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A double life cycle in tourism arrivals to Spain: Unit root tests with gradual change analysis☆

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ABSTRACT

The Tourism Area Life Cycle (TALC) theory by Butler (1980) proposes an S-shaped growth trend for the evolution of the number of tourists to a specific tourist destination. According to the data on tourist arrivals in Spain from 1946 to 2015, there may have been one or two life cycles. This paper sets out to test these hypotheses by unit root tests with gradual change. The results confirm that a double S-shaped or bilogistic curve is the long-run equilibrium, thereby validating the existence of two TALCs in the evolution of Spanish tourism. The two logistic curves overlap in the late 1970s and early 1980s. The first is characterized by the Spanish tourism boom in the 1960s, while the second illustrates the intense growth from 1995 to 2007, a period of sustained world economic growth.

1. Introduction

The COVID-19 pandemic outbreak has rocked the world's economies. The attempts to control the disease have led to restricting travels and meetings, and this has had deeply harmful effects for tourism, a strategic sector for the Spanish economy. The resilience of the tourism industry in Spain has been tested on several occasions: at the beginning of the 1980s, after the oil crisis; during the 1990s, after the Gulf War (1990–1991) and during the years following the Great Recession of 2008. Now, when a new recession is feared, it has become necessary to know how tourism reacts to crises and how it recovers after the subsequent economic expansion. Although our research is focused on the time before COVID-19, some valuable insights into the future can be inferred.

This paper offers a methodology to study tourism evolution over time. The proposed method is inspired in the Tourism Area Life Cycle (TALC) theory proposed by Butler (1980), which advocates an S-shaped trend for the evolution of tourism. Following this theory, the method used in the present paper allows for a non-linear trend for tourism evolution, with one or two S-shaped cycles. The paper shows that it has been successful in capturing slowdowns in the crises, as well as speedups during economic recoveries, in Spanish tourism for the period 1946–2017.

The literature on the TALC theory has grown greatly since 1980 (Butler, 2006a; 2006b). Several studies exist that propose more than one phase of S-shaped growth in tourism. Some theoretical extensions note that mature destinations have passed through different consecutive life cycles (Garay & Cànoves, 2011; Petrevska & Collins-Kreiner, 2017). Moreover, there are situations where choice or necessity may lead a destination to improve its traditional product or enlarge its market, or even abandon either of them in favor of a new start (Baum, 1998). This could be the case in many destinations after the COVID-19 crisis. Should this prove to be the case, the emergence of a new tourism life cycle will be witnessed.

Although the TALC theory is widely accepted among tourism economists, to the best of the authors' knowledge the literature lacks econometric tests supporting it. In this paper a formal model is proposed, with one or two S-shaped tourism life cycles, that can be tested with real data. Taking into account the logistic growth models by Lundtorp and Wanhill (2001) and Albaladejo and Martínez-García (2017), this paper will show that the TALC theory can be validated by

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testing whether a logistic or bilogistic growth trend is a long-run equilibrium path to tourism evolution. Specifically, it is argued here that unit root tests with gradual change, as proposed by Leybourne et al. (1998) and Harvey and Mills (2002), are suitable to test the TALC theory. These tests use the logistic smooth transition function to model structural changes, and they allow us to analyze persistence, taking into account the possibility of one or two phases of S-shaped growth. The ability to capture smooth transitions in economic variables makes unit root tests with gradual change very suitable tools to test persistence in tourism time series. The unit root tests that have usually been applied to tourism series, however, only take into account instantaneous structural changes (Charles et al., 2019; Lean & Smyth, 2009; Narayan, 2005a, 2005b; Perles et al., 2016 among others), which do not allow S-shaped trends, as the TALC theory defends.

The present paper applies the proposed method to the time series data on international tourism arrivals in Spain for the period 1946 to 2017. The empirical results show that the evolution of tourism in Spain is favorable to the TALC theory with two cycles. The long-run equilibrium path is estimated and dating of the stages of the tourism in Spain is provided. The equilibrium path captures the 1960s development stage, the rejuvenation of the sector from the mid-1980s and the new development stage prior to the economic and financial crisis of 2008. In addition, our results indicate that, in the case of Spain, the economic crises, such as the 1970s oil crisis or the 2008 economic recession, are related to the period of tourism stagnation in each of the cycles. The nonlinearity of the estimated trend brings to light that revivals after crises do not arise abruptly, but smoothly, gaining speed over time.

The paper is organized as follows. Section 2 provides a literature review of the TALC theory and the most recent advances in the study of tourism evolution. Section 3 presents an overview of tourism data for Spain since 1946. The data reveal that several socioeconomic and historical events define two different stages in the temporal evolution of international tourism arrivals. Section 4 explains the logistic and bilogistic models, showing their relationship with the unit root tests with smooth transitions. Section 5 uses these unit root tests to analyze the validity of the logistic and bilogistic growth models in the case of Spain. Section 6 provides some conclusions.

2. Literature review

The TALC theory, as proposed by Butler (1980), is one of the most widely accepted theories regarding the evolution of tourist destinations. The theory argues for the existence of an S-shaped life cycle in the development of destinations with six key stages from exploration to a final post-stagnation stage, where decline, rejuvenation or other intermediate solutions are possible (see Fig. 1). Each lifecycle stage – exploration, involvement, development, consolidation and stagnation – is characterized by a different growth rhythm and the upper limit of the curve is determined by the carrying capacity of the destination.

The TALC theory has been widely used as a conceptual framework for studying the evolution of tourism areas, giving rise to a large number of works where it has been applied, applauded, criticized, and complemented with other contents and methods. The relevance of this theory in tourism economics is highlighted by Lagiewski (2006), who presented a selection of 49 relevant works related to the TALC theory. Noteworthy also is the two-volume book edited by Butler in 2006 (Butler, 2006a, b), which provides an important collection of research papers using the TALC theory. Today, the references to the TALC theory are still numerous, as a web search of the term TALC confirms.

Many of these studies apply the TALC theory to specific destinations, describing their changes over time and defining their stages. Some studies show that the life cycle of the analyzed destinations matches the six stages defined by TALC (Cooper & Jackson, 1989; Douglas, 1997; Ioannides, 1992; Priestley & Mundet, 1998; Strapp, 1988; Tooman, 1997; Zhong et al., 2008). Other studies find that the assessed destination life cycle is not entirely represented by the six stages of the TALC theory (Getz, 1992; Weaver, 2000). Some studies add a 'pre-tourism' stage (Young, 1983) or discuss the possibility of alternative stages after stagnation (Agarwal, 1994; Hovinen, 2002). Many studies debate how to measure and identify the lifecycle stages (Getz, 1992; Lundtorp & Wanhill, 2001). Many others show that internal and external factors of the destination can affect the shape of the tourism trend ((Agarwal, 1997); Ioannides, 1992; Zhong et al., 2008).

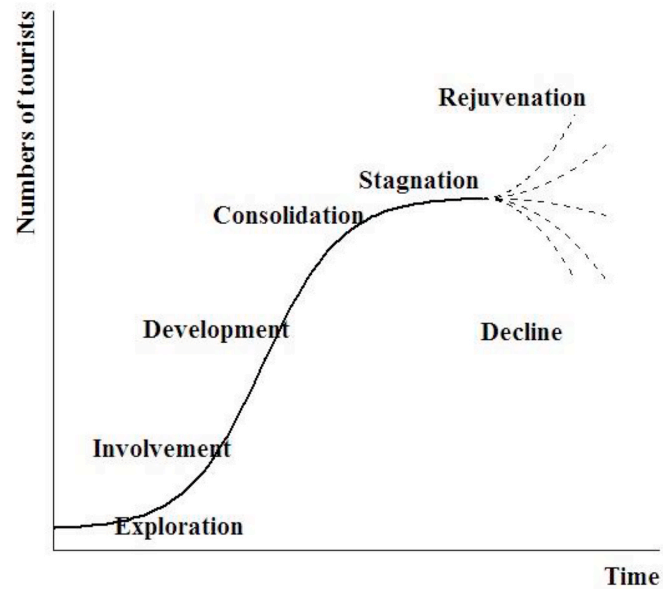

Fig. 1. Evolution of tourist area according to the TALC.
Source Butler (1980).

The TALC theory has also been combined with several other theories to overcome or improve some limitations and weaknesses. Chapman and Light (2016) consider the destinations as a mosaic of different elements, each of which follow a life cycle according to the TALC, but which all fit together. Holmes and Ali-Knight (2017) propose an extension of the TALC theory adding seven other different trajectories. Kubickova and Martin (2020) consider government involvement and destination competitiveness to explain destination development from supply and demand perspectives. There is a new research trend which combines the concepts of the theory of evolutionary economic geography within the evolution of tourism areas (Brouder & Eriksson, 2013; Brouder & Ioannides, 2014; Ma & Hassink, 2013). This new approach supplements the TALC model with concepts as path dependence, co-evolution, complexity, and generalized Darwinism. Path dependence focuses on the initial conditions and existing knowledge. In addition to policy measures or any other triggers, the emergence of tourism also depends on preexisting natural or cultural resources, adventurers' experience, location advantage, and economic base. Moreover, the development of a tourism area is the outcome of the co-evolution of tourist sectors, tourist products and institutions. The adaptation ability of a tourist area to ever-changing circumstances is essential for avoiding the decline (generalized Darwinism). Some applications of these concepts to specific tourism resorts are Ivars i Baidal et al. (2013), Ma and Hassink (2013), and Faisal et al. (2020) among others.

A number of studies propose more than one phase of S-shaped growth in tourism destinations. Baum (1998) presents some examples and proposes two theoretical extensions to the TALC theory, acknowledging that there are situations where choice or necessity may lead a destination to abandon its traditional product and market in favor of an entirely fresh start. Garay and Cànoves (2011) assert that major destinations have a long history and have passed through different consecutive life cycles, boosted by different regulatory measures. They illustrate their theory with the example of Catalonia. Also, for the case of

Macedonia, Petrevska and Collins-Kreiner (2017) identify a double tourism life cycle.

Some mathematical models have also been proposed to represent the TALC theory. Lundtorp and Wanhill (2001), with data of passenger flows to Bornholm from 1912 to 2001, find that the logistic growth model fits the first phases of the TALC theory well. However, since the logistic model assumes a fixed tourism market ceiling, it fails to explain the post-stagnation stage, where rejuvenation, decline, or any other intermediate possibility may arise. Albaladejo and Martínez-García (2017) go further and propose a multilogistic growth model, which is characterized by a non-constant carrying capacity, to represent the superposition of several life cycles in the tourism performance of a destination. Entrepreneurship or governments may induce a rise or decline in the tourism market ceiling by improving infrastructures, enlarging the variety of tourism services offered or implementing regulatory measures or, as has happened since the COVID-19 outbreak, travel restrictions or capacity reductions. The new model by Albaladejo and Martínez-García (2017) takes into account how these economic and social measures modify the carrying capacity. Moreover, the authors estimate the multi-cycle model with the same data as Lundtorp and Wanhill (2001). They find that this model fits the data better than a simple logistic function. Following these papers, the present paper proposes a methodology to validate the TALC theory. The contribution of the paper to the literature is two-fold. Firstly, it will show that the unit root tests with gradual change allow to test if a S-shaped trend (with one or two cycles) is a long-run equilibrium path. Secondly, it will demonstrate that tourism in Spain has followed a double cycle trend.

3. Evolution of tourism in Spain since 1946

Spain began its way in the tourism sector at the final years of the nineteenth century when it appeared tentatively on the lists of peripheral tourist destinations as had Greece and Egypt (Cirer-Costa, 2017). Since then, it has had a dynamic evolution influenced by several situations and has become a firmly consolidated tourism destination. According to data from the World Tourism Organization (UNWTO, 2019), in the 2018 ranking of countries, it was the world's second largest destination, surpassing the US and only behind France in international tourist arrivals (82.8 million), and only behind the US in receipts (US $73.8 billion).

To study the evolution of Spain as a tourism destination, this paper analyzes the arrivals of international tourists from 1946 to 2017. The statistical sources on tourism and passenger movement to Spain, the Spanish National Statistics Institute (INE) and the Institute for Tourist Studies provide only estimates for the number of non-resident visitors from 1950 to the present, but Pellejero-Martínez (2002) gives the numbers of arrivals from 1946 to 1949.[1] Prior to this, in the first three decades of the twentieth century, the number of foreign tourists to Spain was already on the rise and tourism companies were already in existence (Pack, 2008). However, the Spanish Civil War (1936–1939) brought about a decline in transport and accommodation infrastructures. The international isolation of Spain after the end of the Second World War (1939–1945) also had profound negative effects on tourist arrivals.

Fig. 2 shows the numbers of international tourists arriving in Spain from 1946 to 2017. As can be seen, international arrivals in Spain have grown continuously since 1946, with several growth phases and even some years of decrease. The data in this figure show two different periods of intense growth. The first was driven by the tourism boom during the 1960s, and the second was characterized by an accelerated growth at the end of the 1990s and the first years of the 21st century. Both periods of intense growth were followed by periods of deceleration, so two life cycles could better explain tourism evolution in Spain.

[1] This is the longest available data series of tourism in Spain. Note that the number of non-resident visitors includes international tourists and hikers.

In what follows the historical and economic events during the period are presented. After the Spanish Civil War and the Second World War, tourists began to arrive again although in very low numbers compared to previous years (Pellejero-Martínez, 2002). Spain was offering a sea and beach tourism at low prices compared to other mature Mediterranean destinations like France and Italy (Pack, 2008). In addition, in 1951 the Ministry of Information and Tourism was created to coordinate all tourism activities and in 1953 a National Tourism Plan was proposed with the aims of promoting tourism, improving infrastructures and intensifying advertising abroad (Pellejero-Martínez, 2002). In the second half of the 1950s, the number of tourists exceeded 3 million. The supply of accommodation also grew and was heavily regulated and controlled (Pellejero-Martínez, 2002). Tourism in Spain was on the up.

The 1960s were the tourism boom years in Spain (Pellejero-Martínez, 2002; Vallejo, 2002). The 'Stabilization Plan' of 1959, which, among other changes, devalued the peseta by nearly one-third, had an almost immediate effect on the European tourists coming to Spain for sun and beach tourism (Sánchez-Sánchez, 2001). The number of tourists grew from 5.4 million to over 20 million, and as a consequence, the number of hotel establishments multiplied by three and hotel beds by four (Pellejero-Martínez, 2002). The tourism sector began to develop in Spain.

During the 1970s, the tourism sector in Spain slowed down. It suffered sharp drops and rises. In 1973 the first oil crisis began which, together with the decline of Franco's dictatorial regime (he died in 1975), and the democratic transition in Spain, led to a short period, from 1974-1976, where the number of tourists decreased. In 1977 the tourists were higher than in 1976, but this new growth lasted just two years (1977 and 1978). The second oil crisis in 1979 was decisive in causing negative growth for two years, 1979 and 1980, but again in 1981 the tourists were more than in 1978.

In the 1980s, Spain seemed to start a period of rejuvenation in tourism. During the first years of the Spanish democracy, which began with the Constitution of 1978, the tourism model underwent some changes. The price of hotels was no longer fixed by the State; there was a decentralization of tourism policy to the autonomous communities that make up Spain under the new Constitution and, while not forgetting the importance of quantity, there was a certain interest in quality, competitiveness, diversification and sustainability in tourism (Pellejero-Martínez, 2002). All this, together with the entry into the European Economic Community (1986), boosted tourism arrivals and Spain experienced a period of light growth (1984–1988).

From 1989 to 1995, the number of international tourists again fluctuated. The Gulf War (1990–1991), which led to an international economic slowdown, and the crisis in September 1992 and August 1993, which hit the European Monetary System (due to the obstacles that European countries faced in trying to achieve their ultimate goal of full monetary union), contributed to falls in the number of tourists. But this crisis also meant in Spain the devaluations of its national currency in 1992, 1994 and 1995, which had a positive effect on tourism in the subsequent years. Additionally, in 1992, Spain started a strategic policy aimed at boosting tourism competitiveness, Plan FUTURES, and entrepreneurs made significant investments in their facilities (Zoreda & Perelli, 2014). Expo 92 and the Olympic Games contributed significantly to spreading the image of Spain worldwide.

From 1995 to 2007, the number of international tourists grew continuously. Spanish tourism experienced a second strong development period. It was a sun and beach destination with low prices appealing to many tourists. Moreover, some geopolitical circumstances, like the Yugoslav Wars from 1991 to 2001 or the Luxor massacre on 17 November 1997, moved tourists to Spain.

Following this expansive period, the Great Recession of 2008 supposed a decline in the number of tourists in 2008 and 2009. This last year was one of the toughest years for the tourism sector worldwide due to the global economic recession aggravated by the uncertainty around the A(H1N1) influenza pandemic (UNWTO, 2011). In 2010 the growth rate of the number of tourists recovered and in 2011 tourists were more

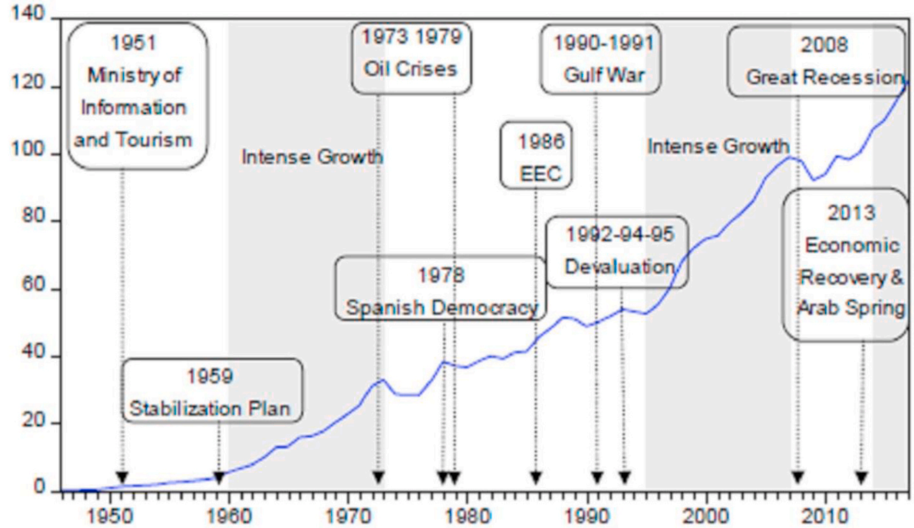

Fig. 2. Numbers of international tourists (millions) arriving in Spain (1946–2017).

than in 2007. A new decline occurred in 2012 due to the double-dip recession that the Euro zone suffered.

Since 2013, due to the beneficial effects of the economic recovery in Europe together with the impact of the Arab spring, the number of international tourists has grown uninterruptedly. This seems to indicate that tourism in Spain could be beginning a new growth cycle that has been truncated by the actual COVID-19 crisis.

4. Tourism area life cycles and the unit root tests with gradual change

According to Albaladejo and Martínez-García (2017), several life cycles in tourism can be formally represented by a multilogistic growth model. Previous historical reviews show that up to two life cycles could have taken place in Spain during the period of time studied. This section presents the logistic and bilogistic growth models as particular cases of the multilogistic model, and the unit root tests with gradual changes as a suitable method to validate them.

4.1. The logistic and bilogistic growth models

The logistic growth model (Lundtorp & Wanhill, 2001) is quite a good theoretical approximation of the S-shaped curve of the TALC theory. However, since the logistic model assumes a fixed tourism market ceiling, it fails to explain the concatenation of more than one growth phase, as seems to have occurred in Spain. Albaladejo and Martínez-García (2017) propose a multilogistic growth model, where the investment or innovation in the tourism sector boosts the addition of new logistic curves which superpose the old ones. This model allows a non-constant tourism carrying capacity. Political measures or sociological and environmental factors can make this ceiling evolve to higher levels. The result is the superposition of several S-shaped curves which can be described by the following differential equations system:

$$\dot{T}_t = \gamma T_t \left[1 - \frac{T_t}{C_t}\right], \quad T_t = T_0 \quad if\ t = 0 \tag{1}$$

$$\dot{C}_t = \delta u_t C_t^{\varphi} - \eta C_t, \quad C_t = c > T_0 \quad if\ t = 0 \tag{2}$$

where T_t is the number of tourists at time t, $\dot{T}_t$ is its temporal derivative, C_t is the maximum level of tourist development and use (carrying capacity), whose temporal evolution $\dot{C}_t$ is driven by u_t, the variable which measures the effort (e.g. share of labor or capital) devoted to increasing C_t. The parameters are $\gamma,\ \delta,\ \varphi > 0$ and $\eta \geq 0$. The parameter γ represents the intrinsic rate of tourism attraction, δ measures the productivity of an effort, u_t, φ are the returns to scale and η is the depreciation rate of the carrying capacity.

Equation (1) with a constant C_t is the logistic growth model proposed by Lundtorp and Wanhill (2001) to represent the sinusoidal development of a tourist destination. This logistic curve generates the first five phases in the development of a resort described by the TALC theory (Fig. 1). Equation (2) was introduced by Albaladejo and Martínez-García (2017) to allow for the possibility of increases in the tourism carrying capacity. Any capacity increment requires economic or human efforts, u_t, in the form of investment in infrastructures, in accommodation or in R&D. Albaladejo and Martínez-García (2017) follow the growth models tradition (Solow, 1956, if there are decreasing returns to scale, or Rebelo, 1991, if there are constant returns to scale) to model carrying capacity increments.

The growth of tourism carrying capacity C_t, depends on u_t, whose value is given by the entrepreneurship activity, government spending on infrastructures and services or tourism promotion polities. If depreciation η is nil and no investment is made ($u_t = 0$ for all t), then the carrying capacity will remain constant at the level c. This is the case of the logistic model by Lundtorp and Wanhill (2001). If this is so, the solution of differential equations (1) and (2) is

$$T_t = cS_t(\gamma, \lambda) \quad \text{and} \quad C_t = c \quad \text{for all} \quad t \geq 0 \tag{3}$$

where $S_t(\gamma, \lambda)$ is the logistic function given by:

$$S_t(\gamma, \lambda) = \{1 + \exp[-\gamma(t - \lambda)]\}^{-1} \quad \gamma \geq 0 \tag{4}$$

where λ is the turning point,

$$\lambda = \frac{1}{\gamma} \ln\left(\frac{c - T_0}{T_0}\right)$$

That is, S_t grows with t at an increasing speed if $t \leq \lambda$, and, although growing also if $t > \lambda$, the speed reduces as t grows from λ. Note that if $t = \lambda$, tourism occupation is 50% of its maximum level, c. Moreover, if $t = 0$, the number of tourists given by (3) is the initial one T_0 and if $t \to +\infty$ the number of tourists approaches c, the maximum level of tourism exploitation if no investment in this sector ($u_t = 0$ for all t). Equation (3) models the transition between two levels of tourism T_0 and c. The parameter γ determines the speed of transition. If γ is close to zero, the transition is very smooth. As γ takes values farther from zero the transition is less smooth and the change becomes more abrupt. When it approaches infinity, the transition is instantaneous. This specification is flexible enough to represent processes with instantaneous transition ($\gamma \to +\infty$) or without any change as limiting cases ($\gamma \to 0$). This sinusoidal curve (3) is represented in Fig. 3.

In (3) it is assumed that the choice of the decision rule $u_t = 0$ is made at time $t = 0$ and the planner (government/entrepreneurship) will always maintain this policy rule. However, if tourism promotion is one of the objectives of the planner, at a certain date $\bar{t}$, they could decide to invest in increasing the tourism capacity. This could have been the case of the Spanish Plan Futures in the 1990s, which may have encouraged the investments in infrastructures and tourism facilities renovation. If so, tourism carrying capacity increases from an initial level c_1 to a higher one, c_2. Inspired by the case of Spain, this paper considers the following decision rule:

$$u_t = 0 \ \ for \ \ t \le \bar{t} \quad and \quad u_t = \begin{cases} \bar{u} & if \ \ C_t \le c_2 \quad for \ \ t > \bar{t} \\ 0 & if \ \ C_t > c_2 \end{cases} \tag{5}$$

where $\bar{u}$ is the net investment (deducting depreciation) on increasing tourism capacity from the date $\bar{t}$ up to the date when capacity reaches the new level c_2. Once this higher capacity is reached, investment vanishes. If this policy rule is adopted, two life cycles can concatenate, as depicted in Fig. 4, where the initial carrying capacity is c_1 and the final one is c_2.

As proved in Albaladejo and Martínez-García (2017), the solution of this differential equation system is the bilogistic growth model:

$$T_t = c_1 S_{1t}(\gamma_1, \lambda_1) + c_2 S_{2t}(\gamma_2, \lambda_2) \tag{6}$$

where $S_{it}(\gamma_i, \lambda_i)$ are logistic functions:

$$S_{it}(\gamma_i, \lambda_i) = \{1 + \exp[-\gamma_i(t - \lambda_i)]\}^{-1} \quad \gamma_i \ge 0 \quad i = 1, 2 \tag{7}$$

Times λ_1 and λ_2 are the midpoints of two transitions. Parameter γ_i determines the speed of each transition, and γ_1 and γ_2 are allowed to differ. Equation (6) models the transition between T_0 to c_1 and, finally, to c_2.

Both models (3) and (6) could be a good approximation of the TALC theory, with either one or two S-growth periods.

4.2. Unit root tests with gradual change as a tool to test TALC

The TALC theory also has implications for the persistence in tourism time series: shocks to the tourism sector must be transitory around a non-linear trend represented by at least one S-shaped curve.

The traditional approach to looking at the degree of persistence of a time series is to apply unit root tests. These tests have been widely used in empirical tourism literature to determine the transitory or permanent effects of economic crises or other types of shocks on tourism (Charles et al., 2019; Lean & Smyth, 2009; Narayan, 2005a, 2005b; Perles et al., 2016, among others), and to examine the convergence hypothesis for tourism markets (Lean & Smyth, 2008; Narayan, 2006; Tang, 2011).

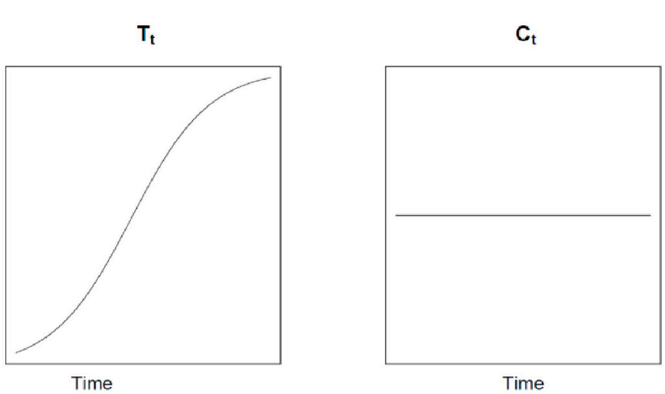

Fig. 3. Constant carrying capacity.

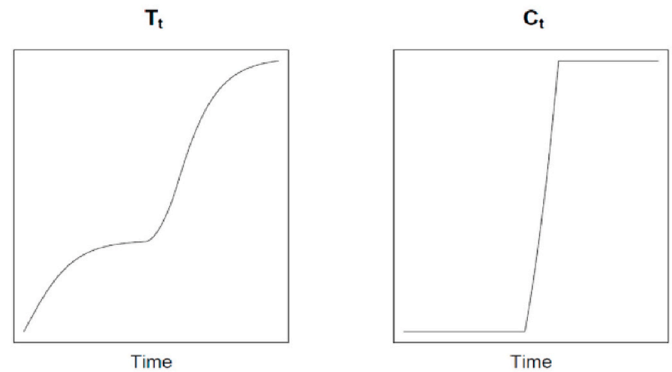

Fig. 4. Increasing carrying capacity.

However, to the best of the authors' knowledge, they have never been applied to test the validity of the TALC theory. Besides this, most of them consider under the alternative a stationary process around either a linear trend or a linear trend with one or more abrupt breaks, neither of which allows an S-shaped evolution as the TALC theory predicts. An increment in the carrying capacity means devoting efforts to tourism investment and a time lag is necessary to achieve the desired carrying capacity. Moreover, a higher carrying capacity increases the growth rate of tourism arrivals, but, again, a time lag is necessary for the number of tourist to achieve the new limit. Thus, tourism arrivals will not react instantaneously to an increment in the carrying capacity, so, the temporal evolution of a tourism series is likely to be better explained by a model that allows gradual rather than instantaneous adjustment.

This paper proposes the use of unit root tests with gradual change, as suggested in Leybourne et al. (1998) and Harvey and Mills (2002), to test whether there have been one or two life cycles in Spanish tourism. These procedures test whether a series is stationary around a deterministic component with one structural change (Leybourne et al., 1998) or two structural changes (Harvey & Mills, 2002) which can occur gradually over time. Both tests model changes using logistic smooth transition functions, allowing an S-shaped evolution of tourism arrivals (the test by Leybourne-Newbold-Vougas) or a double S-shaped evolution (the Harvey and Mills test). Therefore, these tests are suitable tools to test empirically the logistic and bilogistic growth model, respectively, and the TALC as a whole.

When using the Leybourne et al. (1998) unit root test, Model A is considered for the alternative hypothesis because it coincides with the logistic model proposed in (3). This specification contains no trend and involves an S-shaped transition in the deterministic mean. It follows that:[2]

$$T_t = \alpha_0 + cS_t(\gamma, \tau Z) + \upsilon_t \tag{8}$$

where α_0 is the intercept, υ_t is a I(0) stochastic process with zero mean, and function S_t is given in (4). Parameter $\tau \in [0, 1]$ determines the timing of the transition midpoint $\lambda = \tau Z$, where Z is the sample size of the time series.

When using the Harvey and Mills (2002) unit root test, Model A is also considered for the alternative hypothesis. It contains no trend and involves a double transition in the mean only, as in the bilogistic growth model (6). This alternative hypothesis is the following equation:

$$T_t = \alpha_0 + c_1 S_{1t}(\gamma_1, \tau_1 Z) + c_2 S_{2t}(\gamma_2, \tau_2 Z) + \upsilon_t \tag{9}$$

where α_0 is the intercept, υ_t is a I(0) stochastic process with zero mean,

[2] The difference between a stochastic model, like (8), and the deterministic model (3) is the stochastic error term υ_t. A constant $\alpha_0$is also added to capture those seminal tourists prior to the start of the logistic growth. Nevertheless, as is shown later, this constant is not significant in the case of Spain.

and functions S_{it} $(i = 1, 2)$ are given in (7). Parameters $\tau_i \in [0, 1]$ determine the timing of each transition midpoint $\lambda_i = \tau_i Z$, where Z is the sample size of the time series.

Both unit root tests are conducted using the following two-step procedure employed by Leybourne et al. (1998). The first step is to estimate the deterministic component of the model considered under the alternative by nonlinear least squares (NLS) and compute the resulting NLS residuals. The second step is then to estimate the Augmented Dickey Fuller (ADF) equation with the NLS residuals and calculate the t-statistic associated with the ordinary least squares estimate of the coefficient of lagged residuals in ADF equation. Critical values are tabulated in Leybourne et al. (1998) and Harvey and Mills (2002).

A rejection of the null hypothesis of Leybourne-Newbold-Vougas test would indicate that the time series for tourism would be stationary around a single S-shaped curve. A rejection of the null hypothesis of Harley-Mills test would indicate that the shocks to tourism are temporary, and that tourism arrivals in Spain would probably be a stationary time series around a double S-shaped curve, providing empirical evidence in favor of two tourism area life cycles. If tourism in Spain followed a single S-shaped curve, the Leybourne-Newbold- Vougas test would be more powerful than the Harvey and Mills one. However, their results could be wrong if this were not the case, that is if Spanish tourism followed a double S-shaped curve.

Note that the specification of the process under the alternative in each unit root test is sufficiently flexible to nest, as particular cases, a stationary process without structural changes, as well as a stationary process with instantaneous changes. An additional advantage of both procedures is that they do not require us to predetermine the timing of the different phases of the life cycle since they allow the speed and the midpoint of each transition to be determined endogenously.

5. Empirical results

The econometric study analyzes the time series data on arrivals of international tourists in Spain from 1946 to 2017, presented in Section 3. The unit root tests suggested by Harvey and Mills (2002) and Leybourne et al. (1998) are applied to examine the persistence of shocks to this time series, taking into account a possible S-shaped evolution in the number of tourists. The results show that only the Harley-Mills test rejects the null hypothesis.

Both unit root tests were carried out for different sampling periods and the conclusions are robust in terms of sample selection. Establishing the beginning of the sample in 1946, each of the last five years of the period analyzed (2013, 2014, 2015, 2016 and 2017) were considered as the final year. Table 1 presents the Leybourne-Newbold-Vougas and the Harley-Mills tests for each of these five sample periods. The unit root null hypothesis is not rejected for any series at the 10% level when the Leybourne-Newbold-Vougas test is employed. In contrast, the Harley-Mills test rejects at 1% when the sample period ends in 2013, at the 5% level when the sample period ends in 2014 and 2015, and at the 10% level with the sample up to 2016 or 2017. The analysis thus confirms that this Spanish tourism demand series follows a stationary process around a bilogistic function, although this empirical evidence is weaker when the analysis period includes the last two years of the sample. Note that since 2013 the positive effect of the economic recovery of Europe together with the outbreak of the Arab Spring may have generated a new cycle until the 2020 COVID-19 crisis. This extreme will not be confirmed until this crisis reaches an end and more up-to-date data are available.

Table 1
International tourists. Unit root tests with gradual change.

Period	Harley-Mills	Leybourne-Newbold-Vougas
1946–2017	−5.69* (9)	−3.73 (1)
1946–2016	−5.55* (9)	−3.68 (1)
1946–2015	−6.27** (1)	−3.65 (1)
1946–2014	−6.27**(1)	−3.71 (1)
1946–2013	−6.64*** (1)	−3.48 (1)

Note: *,**,*** denote significant at the 10%, 5% and 1% level respectively. Numbers in brackets are the number of lags included in the ADF regressions, which is determined by the Schwarz information criterion, considering 10 as the maximum.

In addition to conducting unit root tests, it is interesting to estimate the implied model in order to fit the corresponding bilogistic function. For this estimation, only the period 1946–2015 was considered, which is the longest sampling period where the null hypothesis of unitary root is rejected at least at 5% against the alternative of stationary around a smooth double transition.[3] The model was estimated with autoregressive errors, whose order is determined by the maximum lag order required in the ADF equation, i.e. AR(2) errors. The intercept turned out to be non-significant, so it is disregarded in the estimation. Table 2 shows the results of the NLS estimation.

All of the estimated coefficients of the double logistic function were significant and the analysis confirms a double transition in the evolution of this tourism demand series. Since the estimated transition speeds take similar values not far from zero, 0.182 and 0.226, the transition between different states occurs smoothly for time series data on arrivals of international tourists, showing evidence in favor of two S-shaped growth periods. The estimated transition midpoint fractions were 0.342 and 0.780 corresponding to years 1970 and 2000. This means that the first growth period is centered around 1970 and the second near to 2000. Thus, the estimated bilogistic function is the sum of two similar logistic functions with the midpoints separated by 30 years. Finally, note that the estimated autoregressive coefficients do not suggest I(1) behavior. Indeed, the autoregressive roots are complex, suggesting cyclical behavior about a double smooth transition in the mean. Therefore, there is empirical evidence for a double S-shaped dynamic.

Fig. 5 presents the estimated deterministic double smooth transition (bilogistic curve) and the actual values of the international tourists arrival series. In general, the data are well represented by this function, which clearly shows the two rapid increases in tourism demand, from the early 1960s and again from the late 1990s until the beginning of the Great Recession.

To provide a clearer interpretation of the results, the two estimated logistic functions (S_{1t} and S_{2t}) are shown in Fig. 6. This figure also identifies the five stages (in Fig. 1) of the life cycle in each logistic function. The date of these stages is obtained following the Lundtorp and Wanhill (2001) procedure. The first logistic curve represents the tourism demand evolution of Spain from 1946 until the 1980s, when a rejuvenation process, represented by the second logistic curve, began in the Spanish tourism sector. The second curve starts to grow when the first one has reached about 80% of saturation, and thus two overlapping S-shaped curves are visible. Since the stages of consolidation and stagnation of the first logistic curve overlap with the first stages of the second curve, the stagnation in the number of tourists in the eighties predicted by the first logistic curve is avoided before it occurs and is unobservable in the data.

Regarding the first logistic curve, the exploration stage goes to 1957, when tourists slowly start to come to Spain again after the Spanish Civil War and the Second World War. The involvement stage, which assumes some regularity in tourism, is achieved in the second half of the 1950s (more precisely, from 1957 to 1963, according to this study's estimations). The development stage starts in the early 1960s, when, as has been explained, Spain experiences a tourism boom with an important and continuous growth. The growth rate drops in the seventies as a result of the 1970s oil crises, and the last stages of this first S-shaped curve begin. The consolidation and stagnation stages date from 1977 to the end of the eighties. Both stages overlap the first stages of the second logistic curve. This second curve shows the change of tourism trend, due

[3] The results obtained for the different sample periods presented in Table 1 are very similar and are available on request.

Table 2
International tourists. NLS estimation (1946–2015).

$$T_t = \underset{(15.261)}{44033532}\, S_{1t}(\hat{\gamma}_1, \hat{\tau}_1 Z) + \underset{(12.650)}{62349696}\, S_{2t}(\hat{\gamma}_2, \hat{\tau}_2 Z) + \hat{\upsilon}_t; \quad \hat{\upsilon}_t \approx \mathrm{AR}(2)$$

$$\hat{\upsilon}_t = \underset{(8.483)}{0.951}\, \upsilon_{t-1} - \underset{(-4.715)}{0.549}\, \upsilon_{t-2}$$

$$\hat{\gamma}_1 = \underset{(8.804)}{0.182}, \quad \hat{\gamma}_2 = \underset{(6.906)}{0.226}, \quad \hat{\tau}_1 = \underset{(23.681)}{0.342}, \quad \hat{\tau}_2 = \underset{(94.103)}{0.780}$$

$$\hat{\tau}_1 Z = 1970 \qquad \hat{\tau}_2 Z = 2000$$

Note: numbers in brackets are t-values. The t-statistics asymptotically have the standard normal distribution.

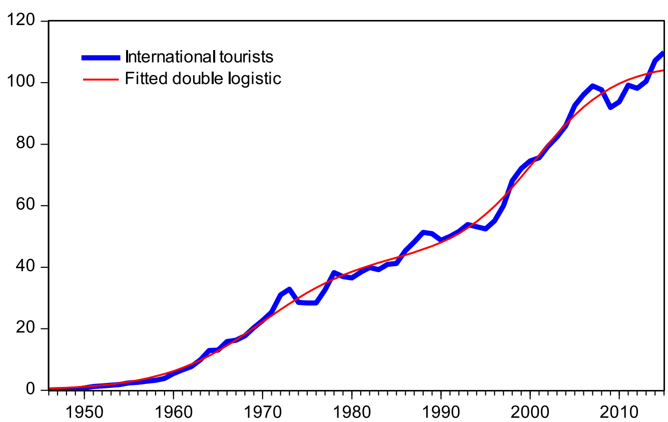

Fig. 5. International tourists (millions) and the fitted double logistic function (1946–2015).

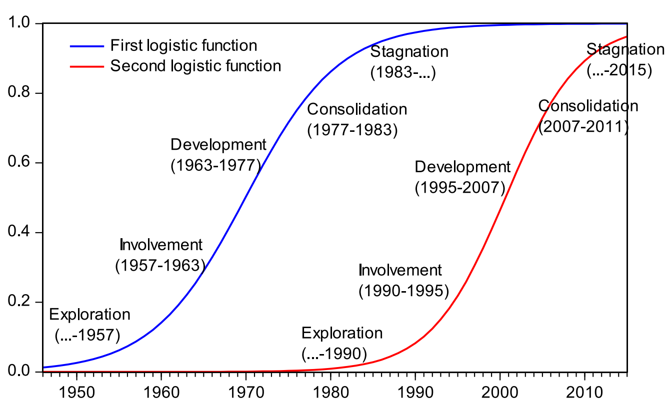

Fig. 6. Fitted logistic functions for international tourists (1946–2015).

to the arrival of democracy in 1978 and the entry into the European Economic Community in 1986. After the Gulf War in 1990 and the European Monetary System crisis in 1992, the growth rate of tourists arrivals increases. Spain starts to be seen as a well-defined tourist destination. This new development stage goes from 1995 to 2007, coinciding with a period of uninterrupted world economic growth. With the Great Recession of 2008 this period of strong growth ends and the stages of consolidation and stagnation of the second curve begin.

To summarize, the results of this study are in accordance with the TALC theory showing evidence in favor of a double S-shaped dynamic in the evolution of Spanish tourism demand. Since the Harvey-Mills unit roots test indicates that the bilogistic function is a long run equilibrium path, shocks to the tourism sector are transitory around a non-linear trend represented by two overlapping S-shaped curves.

6. Concluding remarks

This paper proposes a method to test if the non-linear evolution defended by the TALC theory is a long-run equilibrium path for tourism data series. The logistic and bilogistic models by Lundtorp and Wanhill (2001) and Albaladejo and Martínez-García (2017) are well accepted as mathematical approximations to the TALC theory. The analysis has shown the relationship between these models and the unit root tests with smooth transition by Leybourne et al. (1998) and Harvey and Mills (2002). Their flexibility to capture smooth transitions in economic variables, and their ability to represent the TALC theory, make them both very suitable tools to test persistence in tourism time series. These unit root tests have been applied to analyze whether there is a single or a double life cycle in Spanish tourism from 1946 to 2017.

The results confirm that a double S-shaped trend constitutes a long-run equilibrium path for Spanish tourism and deviations from it are due to transitory shocks. The double life cycle is the result of the superposition of two logistics curves that account for the whole spectrum of stages described by the TALC theory: exploration, involvement, development, consolidation, and stagnation. The first estimated logistic trend goes from 1946 to the 1980s, including the 1960s tourism boom. The second estimated logistic curve overlaps the first one during the 1980s, which shows a rejuvenation of tourism in Spain, and captures the new development stage from 1995 to 2007. The evolution of tourism in Spain after the Great Recession suggests the possibility of the beginning of a new third phase of growth which has been truncated by the current COVID-19 crisis.

There is a noticeable link between Spanish tourism and economic performance in Europe: the main Spanish tourism market. The two stages of intense growth in Spanish tourism occur in periods of European economic prosperity, while the economic recessions suffered in Europe slow down the Spanish tourism growth rate. Moreover, our results also show that the recovery after recessions follows a non-linear trend, very slow initially but reinforcing and gaining speed with time. This means that early investments after a crisis could be crucial to boost this reinforcement process. Once tourism is activated the feedback forces boost its growth and the speed of growth increases.

After the COVID-19 crisis, the economy will sooner or later reactivate. People will gradually return to their normal behavior patterns. However, tourism will emerge at a measured pace, at least until a vaccine is available. People will not hurry to go back to their traditional holiday places and full beaches, as they used to. Visitors will come back to tourism destinations in small numbers initially (those who feel healthy, young or safe). As the economy recovers and the disease scope decreases, visitor numbers will increase, starting a new tourism life cycle. Those destinations that control the epidemic first and succeed in providing security to the visitors (by mean of the necessary investments) will be the first to benefit from the feed-back forces, and will gain visitors at a higher rate as time goes by. Once the process starts, in the light of our analyses, we do not expect a quick and linear recovery, which would produce a trend with the shape of a V. Tourism evolution is non-linear, so the recovery will be S-shaped. Future research will be needed to confirm this prediction.

Author statement

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