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THE GREEK TOURISM-LED GROWTH REVISITED: INSIGHTS AND PROSPECTS

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Abstract

The paper investigates empirically the tourism-growth relationship in Greece, over the period 1960-2020. We find that the long-run relationship between tourism and output is positive and is characterized by a substantially faster convergence of output after a negative shock than after a positive one. Using asymmetric error-correction model analysis the results show that the short-term adjustment path occurs through the level of output for negative deviations from the long-run equilibrium, thus supporting the tourism-led growth hypothesis. Linear quantile regression analysis indicates that while the impact of tourism remains positive and significant across the output distribution it is stronger at lower quantiles of output than at higher ones. Our results have important policy implications, since the tourism-led growth hypothesis is a useful policy recommendation, but it should not be considered a cure-all policy.

JEL- classification: C21, C24, F43, L83

Keywords: tourism, economic growth, tourism-led growth hypothesis, threshold cointegration approach, quantile regression approach.

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1. Introduction

The examination of the relationship between tourism and economic growth is of vital importance due to the sharp increase in tourism internationally and its rising share in GDP and employment. The question is whether tourism acts as a driver for economic growth, or the reverse, or indeed there exists a bi-directional, or a no causality relationship between the two variables. Although the rapidly expanding empirical research opts for a long-run causality running from the expansion of tourism to economic growth, i.e. a "tourism-led growth" hypothesis, the issue is still unresolved. The results depend on the specificities of the cases studied and also on the methodology followed (Brida *et al.*, 2016).

Recently the investigation of the tourism-growth nexus turned to more advanced techniques with rising reliance on non-linear relations. In this context, the link between tourism and output might vary with the state of the economy. Also, each variable may react asymmetrically to negative/positive shocks or to large/small changes in the other variable.

The purpose of this paper is to re-examine the relationship between international tourism and economic activity in Greece, a medium sized country, whose economy, to a great extent, relies on tourism.[1] We investigated the period 1960-2020, which covers the actual beginning of the post war tourism in Greece until the present. For this reason, we present in more detail the peculiarities of GDP growth and especially the characteristics of Greek tourism. Over the period under study, the development of the economy has not been uniform, especially during the severe economic crisis for over a decade (2010s). Since the development of incoming tourism has not been smooth either, we believe that the tourism-output relationship might not be linear or symmetric.

Initially, we investigate the asymmetric relationship between tourism and output using a threshold cointegration approach, while examining the adjustment in the short term via an asymmetric error-correction model estimation with threshold cointegration (Enders and Siklos, 2001; Sun, 2011). The results point to an asymmetric effect both in the short and long term and to a substantial faster and significant speed of adjustment of output for negative deviations from the long-run equilibrium. Our findings support the tourism-led growth hypothesis. Next, following Koenker and Basser (1978) and Nusair and Olson (2019) we use quantile regression (QR) analysis to examine the impact of tourism growth on output growth. Using QR analysis we gather information on the co-movements between tourism and output under various states of the economy, that is whether it is flourishing (upper quantiles), recessionary (lower quantiles) or normal (intermediate quantiles). The results show that the impact of tourism remains positive and significant across the output distribution and the magnitude of the impact is stronger at lower quantiles of output.

In view of the recent econometric advances, our study contributes to the tourism-growth literature in various ways. First, by investigating the existence of a non-linear relationship between the variables through the application of a threshold

[1] In the years before the Covid-19 crisis the international tourist receipts amounted to about 7-8% of GDP.

cointegration and an asymmetric error-correction model estimation. Second, by examining the effects between the variables using QR analysis. QR model estimation allows examining the impact of changes of one variable over a range of values of the other variable, providing more concrete results in the relationship between the two variables. Lastly, our approach differs from that of the great majority of existing studies, including those for Greece, which investigate linear and symmetric behaviour of the tourism-output relationship, not allowing an in-depth analysis of the impact of tourism across the output distribution

The conclusions drawn could be useful for the analysis of other countries with similar characteristics, especially for countries whose economy has undergone significant swings during the recent economic crisis, such as some Southern and Eastern European countries. Our results leave room for national policies to operate for the promotion of economic growth.

The rest of the paper is organised as follows. Section 2 briefly discusses the literature on the relationship between tourism and economic growth. Section 3 presents stylised facts of the Greek economy. Section 4 discusses the variables and data used in the analysis. Section 5 presents the econometric methodology. Section 6 discusses the empirical results of the study. Finally, Section 7 summarises the results and concludes the issue.

2. Literature review

The relationship between tourism flows and economic activity has been investigated by numerous empirical studies yet with unresolved results. The tourism and growth research has been extensively reviewed in the relevant literature (Brida *et al.*, 2016; Comerio and Strozzi, 2019; Nunkoo *et al.*, 2019).

The important interaction of tourism with economic activity has been recognized by McKinnon (1964) who put the foundations of the tourism-led growth hypothesis. This hypothesis was formalized and tested empirically for the first time by Balaguer and Cantavella-Jordá (2002). It postulates that the foreign exchange earnings finance investment and differentiated production, thus promoting economic growth. Also, tourism stimulates investment in new infrastructure and increases competition thus improving efficiency of local firms (Balaguer and Cantavella-Jordá, 2002). Furthermore, tourism generates employment and boosts the accumulation of human capital acting also as a catalyst in the diffusion of technical knowledge (Schubert *et al.*, 2011). Finally, tourism can generate economies of scale and scope thus decreasing production costs for local businesses (Andriotis, 2002).

However, the reverse effect, the “growth-led tourism” hypothesis, is also empirically identified (Narayan, 2004; Oh, 2005; Payne and Mervar, 2010). A country’s sustained economic growth boosts the development of tourism in this country, which in its turn creates a positive economic environment for the attraction of more international tourists. Also, several empirical studies show a bi-directional relationship between tourism and economic growth. A boost of tourism affects economic activity positively, which in turn leads to an increase in tourism (Kim *et al.*, 2006; Tang, 2013; Massidda and Mattana, 2013). Finally, some studies do not find a long-run association between the two variables (Katircioglu, 2009; Jackman and Lorde, 2010).

In the case of Greece, several empirical studies have investigated the relationship between international tourism and the country's economic growth. In particular, Dritsakis (2004) analyzed the relationship between tourism earnings, GDP and exchange rate (1960Q1-2000QIV), using VECM (Johansen) - Granger causality tests and found that tourism Granger causes economic growth with a "strong causal" relationship, while economic growth causes tourism with a "simply causal" relationship. Kasimati (2011) analyzed the relationship between tourist arrivals, GDP and effective exchange rate for Greece over the period 1960-2010, using VECM (Johansen) - Granger causality method and found that there is no causality between the variables.

In addition, Eeckels *et al.* (2012) using VAR analysis showed that the cyclical component of tourism income is significantly influencing the cyclical component of GDP and validated the tourism-led economic growth hypothesis for the case of Greece over the period 1976-2004. Aslan (2013) examined the relationship between tourist receipts, exchange rate and GDP with panel cointegration and Granger causality methodology for twelve Mediterranean countries (1995-2010). He came to mixed results and for the case of Greece he found a unidirectional causality running from economic growth to tourism. Recently, Lolos *et al.* (2021) investigated the tourism-growth nexus in the Greek economy. Using quarterly data for the period 1977i-2020ii they verified the tourism-led growth hypothesis. Also, they showed that tourism growth exhibits an asymmetric impact on output growth and the impact of tourism on output is related to the state of the economy.

Also, Othman *et al.* (2012) investigated 18 major tourist destinations worldwide including Greece, using ARDL methodology and also came to mixed results. In the case of Greece, they found no causal relationship between tourism and growth. Dritsakis (2012) examined the relationship between tourist arrivals, effective exchange rate and GDP for seven Mediterranean countries including Greece (1980-2007), using panel cointegration and fully modified OLS and detected a unidirectional long-run causality running from tourism to economic growth. Antonakakis *et al.* (2015) examined the dynamic relationship between tourism growth and economic growth for 10 European countries over the period 1995-2012. They conclude that the tourism-economic growth relationship is not stable over time in terms of magnitude and direction. They show that this relationship is event-dependent especially in countries that encountered severe economic downturns since 2009, like Cyprus, Greece, Portugal and Spain.

Recently, Wang (2012) examined threshold effects on the tourism development and economic growth relationship, casting doubts on the findings implying the existence of a linear relationship. Also, Shahzad *et al.* (2017) using the quantile-on-quantile (QQ) approach examined the interdependence of the tourism and output variables for ten top tourist destination countries by estimating the effects of the quantiles of tourism growth on the quantiles of the output growth.

3. Stylised facts of the Greek economy

The World War II and the subsequent Civil War left Greece in economic and social disarray. The reconstruction period that followed was mainly financed by the US *Marshall Plan*.[2] The economy was gradually normalized and macroeconomic policies succeeded in achieving internal and external stability (Halikias, 1978). As a result, from the mid-1950s until the first energy crisis (1973), the Greek economy registered unprecedented high annual growth rates of 6-7%. After the first and until the second energy crisis (1978/9) the growth rates receded to 4-5% but afterwards and until the mid-1990s the Greek economy stagnated with annual growth rates of around 1% (Figure 1). Over this period a great shift took place from primary and secondary sectors to the tertiary sector and services, although industrial and international trade policies were quite interventionist (Mitsos, 1989). Also, since the beginning of the 1990s in view of the country joining the Euro area successful Convergence Programmes were implemented (Lolos, 1998). As a result, from the mid-1990s until after the mid-2000s the economy achieved high growth rates of around 4% per annum on average, well above those of the EU countries.

< Insert Figure 1 somewhere here >

However, in the period 2007-09 there was a rapid deterioration of the internal and external balances of the Greek economy which almost coincided with the beginning of the global financial crisis (2008). In 2009, both the external imbalance and the public sector deficit rocketed to around 15% of GDP, while the public debt to GDP ratio increased to 127% from around 95% that it was in the second half of the 1990s. In 2010, the government in order to avoid default was obliged to enforce a severe structural adjustment programme which would turn into a series of adjustment programmes (2010, 2012, 2015) mainly financed by the EU countries (*European Commission*, 2018; *IMF*, 2019). Various governments that came to office over the 2010s were thus obliged to implement severe austerity measures for fiscal consolidation, the achievement of external balance and competitiveness improvement, including tax increases and cuts in wages, pensions and salaries. As a result, the economic activity underwent an unprecedented depression losing around 25% of its output (2010-2017), while the rate of unemployment tripled to 28% relatively to previous periods. After 2017/8 the economy started recovering at annual rates of 2% but in 2020 contracted by 8% due to the Covid-19 crisis. Unemployment dropped gradually to around 16% in 2020.

Since the early 1950s, tourism has emerged as an important force of economic development in Western societies. The foundations for post-war tourist development in Greece were set up at the end of 1940s. Ever since, tourist policy has been *explicitly* framed on the premises of the tourism-led growth hypothesis, in line with the rationale and the directives of the *Marshall Plan*. Thus, international tourism would bring valuable foreign exchange and mobilisation of economic activity, also helping to the modernisation of the whole country. Greece's exceptional natural features, together with its rich history and unique cultural heritage assets, would be the catalyst in this process.

Over the 1950s and 1960s the state embarked on the design and construction

[2] The *Marshall Plan* (officially the *European Recovery Program* was an American initiative passed in 1948 for foreign aid to Western European economies after the end of World War II. For details, see, [Milestones: 1945–1952 - Office of the Historian](history.state.gov) *history.state.gov*.

of a network of modern hotels and related tourist infrastructure all over Greece, the so-called *Xenia Programme*, while private investors hesitated to invest in tourism (Alifragkis and Athanassiou, 2013).[3] Over the 1970s and especially over the 1980s, tourism enjoyed easy finance from the state controlled banking system and a great number of small and medium sized tourist enterprises were established, facilitated by the industrial policy (Law 1262/82) of granting investment incentives to private firms (Giannitsis, 1993). In the period after the beginning of the Greek economic crisis (2010), positive tourist developments were facilitated by tourist market reforms giving a boost to domestic demand, greatly benefiting the struggling economy (Kasimati and Sideris, 2015). Over the whole post-war period, the supply of tourist infrastructure was supplemented by a substantial state financed tourist advertising campaign. Currently, about half of the hotel capacity in Greece belongs to small family units with up to 20 rooms each. Taking also into account that tourist services other than accommodation are mainly provided by small family enterprises, it seems that the revenue from tourism activity is greatly spread to a large number of people.

As shown in Figure 1, since 1960 and until the outbreak of the Covid-19 crisis in 2020 tourism activity increased sharply at an average annual rate of around 8%. Over the 1960s international tourist arrivals were at low levels of less than one million foreign visitors annually and in early 1970s tourist arrivals increased to 2-3 million visitors annually. Since the mid-1970s and after first energy crisis and the fall of the dictatorship (1974), the number of foreign tourists increased at a fast pace (about 10% per year), reaching 6-7 million visitors annually in the mid-1980s. In the two-decade period from the mid-1980s to mid-2000s tourist arrivals doubled to around 14-15 million per year. After the Athens Olympics (2004) and in conjunction with the adverse conditions in the tourist markets in the Eastern Mediterranean in early 2010s,[4] international tourist arrivals increased sharply reaching a peak of 31 million visitors in 2019. However, in 2020 tourism activity was severely hit by Covid-19 but in 2021 it is expected to gain 50% of its 2019 level. This performance will place foreign tourism activity at the level just before the sharp increase in early 2010s.

Tourism activity has always been considered a priority sector in Greece. The bulk of Greek tourism has always been oriented towards Western societies. Over the years, the Greek tourist market has also been attracting visitors from East European countries, Russia in particular and Asian countries as well, with a high share of China. Also, in recent years a more even expansion of tourism across regions is observed (*Bank of Greece*, 2019). However, the nature of Greek tourism has not moved away from a mass tourism model despite its drawbacks. Many popular destinations are exceeding their carrying capacity that results in the deterioration of social, cultural and local characteristics, noise and visual pollution and damage of

[3] The *Xenia Programme* (1950-1974) was implemented by a team of architects of the modernist style and besides tourist development it was a cultural intervention. Over this period, more than 50 high quality major units (hotels, motels, tourist pavilions etc.) were built, all of which were set at picturesque locations and historical sites. In 1967, with the enforcement of the dictatorship the *Programme* faded out and towards its official termination the operation of the state managed units deteriorated, been unable to face competition.

[4] Events such as the Arab Spring and the Syrian civil war (2011); also, the crisis of Crimea and Ukraine (2014).

natural environment. Also, the excessive reliance on mass tourism having strong seasonality makes the economy vulnerable to external shocks (as with Covid-19). Besides, Greek tourism is facing competition from many Asian destinations due to the reduction in transportation costs.

This situation calls for tourism reforms that put more emphasis on sustainable thematic and alternative forms of tourism. These initiatives offer the opportunity for destinations to diversify their tourist products and prolong the tourist season with the prospect of year-round tourism. They make destinations more attractive by awarding them local identity that will be further enhanced if connected to local production and gastronomy (Andersson et al., 2017). These changes will boost employment, human capital and incomes and mobilise new investment, thus enhancing regional competitiveness, productive capacity and wellbeing. Although frequently discussed, these sustainable tourist initiatives are very little put into practice due to existing structural deficiencies such as lack of skills and entrepreneurship at local level and state reluctance to support reforms of this kind in the tourist industry. Note that alternative forms of tourism have been existing for long in many European countries such as Italy and France, while in other countries such as Spain structural changes in the tourist model are on the way.

Cultural tourism in particular related to cultural heritage, which has been a major pillar of the post war tourist development, should be relaunched in order to boost the attractiveness of various regions, especially the less visited ones. The backing of cultural tourism should involve the promotion of cultural characteristics of the region through the digitisation of presentation, the highlighting of local myths, legends and the human presence over the centuries together with the promotion of natural features. Note that despite the significant increase in publicly accessible monuments and the number of tourists and visitors to monuments, the ratio of monuments' visitors to tourist arrivals in Greece amounts to 60% of the respective figure in other European Mediterranean countries. That means that there is a great margin for expanding cultural tourism (Kostakis et al., 2020).

4. Data and variables

The empirical analysis of the long-run relationship between tourism and output is carried out using annual data for Greece over the period 1960-2020. For the output variable we use data for GDP per capita at 2010 US dollars, obtained from the World Bank.[5] For the indicator for tourism flow we employ data for the number of international tourist arrivals to Greece, obtained from the Hellenic Statistical Authority (ELSTAT). The two variables are hereafter referred to as Y for output and T for tourism and their relationship is expected to be positive.

In the relevant empirical research, the volume of tourism flow is captured by certain variables. They include the number of tourist arrivals (Dritsakis, 2004; Kim *et al.*, 2006; Katircioglu, 2009; Othman, *et al.*, 2012), tourist receipts (e.g. Balaguer and Cantavella-Jordá, 2002; Aslan, 2013; Ridderstaat *et al.*, 2013), or tourist expenditures (Schubert *et al.*, 2010; Cárdenas-García *et al.*, 2015). However, all

[5] GDP per capita is gross domestic product divided by midyear population. Source: Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/NYGDPPCAPKDGRC.

three variables are suitable for empirical research because there is a strong positive correlation among them, since high numbers of tourist arrivals are related to high tourist expenditures and high tourist receipts.

The statistical properties of the two series provide evidence of non-normal distribution, since Y series exhibits negative skewness (Y: -0.419) and T series exhibits positive skewness (T: 0.935). Also, the kurtosis statistic for output is lower than 3 (2.755, platykurtic distribution), while that for tourism is higher than 3 (3.503, leptokurtic distribution), which is also a sign of non-normal distribution The normality properties of the series are examined applying conventional and quantile mean covariance normality tests, such as Jarque-Berra (JB), Shapiro-Francia (SF), Shapiro-Wilk (SW), Kolmogorov-Smirnov (KS) and Joint Skewness and Kurtosis tests of normality. The test results provide strong evidence against normal distribution for both series.[6] For tourism all tests, except for KS, are in favour of the rejection of the null hypothesis. As for the output series the results are mixed, though most tests reject normality except for the joint skewness/kurtosis and Jarque-Berra tests.

Relying on a conventional test of normality, based on the conditional central tendency, could lead to erroneous conclusions that the behaviour of the series is uniform across the whole distribution. To investigate the existence of asymmetric distribution in the sampling performance of the two series the quantile-mean covariance (QC) test developed by Bera *et al.* (2016) is applied. The results of the QC normality test indicate an asymmetric behaviour of the series distribution.[7] For the tourism series there are signs for the presence of non-Gaussian features in the tails of the series. For the output variable the statistics reveal the existence of non-Gaussian features in the tails of the series and the presence of non-normality at the middle of the distribution.

Overall, the results provide evidence of significant nonlinearities and asymmetric distribution, with the non-Gaussian features arising mostly at the tails of the series.

5. Econometric methodology

Having detected the existence of heavy tailed and nonlinear behaviour between the variables, their relationship is investigated econometrically. Following Koenker and Basser (1978) and more recently Nusair and Olson (2019) we present a quantile regression model that considers the effects of positive and negative changes of the explanatory variable on different quantiles of the dependent variable. Quantile regression analysis provides a more comprehensive description of the conditional distribution than the ordinary mean approach and it offers a more robust econometric technique in the presence of conditional heterogeneity and departures from the Gaussian conditions.

The quantile regression is formulated as follows. Let $\{y_t : t = 1, \ldots, T\}$ be a random sample on a random variable Y having probability distribution function

[6] The results are available from the authors upon request.

[7] The results are available from the authors upon request.

$F(y) = \text{Prob}(Y \leq y)$, where the τ -th quantile of Y , $0 < \tau < 1$ is defined as the smallest y satisfying $F(y) \geq \tau$, such that $Q(\tau) = \inf\{y_t : F(y) \geq \tau\}$.

Therefore, the τ -th conditional quantile function of y can be written as:

$$Q_y(\tau / x) = \inf\{b / F_y(b / x) \geq \tau\} = \sum_t \left(a^\tau + x_t \beta^\tau\right) = a^\tau + x_t^{'} \beta^\tau \quad (1)$$

Generally, a conditional quantile model is specified in the following manner:

$$Q_{y_t}(\tau / x) = a^\tau + x_t^{'} \beta^\tau \quad (2)$$

where, $Q_{y_t}(\tau / x)$, $0 < \tau < 1$, is the conditional τ -th quantile of the dependent variable, y_t, x_t is a vector of independent variables, β^τ denotes the estimated coefficients and a^τ are the unobserved effects. The corresponding coefficients of the τ -th quantile of the conditional distribution are given, equivalently, as the solution to the following minimization problem:

$$Q_{q_t}(\tau / x_t) = \arg\min_{\hat{\beta} \varepsilon R^k} \left[\sum_{t:1 y \geq a^\tau + x_t^{'} \hat{\beta}^\tau} \tau \left| y_t - a^\tau - x_t^{'} \beta^\tau \right| + \sum_{t: y < a^\tau + x_t^{'} \hat{\beta}^\tau} (1-\tau) \left| y_t - a^\tau - x_t^{'} \beta^\tau \right| + \right] =$$

$$= \arg\min_{\hat{\beta} \varepsilon R^k} \sum_t \rho_\tau \left(y_t - a^\tau - x_t^{'} \hat{\beta}^\tau \right) \quad (3)$$

Equation (3) expresses the minimization of the weighted absolute deviations between the dependent and the explanatory variables, where ρ_τ is a weighted factor, the check function, which weighs positive and negative values asymmetrically and it is defined for $\tau = 1/2 \varepsilon$ (0,1) as $\rho_\tau(z) = \tau z$, if $z \geq 0$ or $\rho_\tau(z) = (\tau - 1) z$, if $z < 0$, where $z_\tau = y_t - a^\tau - x_t^{'} \beta^\tau$. Consequently, the quantile regression methodology minimizes the sum of the residuals, where positive and negative residuals are weighted unequally, thus receiving a weight of τ and $1 - \tau$, respectively. The regression quantile for $\tau = 1/2$ corresponds to the least absolute error estimator, namely the regression median. The impact of the mean will represent the entire distribution only under the assumption that the marginal effects of the independent variable will be a simple location shift. Otherwise, the coefficient β^τ represents the effects of the independent variable on the conditional τ -th quantile of the conditional distribution.

To examine the effects of tourism on output we apply the quantile regression analysis as described in Eq. (4) below. Both variables are expressed as first differences of their natural logarithms, namely $\Delta \ln Y = \ln Y_t - \ln Y_{t-1}$ and $\Delta \ln T = \ln T_t - \ln T_{t-1}$. $Q_{\Delta \ln Y}(\tau / \Delta \ln T_t)$ denotes the conditional τ -th quantile of the dependent variable $\Delta \ln Y$, a^τ is the intercept depending on the quantile, and β^τ is a vector of the coefficients to be estimated.

$$Q_{\Delta \ln Y_t}(\tau / \Delta \ln T_t) = \alpha^\tau + \beta^\tau \Delta \ln T_t \quad (4)$$

Following Nusair and Olson (2019) the quantiles are categorized into three regimes, corresponding to a *recessionary* economy, where $\tau = (0.10, 0.20, 0.30)$; a *normal* economy, where $\tau = (0.40, 0.50, 0.60)$; and a *flourishing* economy, where $\tau = (0.70, 0.80, 0.90)$.

6. Empirical results

Initially we examine whether the two variables in consideration are characterized by a long-run equilibrium relationship, by applying the threshold autoregressive approach, developed by Enders and Siklos (2001). Then, following Sun (2011), we estimate an asymmetric error-correction model with threshold cointegration, which allows capturing asymmetries in the adjustment process and the causal relationships between the two variables.

6.1. Threshold cointegration analysis

Unit root tests

The first step is to verify the order of integration of the variables since the examination of long-run relationship among output and tourism, the presence of asymmetries and the relevant causality tests are valid only if the variables have the same order of integration. Conventional unit root tests are applied to test the stationary properties of the variables.

< Insert Table 1 somewhere here >

To this end, the stationarity properties of the variables are examined using the Augmented Dickey Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. For both tests we consider the case with intercept and the case with intercept and trend. The ADF tests the null hypothesis of a unit root and the KPSS tests the null hypothesis of stationarity. The results are reported in Table 1 (Part A). The ADF test statistics show that the null hypothesis of the unit root test for the level forms of the log transformed variables (ln Y, ln T) cannot be rejected, but it is rejected for the first-order differences of the variables (Δln Y, Δln T) at the 1% significance level. For the KPSS test the null hypothesis of stationarity is rejected but it cannot be rejected for the first-order differences, revealing that both variables are integrated of order one I(1).

Moreover, we apply the Andrews and Zivot (1992) unit root test and the Lagrange Multiplier unit root test by Lee and Strazicich (2004) to account for possible structural breaks that indicate an asymmetric behaviour. The results are reported in Table 1 (Part B), showing that both variables are integrated of order one I(1). Overall, the results from all tests confirm that the two variables are integrated of order one, which implies that cointegration test can be used to search for the existence of a long-run equilibrium relationship between the two series.

Long-run equilibrium model

Having established that the variables are integrated of order one I(1), we investigate their long and short-term interactions. To examine the existence of non-parametric effects and the presence of a causal equilibrium relationship between the variables, we apply threshold cointegration estimation techniques. The Threshold Autoregression Model (TAR) and the Momentum Autoregression Model (MTAR), initially developed by Enders and Siklos (2001) and extended by Sun (2011). The TAR model captures deep movements in the residuals, while the MTAR deals with steep variations in the residuals.

We proceed by establishing a long-term equilibrium relationship between the two variables, as follows:

$$\ln Y_t = a_0 + \alpha_1 \ln T_t + \varepsilon_t \quad (5)$$

where a_i are the coefficients of the relationship and ε_t is the error term. The empirical results (Table 2) show that tourism has a statistically significant positive effect on output in the long term. The elasticity of output with respect to tourism is 0.312, implying that a 10 percent increase in tourist arrivals is associated with an increase of 3.12 percentage points in output.

< *Insert Table 2 somewhere here* >

To examine whether the relationship between tourism and output adjusts towards the estimated long-run equilibrium model, a two-regime threshold model is applied that allows for possible asymmetric cointegrating effects, as follows:

$$\Delta \hat{\varepsilon}_t = \rho_1 I_t \hat{\varepsilon}_{t-1} + \rho_2 (1 - I_t) \hat{\varepsilon}_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta \hat{\varepsilon}_{t-1} + \mu_t \quad (6)$$

$$I_t = 1, \hat{\varepsilon}_{t-1} \geq \tau \text{ , 0 otherwise} \quad (6.1)$$

$$I_t = 1, \Delta \hat{\varepsilon}_{t-1} \geq \tau \text{ , 0 otherwise} \quad (6.2)$$

where, $\hat{\varepsilon}_t$ are the estimated residuals from the long-run equilibrium relationship, $\rho_1, \rho_2, \varphi_i$ are coefficients to be estimated, p is the number of lags, $\mu_t \approx iid\left(0, \sigma_\varepsilon^2\right)$. The lag selection of p is specified using AIC and BIC values. I_t is the Heaviside indicator, where τ is the value of threshold, which can be endogenously determined using Chan's (1993) methodology. The Heaviside indicator can be specified with two different definitions of the threshold variable (τ), defining the TAR model (eq. 6.1) and the MTAR model (eq. 6.2).

< *Insert Table 3 somewhere here* >

Following Sun (2011), the four threshold cointegration models presented in Table 3 are specified as follows: (a) TAR where in equation (6.1) $\tau = 0$, (b) consistent TAR where in equation (6.1) τ is estimated using Chan's (1993) methodology, (c) MTAR where in equation (6.2) $\tau = 0$ and (d) consistent MTAR where in equation (6.2) τ is estimated using Chan's (1993) methodology.[8] For each

[8] According to this method the values of the estimated residual series, $\hat{\varepsilon}_{t-1}$ or the case of the TAR model and $\Delta \hat{\varepsilon}_{t-1}$ for the case of the MTAR model are sorted in ascending order and the largest and smallest 15% of the values are discarded. The remaining 70% of the values are considered to be

of the consistent models, namely the consistent TAR and the consistent MTAR model, the threshold value with the lowest sum of squared errors is presented (Table 3, second row). Thus, for the consistent TAR model, the threshold value with the lowest sum of squared errors (0.180) is -0.150, while for the consistent MTAR model, the threshold value with the lowest sum of squared errors (0.181) is 0.033. To select the appropriate number of lags for each of the four models, initially a maximum of three lags is specified. Then diagnostic analysis on the residuals using the AIC and BIC statistics is applied. The lag specifications with the lowest AIC and BIC values are selected and in all cases one lag provides the lowest AIC and BIC values. The consistent MTAR model has the lowest AIC (-166.143) and BIC (-157.833) statistics and it is chosen as the best model for the development of the error-correction model (ECM) estimation.

The Φ -statistic $(H_0 : \rho_1 = \rho_2 = 0)$ for the consistent MTAR model has a value of 4.998, which is statistically significant. Therefore, the null hypothesis of no threshold cointegration is rejected and the level of output and the level of tourism are cointegrated. Also, the F -statistic $(H_0 : \rho_1 = \rho_2)$ of the MTAR model has a value of 3.314 which is also statistically significant. Therefore, the null hypothesis of symmetric adjustment is rejected and when the level of output and tourism are adjusting towards the long-run equilibrium, the adjustment process is asymmetric, implying a threshold cointegration. In particular, the point estimate for the adjustment process for positive shocks, namely ρ_1 , is -0.118, which is above threshold deviations from long-run equilibrium ($\Delta\hat{\varepsilon}_{t-1} \geq 0.033$). For negative shocks it is -0.204, which is below threshold deviations from long-run equilibrium ($\Delta\hat{\varepsilon}_{t-1} < 0.033$). Consequently, the threshold cointegration analysis reveals that the long-term relationship between tourism and output is characterized by a substantially faster convergence of output after a negative shock, than after a positive one. This indicates that tourism contributes to a faster absorption of a negative exogenous shock in output compared to a positive one.

Short-run asymmetric dynamics error-correction model with threshold cointegration

To examine the short-run dynamics of the tourism-output relationship we follow the seminal work of Sun (2011) and further applied in Palaios and Papapetrou (2019). This process allows examining how the two variables interact with each other through an adjustment process to a new target level when a positive or negative exogenous shock, occurs. Given that the consistent MTAR model is preferable to other models, we construct the error-correction terms using equations (6) and (6.2). A lag of one is selected for the models based on the AIC and BIC statistics. We proceed by estimating the two asymmetric error-correction models with threshold cointegration as in equations (7) and (8):

possible thresholds and the estimated threshold yielding the lowest residual sum of squares is the consistent estimate of the threshold parameter. Alternatively, the threshold value τ can be set equal to zero.

$$\Delta \ln Y_t = \theta_{\ln Y} + \delta^{+}_{\ln Y} E^{+}_{t-1} + \delta^{-}_{\ln Y} E^{-}_{t-1} + \sum_{j=1}^{J} a^{+}_{\ln Yj} \ln Y^{+}_{t-j} + \sum_{j=1}^{J} a^{-}_{\ln Yj} \ln Y^{-}_{t-j}$$

$$+ \sum_{j=1}^{J} \beta^{+}_{\ln Yj} \ln T^{+}_{t-j} + \sum_{j=1}^{J} \beta^{-}_{\ln Yj} \ln T^{-}_{t-j} + u_{\ln Yt} \quad (7)$$

$$\Delta \ln T_t = \theta_{\ln T} + \delta^{+}_{\ln T} E^{+}_{t-1} + \delta^{-}_{\ln T} E^{-}_{t-1} + \sum_{j=1}^{J} a^{+}_{\ln Tj} \ln Y^{+}_{t-j} + \sum_{j=1}^{J} a^{-}_{\ln Tj} \ln Y^{-}_{t-j}$$

$$+ \sum_{j=1}^{J} \beta^{+}_{\ln Tj} \ln T^{+}_{t-j} + \sum_{j=1}^{J} \beta^{-}_{\ln Tj} \ln T^{-}_{t-j} + u_{\ln Tt} \quad (8)$$

where θ is a constant, a_j , β_j are the coefficients of the lagged first differences, j represents the number of lags, which is chosen taking into account the AIC and BIC statistics, ensuring that the residuals have no serial correlation, u is the error term and E are the error-correction terms. $E^{+}_{t-1} = I_t \hat{\varepsilon}_{t-1}$ and $E^{-}_{t-1} = (1 - I_t) \hat{\varepsilon}_{t-1}$ are constructed from the threshold cointegration regressions in equations (6) and (6.2) and account for the asymmetric level of tourism and output in response to positive and negative shocks to the deviations from long-run equilibrium and also consider the impact of threshold cointegration through the construction of Heaviside indicator in Eqs. (6) and (6.2). The lagged variables in first difference $\Delta \ln Y_{t-j}$, $\Delta \ln T_{t-j}$ are split into positive $\left(\Delta \ln Y^{+}_{t-j}, \Delta \ln T^{+}_{t-j}\right)$ and negative components $\left(\Delta \ln Y^{-}_{t-j}, \Delta \ln T^{-}_{t-j}\right)$.

< Insert Table 4 somewhere here >

The results of the asymmetric error-correction models are reported in Table 4. The point estimates of the ECM's coefficients for output growth are -0.076 and -0.253 for positive and negative shocks respectively. Output adjustment to long-run equilibrium due to negative shocks fade out at an annual rate of 7.6%, while negative deviations at a rate of 25.3%. Therefore, in the short-run, output has a substantially faster responding speed for negative deviations. Furthermore, the ECM's coefficients for positive shocks are statistically insignificant and for negative shocks are significant at 5% level of confidence. This evidence suggests that in the short-term the adjustment path occurs through the level of output for negative deviations from long-run equilibrium. Consequently, as the adjustment process is performed through the modification of output, the driving force (exogenous) variable is tourism. In addition, there is not short-term momentum equilibrium adjustment path in the tourism ECM as the point estimates of the ECM's coefficients for tourism growth for positive and negative shocks are not statistically significant.

Moreover, judging from the lower values of the AIC and BIC statistics for the equation of output compared to that of tourism it follows that the model specification has a better fit on the output ECM than on tourism and also that the adjustment process takes place through output. Thus, the only causality channel is through output, whereas tourism is evolving more independently, thus representing the exogenous variable.

Overall, our results provide evidence in favour of both an asymmetric and a causality effect. Firstly, we document asymmetric effect behaviour both in the short and long term, as there is a substantial faster and statistically significant speed of adjustment of output in the case of negative shocks compared to positive ones. In fact, there is not a statistically significant adjustment process for output when a positive shock occurs. Secondly, the threshold error-correction model analysis reveals that the short-run equilibrium adjustment process occurs through the output variable, while the tourism variable is the driving force (exogenous variable). These findings add to the existing literature in that tourism leads to a faster absorption of a negative exogenous shock in output, in comparison to a positive shock. This evidence reveals that tourism contributes to a faster output adjustment after a negative shock, thus restricting the intense output fall and contributing to a more rapid absorption of negative shock effects.

6.2. Quantile regression (QR) analysis

As presented above, there is ample evidence that QR analysis would allow the effects of the covariates to differ across conditional quantiles and in particular examine the tourism-output relationship at different points in the conditional distribution of output, that is in the case of a recessionary (lower quantile), flourishing (upper quantile) or normal (intermediate quantile) economy.

< *Insert Table 5 somewhere here* >

Table 5 presents the results from the linear quantile regression model as shown in Eq. (4). Following Nusair and Olson (2019) the quantiles are categorized into three regimes, that is a recessionary economy [$\tau = (0.10, 0.20, 0.30)$], a normal economy [$\tau = (0.40, 0.50, 0.60)$] and a flourishing economy [$\tau = (0.70, 0.80, 0.90)$]. The results provide evidence in favour of the existence of a positive dependence path between the two variables, as for all quantiles the impact of tourism on output is statistically significant at the conventional level. In addition, besides a strong degree of path dependency, the findings indicate that at the lower part of the conditional distribution of output the effect of tourism becomes stronger. Specifically, in the case of a flourishing economy, the corresponding quantile coefficients are $Q_{\Delta lnY} = (0.083, 0.092, 0.106)$ with the highest impact being equal to 0.106 observed for $\tau = 0.90$. When the economy is normal, the estimated quantile coefficients are $Q_{\Delta lnY} = (0.101, 0.072, 0.078)$, with the highest impact being equal to 0.101, for $\tau = 0.40$. In the lower tail of the distribution corresponding to a recessionary economy, the estimated coefficients are $Q_{\Delta lnY} = (0.171, 0.158, 0.156)$ and the strongest impact is estimated 0.171 for $\tau = 0.10$. Overall, our results indicate that although the impact of tourism remains positive and statistically significant over the whole distribution, the size of the magnitude is more intense at the lower quantiles of the output distribution.

7. Conclusions and policy implications

The paper provides empirical evidence on the tourism-economic growth relationship in the case of Greece, a country greatly relying on tourism, using annual data over the period 1960-2020. Initially, we examine the existence of a non-linear relationship between tourism and output through the application of a threshold cointegration and an asymmetric error-correction model. Then, we examine the effects of tourism changes on output using quantile regression (QR) analysis. QR model estimation allows examining the impact of tourism changes over a range of values of output providing more concrete results on the relationship between the two variables across the output distribution.

The results are as follows. First, we show that the long-run relationship between tourism and output is positive and is characterized by a substantially faster convergence of output after a negative shock than after a positive one. Second, the asymmetric error-correction model analysis shows that in the short term the adjustment path occurs through output for negative deviations from the long-run equilibrium. Consequently, the adjustment process is carried out through the modification of output supporting the tourism-led growth hypothesis for Greece. Our findings add to the relevant literature in that tourism contributes to a faster output adjustment after a negative shock and restricts the intensity of the output fall, thus ensuring a more rapid absorption of the negative shock. Third, linear quantile regression analysis shows that the impact of tourism is positive and significant across the output distribution. The magnitude of the effect is more pronounced at the lower quantiles of output that is in a recessionary economy.

Our findings have important policy implications, since the effects of tourism changes are not uniform throughout the output distribution and findings based on linear methodology may be misleading to policymaking. The tourism-led growth hypothesis, validated by our results, is a useful policy recommendation but it should not be considered a panacea.

Overall, positive tourism shocks and active tourism policies greatly facilitate the recovery of a weak economy since tourism activity has the flexibility to increase capacity utilization and absorb unemployment. In the case of a booming economy positive tourism shocks might be less effective, since there are fewer economic slacks to be absorbed by the tourism sector. Instead, other policy options gain importance, such as structural reforms, the creation of business-friendly environment to attract foreign investment, the upgrading of human capital and the promotion of technology advances. Regarding tourism policies, structural reforms should be directed towards alternative forms of sustainable tourism that reduce tourist seasonality, protect the environment and upgrade regional competitiveness.

Finally, although the analysis covers partially the Covid-19 period, our findings highlight that the expected limited rise in tourism in 2021 after its significant drop in 2020 might not be sufficient for a quick output recovery. The implementation of the aforementioned structural policies together with the realisation of the significant investment projects of the *National Recovery and Resilience Plan* for Greece will be necessary for the achievement of the anticipated fast economic growth over the 2020s.

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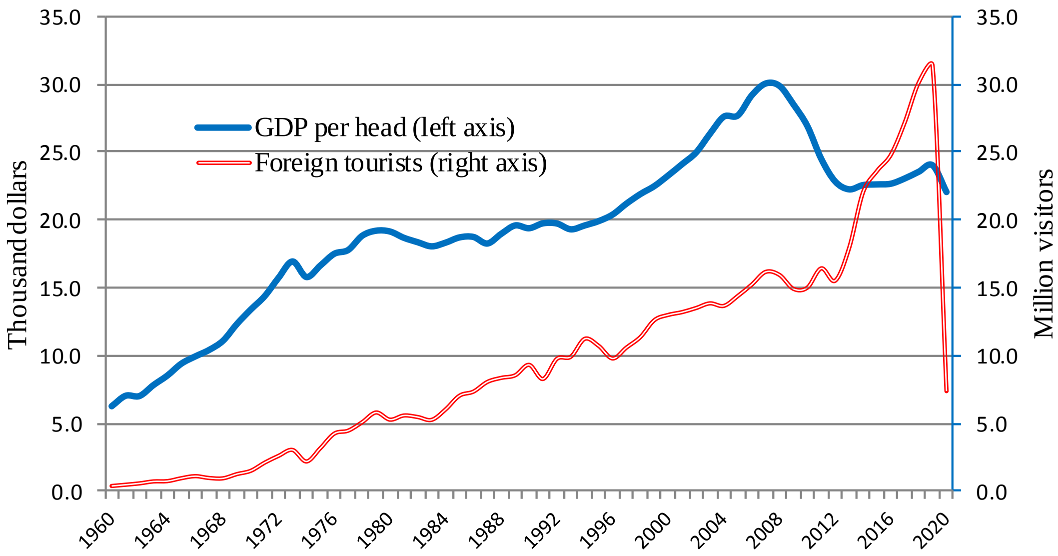
Tables and Figures

Figure 1: Output and tourism in Greece, 1960-2020



Sources: World Bank and ELSTAT

Table 1: Unit root tests

	ln *Y*	Δ ln *Y*	ln *T*	Δ ln *T*
Part A: Unit root test not allowing for structural breaks				
ADF (intercept)	2.333 [1]	-3.477 [0] ***	2.096 [0]	-3.611 [0] ***
ADF (intercept & trend)	0.069 [1]	-4.323 [0] ***	0.126 [0]	-4.176 [0] ***
KPSS (intercept)	1.830 [2[***	0.102 [2]	2.110 [2] ***	0.299 [2]
KPSS (intercept & trend)	0.381 [2] ***	0.125 [2]	0.509 [2] ***	0.060 [2]
Part B: Unit root tests allowing for structural breaks				
Zivot-Andrews (1 break)	-2.600 [1]	-5.243 [0] ***	-3.550 [0]	-4.157 [0] *
Breakpoint	2005	1981	1980	1973
Lee and Strazicich (1 break)	-1.948 [2]	-5.784 [0] ***	-2.983[1]	-5.351 [2] ***
Breakpoint	1985	2015	1965	2001
Lee and Strazicich (2 breaks)	-2.153 [0]	-4.867 [1] **	-3.347 [0]	-5.654 [1] ***
Breakpoints	1989, 2015	1996 2004	1964, 2017	1975, 2011

Notes: In brackets is the number of lags used in the test; the lag order is in accordance with the Akaike Information Criterion (AIC). *, **, *** denote significance at 10%, 5% and 1% level.

Table 2: Long-run (cointegrating) relationship
Dependent variable: ln *Y*

Variable	estimate	t-statistic
ln *T*	0.312***	21.963
intercept	7.091***	56.880
R^2- adj.	0.8892	
S.E of Regression	0.1253	
F-statistic	482.4	

Notes: *** denotes significance level at 1% level.

Table 3: Results of threshold cointegration estimations

Estimate	TAR	Consistent TAR	MTAR	Consistent MTAR
Threshold	0.000	-0.150	0.000	0.033
ρ_1	-0.085 (0.359)	-0.092 (0.270)	-0.273*** (0.004)	-0.118 (0.478)
ρ_2	-0.227** (0.011)	-0.250** (0.011)	-0.065 (0.438)	-0.204*** (0.003)
φ_1	0.445** (0.021)	0.433** (0.024)	0.443** (0.019)	0.439** (0.020)
Diagnostics				
AIC	-164.112	-164.393	-164.702	-166.143
BIC	-155.802	-156.083	-156.392	-157.833
LB (4)	0.990	0.991	0.981	0.982
LB(8)	0.987	0.996	0.954	0.991
LB(12)	0.927	0.956	0.768	0.973
Hypotheses				
$\Phi(H_0: \rho_1 = \rho_2 = 0)$ No cointegration	3.881** (0.026)	4.033** (0.023)	4.752** (0.012)	4.998*** (0.010)
$F(H_0: \rho_1 = \rho_2)$ Symmetry	1.307 (0.258)	1.581 (0.214)	2.873* (0.096)	3.314* (0.074)

Notes: *, **, *** denote significance at 10%, 5% and 1% level respectively.

Table 4: Results of the asymmetric error-correction model with threshold cointegration

Estimate	$\Delta \ln Y$		$\Delta \ln T$	
	estimate	t-ratio	estimate	t-ratio
θ	0.001 (0.955)	0.057	-0.031 (0.579)	-0.558
δ^+	-0.076 (0.253)	1.155	0.521 (0.184)	1.346
δ^-	-0.253** (0.030)	-2.231	-0.796 (0.239)	-1.192
α_1^+	0.438** (0.030)	2.228	0.393 (0.735)	0.340
α_1^-	0.776** (0.012)	2.589	-0.687 (0.698)	-0.390
β_1^+	-0.045 (0.691)	-0.400	-0.486 (0.466)	-0.734
β_1^-	-0.026 (0.587)	-0.546	0.453 (0.108)	1.637
Diagnostics				
AIC	-209.078		-0.107	
BIC	-192.458		16.514	
LB (4)	0.991		0.896	
LB (8)	0.942		0.972	
LB (12)	0.934		0.997	
DW	1.824		1.375	
$adj - R^2$	0.352		0.053	
Hypotheses				
$F(H_0: a_i^+ = a_i^- = 0)$ *Asymmetric Granger Causality*	9.180*** (0.000)		0.098 (0.906)	
$F(H_0: \beta_i^+ = \beta_i^- = 0)$ *Asymmetric Granger Causality*	2.637* (0.081)		1.262 (0.292)	

Notes: *, **, *** denote significance at 10%, 5% and 1% level respectively; p-values are in parentheses.

Table 5: Estimation results for the linear quantile model

		$\Delta \ln T$		*Constant*	
	Quantile	Estimate	t-statistic	Estimate	t-statistic
Recessionary economy	$Q_{0.1}$	0.171***	5.026	-0.035***	-4.440
	$Q_{0.2}$	0.158***	4.830	-0.019**	-2.429
	$Q_{0.3}$	0.156***	4.867	-0.005	-0.731
Normal economy	$Q_{0.4}$	0.101***	3.047	0.007	0.844
	$Q_{0.5}$	0.072**	2.205	0.019**	2.472
	$Q_{0.6}$	0.078**	2.426	0.028***	3.694
Flourishing economy	$Q_{0.7}$	0.083**	2.654	0.034***	4.668
	$Q_{0.8}$	0.092***	2.775	0.048***	6.184
	$Q_{0.9}$	0.106***	2.815	0.068***	7.687

Notes: *, **, *** denote significance at 10%, 5% and 1% level respectively.

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