Persistence change in tourism data

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The authors apply recently proposed persistence change tests to inbound tourism series in order to evaluate whether their properties have changed over time. By using quarterly series of the number of overnight stays in hotel accommodation and similar establishments in the Algarve, from 1987:01 to 2008:03, they gathered evidence of persistence change in all series. In particular, a change from I(1) to I(0) was detected for some countries, while for others the direction change was not clear-cut. These results have implications from a policy perspective and shed light on the generally accepted conviction that policy decision processes should not ignore the fact that, in general, tourism inbound series display mean reverting behaviour, being only temporarily affected by external shocks.

Keywords: persistence change; non-stationarity; stationarity; tourism demand

JEL classification: C12; C22

Testing for the presence of a unit root is now routine practice in empirical research given the different statistical and economic implications of classifying a series as stationary or non-stationary. Establishing this distinction is meaningful in that it helps in understanding the effects of shocks on macroeconomic variables. While the impact of shocks will be transitory for a stationary series, for a non-stationary one any random shock may have persistent effects. In other words, while a stationary time series will display mean reverting behaviour, a non-stationary variable will display persistent behaviour; that is, shocks will have long-lasting effects, thus preventing the series from returning to any defined level.

Therefore, the study of the statistical properties of time series has attracted a great deal of attention because of their implications on model building and forecasting in applied macroeconomics and finance. A great effort has been concentrated mainly on variables such as inflation whose statistical properties have been analysed in a large number of empirical and theoretical papers published recently in the literature (see among others Fuhrer and Moore, 1995; Gibson and Lazaretou, 2001; Johnson, 2002; Galí *et al*, 2003; Steinsson, 2003; Angeloni *et al*, 2006; Batini, 2006; Dotsey and King, 2006). Two broad reasons have motivated this upsurge. First, inflation has been a key variable of the monetary policies followed in European countries that have adopted inflation-targeting regimes in the context of their adhesion to the European Monetary Union. Second, the evolution of GDP has been widely analysed with multiple purposes, as it plays a key role in the catching-up process involving European countries. However, in recent years, it has been observed that macroeconomic variables may display both stationary and non-stationary features within a specific period; see, for instance, Halunga *et al* (2009). Indeed, it seems that some series could be switching from I(0) to I(1) behaviour, or vice versa.

Parallel to macroeconomic variables and with direct implications on a country's macroeconomic performance, tourism activity has revealed itself as one of the world's largest and fastest growing industries, playing a key role in the economic growth of many countries, lending itself to other economic sectors through direct and indirect multiplier effects. Portugal relies heavily on this industry as an important means of (economic) resource, catering largely to the European market. In 2006, the country was visited by 12.8 million tourists, being responsible for 5% of GDP and 10% of employment. The increasing number of tourists and their strategic importance, in terms of revenue and employment, as well as in terms of direct and indirect effects on several other economic sectors, has led economic agents to adopt important dynamic measures in relation to supply. Portugal has been able to keep its international market share despite the growing number of competing markets that are once again attracting tourists to traditional destinations.

The strategic importance of tourism has contributed decisively to extensive research on its effects on the economic performance of Portugal, whose reliability imposes a careful analysis of the statistical properties of the series. On the other hand, assessing its persistence by quantifying the response of tourism to shocks hitting the economy is crucial for the implementation of efficient policies towards the sector. In particular, quantifying the sluggish response of tourism to changes in economic conditions or others appears as a fundamental prerequisite if the government aims to implement a policy strategy towards the sector's development. Furthermore, and in order to understand the determinants of tourism demand behaviour better, it would be relevant to be able to identify whether tourism inflows follow a stationary process, allowing for the possibility of variations in the degree of persistence due to changes in the structure of the economy or in policies towards the sector.

This paper contributes to the literature by analysing whether the persistence of tourism has changed over the period 1987–2008, by employing the tests of Kim (2000) and Harvey *et al* (2006). The results suggest that tourism inflows to Portugal may have undergone a structural change, having switched from non-stationary to stationary behaviour.

The paper is organized as follows. The next section reviews the statistical procedures to test for changes in persistence of tourism inflows to Portugal. The subsequent two sections, respectively, present finite sample results of the performance of the persistence change tests when applied to seasonally unadjusted data, and provide the empirical results. Finally, we offer our conclusions.

Methodological framework

The persistence change model

For the purpose of presenting the persistence change tests, we follow Harvey *et al* (2006) and Busetti and Taylor (2004) and consider the following data-generation process,

$$y_t = x_t' \beta + v_t \qquad (1)$$

$$v_t = \rho_t v_{t-1} + \varepsilon_t , \qquad t = 1,...,T \qquad (2)$$

with $v_0 = 0$. In (1), x_t is a set of deterministic variables, such as seasonal dummies only or seasonal dummies and a time trend. The vector x_t is assumed to satisfy the mild regularity conditions of Phillips and Xiao (1998), and the innovation sequence $\{\varepsilon_t\}$ is assumed to be a mean zero process satisfying the familiar α-mixing conditions of Phillips and Perron (1988, p 336) with strictly positive and bounded long-run variance, $\omega^2 \equiv \lim_{T \to \infty} E(\sum_{t=1}^T \varepsilon_t)^2$ (see Harvey *et al,* 2006, p 444). In (1)–(2), considering the zero frequency roots only, four hypotheses can be considered:

(1) H_1: y_t is I(1) (that is, non-stationary) throughout the sample period;
(2) H_{01}: y_t is I(0) changing to I(1) (in other words, stationary changing to non-stationary) at time $[\tau^* T]$. The change point proportion is assumed to be an unknown point in $\Lambda = [\tau_l, \tau_u]$, an interval in (0,1) which is symmetric around 0.5;
(3) H_{10}: y_t is I(1) changing to I(0) (that is, non-stationary changing to stationary) at time $[\tau^* T]$;
(4) H_0: y_t is I(0) (stationary) throughout the sample period.

Ratio-based tests

In order to test the hypotheses in (1)–(4), Kim (2000), Kim *et al* (2002) and Busetti and Taylor (2004) have developed tests for the constant I(0) data-generating process (DGP) (H_0) against the I(0)–I(1) change DGP (H_{01}), which are based on the ratio statistic,

$$K_{[\tau T]} = \frac{(T - [\tau T])^{-2} \sum_{t=[\tau T]+1}^{T} (\sum_{i=[\tau T]+1}^{t} \tilde{v}_{i,\tau})^2}{[\tau T]^{-2} \sum_{t=1}^{[\tau T]} (\sum_{i=1}^{t} \hat{v}_{i,\tau})^2} \qquad (3)$$

where $\hat{v}_{t,\tau}$ is the residual from the OLS regression of y_t on x_t for observations up to $[\tau T]$ and $\tilde{v}_{t,\tau}$ is the OLS residual from the regression of y_t on x_t for

$t = [\tau T],\ldots,T$. For example, in the seasonal dummy case, x_t is an $S \times 1$ vector, with 1 corresponding to season s, $s = 1,\ldots S$ and zero everywhere else, $\hat{v}_{s,\tau} = y_t - \bar{y}_s(\tau)$, with $\bar{y}_s(\tau)$ corresponding to the mean of season s over the subsample $t = 1,\ldots,[\tau T]$.

Since the true change point, τ^*, is assumed unknown, Kim (2000), Kim *et al* (2002) and Busetti and Taylor (2004) consider three statistics based on the sequence of statistics $\{K(\tau), \tau \in \Lambda\}$, where $\Lambda = [\tau_l, \tau_u]$ is a compact subset of $[0,1]$, that is,

$$K_1 = T_*^{-1} \sum_{s=[\tau_l T]}^{[\tau_u T]} K(s/T) \tag{4}$$

$$K_2 = \ln\left\{ T_*^{-1} \sum_{s=[\tau_l T]}^{[\tau_u T]} \exp\left(\frac{1}{2} K(s/T)\right) \right\} \tag{5}$$

$$K_3 = \max_{s \in \{[\tau_l T],\ldots,[\tau_u T]\}} K(s/T) \tag{6}$$

where $T_* = [\tau_u T] - [\tau_l T] + 1$ and τ_l and τ_u correspond to the (arbitrary) lower and upper values of τ^* (in the empirical section, we set $\tau_l = 0.2$ and $\tau_u = 0.8$, as is frequently adopted in the literature). Limit results and critical values for the statistics in (4)–(6) can be found in Harvey *et al* (2006).

Note that the procedure in (4) corresponds to the mean score approach of Hansen (1991); (5) is the mean exponential approach of Andrews and Ploberger (1994); and, finally, (6) is the maximum Chow approach of Davies (1977) (see also Andrews, 1993).

In order to test H_0 against the I(1)–I(0) change DGP (H_{10}), Busetti and Taylor (2004) propose further tests based on the sequence of reciprocals of K_t, $t = [\tau_l T],\ldots,[\tau_u T]$. They define K_1^R, K_2^R and K_3^R as the respective analogues of K_1, K_2 and K_3, with K_j, $j = 1,2,3$ replaced by K_j^{-1} throughout. Furthermore, to test against an unknown direction of change (that is either a change from I(0) to I(1), or vice versa), they also propose $K_i^M = \max[K_i, K_i^R]$, $i = 1,2,3$. Thus, tests which reject for large values of K_1, K_2 and K_3 can be used to detect H_{01}, tests which reject for large values of K_1^R, K_2^R and K_3^R can be used to detect H_{10}, and tests which reject for large values of K_1^M, K_2^M and K_3^M can be used to detect either H_{01} or H_{10}.

Modified ratio-based test

As noted by Harvey *et al* (2006), all statistics previously presented possess pivotal limit distributions under both H_0 and H_1. Thus, they employ the approach of Vogelsang (1998) to produce tests based on modified versions of these statistics which, for a given test and significance level, have the same critical value in the limit as the corresponding unmodified test under H_0, but where the same limit critical value is also appropriate under H_1.

The modification is largely the same for all tests. In other words, following Vogelsang (1998) and Harvey *et al* (2006), a modified variant of K_i can be considered as,

$$K_{im} = \exp(-b_i J_{1T})K_i, \qquad i = 1,2,3$$

where b_i, $i = 1,2,3$ are finite constants and J_{1T} is a T^{-1} times the Wald statistic for testing the joint hypothesis $\gamma_{k+1} = \dots = \gamma_9 = 0$ in the regression,

$$y_t = x_t' \beta + \sum_{i=k+1}^{9} \gamma_i t^i + error, \qquad t = 1,\dots,T.$$

Note that J_{1T} is the unit root test statistic proposed by Park and Choi (1988) and Park (1990), which is used to test explicitly for zero frequency non-stationarity of $\{y_t\}$. This statistic will serve as an activation mechanism of the correction factor $\exp(-b_i J_{1T})$. This results from the fact that if the series is stationary, asymptotically, $J_{1T} \to 0$ and hence $\exp(-b_i J_{1T}) \to 1$, whereas if the series is non-stationary, J_{1T} will not converge to zero, therefore inducing $\exp(-b_i J_{1T})$ to provide the necessary scaling to adjust the critical value.

Harvey *et al* (2006) also suggest a variant of this modification procedure, which is perhaps more natural to consider when testing against H_{01} by replacing the correction factor J_{1T} with $J_{min} = \min_{\tau \in \Lambda} J_{1,[\tau T]}$ where $J_{1,[\tau T]}$ is T^{-1} times the Wald statistic for testing the joint hypothesis $\gamma_{k+1} = \dots = \gamma_9 = 0$ in the regression

$$y_t = x_t' \beta + \sum_{i=k+1}^{9} \gamma_i t^i + error, \qquad t = 1,\dots,[\tau T].$$

Note that for the reciprocal statistics, the J_{min}^R correction is given from $J_{min}^R = \min_{\tau \in \Lambda} J_{[\tau T]T}$, where $J_{[\tau T]}$ is T^{-1} times the Wald statistic for testing the joint hypothesis $\gamma_{k+1} = \dots = \gamma_9 = 0$ in the regression

$$y_t = x_t' \beta + \sum_{i=k+1}^{9} \gamma_i t^i + error, \qquad t = [\tau T],\dots,T.$$

Furthermore, as regards the test against an unknown direction of change, the two modifications suggested by Harvey *et al* (2006) to K_i^M are defined as,

$$K_{i,J}^M = \exp(-b_i^M J_{1,T})K_i^M$$

and

$$K_{i,\,min}^M = \exp(-b_i^{M^\tau} \min[J_{min}, J_{min}^R])K_i^M, \qquad i = 1,2,3.$$

Regarding the necessary b values to implement the tests presented in this section, we refer to Harvey *et al* (2006, p 453), who provide a table with the asymptotic b values for modified tests of stationarity or a unit root against a change in persistence.

Finite sample performance of the persistence change tests

Harvey *et al* (2006) present an in-depth study of the empirical size and power performance of the persistence change tests previously introduced in the context of non-seasonal data. In this section, we complement that analysis by looking at the behaviour of the tests when applied to seasonal data.

For the purpose of our Monte Carlo study, we consider the following DGP,

$$y_t = x_t' \beta + v_t \tag{7}$$

$$(1 - \rho_{0t}L)(1 - \rho_{1t}L)(1 - \rho_{2t}L^2)v_t = \varepsilon_t, \qquad t = 1,...,T \tag{8}$$

with $v_{-3} = ... = v_0 = 0$. In (7), x_t is a deterministic kernel (such as seasonal
dummies only or seasonal dummies and a time trend), $\varepsilon_t \sim nid(0,1)$ and $\rho_{it} = \{0,1\}$, $i = 0,1,2$. The critical values used in our analysis were taken from Harvey
et al (2006, Table 1, p 451).

Tables 1 and 2 present the empirical size and power of the K_i, K_i^R and K_i^M,
$i = 1,2,3$ tests. The lines with numbers in bold represent the power of the zero
frequency (long-run) persistence change tests and the remaining correspond to
the empirical size. From the analysis of these two tables, we observe that
although at times empirical size exceeds the nominal size considered, it is
generally acceptable. The more severe size distortions are observed when a
change from I(1) to I(0) at the Nyquist frequency and from I(0) to I(1) at the
annual frequency is considered simultaneously. This is particularly severe when
seasonal demeaning and detrending is considered (note that an empirical size
of 36% is observed). It should be noticed, however, that the results refer to
the cases where $\rho_{it} = \{0,1\}$, $i = 1,2,3$ and that if $|\rho_{it}| < 1$, the empirical size
of all tests would be smaller or equal to 5%,[1] which is an encouraging result
given that existing empirical evidence in the literature is not supportive of the
full set of seasonal unit roots (see Osborn, 1990), neither are the results
presented in Table 3 (see next section) for the series under analysis.

Note, however, that further analysis needs to be carried out in order to
understand the properties of these tests better when applied to the seasonal
context.

Empirical results

Properties of tourism data

For the purposes of empirical analysis, we consider the number of overnight
stays in hotel accommodation and similar establishments in the Algarve by
tourists from the UK, Germany, the Netherlands, Ireland, Portugal and Spain.
The sample period considered is from the first quarter of 1987 to the third
quarter of 2008 (87 observations). The data are taken from statistics published
by the Portuguese Office for National Statistics.

Figure 1 presents the graphs of the natural logarithms of the series for the
six countries under analysis. To get a clearer picture of the series, we present
their seasonally demeaned and seasonally demeaned and detrended
representations in Figure 2. A visual inspection suggests that all series exhibit
non-stationary behaviour for the full sample. After an increasing trend, the
series of tourism from the UK seems to be stationary from 2000 onwards. For
Germany, an increasing trend over the first half of the sample is followed by
a decreasing trend in the second half. The non-stationarity also seems to be
present in the series of the Netherlands, Ireland and Portugal, showing
increasing trends, while for Spain the trend is much less pronounced.

Table 1. Empirical size and power of persistence change tests – seasonally demeaned case.

ρ_0 [1;τT]	[τT;T]	ρ_1 [1;τT]	[τT;T]	ρ_2 [1;τT]	[τT;T]	K_1	K_2	K_3	K_1^R	K_2^R	K_3^R	K_1^M	K_2^M	K_3^M
0	0	0	0	0	0	0.056	0.056	0.056	0.055	0.053	0.053	0.062	0.053	0.053
1	0	0	0	0	0	0.208	0.383	0.385	0.977	0.978	0.976	0.969	0.971	0.970
0	1	0	0	0	0	0.985	0.983	0.981	0.144	0.285	0.289	0.979	0.976	0.975
0	0	1	0	0	0	0.042	0.044	0.048	0.056	0.054	0.055	0.046	0.048	0.051
0	0	0	1	0	0	0.071	0.067	0.066	0.012	0.035	0.040	0.039	0.053	0.056
0	0	0	0	0	1	0.053	0.033	0.055	0.037	0.073	0.080	0.042	0.070	0.073
0	0	0	1	1	0	0.037	0.039	0.043	0.042	0.042	0.042	0.036	0.036	0.039
0	0	0	1	0	1	0.134	0.122	0.125	0.010	0.033	0.038	0.077	0.081	0.085
0	0	1	1	1	0	0.007	0.015	0.018	0.106	0.088	0.090	0.059	0.055	0.057
0	0	0	0	0	1	0.043	0.058	0.061	0.040	0.105	0.114	0.035	0.093	0.099
0	0	0	1	1	0	0.075	0.187	0.201	0.087	0.191	0.205	0.082	0.229	0.237
0	0	1	0	0	0	0.049	0.047	0.048	0.053	0.044	0.048	0.047	0.046	0.047
0	0	0	0	0	1	0.029	0.026	0.029	0.027	0.027	0.032	0.025	0.025	0.027

Note: Results are computed from the application of the persistence change tests to seasonally demeaned data. A 5% nominal size was considered, $T = 100$ and $\tau = 0.5$.

Table 2. Empirical size and power of persistence change tests – seasonally demeaned and detrended case.

ρ₀ [1;τI;T]	[τI;T]	ρ₁ [1;τI]	[τI;T]	ρ₂ [1;τI]	[τI;T]	K_1	K_2	K_3	K_1^R	K_2^R	K_3^R	K_1^M	K_2^M	K_3^M
0	0	0	0	0	0	0.057	0.060	0.059	0.051	0.052	0.054	0.052	0.054	0.056
1	0	0	0	0	0	**0.390**	**0.569**	**0.589**	**0.992**	**0.992**	**0.989**	**0.985**	**0.986**	**0.983**
0	1	0	0	0	0	**0.980**	**0.983**	**0.979**	0.199	0.427	0.467	**0.973**	**0.980**	**0.976**
0	0	1	0	0	0	0.119	0.110	0.105	0.046	0.048	0.051	0.099	0.087	0.085
0	1	0	0	0	0	0.058	0.060	0.061	0.068	0.102	0.124	0.070	0.101	0.119
0	0	0	0	0	0	0.040	0.038	0.041	0.044	0.073	0.095	0.040	0.065	0.081
0	1	0	1	0	1	0.094	0.084	0.087	0.025	0.028	0.036	0.070	0.062	0.070
0	0	1	0	0	0	0.109	0.098	0.094	0.012	0.031	0.049	0.064	0.067	0.078
0	0	1	1	0	1	0.024	0.021	0.028	0.084	0.070	0.075	0.055	0.044	0.051
0	0	0	0	0	0	0.102	0.104	0.108	0.073	0.117	0.143	0.103	0.135	0.154
0	1	1	1	1	0	0.188	0.297	0.359	0.182	0.261	0.305	0.227	0.339	0.380
0	1	1	1	0	0	0.113	0.101	0.091	0.107	0.096	0.090	0.145	0.123	0.113
0	0	0	0	0	1	0.060	0.051	0.052	0.064	0.053	0.055	0.067	0.055	0.059

Note: Results are computed from the application of the persistence change tests to seasonally demeaned data. A 5% nominal size was considered, $T = 100$ and $\tau = 0.5$.
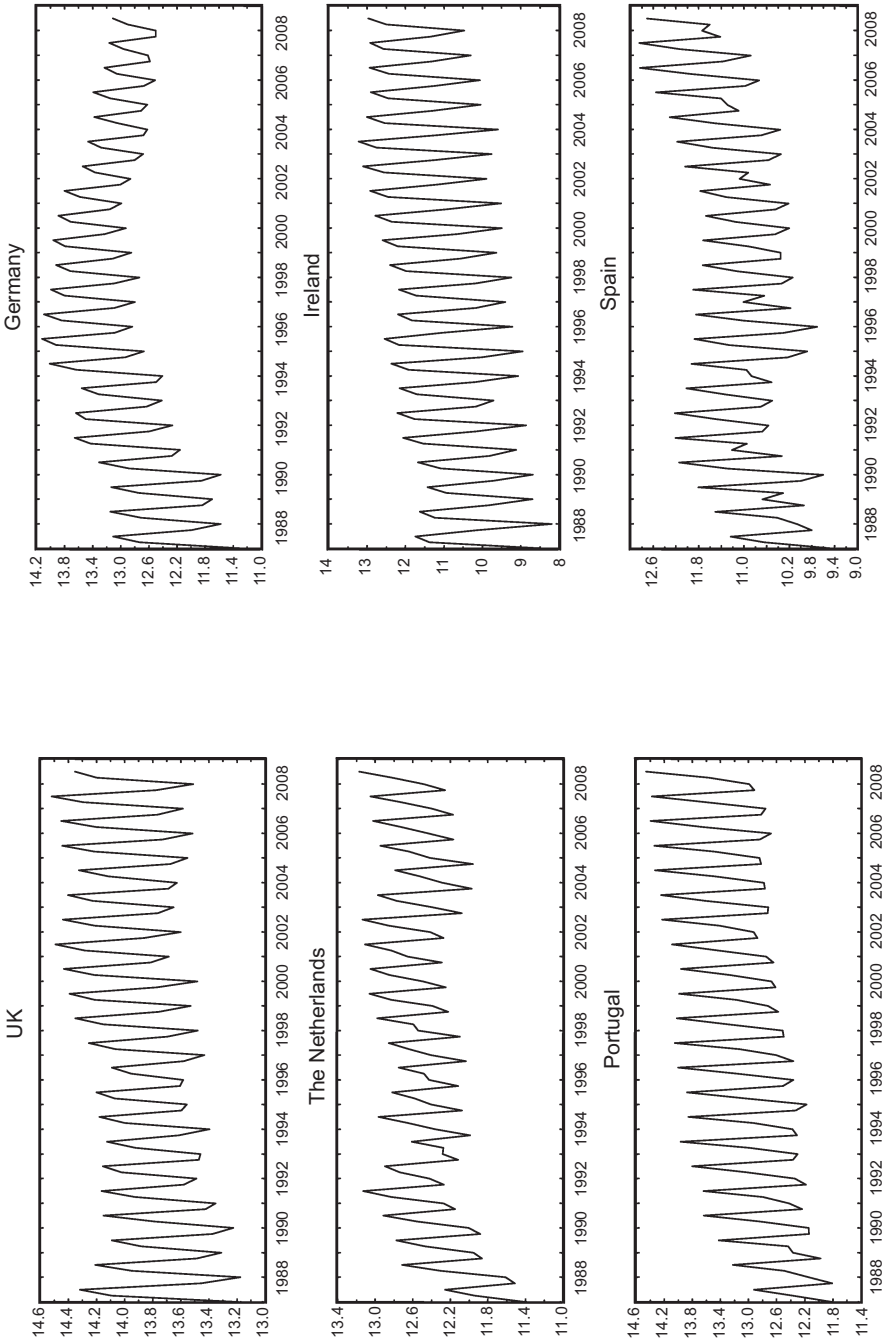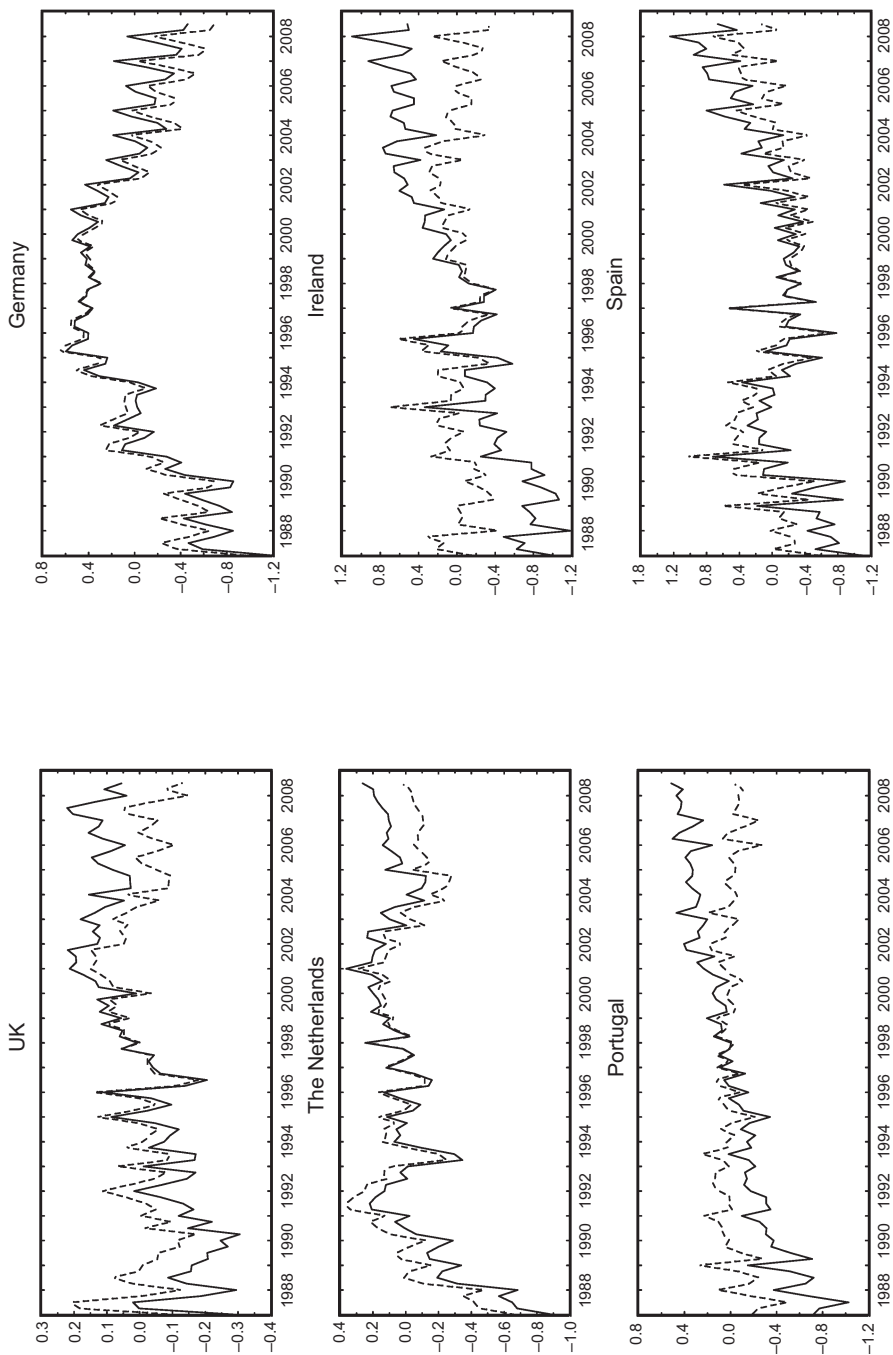
Figure 1. Logs of overnight stays by country of origin.

Figure 2. Demeaned and detrended logs of overnight stays by country of origin.

Note: The solid line corresponds to the seasonally demeaned data and the dashed line to the seasonally demeaned and detrended data.

Table 3. Seasonal unit root test results.

	Lags	t_1	t_2	F_3	F_{23}	F_{123}
UK	0	−1.117	−3.739**	16.093**	19.584**	15.021**
		−1.905	−3.783**	16.490**	20.019**	15.895**
Germany	1,2,3	−2.000	−2.772	0.298	2.849	3.226
		−1.287	−2.831*	0.344	2.996	2.718
The Netherlands	1	−4.124**	−3.530**	8.060*	9.739**	12.238**
		−4.410**	−3.478**	8.745*	9.735**	13.070**
Ireland	1	−1.068	−4.610**	17.555**	17.993**	13.810**
		−2.098	−4.412**	16.092**	16.302**	15.164**
Portugal	1,2	−1.927	−4.310**	7.481*	14.481**	13.065**
		−3.159	−4.323**	6.546	13.566**	15.062**
Spain	1,2,4	−1.035	−4.992**	30.785**	29.180**	21.916**
		−1.962	−5.091**	31.213**	29.964**	22.738**

Note: * and ** denote significance at the 5% and 1% significance levels, respectively. The order of augmentation used in the HEGY test regression, in order to account for autocorrelation, is indicated in the column lags and results are presented for test regressions with seasonal dummies only (D_t) and with seasonal dummies and a time trend ($D_t + t$). All tests were computed using *Eviews* 6. The column 'Lags' indicates the number of lags to guarantee the correction for autocorrelation.

We start this empirical section by looking at the non-stationary properties of the data, using for that purpose the seasonal unit root test proposed by Hylleberg *et al* (1990) [HEGY henceforth]. This preliminary investigation will allow us to establish the apparent degree of integration of the series at the seasonal and non-seasonal frequencies. This analysis will be complemented in the next section with the tests for persistence change.

Table 3 presents the results of the application of the HEGY seasonal unit root tests to the six quarterly time series under analysis. In performing the tests, auxiliary regressions with seasonal dummies only and seasonal dummies and a time trend were considered, as well as augmentation to correct for possible autocorrelation (the column '*Lags*' indicates the number of lags found necessary in each case). The number of lags employed was determined using a general to specific lag selection strategy. For the purpose of analysis, the one-sided zero and Nyquist (biannual) frequency unit root *t*-statistics, t_1 and t_2, were considered. These statistics consider that under the null hypothesis there is a unit root, whereas under the alternative the series are stationary at these specific frequencies. Furthermore, joint test statistics to test for non-stationarity at the harmonic (annual) frequencies, F_3, at all seasonal frequencies, F_{23}, and at all frequencies, F_{123}, were also used. The critical values used are shown in Table 4.

We observe from Table 3 that for the full sample with the exception of Germany, no seasonal unit roots can be found in the data, though all series with the exception of the Netherlands display a zero frequency (long-run) unit root, irrespective of whether seasonal dummies and a time trend or just seasonal dummies are considered in the regression. Next, we proceed by performing

Table 4. Critical values used.

	u		τ	
	5%	1%	5%	1%
t_1	−2.82	−3.42	−3.37	−3.96
t_2	−2.82	−3.42	−2.82	−3.42
F_{123}	5.72	7.33	6.49	8.22
F_{23}	6.03	8.01	6.00	7.95
F_3	6.61	9.00	6.56	8.95

Note: u and τ indicate that seasonal dummies only and seasonal dummies and a time trend were considered in the test regression, respectively. These critical values were computed based on 50,000 replications.

Table 5. Standard unit root test results.

	ADF		DF(ERS)		KPSS	
Levels	C	CT	C	CT	C	CT
UK	−1.151	−2.791	0.157	−1.467	0.425*	0.081
Germany	−1.509	−1.259	−0.684	−0.671	0.434*	0.401***
The Netherlands	−2.445	−2.885	0.284	−1.006	0.715**	0.196**
Ireland	−1.139	−2.747	0.013	−1.626	1.201***	0.069
Portugal	−1.124	−3.099	2.378	0.743	0.789***	0.071
Spain	−0.097	−0.857	1.153	−0.966	1.285***	0.124**

Note: *, ** and *** denote significance at the 10%, 5% and 1% significance levels, respectively. All tests were computed using *Eviews 6*.

standard unit root tests at the zero frequency. The results of the augmented Dickey–Fuller test (ADF), the Elliott, Rothenberg and Stock's recently proposed Dickey–Fuller type unit root test (DF-GLS) and the Kwiatkowski–Phillips–Schmidt–Shin test (KPSS) are displayed in Table 5. The results basically seem to confirm either the non-stationarity of the series in levels, that is the series are I(1) over the whole sample.

Persistence change evidence

To assess the validity of the persistence change hypothesis, we proceed by applying the tests described above, and the results are presented in Tables 6 and 7. Although the modified variants K_{ij}, K_{ij}^{R} and K_{ij}^{M} have also been computed, they are not reported here as the results are of the same order of magnitude and therefore do not change the conclusions. Given the sample size, we considered the possibility of at most one change only in the order of integration.

Using the critical values presented in Table 1 of Harvey *et al* (2006, p 451), the analysis in general indicates that all series present evidence of persistence change, although its direction is sometimes unclear. These are the cases for the tourism flows from the UK, Germany, Ireland and Spain. For these countries, the null hypothesis of I(0) is strongly rejected in favour of the I(0)–I(1) or

Table 6. Persistence change test results.

		K_1	K_2	K_3	K_1^R	K_2^R	K_3^R	K_1^M	K_2^M	K_3^M
UK	D_t	5.74**	15.54***	38.89***	32.90***	80.23***	167.60***	32.90***	80.23***	167.60***
	$D_t + t$	1.91	1.37	6.73*	1.19	0.77	3.85	1.91	1.37	6.73
Germany	D_t	0.80	0.77	7.03	12.19***	33.27***	74.06***	12.19***	33.27***	74.06***
	$D_t + t$	2.73*	8.89***	25.71***	58.64***	272.94***	553.82***	58.64***	272.94***	553.82***
The Netherlands	D_t	0.07	0.04	0.15	16.53***	12.27***	29.84***	16.53***	12.27**	29.84**
	$D_t + t$	0.73	0.63	4.84	7.63***	25.45***	57.58***	7.63	25.45***	57.58***
Ireland	D_t	9.33***	99.22***	206.37***	37.94***	138.01***	283.93***	37.94	138.01***	283.96***
	$D_t + t$	1.13	0.72	3.90	2.44	2.37**	10.94**	2.44	2.37	10.94**
Portugal	D_t	1.11	1.06	6.86	25.04***	72.63***	152.55***	25.04	72.63***	152.55***
	$D_t + t$	0.42	0.26	2.63	9.73***	12.20***	30.57***	9.73	12.20***	30.57***
Spain	D_t	3.27	1.79	4.91	0.39	0.21	2.06	3.27	1.79	4.91
	$D_t + t$	4.27**	10.14***	26.06***	10.23***	12.02***	29.88***	10.23	12.02***	29.88***

Note: *, ** and *** denote significance at the 10%, 5% and 1% significance levels, respectively.

Table 7. Persistence change test results.

		$K_{1,J\min}$	$K_{2,J\min}$	$K_{3,J\min}$	$K^R_{1,J\min}$	$K^R_{2,J\min}$	$K^R_{3,J\min}$	$K^M_{1,J\min}$	$K^M_{2,J\min}$	$K^M_{3,J\min}$
UK	D_t	5.65**	15.17***	38.11***	32.58***	79.08***	165.58***	32.45***	78.69***	164.79***
	$D_t + t$	1.91	1.37	6.70	1.18	0.75	3.76	1.88	1.33	6.56
Germany	D_t	0.75	0.70	6.49	11.81***	31.75***	71.20***	11.66***	31.24***	70.11***
	$D_t + t$	2.72*	8.80***	25.51***	56.93***	259.07***	531.68***	56.29***	254.21***	522.99***
The Netherlands	D_t	0.07	0.03	0.13	16.08***	11.78***	28.83***	15.90***	11.61**	28.44**
	$D_t + t$	0.72	0.62	4.78	7.26***	23.32***	53.76***	7.13***	22.59***	52.29***
Ireland	D_t	9.14***	96.33***	201.33***	37.44***	135.34***	279.34***	37.24***	134.43***	277.56***
	$D_t + t$	1.13	0.72	3.89	2.42*	2.34**	10.82**	2.41	2.33	10.77**
Portugal	D_t	1.07	1.02	6.61	24.51***	70.37***	148.55***	24.30***	69.61***	147.02***
	$D_t + t$	0.42	0.26	2.63	9.63***	11.98***	30.14***	9.61***	11.94***	30.05***
Spain	D_t	3.17	1.71	4.72	0.37	0.20	1.97	3.13	1.68	4.65
	$D_t + t$	4.24**	9.97***	25.72***	10.02***	11.61***	29.07***	9.95***	11.46***	28.74***

Note: *, ** and *** denote significance at the 10%, 5% and 1% significance levels, respectively.

I(1)–I(0) change. On the other hand, domestic tourism flows and flows from the Netherlands present evidence of a change from I(1) to I(0). In fact, the null hypothesis of I(0) is not rejected against the I(0)–I(1) change, but it is strongly rejected against the hypothesis of an I(1)–I(0) change. Hence, the analysis reveals statistically significant evidence that persistence has decreased in all countries. This decrease assumes a clearer pattern in the cases of Portugal and the Netherlands and a less clear direction in the remaining cases.

The results allow us to derive conclusions at two levels. First, the series show a persistence change from I(1) to I(0), which is symptomatic of a persistence decrease and a general trend towards a mean reverting behaviour. Second, it seems that the changes occur in the last years of the sample, in particular between 2000 and 2004, in all countries, implying that the results should be interpreted with some caution since the second subsample accounts for about 20 observations only.

EU membership has brought many benefits to Portugal by improving access to European policies and funds. The tourism sector is one of the fastest growing industries in the country (accounting for approximately 11% of GDP) and it has benefited strongly from EU integration, making Portugal one of the top destinations in the world. However, several events occurred in the period 2000–2005 that definitely affected worldwide economies through the most sensitive sectors such as tourism. Nonetheless, the recent economic slowdown, coupled with phenomena of worldwide proportions (the terrorist attacks of 11 September and 4 March, the SARS outbreak and, most recently, the avian flu threat) have changed destination preferences and produced some substitution effects from which Portugal has benefited as a tourism destination.

Conclusion

This paper gathers evidence on persistence changes of tourism inflows from the UK, Germany, the Netherlands, Ireland, Portugal and Spain, measured by the number of overnight stays in hotel accommodation and similar establishments in the Algarve, one of the main tourism destinations in Portugal.

The central objective of this paper is an important issue for a country like Portugal, for two main interrelated reasons. First, the Portuguese economy relies heavily on tourism inflows, in particular the Algarve, the most prominent tourist region by excellence. Nevertheless, tourism inflows are also the basis of other regional economies as well. This has led to the development of research on the effects of tourism on economic performance at different levels: national, regional or even sectorial. The evidence of persistence change in tourism inflows brings a new challenge to empirical research and it will be at the centre of new developments regarding the role of the tourism industry worldwide.

The empirical results relied on the tests proposed by Kim (2000) and Harvey *et al* (2006), as the latter were particularly interesting in that they considered the null hypothesis to be I(0) or I(1) and allowed for breaks between periods of I(0) and I(1) under the alternative.

The preliminary analysis performed with the HEGY seasonal unit root tests detected a zero frequency non-stationary pattern in all series. The analysis that followed presented evidence of persistence change in the tourism inflows from

all countries considered in the sample. This means that tourism inflows to the Algarve are now less volatile than they were before and this may open the door for the definition of a global strategic plan towards the development of the sector in order to minimize the effects of seasonality and motivate tourists to return.

Although the identification of the reasons for this change is beyond the objective of this paper, we believe that the set of negative events that occurred at the beginning of this century, like the terrorist attacks and avian flu, may have contributed to the stabilization of tourism inflows, since there is evidence of positive destination substitution effects for Portugal, as documented in the literature (see, Andraz and Rodrigues, 2010). In fact, economic and social factors are usually mentioned as having direct effects on the willingness to travel to a foreign country. If economic instability with direct impact on people's certainty about the future is determinant, the safety and political stability in the destination are also decisive factors. Portugal's experience has been positive in terms of safety, as it has not experienced international or domestic security problems. Also, political stability has been a positive factor.

Furthermore, persistence change may be symptomatic of the positive effects generated by the adoption of the Euro as a common currency unit in most of the countries under analysis. Nevertheless, the analysis of the relative importance of these factors on tourism inflows to Portugal is far from being exhausted and will be explored in future research. Furthermore, the reduction of tourism volatility may also be a result of a long-term structural policy based on promoting the country and investment in tourism infrastructures and facilities, enacted by the Portuguese authorities with the purpose of attracting tourist loyalty and to make Portugal a preferential touristic destination. Of course, once this goal is achieved, government action will turn to short-run measures in order to minimize the effects of sudden shocks.

Finally, the results of this paper are not parochial with strict relevance for the Portuguese authorities. Tourism is a worldwide activity and several countries exhibit a structural dependency on this industry. Consequently, empirical research on tourism effects assumes a relevant position in the academic and political debate and a clear knowledge of its statistical properties is therefore required.

Endnotes

1. Results are omitted to save space but can be obtained from the authors on request.

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