.34	1.17	0.788	0.595	13	0.216	0.176	0.146	0.119	
lnGDPramd	3.71	1.87	1.26	0.952	13	0.216	0.176	0.146	0.119	Not stationary
Arrivalsd	1.16	0.586	0.396	0.302	13	0.216	0.176	0.146	0.119	
lnArrivalsd	1.86	0.936	0.631	0.48	13	0.216	0.176	0.146	0.119	Not stationary

are jointly set to zero. The result of the bounds test leads to the rejection of H_0 and confirmation of cointegration at the 1% level (in both models). Moreover, the adjustment coefficient is statistically significant, together with the appropriate (negative) signal. The coefficient value suggests that about 5.9% of disequilibrium errors are corrected each year, from which we can infer that the convergence process to equilibrium is achievable in approximately 17 years. The short-term effect of arrivals on GDP amounts to 0.2237 (a 1% increase in receipts, leading to a 0.22% increase in GDP). Moreover, the control variables have a significant short-term effect on the level of GDP. The long-

Table 3a: Unit root tests with structural breaks (Zivot &Andrew, 1992)

8		Critical Values			Conclusion	Break
Variable	t	1%	5%	10%		
lnGDPramd	-3.992	-5.34	-4.80	-4.58	I(1)	1987Q2
GDPramd	-4.596	-5.34	-4.80	-4.58		2009Q4
Arrivals	-4.066	-5.34	-4.80	-4.58	I(0)	2012Q2
lnArrivalsd	-5.175	-5.34	-4.80	-4.58		2008Q2

Table 3b: Unit root tests with structural breaks test (Clemente et al., 1998)

Variable	GDPramd					
	du1	du2	(rho-1)	Const	Breaks	Conclusion
Coefficient	1848.71	1477.313	-0.08559	1344.68	66,106	I(1)
t-statistic	19.260	15.442	-2.855	-		
p-value	0.000	0.000	-5.490		5% critical value	
Variable	lnGDPramd					
	du1	du2	(rho-1)	Const	Breaks	Conclusion
Coefficient	0.88582	0.57510	-0.17024	6.95088	50,91	I(*)
t-statistic	26.425	18.898	-3.673			
p-value	0.000	0.000	-5.490		5% critical value	
Variable	dlnGDPramd					
	du1	du2	(rho-1)	Const	Breaks	Conclusion
Coefficient	0.00026	-0.01267	-0.18663	0.01408	44,140	I(0)
t-statistic	0.072	-3.210	-2.925			
p-value	0.943	0.002	-5.490		5% critical value	
Variable	Guests					
	du1	du2	(rho-1)	Const	Breaks	Conclusion
Coefficient	329392.43145	478287.07218	-0.03461	3.71*105	62,102	I(1)
t-statistic	10.006	14.903	-1.508			
p-value	0.000	0.000	-5.490		5% critical value	
Variable	lnArrivalsd					
	du1	du2	(rho-1)	Const	Breaks	Conclusion
Coefficient	0.62720	0.52407	-0.06774	12.81938	62,102	I(1)
t-statistic	16.182	13.871	-1.985			
p-value	0.000	0.090	-5.490		5% critical value	
Variable	dlnArrivalsd					
	du1	du2	(rho-1)	Const	Breaks	Conclusion
Coefficient	-0.03432	0.03460	-0.32932	0.01114	131,135	I(0)
t-statistic	-3.815	3.714	-3.156			
p-value	0.000	0.000	-5,490		5% critical value	

Table 3c: Unit root tests with structural breaks (Bai & Perron; 1998, 2002)

	GDPramd			Lngdpram		
Break Test	F-statistic	Break dates		F-statistic	Break dates	
0 vs. 1	521,5253	2012Q2	1987Q4	412.4835	1987Q4	1987Q3
1 vs. 2	39.08879	1987Q4	2003Q4	356.4038	1997Q4	1996Q3
2 vs. 3*	65.76110	2003Q4	2011Q4	34.70772	2004Q1	2004Q1

run coefficient associated with the number of arrivals is 0.809, which is statistically significant at the 1% level.

The cointegration bond test indicates that the value of the F-statistic for the ARDL model was 12.208 (8.221 in the "levels" model), which is statistically significant based on the critical values of the upper bond level of significance of 5%. This value of the F-statistic permits the rejection of H_0, indicating the existence of a long-run relationship between tourism arrivals and GDP growth.

The dummy variables used for structural breaks identified above did not lead any satisfactory conclusions in terms of statistical significance. For the reasons explained above, there are too many events to account for. In line with expectations, the impact of the economic growth dynamics in Europe is positive, as well as the impact of devaluations of the escudo and euro against a basket of European countries' currencies (including, since 2011, against the pound sterling). An inflation rate above that recorded in the main countries of origin negatively impacts tourism dynamics. Again, in line with expectations, the sizeable reduction in the volume of funds allocated by the EU to Madeira after 2007 had a negative impact on GDP.

Given that Madeira has experienced a series of economic events with different degrees of impact, it is not surprising that the impacts of these events are not symmetric or of equal magnitude in terms of their impact on GDP. Table 6 shows the long-run coefficients for the asymmetric relationship between the independent and dependent variables based on the STATA output. This suggests that tourism growth measured by the number of arrivals positively influences economic growth at a 1% level of significance. Therefore, high tourist arrivals cause economic growth based on higher local production and sales. According to the NARDL estimates, the economic dynamics are influenced by G_NEG and G_POS, which implies that a reduction in arrivals leads to a decrease in GDP, while positive changes in the number of arrivals significantly increase GDP. Note that Table 5 confirms the presence of short-term impacts. It is worth noting that the "levels" model produces better statistical results than the "logs" version using the NARDL approach. While other specifications based on a different set of control variables produced a better fit, it was decided to keep the list of control variables employed in the ARDL model for consistency purposes. For that reason, the information provided in Table 5 is based on the model in levels.

The respective FPSS and tBDM test statistics (in Table 5) of 13.645 and 6.189 suggest rejecting the null hypotheses of no-cointegration at the 1% level. All in all, the NARDL estimates are statistically significant, given the high adjusted R-squares. The NARDL model, this was assessed using four diagnostic tests (see the end of Table 5), namely the standard diagnostic tests (serial correlation, normality, heteroscedasticity, and functional form). The tests examined in this study, with the notable exception of the normality test, can be deemed appropriate. Various solutions were attempted to address the violation of the normality assumption, such as the inclusion of dummy variables and the inclusion of other control variables. While it was possible to validate the "normality assumption" under certain circumstances, such efforts resulted in undesirable consequences in terms of the other tests. The explanation may be that there were too many outlier events, leading to residuals lying in the extremities of the normal distribution. In line with Knief and Forstmeier (2021), it was considered that "violating the normality assumption" was a lesser evil, especially given the huge number of shocks. Non-normal errors are a major issue when predicting from a linear model, but this is not the present case.

The presence or otherwise of asymmetric effects of arrivals on economic growth was investigated using WALD tests on the coefficients of the positive and negative shocks of tourism. The results of the WALD tests are provided in Table 6. Both F-tests suggested that there was asymmetry in the short-term or long-run relationships between arrivals and economic growth.

The results, in terms of the long-run effect, as shown in Table 6, suggest that when arrivals increase by 1 (perhaps due to a positive shock following a successful promotion campaign abroad, or increased security concerns in Madeira's competitor destinations), the level of GDP increases by $0.001*10^6$€ (1000€), which is very much in line with the information provided by the Tourism Satellite Account from the Madeira Statistical Office. However, when the independent variable decreases by 1 (perhaps due a negative shock, such as the 2010 natural disaster in Madeira), the level of GDP decreases by 7000€ in the long run.

The long- and short-run Wald tests, termed WLR and WSR, reported in Table 5, lead to the acceptance of the null hypothesis of long- and short-run symmetry at the 1% level. The associated plot of the cumulative sum (CUSUM, not shown), suggests that regression coefficients are generally stable over the sample period.

When the results of the NARDL model confirm the existence of an asymmetric cointegration relationship, cumulative dynamic multipliers can be used to illustrate the asymmetric responses of economic growth during a change in the volume of arrivals. As shown in Figure 2, the asymmetric impact of arrivals on economic growth is significant in both the short term and the long run because

Table 4: ARDL output and tests

D.	Model in logs				Model in levels			
gdpram1976d	Coef.	Std. err.	t	P>t	Coef.	Std. err.	T	P>t
ADJ								
gdpram1976d								
L1.	-0.0594771	0.0122647	-4.85	0.000	-0.0330029	0.0091816	-3.59	0.000
LR								
arrivalsd								
L1.	0.8091705	0.2351952	3.44	0.001	0.0040375	-.0010514	3.84	0.000
SR								
gdpram1976d	0.6974089	0.0561645	12.42	0.000	0.6984926	.0549762	12.71	0.000
LD.								
arrivalsd								
D1.	0.207203	0.0908929	2.28	0.024	0.0007792	0.0002723	2.86	0.005
LD.	-0.1308579	0.0931934	-1.40	0.163	-0.0005403	0.0002726	-1.98	0.049
time	-0.0001365	0.0002144	-0.64	0.526	-0.3488995	0.4398681	-0.79	0.429
lnexchangerate	0.0160653	0.0084455	1.90	0.059	6.499078	4.891799	1.33	0.186
lneuropegdppcd	0.0242059	0.0080123	3.02	0.003	0.0015652	0.0010925	1.43	0.154
program07	-0.0115173	0.0065889	-1.75	0.083	-2.428 026	1.282889	-1.89	0.060
program14	-0.0191729	0.0098561	-1.95	0.054	-5.055188	0.197285	-2.56	0.011
lninflation	-0.0020383	0.001732	-1.18	0.241	-0.6519132	0.3604449	-1.81	0.072
Goodness of fit								
_cons	-0.3830505	0.1785376	-2.15	0.034	-1.630177	1.90022	-0.86	0.393
R2	0.7153				0.7134			
adj R2	0.6914				0.6936			
F-bounds test								
F	12,208				8,211			
t	-4,849				-3,594			
Model diagnostics								
B.–G. LM test for autocorrelation	χ=0.005; p=0.9576				χ=1.376; p=0.2409			
Durbin's test for autocorrelation	χ=0.003; p=0.9595				χ=1.281; p=0.2577			
B.–P./C.–W. test for heteroskedasticity	χ=38.09; p=0.0000				χ=3.53; p=0.0602			
White's test	chi(44)=68.94; p=0.5472				chi(44)=111.12; p=0.0034			
C. & T. decomposition of IM-test								
Heteroskedasticity	chi(2)= 68.94; p=0.5472				chi(2); 111.12; p=0,0043			
Skewness	chi(2)=15.32; p=0.1681				chi(2)=36.79; p=0.000			
Kurtosis	chi(2)=1.34; p=0.2462				chi(2)=1.34; p=0.2462			
Total	chi(2)=85.86; p=0.4006				chi(2)=9.62; p=0.0019			
Skewness and kurtosis tests for normality	chi(2)=73.25; p=0.0000				chi(2)=26.84; p=0.0000			
Skewness	p=0.000				p=18.03			
Kurtosis	p=0.000				p=0.000			
Cumulative sum test for parameter stability					t=0.4793 ((1%)1.6276;(5%)1.3581;(10%)1.2 238)			
estimated break	199Q4 (p=261.2984; p=0.000)				2012Q2 (p=1043.050; p=0.000)			

Table 5: NARDL model

Model in logs				**Model in levels**			
	coeff.	**t-sta**	**prob.**		**coeff.**	**t-sta**	**prob.**
Constant				Constant			
lnGdpt-1	-0.0617946	-4.39	0.000	Gdpt-1	-0.0826226	-6.19	0.000
lnGt-1⁺	0.0668194	2.11	0.037	TRt-1⁺	0.0001177	2.81	0.006
lnGt-1⁻	0.0631038	1.21	0.229	TRt-1⁻	0.0005806	5.48	0.000
LndGDP	0.7167527	11.29	0.000	dgdp	0.6413531	11.68	0.000
dlnGt+	0.2763233	1.48	0.141	dGt+	0.0009089	2.17	0.032
dlnGt-1+	-0.2286913	-0.97	0.333	dGt-1+	-0.0007912	-1.50	0.136
dlnGt-2+	-0.0507689	-0.22	0.824	dGt-2+	-0.0000488	-0.10	0.924
dlnGt-3+	-0.0143055	-0.06	0.952	dGt-3+	-0.0000943	-0.18	0.855
dlnGt-4+	0.3506473	1.50	0.137	dGt-4+	0.0013204	2.54	0.012
dlnGt-5+	-0.3761953	-2.04	0.044	dGt-5+	-0.0012687	-3.09	0.002
dlnGt-	0.3489861	0.98	0.330	dGt-	0.0006949	0.97	0.332
dlnGt-1-	-0.2399715	-0.55	0.582	dGt-1-	-0.000539	-0.60	0.550
dlnGt-2-	-0.0110366	-0.03	0.978	dGt-2-	-0.0002911	-0.33	0.743
dlnGt-3-	-0.0146184	-0.04	0.972	dGt-3-	-0.0005999	-0.67	0.503
dlnGt-4-	0.3083835	0.74	0.461	dGt-4-	-0.0017387	-1.94	0.054
dlnGt-5-	-0.1674042	-0.50	0.617	dGt-5-	0.0006251	0.87	0.383
time	-0.0000262	-0.05	0.960	time	1.805742	3.70	0.000
lneuropegdppcd	0.0207644	2.00	0.048	europegdppcd	0.0020522	1.87	0.063
program94	-0.0041191	-0.44	0.659	program94	4.479043	3.73	0.000
program00	-0.013331	-1.27	0.208	program00	5.729251	3.17	0.002
program07	-0.0267423	-2.24	0.027	program07	4.053956	1.82	0.071
program14	-0.0404413	-2.20	0.030	program14	3.086442	0.98	0.328
lnInflation	-0.0010019	-0.46	0.644	Inflation	-0.7801926	-1.88	0.062
_cons	0.2386126	2.11	0.037	_cons	5.635482	4.12	0.000
long-run asymmetric effects				long-run asymmetric effects			
lnTR+	1.081	0.026		lnTR+	0.001	0.004	
lnTR-	-1.021	0.201		lnTR-	-0.007	0.000	
statistics and diagnostics				statistics and diagnostics			
R2	0.7312			R2	0.7721		
adj R2	0.6775			adj R2	0.7354		
χ2 sc	55.2	0.0554		χ2 sc	52.18	0.0940	
χ2 nor	39.77	0.0000		χ2 nor	1.287	0.2567	
χ2 het	0.5535	0.6468		χ2 het	2.319	0.0781	
χ2 FF	38.15	0.0000		χ2 FF	190.2	0.0000	
tBDM	-43.942			tBDM	-6.1897		
FPSS	65.278			FPSS	13.6448		
WLR	0.003045	0.957		WLR	31.96	0.000	
WSR	0.4803	0.490		WSR	5.257	0.023	

the line marked "asymmetry" (which shows the effect regardless of whether the change is positive or negative) is significantly different to 0 over the entire period considered. It is also evident that a decrease in the number of tourist arrivals (indicated by lower dotted line) has a stronger impact on economic growth than the rise in number of arrivals, represented by the green dotted line. This confirms the main conclusions obtained from Table 6. In addition, Figure 2 depicts a relatively rapid decrease of GDP from 0 in the case of a downturn; the rate of change slows continuously until the 10th period, and stabilises by the 20th period. The impact of a reduction in the number of arrivals is constant and permanent. Increased levels of tourist arrivals do have a positive effect on GDP, but this is small in magnitude compared to the drop in demand. A rise in the number of arrivals therefore has a smaller effect on economic growth than a decrease.

According to Kumar et al., in the absence of an "obvious or proven theoretical consensus [or] *a priori* empirical evidence on which direction the causality between the variables should hold, VAR analysis is useful." (2022b, p.5). That is not the case in Madeira, however, as past evidence has corroborated the importance of tourism in the island context (Madjak & de Almeida, 2022). In line with the practice, therefore, Granger causality tests were carried out. To test for cointegration and to carry out Granger causality tests, it is necessary to specify the maximum lag length for analysis. The results stipulate a maximum lag length of 2, which we define as the maximum lag length for testing cointegration and estimating the long-run and short-run parameters. The causality results are shown in Table 7 with a maximum lag of 2 in the VAR models. As expected, unidirectional causality from tourism growth was found, which confirms the TLGH rather than the linear models.

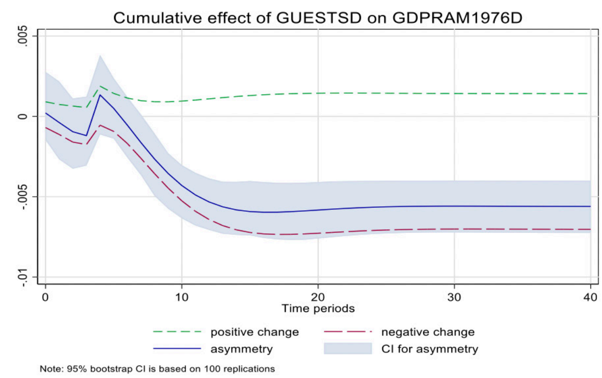


Figure 2: Cumulative effects of tourism receipts on GDP

5 Discussion

This paper examines the effects of changes in the level of tourism receipts on economic growth in Madeira. It uses annual data for the period spanning 1976–2019 and employs a NARDL model to examine the short-term and long-run symmetry of both negative and positive changes in tourism arrivals. Some previous studies have used tourism arrivals (e.g., Brida et al., 2015; Kumar et al., 2020) or tourism nights (Mérida & Golpe, 2016) to proxy tourism receipts. This, however, requires the assumption of relatively constant prices, and it is possible for either of these to rise while tourism receipts fall, and *vice versa*. Other studies again have attempted to address this limitation by transforming annual data into quarterly data using some form of data interpolation (e.g., Kumar et al., 2022b). Such techniques may adversely affect the robustness of the findings, calling into question their conclusions.

The present study started with annual data from 1976 to 2019, which is arguably able to produce more reliable results. However, when it was not possible to identify short-run asymmetry, the annual data were transformed into quarterly figures, which were reassured and encouraged by the statistically significant results obtained with annual data.

Table 6: Asymmetry tests ('Levels' model)

Exog. var. (Level)	**Long-run effect [+]**			**Long-run effect [-]**		
	coef.	F-stat	p>F	coef.	F-stat	p>F
Guestsd	0.001	8.698	0.004	-0.007	60.43	0.000
	Long-run asymmetry			Short-run asymmetry		
	F-stat	p>F		F-stat	p>F	
	31.96	0.000		5.257	0.023	

Table 7: Granger causality test

Equation	Excluded	chi2	df	Prob > chi2
dlnGDP	dlnTR	11.785	2	0.005
dlnPIB	ALL	11.785	2	0.005
dlnTR	dlnGDP	2.0885	2	0.572
dlnTR	ALL	2.0885	2	0.574

Model	Ho	Chi-square	p-value
GDP=f(G)	G does not Granger-cause GDP	11.785	0.004
G=f(GDP)	GDP does not Granger-cause G	2.0885	0.572

With regard to causality, significant unidirectional causality was found to run from arrivals to GDP growth, thus corroborating the TLGH. This is in keeping with most empirical studies of the TLGH (Bilen et al., 2017; Brida et al., 2016; Nunkoo, 2020; Shahzad et al., 2017), though not all. As such, this study adds further evidence in support of the TLGH, characterising the growth of tourism as having a positive, substantial and significant effect on the size of the destination's economy.

The results of this study indicate that both positive and negative shocks to tourism flows can significantly affect the rate of GDP growth experienced in the economy as a whole. This is in keeping with most previous studies, although there have been exceptions to this (e.g., Kumar et al., 2022b). Further analysis suggests, however, that the negative effect is significantly greater than the positive one. This result corroborates those of studies such as Kumar et al. (2022a), but is in direct contradiction with Kumar et al. (2020), which suggested that the long-run effect of positive changes in tourism was as much as three times that of the equivalent negative effect. Kumar et al. (2022b), meanwhile, found there to be an effect associated with positive changes, but no significant effect from negative changes. As such, this study adds to the body of evidence suggesting that a decline in tourism may have significantly greater implications for the destination economy than an increase. This implies that while the economy may benefit from the growth of tourism, it may also be particularly vulnerable to a reduction in tourism receipts.

Evidence of asymmetry was found with regard to the dynamics in both the short term and the long run, for positive or negative shocks. This corroborates the findings of previous studies, which have tended to suggest a nonlinear relationship (e.g., Brida et al., 2015) and hence prefer the use of NARDL (rather than simpler ARDL) models. Nevertheless, this result has important managerial implications, because the results obtained are dependent on the additions of a number of control variables.

Many empirical studies investigating the relationship between tourism and economic growth exist. As noted above, a disproportionate number have focused on small-island destinations. Many of these have been developing countries. To the authors' knowledge, this is the first empirical study that has focused on an autonomous island region, one that is heavily dependent of EU funds and has an oversized public sector. This is important with respect to drawing out the managerial implications of this study, in that Madeira has substantial – but not unlimited – scope to responses to its findings. In short, Madeira's scope for action is, at least to some extent, constrained within the broad policy-making context set by Portugal and, of course, the European Union, of which Portugal is a full member. An example of the effects of this dynamic is the IMF intervention in Portugal following the 2008–2011 financial crisis, which required Madeira to make a sharp reduction in its public spending. This point is made by Nunkoo et al. (2020), who recommend that more studies be carried out at the regional (sub-national) level.

This is important because, in the case of Madeira, there is evidence that negative changes in inbound tourism are likely to have a stronger effect of hindering economic growth than positive changes have in promoting it. Developing the tourism sector to attract tourists with higher incomes and willingness to spend thus represents something of a two-edged sword as a policy. The growth of tourism receipts will promote economic growth – so long as it continues – but the policy carries with it an inherent risk. Any decline in tourism, for example due to exogenous factors or loss of dynamics, can be expected to lead to a substantially larger recessive effect on the destination economy. This suggest that destination marketers need to develop ways to anticipate and mitigate the consequences of external shocks (Hernández-Martín, 2008). A programme of measures to decouple the tourism sector from the broader economy in times when tourism demand is in decline is therefore recommended.

In the meantime, Madeira also needs to harness tourism as an engine of economic growth and to cash in where demand is growing. The identification of unidirectional causality running from tourism to economic growth suggests that the region can effectively boost economic growth performance by implementing economic policies that actively promote the expansion of the tourism sector. However, as this sector has reached a mature stage in its life cycle, a different set of strategies is required, one that is not geared towards new openings of hotel establishments or infrastructural investment but rather focused on the quality of the tourism products. The sector needs to ensure that it meets international standards in terms of sustainable, smart and eco-friendly tourism that is based on circular economy principles. It also needs to attract new private investment in market niches and business models in line with the need to protect and enhance Madeira's natural, cultural and historical resources.

6 Conclusions, limitations and recommendations for future study

This study contributes to knowledge in several important ways. First, it confirms the TLGH at the regional level. This is important because there are likely to be forces at work at the regional level that are not fully captured in national-level data. There are also likely to be policy measures available to independent states that are not available to autonomous regions, and perhaps *vice versa*. The findings of this study support the TLGH, which suggests that the growth of the tourism sector can serve as a long-run driver of growth in the destination economy.

Second, the use of the NARDL model allows the effects of positive and negative changes in tourism receipts to be assessed. In the case of the present study, significant effects are found in both cases, with the former being significantly larger in magnitude than the latter. This implies that a fall in arrivals will have a greater long-run effect in retarding economic growth than an equivalent increase in arrivals will have in promoting it. This recommends an ambitious-yet-cautious approach to developing the tourism economy in Madeira: one that harnesses the potential for tourism to boost the economy when tourism demand is solid or increasing, but also insulates the economy from a stronger recessive effect when tourism demand is weakening or in decline. Investing in and promoting high-end, sustainable tourism may be part of such a strategy, in that it enables the growth potential of tourism to be harnessed without necessarily creating an economic over-dependence on the sector.

This study has some shortcomings that must be duly acknowledged. First, it was not possible to incorporate control variables such as capital investment due to data limitations; these data are not available in the case of Madeira for the full span of such a long period (1978-2019). Second, it is possible that this study was not able to fully consider the short-run period. This is because other variables not recorded in the tables provided above may have not been acknowledged.

Future research should investigate the viability of complementary sectors, such as market niches in agriculture and in the tertiary sector, in order to identify which balance of growth across sectors would be most appropriate from a risk-minimisation viewpoint in order to promote overall economic growth. There could also be much to gain in terms of understanding the short-term dynamics of the adjustment process by making use of monthly data. In the present case, quarterly data series of sufficient quality were not available, which forced us to apply data conversion techniques.

Bionotes

Brian Garrod is Professor of Marketing in the School of Management at Swansea University. His main research interests are in the marketing and management of tourism destinations, sustainable tourism, and accessible tourism. He has published over 50 papers in peer-reviewed journals and co-authored eight books, including *Managing Visitor Attractions*, which is now in its third edition. He has conducted research for the UN World Tourism Organization, the Organisation for Economic Cooperation and Development, the European Union and the UKRI. He is the founding co-editor-in-chief of the *Journal of Destination Marketing and Management* and is currently editor-in-chief of *Tourism and Hospitality*. He also serves on the editorial boards of several other prominent journals in the field. ORCID: 0000-0002-5468-6816.

António Almeida is an Associate Professor at the University of Madeira. His main research interests are in the fields of tourism economics and regional development.

With two dozen papers and chapters published in peer-reviewed journals, he has worked in consultancy projects in the field of tourism. His teaching duties are in microeconomics, regional science, and tourism. ORCID: 0000-0002-3216-2018

Luiz Machado is an Assistant Professor at the University of Madeira. His main research interests are in the field of tourism economics. Luiz Machado has published papers and chapters in top peer-reviewed journals. His teaching duties are in the fields of economics and tourism. ORCID: 0000-0001-6209-969X

References

[1] Adedoyin, F. F., Erum, N., & Bekun, F. V. (2021). How does institutional quality moderates the impact of tourism on economic growth? Startling evidence from high earners and tourism-dependent economies. *Tourism Economics*, *28*(5), 1311–1332. https://journals.sagepub.com/doi/epub/10.1177/1354816621993627

[2] Adnan Hye, Q. M., & Ali Khan, R. E. (2013). Tourism-Led Growth Hypothesis: A Case Study of Pakistan. *Asia Pacific Journal of Tourism Research*, *18*(4), 303-313. https://doi.org/10.1080/10941665.2012.658412

[3] Akadiri, S. S., & Akadiri, A. C. (2021). Examining The Causal Relationship Between Tourism, Exchange Rate, And Economic Growth In Tourism Island States: Evidence From Second-Generation Panel. *International Journal of Hospitality & Tourism Administration*, *22*(3), 235–250. https://doi.org/10.1080/15256480.2019.1598912

[4] Almeida, A., & Garrod, B. (2021). Cross-leveraging synergistic benefits from across an event portfolio: Empirical evidence from Madeira. *Journal of Destination Marketing & Management, 21*(2021), 1–12. https://doi.org/10.1016/j.jdmm.2021.100630

[5] Apergis, N., & Payne, J. (2012). Tourism and Growth in the Caribbean: Evidence from a Panel Error Correction Model. *Tourism Economics*, *18*(2), 449–456. https://doi.org/10.5367/te.2012.0119

[6] Archer, B. (1995). Importance of tourism for the economy of Bermuda. *Annals of Tourism Research*, *22*(4), 918–930. https://doi.org/10.1016/0160-7383(95)00018-1

[7] Archer, B., & Fletcher, J. (1996). The economic impact of tourism in the Seychelles. *Annals of Tourism Research*, *23*(1), 32-47. https://doi.org/10.1016/0160-7383(95)00041-0

[8] Aslan, A. (2014). Tourism development and economic growth in the Mediterranean countries: evidence from panel Granger causality tests. *Current Issues in Tourism*, *17*(4), 363–72. https://doi.org/10.1080/13683500.2013.768607

[9] Bai, J., & Perron, P. (1998). Estimating and Testing Linear Models with Multiple Structural Changes. *Econometrica*, *66*(1), 47–78. https://doi.org/10.2307/2998540

[10] Bai, J., & Perron, P. (2002). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, *18*(1), 1–22. https://doi.org/10.1002/jae.659

[11] Balaguer, J., & Cantavella-Jordá, M. (2002). Tourism as a long-run economic growth factor: the Spanish case. *Applied Economics*, *34*(7), 877–884. https://doi.org/10.1080/00036840110058923

[12] Balsalobre-Lorente, D., Driha, O. M., Bekun, F. V., & Adedoyin, F. F. (2021). The asymmetric impact of air transport on economic growth in Spain: fresh evidence from the tourism-led growth hypothesis. *Current Issues in Tourism*, *24*(4), 503–519. https://doi.org/10.1080/13683500.2020.1720624

[13] Bardolet, E., & Sheldon, P. J. (2008). Tourism in archipelagos: Hawai'i and the Balearics. *Annals of Tourism Research*, *35*(4), 900–923. https://doi.org/10.1016/j.annals.2008.07.005

[14] Bastidas-Manzano, A.-B., Sanchez-Fernández, J., & Casado-Aranda, L.-A. (2020). The Past, Present, and Future of Smart Tourism Destinations: A Bibliometric Analysis. *Journal of Hospitality & Tourism Research*, *45*(3), 529–552. https://doi.org/10.1177/1096348020967062

[15] Bildirici, M. E., & Turkmen, C. (2015). Nonlinear causality between oil and precious metals. *Resources Policy*, *46*(2), 202–211. https://doi.org/10.1016/j.resourpol.2015.09.002

[16] Bilen, M., Yilanci, V., & Eryüzlü, H. (2017). Tourism development and economic growth: a panel Granger causality analysis in the frequency domain. *Current Issues Tourism*, *20*(1), 27–32. https://doi.org/10.1080/13683500.2015.1073231

[17] Brida, J. G., & Risso, W. A. (2009). Tourism as a factor of long-run economic growth: An empirical analysis for Chile. *European Journal of Tourism Research*, *2*(2), 178–185. https://doi.org/10.54055/ejtr.v2i2.36

[18] Brida, J. G., Cortes-Jimenez, I., & Pulina, M. (2016). Has the tourism-led growth hypothesis been validated? A literature review. *Current Issues in Tourism*, *19*(5), 394–430. https://doi.org/10.1080/13683500.2013.868414

[19] Brida, J. G., Lanzilotta, B., Pereyra, J. S., & Pizzolon, F. (2015). A nonlinear approach to the tourism-led growth hypothesis: The case of the MERCOSUR. *Current Issues in Tourism*, *18*(7), 647–666. https://doi.org/10.1080/13683500.2013.802765

[20] Cannonier, C., & Burke, M. G. (2019). The economic growth impact of tourism in Small Island Developing States: evidence from the Caribbean. *Tourism Economics*, *25*(1), 85–108. https://journals.sagepub.com/doi/pdf/10.1177/1354816618792792

[21] Charfeddine, L., & Dawd, I. (2022). Analysis of the resilience of the Turkey tourism industry to exogenous shocks: new evidence from a NARDL model. *Tourism Recreation Research*, *1*(1), 1–16. https://doi.org/10.1080/02508281.2022.2026615

[22] Chiou-Wei, S. Z., Chen, C. F., & Zhu, Z. (2008). Economic growth and energy consumption revisited — Evidence from linear and nonlinear Granger causality. *Energy Economics, 30*(6), 3063–3076. https://doi.org/10.1016/j.eneco.2008.02.002

[23] Clemente, J., Montañés, A., & Reyes, M. (1998). Testing for a unit root in variables with a double change in the mean. *Economic Letters*, *59*(2), 175–182. https://doi.org/10.1016/S0165-1765(98)00052-4

[24] Comerio, N., & Strozzi, F. (2019). Tourism and its economic impact: A literature review using bibliometric tools. *Tourism Economics*, *25*(1), 109–131. https://journals.sagepub.com/doi/pdf/10.1177/1354816618793762

[25] Da Costa Ribeiro, E., & Wang, B. (2019). Tourism led growth hypothesis: has the tourism industry an impact on the economic growth of Sao Tome and Principe? *International Journal of Economic Finance Issues*, *10*(1), 180–185. https://www.econjournals.com/index.php/ijefi/article/view/9105

[26] De Vita, G., & Kyaw, K. (2016). Tourism development and growth. *Annals of Tourism Research*, *60*(9), 23–26. https://dx.doi.org/10.1016/j.annals.2016.05.011

[27] De Vita, G., & Kyaw, K. S. (2017). Tourism Specialization, Absorptive Capacity, and Economic Growth. *Journal of Travel Research*, *56*(4), 423–435. https://doi.org/10.1177/0047287516650042

[28] Dogru, T., & Bulut, U. (2018). Is tourism an engine for economic recovery? Theory and empirical evidence. *Tourism Management*, *67*(2018), 425–434. https://doi.org/10.1016/j.tourman.2017.06.014

[29] Direção Regional de Estatística da Maderia [DREM] (2022). *Em Foco: Conta Satélite de turismo da Região Autónoma da Madeira, 2019 (In Focus: Tourism Satellite Account of the Autonomous Region of Madeira, 2019)*. https://estatistica.madeira.gov.pt/

[30] Ekanayake, E. M., & Long, A. E. (2012). Tourism development and economic growth in developing countries. *The International Journal of Business and Finance Research,* *6*(1), 51-63. http://www.theibfr2.com/RePEc/ibf/ijbfre/ijbfr-v6n1-2012/IJBFR-V6N1-2012-5.pdf

[31] Engle, R. F., Granger, C. W. J., Hylleberg, S., & Lee, H. (1993). Seasonal cointegration: The Japanese consumption function. Journal of Econometrics, *55*(1-2), 275–298. https://doi.org/10.1016/0304-4076(93)90016-X

[32] Fahimi, A, Akadiri S., Seraj, M., & Akadiri, A. (2018). Testing the role of tourism and human capital development in economic growth. A panel causality study of micro states. *Tourism Management Perspectives*, *28*(2018), 62–70. https://doi.org/10.1016/j.tmp.2018.08.004

[33] Fonseca, N., & Sánchez-Rivero, M. (2020a). Publication bias and genuine effects: the case of Granger causality between tourism and income. *Current Issues in Tourism*, *23*(9), 1084–1108. https://doi.org/10.1080/13683500.2019.1585419

[34] Fonseca, N., & Sánchez-Rivero, M. (2020b). Significance bias in the tourism-led growth literature. *Tourism Economics*, *26*(1), 137–154. https://doi.org/10.1177/1354816619833564

[35] García-Falcón, J. M., & Medina-Muñoz, D. (1999). Sustainable tourism development in islands: a case study of Gran Canaria. *Business Strategy and the Environment*, *8*(6), 336–357. https://doi.org/10.1002/(SICI)1099-0836(199911/12)8:6%3C336::AID-BSE217%3E3.0.CO;2-7

[36] Granger, C. W. J. (1988). Causality, cointegration, and control. *Journal of Economic Dynamics and Control*, *12*(2-3), 551–559. https://doi.org/10.1016/0165-1889(88)90055-3

[37] Hernández-Martín, R. (2008). Structural Change and Economic Growth in Small Island Tourism Countries. *Tourism and Hospitality Planning & Development*, *5*(1), 1–12. https://doi.org/10.1080/14790530801936411

[38] Hospers, G. -J. (2003). Localization in Europe's Periphery: Tourism Development in Sardinia. *European Planning Studies*, *11*(6), 629–645. https://doi.org/10.1080/0965431032000108369

[39] Hu, J., Xu, J., Tong, L., & Razi, U. (2022). The dynamic role of film and drama industry, green innovation towards the sustainable environment in China: fresh insight from NARDL approach. *Economic Research-Ekonomska Istraživanja*, *35*(1), 5292–5309. https://doi.org/10.1080/1331677X.2022.2026239

[40] Hu, K., Raghutla, C., Chittedi, K. R., Zhang, R., & Koondhar, M. A. (2021). The effect of energy resources on economic growth and carbon emissions: A way forward to carbon neutrality in an emerging economy. *Journal of Environmental Management*, *298*(2021), 1–10. https://doi.org/10.1016/j.jenvman.2021.113448

[41] Husein, J., & Kara, S. M. (2020). Nonlinear ARDL estimation of tourism demand for Puerto Rico from the USA. *Tourism Management*, *77*(2), 1–4. https://www.researchgate.net/publication/339210992_Nonlinear_ARDL_estimation_of_tourism_demand_for_Puerto_Rico_from_the_USA

[42] Hylleberg S., Engle R. F., Granger C. W. J., & Yoo B. S. (1990). Seasonal integration and cointegration. *Journal of Econometrics, 44*(1-2), 215–238. https://doi.org/10.1016/0304-4076(90)90080-D

[43] Ibrahim, M. H. (2015). Oil and food prices in Malaysia: a nonlinear ARDL analysis. *Agricultural and Food Economics*, *3*(1), 1–14. https://agrifoodecon.springeropen.com/articles/10.1186/s40100-014-0020-3

[44] ISMERI Europa (2011). *Growth factors in the Outermost Regions*. https://www.researchgate.net/publication/305084005_Growth_factors_in_the_Outermost_Regions_of_the_EU

[45] Jin, J. C. (2011). The Effects of Tourism on Economic Growth in Hong Kong. *Cornell Hospitality Quarterly*, *52*(3), 333–340. https://doi.org/10.1177/1938965510394169

[46] Katircioglu, S. T. (2009a). Revisiting the tourism-led-growth hypothesis for Turkey using the bounds test and Johansen approach for cointegration. *Tourism Management*, *30*(1), 17–20. https://doi.org/10.1016/j.tourman.2008.04.004

[47] Katircioglu, S. T. (2009b). Testing the tourism-led growth hypothesis: the case of Malta. *Acta Oeconomica*, *59*(3), 331–343. https://www.researchgate.net/profile/Salih-Katircioglu/publication/247850385_Testing_the_Tourism-led_Growth_Hypothesis_The_Case_of_Malta/links/5476fb550cf245eb4372993e/Testing-the-Tourism-led--Growth-Hypothesis-The-Case-of-Malta.pdf

[48] Kim, H. J., Chen, M. H., & Jang, S. (2006). Tourism expansion and economic development: The case of Taiwan. *Tourism Management*, *27*(5), 925–933. https://doi.org/10.1016/j.tourman.2005.05.011

[49] Knief, U., & Forstmeier, W. (2021). Violating the normality assumption may be the lesser of two evils. *Behavior Research Methods, 53*(2021), 2576–2590. https://doi.org/10.3758/s13428-021-01587-5

[50] Kumar, N. N., & Patel, A. (2022). Modelling the impact of COVID-19 in small pacific island countries. *Current Issues in Tourism*, *25*(3), 394–404. https://doi.org/10.1080/13683500.2021.1963214

[51] Kumar, N. N., Patel, A., Chandra, R. A., & Kumar, N. N. (2021). Publication bias and the tourism-led growth hypothesis. *PLoS One*, *16*(10), 1–18. https://doi.org/10.1371/journal.pone.0258730

[52] Kumar, N. N., Patel, A., Kimpton, S., & Andrews, A. (2022a). Asymmetric reactions in the tourism-led growth hypothesis. *Australian Economic Papers*, *61*(4), 661–77. https://doi.org/10.1111/1467-8454.12272

[53] Kumar, N. N., Patel, A., Chandra, R., & Kumar, N. (2022b). Nonlinear effect of tourism on economic growth: evidence from Papua New Guinea. *Journal of Policy Research in Tourism, Leisure and Events*, *1*(1), 1–23. https://www.tandfonline.com/doi/abs/10.1080/19407963.2022.2062599

[54] Kumar, N., Kumar, R. R., Kumar, R., & Stauvermann, P. J. (2020). Is the tourism–growth relationship asymmetric in the Cook Islands? Evidence from NARDL cointegration and causality tests. *Tourism Economics*, *26*(4), 658–681. https://doi.org/10.1177/1354816619859712

[55] Kyara, V. C., Rahman, M. M., & Khanam, R. (2021). Tourism expansion and economic growth in Tanzania: A causality analysis. *Heliyon*, *7*(5), 1–9. https://doi.org/10.1016/j.heliyon.2021.e06966

[56] Kyophilavong, P., Gallup, J. L., Charoenrat, T., & Nozaki, K. (2018). Testing tourism-led growth hypothesis in Laos? *Tourism Review*, *73*(2), 242–251. https://doi.org/10.1108/TR-03-2017-0034

[57] Lanza, A., Temple, P., & Urga, G. (2003). The implications of tourism specialisation in the long run: An econometric analysis for 13 OECD economies. *Tourism Management*, *24*(3), 315–321. https://doi.org/10.1016/S0261-5177(02)00065-1

[58] Lawal, A. I., Asaleye, A. J., Iseolorunkanmi, J., & Popoola, O. R. (2018). Economic growth, agricultural output and tourism development in Nigeria: an application of the ARDL bound testing approach. *Journal of Environmental Management Tourism*, *9*(4), 786–794. https://doi.org/10.14505//jemt.v9.4(28).12

[59] Li, K., Jin, M., & Shi, W. (2018). Tourism as an important impetus to promoting economic growth: A critical review. *Tourism Management Perspectives*, *26*(2018), 135–142. https://isiarticles.com/bundles/Article/pre/pdf/91567.pdf

[60] Liu, H., & Song. H. (2018). New evidence of dynamic links between tourism and economic growth based on mixed-frequency Granger causality tests. *Journal of Travel Research*, *57*(7), 899–907. https://doi.org/10.1177/0047287517723531

[61] Long, S., & Zhang, R. (2022). The asymmetric effects of international oil prices, oil price uncertainty and income on urban residents' consumption in China. *Economic Analysis and Policy*, *74*(2022), 789–805. https://doi.org/10.1016/j.eap.2022.04.008

[62] Majdak, P., & de Almeida, A. M. M. (2022). Pre-emptively managing overtourism by promoting rural tourism in low-density areas: Lessons from Madeira. *Sustainability*, *14*(2), 1–20. https://doi.org/10.3390/su14020757

[63] Marrocu, E., & Paci. R. (2014). Tourism and regional growth in Europe. *Papers in Regional Science*, *93*(1), 25–50. https://doi.org/10.1111/pirs.12085

[64] Meo, M., Khan, V., Ibrahim, T., Khan, S., Ali, S., & Noor, K. (2018). Asymmetric impact of inflation and unemployment on poverty in Pakistan: new evidence from asymmetric ARDL cointegration. *Asia Pacific Journal of Social Work and Development*, *28*(4), 295–310. https://doi.org/10.1080/02185385.2018.1523745

[65] Mérida, A. & Golpe, A. (2016). Tourism-led growth revisited for Spain: causality, business cycles and structural breaks. *International Journal of Tourism Research*, *18*(1), 39–51. https://doi.org/10.1002/jtr.2031

[66] Nadeem, M. A., Liu, Z., Ali, H. S., Younis, A., Bilal, M., & Xu, Y. (2020). Innovation and sustainable development: Does aid and political instability impede Innovation? *SAGE Open, 10(4)*, 1–16. https://doi.org/10.1177/2158244020973021

[67] Narayan, P. K. (2004). Fiji's tourism demand: the ARDL approach to cointegration. *Tourism Economics*, *10*(2), 193–206. https://journals.sagepub.com/doi/pdf/10.5367/000000004323142425

[68] Nowak, J.-J., Sahli, M., & Cortés-Jiménez, I. (2007). Tourism, capital good imports and economic growth: Theory and evidence for spain. *Tourism Economics*, *13*(4), 515-536. https://doi.org/10.5367/000000007782696113

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

[70] Oh, C. –O. (2005). The contribution of tourism development to economic growth in the Korean economy. *Tourism Management*, *26*(1), 39–44. https://doi.org/10.1016/j.tourman.2003.09.014

[71] Orzeszko, W. (2021). Nonlinear causality between crude oil prices and exchange rates: Evidence and forecasting. *Energies, 14*(19), 1–16. https://doi.org/10.3390/en14196043

[72] Othman, R., Salleh, N. H. M., & Sarmidi, T. (2012). Analysis of causal relationship between tourism development, economic growth and foreign direct investment: An ARDL approach. *Journal of Applied Sciences*, *12*(12), 1245–1254. https://scialert.net/abstract/?doi=jas.2012.1245.1254

[73] Pablo-Romero, M. P., & Molina, J. A. (2013). Tourism and economic growth: A review of empirical literature. *Tourism Management Perspectives*, *8*(23), 28–41. https://doi.org/10.1016/j.tmp.2013.05.006

[74] Perles-Ribes, J. F., Ramón-Rodríguez, A. B., Rubia, A., & Moreno-Izquierdo, L. (2017). Is the tourism-led growth hypothesis valid after the global economic and financial crisis? The case of Spain 1957–2014. *Tourism Management*, *61*(2017), 96–109. https://doi.org/10.1016/j.tourman.2017.01.003

[75] Pesaran, M. & Smith, R. (2014). Signs of impact effects in time series regression models. *Economics Letters*, *122*(2014), 150–153. https://dornsife.usc.edu/assets/sites/890/docs/Papers_pdfs/2014/Pesaran__Smith_Economics_Letters_2014_Signs_of_imapct_effects_150-153.pdf

[76] Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289–326. https://www.jstor.org/stable/2678547

[77] Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335–346. https://doi.org/10.2307/2336182

[78] Pulido-Fernández, J. I., & Cárdenas-García, P. J. (2021). Analyzing the bidirectional relationship between

tourism growth and economic development. *Journal of Travel Research*, *60*(3), 583– 602. https://doi.org/10.1177/0047287520922316
[79] Roudi, S., Arasli, H., & Akadiri, S. S. (2019). New insights into an old issue – examining the influence of tourism on economic growth: evidence from selected small island developing states. *Current Issues in Tourism*, *22*(11), 1280–1300. https://doi.org/10.1080/13683500.2018.1431207
[80] Schubert, S. F., Brida, J. G., & Risso, W. A. (2011). The impacts of international tourism demand on economic growth of small economies dependent on tourism. *Tourism Management*, *32*(2), 377–385. https://doi.org/10.1016/j.tourman.2010.03.007
[81] Seetanah, B. (2011). Assessing the dynamic economic impact of tourism for island economies. *Annals of Tourism Research*, *38*(1), 291–308. https://doi.org/10.1016/j.annals.2010.08.009
[82] Shahbaz, M., Shahzad, S. J. H., Mahalik, M. K., & Sadorsky, P. (2018). How strong is the causal relationship between globalization and energy consumption in developed economies? A country-specific time-series and panel analysis. *Applied Economics, 50*(13), 1479–1494. https://doi.org/10.1080/00036846.2017.1366640
[83] Shahzad, S. J. H., Shahbaz, M., Ferrer, R., & Kumar, R. R. (2017). Tourism-led growth hypothesis in the top ten tourist destinations: New evidence using the quantile-on-quantile approach. *Tourism Management*, *60*(2017), 223–232. https://doi.org/10.1016/j.tourman.2016.12.006
[84] Shahzad, S., Hernandez, J., Al-Yahyaee, K., & Jammazi, R. (2018). Asymmetric risk spillovers between oil and agricultural commodities. *Energy Policy, 118*(2018)*,* 182–98. https://doi.org/10.1016/j.enpol.2018.03.074
[85] Sharpley, R. (2003). Tourism, Modernisation and Development on the Island of Cyprus: Challenges and Policy Responses. *Journal of Sustainable Tourism*, *11*(2–3), 246–265. https://doi.org/10.1080/09669580308667205
[86] Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles & W. C. Horrace (Eds.), *Festschrift in Honor of Peter Schmidt* (pp. 281–314). Springer. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1807745
[87] Singh, D. R., Wright, A. S., Hayle, C., & Craigwell. R. (2010). Is the tourism-led growth thesis valid? The case of the Bahamas, Barbados, and Jamaica. *Tourism Analysis*, *15*(4), 435–445. https://doi.org/10.3727/108354210X12864727453223
[88] Smeral, E. (2018). Variations in seasonal outbound travel across the business cycles. *Journal of Travel Research*, *57*(7)*,* 936–946. https://doi.org/10.1177/0047287517727367
[89] Sokhanvar, A., Çiftçioglu, S., & Javid, E. (2018). Another look at tourism-economic development nexus. *Tourism Management Perspectives*, *26*(2018), 97–106. https://doi.org/10.1016/j.tmp.2018.03.002
[90] Solarin, S. A. (2018). Does tourism-led growth hypothesis exist in Mauritius? Evidence from disaggregated tourism markets. *Current Issues in Tourism*, *21*(9), 964–969. https://doi.org/10.1080/13683500.2016.1232377
[91] Song, H., Qiu, R. T. R., & Park, J. (2019). A review of research on tourism demand forecasting: Launching the *Annals of Tourism Research* Curated Collection on tourism demand forecasting. *Annals of Tourism Research*, *75*(2019), 338–362. https://doi.org/10.1016/j.annals.2018.12.001
[92] STATA. (2023). *STATA Time Series Reference Manual*: *Release 18*. Stata Press. https://www.stata.com/manuals/ts.pdf
[93] Suryandaru, R. (2020). Measuring tourism-led growth hypothesis in Indonesia. *International Journal of Culture, Tourism and Hospitality Research*, *14*(2), 295–300. https://doi.org/10.1108/IJCTHR-03-2019-0055
[94] Tang, C. F. (2018). The impacts of governance and institutions on inbound tourism demand: evidence from a dynamic panel data study. *Asia Pacific Journal of Tourism Research*, *23*(10), 1000–1007. https://doi.org/10.1080/10941665.2018.1513052
[95] Tang, C. F., & Tan, E. C. (2013). How stable is the tourism-led growth hypothesis in Malaysia? Evidence from disaggregated tourism markets. *Tourism Management*, *37*(2013), 52–57. https://doi.org/10.1016/j.tourman.2012.12.014
[96] Tang, C. F., & Tan, E. C. (2015). Tourism-led growth hypothesis in Malaysia: evidence based upon regime shift cointegration and time-varying Granger causality techniques. *Asia Pacific Journal of Tourism Research*, *20*(sup1), 1430–1450. https://doi.org/10.1080/10941665.2014.998247
[97] Trang, N. H. M., Duc, N. H. C., & Dung, N. T. (2014). Research note: Empirical assessment of the tourism-led growth hypothesis: The case of Vietnam. *Tourism Economics*, *20*(4), 885–892. https://doi.org/10.5367/te.2013.0307
[98] Tugcu, C. T. (2014). Tourism and economic growth nexus revisited: A panel causality analysis for the case of the Mediterranean Region. *Tourism Manag*ement, *42*(2014), 207–212. https://doi.org/10.1016/j.tourman.2013.12.007
[99] Wu, T.-P., & Wu, H.-C. (2018). The causal nexus between international tourism and economic development. *Tourism Analysis*, *23*(1), 17–29. https://doi.org/10.3727/108354218X15143857349468
[100] Zivot, E., & Andrews, D. W. K. (1992). Further evidence on the Great Crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business & Economic Statistics*, *10*(1), 251–270. https://doi.org/10.2307/1391541
[101] Zuo, B., & Huang, S. (2018). Revisiting the tourism-led economic growth hypothesis: the case of China. *Journal of Travel Research*, *57*(2), 151–163. https://doi.org/10.1177/0047287516686725
[102]