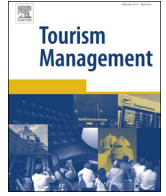




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Research note

Structural breaks in international tourism demand: Are they caused by crises or disasters?

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HIGHLIGHTS

- We study the number and date of structural breaks in international tourism demand.
- We use Bai and Perron (1998) structural break test for 25 countries and Madeira.
- We fill a gap in the literature regarding the *ex-post* detection of tourism crisis.
- We compare the date of tourism crises to the dating of these structural breaks.
- We observe those tourism crises are largely consistent with the dates of breaks.

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ABSTRACT

It is recognised that the tourism industry is vulnerable to some form of crises or disaster. However, despite the attention given to the nature and consequences of tourism crises and disasters, there is a gap in the literature regarding the *ex-post* detection of these events. In this article, we estimate both the number and date of structural breaks in international tourism arrival series for 25 countries and Madeira Island using the Bai and Perron (1998) structural break test. We compare the date of tourism crises and disasters to the dating of these structural breaks. We observe that tourism crises and disasters are largely consistent with the dates of breaks. Therefore, this method allows us to solve a gap in the tourism industry related to the correct allocation of negative shocks in international tourism arrival demand to crisis or disaster phenomena.

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1. Introduction

Tourism crises and disasters are not new phenomena. The media is replete with negative reports of well (and lesser)-known examples of events such terrorist attacks, natural disasters, political instability, outbreak of war, economic recession, biosecurity, disease threats and other negative events that threaten the tourism industry. As reported by Ritchie (2008), whatever the source of these negative events, the subsequent decrease in international tourist arrivals may have a significant social and economic impact both for the destination and the wider global economy.

After the publication of Faulkner's (2001) seminal work on tourism crises and disasters, an increasing number of articles have

been published on this subject, especially in crisis and disaster management. This is due to the fact that, as mentioned by Speakman and Sharpley (2012: 67), even though the tourism industry continues to grow in scope and scale, such events appear, perhaps inevitably, to occur with increasing frequency, to the extent that "tourism destinations in every corner of the globe face the virtual certainty of experiencing a disaster of one form or another at some point in their history" (Faulkner, 2001, p. 142).

Nevertheless, despite the growing number of studies in the tourism field on tourism crisis management there is no clear and commonly accepted definition and statistical methodology that allows us to define a crisis or disaster event in the tourism sector. In part this problem is explained by the fact that most of these studies may have simply adopted a qualitative case study research design that is by nature not quantitative. The majority of the studies on tourism crises and disasters appear to be concerned with prevention, planning, response and recovery of such events (see, e.g.,

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Ritchie, 2008; Hall, 2010). The only references in this respect are limited to the definition of the terms crisis and disaster¹ without defining a methodology for *ex-post* detection of these negative events.

The present paper differs from previous studies as we seek to fill a gap in the literature regarding the *ex-post* detection of tourism crises and disasters. Accordingly, given the nature of these events – “a sudden unpredictable catastrophic change over which it has little control” (Faulkner, 2001), we propose the Bai and Perron (1998, 2003a, b) (hereafter BP) structural break method to estimate both the number and date of structural breaks in international tourism arrival series for 25 countries and Madeira Island. This method has been widely used in different sectors of activity in the determination of structural changes. After that, we compare the date of tourism crises and disasters to the dating of these structural breaks. We observe that tourism crises and disasters are largely consistent with the dates of breaks.

Therefore, this method contributes in two ways to the literature related to crisis or disaster events in the tourism sector. First, this method allows us to close a gap in the tourism industry related to the correct allocation of negative shocks in international tourism arrival demand to crisis or disaster phenomena. As stated by Intriligator, Bodkin, and Hsiao (1996: 579) “a break in structure is always a serious matter because it implies that none of the statistical techniques (hypothesis testing, confidence intervals, etc.) is valid any longer. Moreover, the substantive conclusions about the system being modeled that one might wish to draw are also vitiated, to a greater or smaller extent”. Thus, we should be careful in interpreting the results of studies using international tourism demand data that did not take into account these structural breaks, to the extent that their results can be biased. Second, this method can be an important tool for monitoring the impact of a crisis event on the performance of the sector and to provide useful information to develop adequate policy responses to governments, destination managers and hotel managers. A crisis event that causes a structural break should require a specific policy and a greater allocation of resources by policymakers.²

The structure of the remaining paper is as follows. Section 2 provides some conceptual background and a review of previous studies about tourism crises and disasters and Bai and Perron's method and Section 3 the econometric procedure. Data is presented in Section 4, and Section 5 reports and discusses the results. The conclusion, limitations and future research appear in Section 6.

2. Literature review

2.1. Tourism crises and disasters

The important question we seek to discuss in this section is the definition of a criterion/detection methodology of the presence of a crisis or disaster event in the tourism sector. Scott and Laws (2005: 152) present a table with different definitions of the terms crisis and disaster. We present three of these definitions. Reilly (1993) defines crisis as “a situation which is harmful and disruptive, of high magnitude and is outside the firm's typical operating frameworks”. Carter (1991, p. xxiii) defines a disaster as “an event, natural

or man-made, sudden or progressive, which impacts with such severity that the affected community has to respond by taking exceptional measures”. Finally, the Pacific Asia Travel Association (PATA) (1991) describes a tourism crisis as “a disaster, whether natural or man-made, that has the potential to totally disrupt the tourism industry”. As Faulkner (2001: 137) emphasizes, all these definitions have transformational connotations, with each event having potentially negative outcomes.

The question is how to know when there is “in practice” a tourism crisis or disaster. Hall (2010: 403) refers that “any period where international tourism numbers only increase by 2% or less often appears to be described as a crisis for the industry”. We are of the opinion that this is a simplistic definition that may explain the high number of researches on crises in the tourism sector. In fact, the author emphasizes a substantial number of publications that have looked at tourism crises. He reports 103,000 publications whose abstracts refer to crises, tourism crises and different types of crises. However, Brecher (1978) highlights the danger of oversimplification and the importance of recognizing that the crisis can be a complex phenomenon, given the chaotic nature of crises and disasters and the uncertainty that surrounds them. Given that crises and disasters can lead to chaotic situations and complex interrelations between human and natural systems, the comprehension of the relationship between cause and effect and the implications of decisions and actions is a complicated process (Faulkner, 2001). In this sense Brecher (1978) highlights the seven aspects of the crisis that must be analyzed – source, gravity, complexity, time, communication patterns, outcomes and potential intensity.

The study of crisis events and disasters in the tourism sector, in particular the impacts of such events on the tourism industry and the responses of industry and the relevant government agencies are extremely important (Faulkner, 2001). The author states that tourism, as an area of human activity is no less prone to disasters than any other. However, the recovery of this industry from a crisis is far more complicated than for other industries (Cavlek, 2002). A very strong partnership and coordinated work among the government, national tourism organizations, foreign tour operators, local travel organizers, and local hospitality officials are essential, according to Cavlek (2002: 487). Each needs to participate to an important degree in order to secure the fulfilment of several important actions. These include successful rebuilding of the destination image, overcoming any adverse policy resulting from the crisis, short-term restoration and long-term reconstruction of the damaged tourism facilities and infrastructures, effective management of media coverage, reduction of barriers and travel facilitation, and business and consumer regulation support and subsidies (Cavlek, 2002; Steiner et al. 2013).

The past few years seem to confirm the scenario that tourism is no less prone to disasters than any other industry, by showing an increasing number of disaster and crisis which affect the tourism industry, ranging from human-to nature-influenced incidents. Are examples of these events the terrorist attacks, natural disasters, political instability, outbreak of war, economic recession, biosecurity and disease threats (for detailed information about the various studies carried out on tourism crises and disasters, see, e.g., Ritchie, 2008; Hall, 2010).

Finally, although various studies have extensively investigated crisis phenomena by using quantitative approaches in order to identify disruptions in tourist arrivals (e.g. Cavlek, 2002; Enders, Sandler, & Parise, 1992; Steiner et al., 2013), none presents a methodology for identifying tourism crises or disasters. The identification of a “real crisis” is often a complex issue for several reasons. Sometimes countries suffer damage caused by a “ripple” effect that goes far beyond the destinations and parties directly

¹ Scott and Laws (2005) present in Table 1, of your study, various definitions of terms crisis and disaster.

² The chapter 2.4. – “Policy Responses to the Global Economic Crisis” in Steiner et al. (2013) reviews information on measures undertaken to mitigate the impact of the crisis on the tourism sector. These measures range from marketing and promotion, business regulatory support and subsidies, consumer regulatory support and subsidy, reducing barriers and facilitating travel to long-term investment and regulations.

involved in the incident that may result in a crisis (Cavlek, 2002, p. 481). As shown by Young and Montgomery (1998:4) "... a crisis has the potential to be detrimental to the marketability of any tourist destination, particularly if it is dramatised and distorted through rumours and the media". On the other hand, as stated by Faulkner (2001:142), "the effectiveness with which the tourism industry in a disaster area handles a crisis, and therefore the degree to which it is prepared for it", could explain why potentially serious crisis events for the industry did not bring about negative results. For this reason, we propose the application of Bai and Perron's (1998) method to identify structural changes in the international tourism arrival series.³ This method also allows us to examine whether the dates defined by the method correspond to crisis or disaster events cited among other authors in Hall (2010) and Ritchie (2008). Given that the BP method determines endogenously the structural break dates that we do not know in practice, it allows us to see which crisis events were truly harmful to the tourism industry, i.e., the real crisis events.

We are of the opinion that it is the best method to identify an *ex-post* tourism crisis or disaster since this method determines endogenously structural breaks and therefore "a situation which is harmful and disruptive". Subsequently, in the explanation of structural breaks, we can relate them to crisis and disaster events referred to in researches and in the media.

2.2. Bai and Perron's multiple structural break approach

We use the Bai and Perron (1998, 2003a, b) structural break method to test for infrequent structural breaks in international tourism arrivals. We use the BP method for three reasons. First, the method can deal with multiple structural breaks. We are not interested in models that can only detect a single structural break. Second, the method assumes that potential structural breakpoints are unknown and determine endogenously the structural break dates that we do not know in practice. Finally, the BP method is also revealed to be appropriate for small samples (see Jones & Olken, 2008).

The BP method has been widely used in different sectors of activity, in the determination of structural changes. This method appears in the top 1% ranking of research items by number of citations.⁴ Its scope ranges from the energy sector – e.g. Aruga (2016) and Wakamatsu and Aruga (2013) use the BP method to identify the break data related to the shale gas revolution and Noguera (2013) in oil prices; sports – e.g. Groothuis, Rotthoff, and Strazicich (2015) use time-series tests with structural breaks in Major Baseball performance; legal studies – e.g. Vujić, Commandeur, and Koopman (2016) apply the BP method to investigate the monthly crime rates in Virginia and Smyth and Narayan (2004, 2006) examine structural changes in the level of consensus on the high court of Australia and on the U.S. supreme court, respectively; fisheries and farming – e.g. Wakamatsu and Miyata (2015); Gutierrez, Westerlund, and Erickson (2007) and Kristofersson and Anderson (2006) use it on the economic and financial sector (with the highest number of papers) – (i) interest rates – e.g. Caporale and Grier (2000) and Rapach and Wohar (2005), (ii) inflation rate – e.g. Gadea, Sabaté, and Serrano (2004) and Hassler and Meller (2014), (iii) foreign exchange – e.g. Kellard, Jiang, and Wohar (2015) and Frankel and Xie (2010), (iv)

government debt – e.g. Cuestas, Gil-Alana, and Staehr (2014) and Tamakoshi and Hamori (2014), (v) stock market – e.g. Bekiros, Gupta, and Kyei (2016), (vi) nominal wage – e.g. Gottschalk (2005), (vii) commodity prices – e.g. Enders and Holt (2012), (viii) productivity growth – e.g. Fernald (2007), (ix) output growth – e.g. Ćorić and Pugh (2013) and (x) real estate market – e.g. Martins, Serra, Martins, and Stevenson (2015). Nevertheless, we do not find any application of the BP method in the tourism sector, although this sector often uses time series.

The BP method is applied by us in a series of international tourism demand to identify possible structural changes in country tourism demand and to check whether this break is caused by a crisis or disaster in the tourism sector. In this manner, we are only interested in the structural breaks that led to a decrease in the number of international tourists, seeking to identify the tourism crises or disasters that are at its origin. As is pointed out by Pesaran and Timmermann (2004), the majority of time series are subject to occasional structural breaks and it can be very costly to ignore breaks because the results will be biased and forecasts inconsistent. Given that the majority of researches using international tourism arrival data do not analyze the existence of breaks in tourism demand series, the quality of the results is not guaranteed, neither is the correct identification of crisis and disaster phenomena in the tourism sector. In this sense, the BP method is used by us in this study in order to analyze the linkage between structural changes and crisis and disaster phenomena in the tourism sector. In the next section, the BP method is explained in detail.

3. Econometric procedure

Bai and Perron (1998, 2003a, b) provide theoretical and computational testing procedures by which we can identify unknown breakpoints given T observations and m potential breaks (producing $m+1$ regimes) by least squares. Following among others, Caporale and Grier (2000) and Rapach and Wohar (2005), we regress international tourism arrival series on a constant and test for structural breaks in the constant. The model is:

$$y_t = \beta_j + \varepsilon_t, t = T_{j-1}, \dots, T_j, \quad (1)$$

for $j = 1, \dots, m + 1$, where y_t is the international tourism arrival series in period t and β_j ($j = 1, \dots, m + 1$) is the mean of a dependent variable in the j th regime. The m -partition, (T_1, \dots, T_m) , represents the breakpoints for the different regimes (by convention, $T_0 = 0$ and $T_{m+1} = T$). We can identify multiple structural changes in the following manner: For each m -partition, (T_1, \dots, T_m) the least-squares estimates of β_j are obtained by minimizing the sum of squared residuals,

$$S_T(T_1, \dots, T_m) = \sum_{j=1}^{m+1} \sum_{t=T_{j-1}+1}^{T_j} (y_t - \beta_j)^2 \quad (2)$$

where, S_T represents the sum of squared residuals in m -partition. Being the regression coefficient estimates based on a given m -partition, (T_1, \dots, T_m) be denoted by $\hat{\beta}(\{T_1, \dots, T_m\})$, where $\hat{\beta} = (\hat{\beta}_1, \dots, \hat{\beta}_{m+1})$. Next, substituting these into Equation (2), gives the estimated break points

$$(\hat{T}_1, \dots, \hat{T}_m) = \operatorname{argmin}_{T_1, \dots, T_m} S_T(T_1, \dots, T_m), \quad (3)$$

where $S_T(T_1, \dots, T_m)$ denotes the sum of squared residuals. After estimating the breakpoint, it is straightforward to compute the corresponding least-squares regression parameter estimates as $\hat{\beta} = \hat{\beta}(\{\hat{T}_1, \dots, \hat{T}_m\})$. Bai and Perron (2006) developed an efficient

³ Hall (2010: 403) argues that "growth in international tourist arrivals provides and important benchmark for tourism" and as such is used in the study of crises in the tourism sector.

⁴ The Bai and Perron (1998) method is the 123th most cited publication in IDEAS (see <https://ideas.repec.org/top/top.item.nbcsites.html>).

algorithm for the minimization problem in Equation (3) based on the principle of dynamic programming.

Bai and Perron (1998) suggest the application of the three following tests to determine the existence of structural changes and to identify the number of breaks: (i) $SupF_T(m)$ test; (ii) “double maximum” statistics given by $UD_{max} = \max_{1 \leq m \leq M} SupF_T(m)$ and $UD_{max} = \max_{1 \leq m \leq M} W_m SupF_T(m)$; (iii) the sequential $SupF_T(m + 1|m)$ test. According to the authors, the procedure to determine the existence of structural changes and to identify the number of breaks is as follows. First, let $SupF_T(m)$ indicate the F -statistic for testing the null hypothesis of no structural breaks against the alternative hypothesis that there are $m = b$ breaks, which are selected according to (3). Second, let $UD_{max} = \max_{1 \leq m \leq M} SupF_T(m)$ and $UD_{max} = \max_{1 \leq m \leq M} W_m SupF_T(m)$ denote the two “double maximum” statistics, to test the null hypothesis of no structural breaks against the alternative hypothesis of an unknown number of breaks given an upper bound, M . Third, let $SupF_T(m + 1|m)$ denote the F -statistic to test the null hypothesis of m breaks against the alternative hypothesis of $m+1$ breaks. Fourth, see the UD max or WD max tests to know if at least one break is present. Finally, see the sequential $SupF_T(m + 1|m)$ statistics and define the number of breaks at the 5% level.

4. Data

To study the presence of structural changes in international tourism demand, we collect data on international tourism arrivals for 25 countries between 1995 and 2014 from the World Bank.⁵ The first countries to be analyzed are the Maldives, Thailand, Sri Lanka, Indonesia, Singapore, Taiwan, Vietnam, Hong Kong, China and Japan. For these countries, we want to check if structural breaks are linked to any of these crises identified in tourism literature – Asian financial crisis, tsunami and earthquakes and Severe Acute Respiratory Syndrome (SARS) and avian flu. Next, we analyze Syria, Tunisia, Egypt and Israel to check if structural breaks are linked with the Gulf War, 9/11 attacks and the Arab Spring.⁶ We also analyze the tourism demand of New Zealand and Haiti to study the impact of earthquakes in these two countries. It is followed by the analysis of the impact of the foot and mouth disease disaster, 9/11 attacks and AH1N1 influenza crisis in the United Kingdom, USA and Mexico, respectively. Finally, we analyze the effects of the recent financial and economic crises in Ireland and in five southern European countries – Greece, Cyprus, Portugal, Spain and Italy.

Additionally it is for us examined the case of Madeira Island, where we intend to determine the existence of structural breaks and check if any of the dates of the breaks correspond with the storms of October 1993 and February 2010. In this case we collect data about “guest arrivals in hotel establishments” between 1991 and 2014 from Tourism Statistics of the Autonomous Region of Madeira.⁷

5. Structural break points and tourism crises and disasters

The structural break estimation results through EViews 8 are presented in Table 1. We only report the structural breaks that led to a decrease in the number of international tourists. Posteriorly, we compare the dates of tourism crises and disasters to the dating of these structural breaks. We observe that tourism crises and disasters are largely consistent with the dates of breaks.

5.1. Asian countries panel

The results reveal the existence of structural breaks in the ten Asian countries analyzed. In the case of China, Hong Kong, Japan, Singapore, Taiwan and Vietnam, the BP method reveals the existence of a structural break in 2003, which can be explained by SARS and avian flu. In this regard, among others, Wen, Huimin, and Kavanaugh (2005) and Zeng, Carter, and Lacy (2005), in the case of China; Au, Ramasamy, and Yeung (2005), in the case of Hong Kong; Henderson and Ng (2004), in the case of Singapore; and McKercher and Chon (2004) and Kuo, Chen, Tseng, Ju, and Huang (2008) for the generality of Asian countries, highlight the negative effects of SARS on the tourism sector in these countries. Our results also show that the tsunami of 26 December 2004 in the Indian Ocean had a negative effect on the tourism industry of the Maldives, Sri Lanka, Thailand and Indonesia. In this latter country the Bali bombings have also contributed to poor performance of the tourism sector. The structural breaks identified in 2005 are in line with the devastation of the tourism industry verified in these countries, as is indicated by Sharpley (2005). Finally, we detected the existence of three more structural breaks - in 2007 and 2008 in Hong Kong and Sri Lanka and in 2011 in Japan. In the latter case, we believe that structural change is due to the earthquake, tsunami, and nuclear accident that had occurred consecutively in Fukushima, Japan, in March 2011 (in this regard see, e.g., Kim & Park, 2016). The breaks identified in Hong Kong and Sri Lanka in 2007 and 2008, were probably due to the impact of financial and economic crisis. Song and Lin (2010) argue that financial and economic crisis have a negative impact on both inbound and outbound tourism in Asia.

5.2. MENA countries panel

The results of the BP structural break method for the four countries of MENA analyzed show that the 9/11 attacks and the Arab Spring are responsible for the fall of the flow of tourists registered in 2001 and 2011, in most of these countries. With regard to the 9/11 attacks, Avraham (2015: 226) states that “tourism flow to these countries has been affected not only by events that occurred there but also by events that happened elsewhere and involved Arab citizens, as is the case of 9/11 attacks”. The author further notes that in the case of the Arab Spring the negative effect on tourism on the Middle East is due to the intensive coverage that the Arab Spring uprisings got in the media. Finally, we also verified the existence of a structural break in 2008 in Israel, which we believe is a result of the financial crisis that has affected all countries in a generalized way, as shown by Papatheodorou, Rosselló, and Xiao (2010).

5.3. Ireland and southern European countries panel

With regard to Ireland and the five countries of southern Europe analyzed, the results reveal the existence of structural breaks in four of them – Cyprus, Greece, Ireland and Spain - and the absence of any structural break in Portugal and Italy. Costa, Gomes, and Montenegro (2014) and Cellini and Cuccia (2015) maintain that the tourism industry of Portugal and Italy, respectively, as a whole has been more resilient to economic crisis than the other industries. In the case of Italy, the authors show that the “tourism industry has been able to substitute domestic demand with foreign demand, thus limiting the negative effect of severe domestic crisis”.

For the other four countries, the financial crisis is responsible for the observed structural breaks. In the case of Cyprus, we identify two structural breaks – in 2002 and 2009 – that can be explained according to Boukas and Ziakas (2013), by the financial crisis. The authors argue that “the overdependence of this island on tertiary

⁵ The data is available here: <http://data.worldbank.org/indicator/ST.INT.ARVL>.

⁶ Libya and Iraq were excluded from analysis due to lack of data.

⁷ The data is available here: <http://estatistica.gov-madeira.pt/index.php/en/download-now-3/economic/turismo-gb/turismo-serie-gb/long-series>.

Table 1

Structural Break Estimation Results and its Rationale.

This table presents for each country analyzed the results of the [Bai and Perron \(1998, 2003a, b\)](#) structural break method to test for infrequent structural breaks in international tourism arrivals. For the identified structural break dates, we seek to identify their rational, i.e. the existence of a crisis or disaster in the tourism sector of the country. In this manner, we are only interested in the structural breaks that led to a decrease in the number of international tourists, seeking to identify the tourism crises or disasters that are at its origin. * Significant at the 0.05 level. ** [Bai and Perron \(2003b\)](#) critical values.

Country	Break Test	F-statistic	Critical Values	Break Dates	Rational
Asian Countries					
China	0 vs 1 *	14.58	8.58 **	2003	SARS + Avian Flu
Hong Kong	0 vs 1 *	40.06	8.58 **	2003	SARS + Avian Flu
	1 vs 2 *	20.82	10.13 **	2007	Financial Crisis
Indonesia	0 vs 1 *	11.90	8.58 **	2005	Bali Bombings and Tsunami
Japan	0 vs 1 *	28.88	8.58 **	2003	SARS + Avian Flu
	1 vs 2 *	15.39	10.13 **	2011	Earthquake
Maldives	0 vs 1 *	11.96	8.58 **	2005	Tsunami
Singapore	0 vs 1 *	22.49	8.58 **	2003	SARS + Avian Flu
Sri Lanka	0 vs 1 *	16.42	8.58 **	2005	Tsunami
	1 vs 2 *	14.16	10.13 **	2008	Financial Crisis
Taiwan	0 vs 1 *	76.68	8.58 **	2003	SARS + Avian Flu
Thailand	0 vs 1 *	53.99	8.58 **	2005	Tsunami
Vietnam	0 vs 1 *	56.70	8.58 **	2003	SARS + Avian Flu
MENA Countries					
Egypt	0 vs 1 *	73.76	8.58 **	2001	9/11 attacks
	1 vs 2 *	10.84	10.13 **	2011	Arab Spring
Israel	0 vs 1 *	22.99	8.58 **	2001	9/11 attacks
	1 vs 2 *	14.29	10.13 **	2008	Financial Crisis
Syria	0 vs 1 *	32.56	8.58 **	2011	Arab Spring
Tunisia	0 vs 1 *	22.95	8.58 **	2001	9/11 attacks
	1 vs 2 *	18.50	10.13 **	2011	Arab Spring
Ireland and Southern European Countries					
Cyprus	0 vs 1 *	17.14	8.58 **	2002	Financial Crisis
	1 vs 2 *	11.19	10.13 **	2009	Financial Crisis
Greece	0 vs 1 *	24.12	8.58 **	2012	Financial Crisis
Ireland	0 vs 1 *	36.91	8.58 **	2008	Financial Crisis
Italy	0 vs 1 *	6.58	8.58 **	None	–
Portugal	0 vs 1 *	6.48	8.58 **	None	–
Spain	0 vs 1 *	43.38	8.58 **	2009	Financial Crisis
Other Countries and Madeira Island					
Haiti	0 vs 1 *	105.60	8.58 **	2010	Earthquake
Madeira	0 vs 1 *	105.60	8.58 **	1993	Storm
	1 vs 2 *	11.19	10.13 **	2009/2010	Financial Crisis + Storm
Mexico	0 vs 1 *	105.60	8.58 **	2009	AH1N1 Influenza Crisis
New Zealand	0 vs 1 *	3.44	8.58 **	None	–
UK	0 vs 1 *	124.32	8.58 **	2001	Foot and Mouth Disease
USA	0 vs 1 *	50.01	8.58 **	2001	9/11 Attacks
	1 vs 2 *	26.86	10.13 **	2009	Financial Crisis

sector/tourism and on the foreign capital makes it susceptible to global crises". Finally, we identify one structural break in Greece, Ireland and Spain that is due to the impact of the financial and economic crisis, as emphasized by [O'Brien \(2012\)](#), [Alonso-Almeida and Bremser \(2013\)](#), [Smeral \(2009, 2010\)](#) and [Papatheodorou et al. \(2010\)](#).

5.4. Other countries and Madeira Island panel

Haiti and New Zealand both recently suffered an earthquake. In the case of Haiti, the earthquake of January 2010 caused heavy damage to the tourism sector, so the structural break identified in 2010 was to be expected. In the case of New Zealand, the earthquake of February 2011 caused damage mainly around Christchurch and we have not identified any structural break in the international tourism arrival series. As stated by [Brecher \(1978\)](#), the gravity and potential intensity are two important factors for the beginning of a crisis that probably not have occurred in the case of New Zealand. The same idea is present in the two structural breaks identified in Madeira. In both cases, natural disasters are at their source. As noted by [Machado \(2012\)](#), the "Island of Madeira was not prepared for a catastrophe such as the one that occurred in February 2010, and its consequence has been a huge drop in the tourism industry". Finally, we identify four structural breaks for

Mexico, the UK and the USA. The structural break that we find in Mexico is due to the AH1N1 influenza outbreak that has occurred in the country in 2009. As underlined by [Speakman and Sharpley \(2012: 72\)](#), soon as the "situation dominate the world's media, international visitor numbers to Mexico decreased rapidly with the news of the influenza outbreak". In the case of the UK the structural break identified is related to the foot and mouth disease, which was studied by, among others, [Baxter and Bowen \(2004\)](#). The two structural breaks identified for the US are related to the 9/11 attacks and the financial crisis. The negative impact of the 9/11 attacks on US tourism and air travel is highlighted by [Goodrich \(2002\)](#) and [Blunk, Clark, and McGibany \(2006\)](#). The recent economic and financial crisis seems to explain the structural break in 2009, as stated by [Ritchie, Molinar, and Frechtling \(2010\)](#).

6. Conclusion

In this article, we use the [Bai and Perron \(1998, 2003a, b\)](#) multiple regime shift procedure to identify the exact number and dates of breakpoints in international tourism arrival series of 25 countries and in Madeira Island. Our results suggest that this method is shown to be reliable in ex-post detection of negative impacts of tourism crises and disasters related to natural disasters, terrorist attacks, political instability, economic and financial crisis and

biosecurity and disease threats. The Bai and Perron's method has the advantage of determining endogenously structural breaks and identifying the respective dates, which allows a relationship between these dates and crisis and disaster events. Therefore, this method contributes in two ways to the literature related to crisis or disaster events in the tourism sector. First, this method allows us to solve a gap in the tourism industry related to the correct allocation of negative shocks in international tourism arrival demand to crisis or disaster phenomena, ensuring that the estimated results are not biased. Second, this method can be an important tool for monitoring the impact of a crisis event on the performance of the sector and for providing useful information to develop adequate policy responses to governments, destination managers and hotel managers. A crisis event that causes a structural break should require a specific policy and a greater allocation of resources by policymakers'.

6.1. Limitations and future research

While our research has valuable contributions, it also has some limitations. The first limitation is related to the fact that different crises may occur simultaneously in a given country or region. Given that Bai and Perron's method only determines endogenously the structural breaks and identifies their dates, it is impossible to know in these cases if only one or both of these crises are responsible for the structural break in demand for international tourism.

Secondly, given the *ex-post* detection of structural breaks, it can be argued that the intended monitoring of statistical data for management purposes seems to be solely possible within certain time lag. This is an extremely important point and has been one of the highlights of the current review of the European Union Solidarity Fund (EUSF) Regulation that provides financial support to a Member State in the event of a major natural disaster.⁸ The recommendations for improving the EUSF include (i) budgetary discipline; (ii) reduction of the time taken to provide aid and (iii) a greater clarity as regards scope and definitions. The authors of the document consider that the time currently taken to mobilise the fund is unacceptably long, introducing the possibility of paying advances as soon as the affected state has applied for assistance and the aid would have to be returned to the Union budget in the event that the application was not accepted. For this purpose, it is necessary to define clearly and simply what a disaster is. Given that in developed countries it is possible to incorporate forecasts in international tourism demand series based on travel and accommodation booking requests, it may be possible to detect structural breaks in a short period of time. In the presence of a tourism crisis, the cancellation of travel and hotel reservations often occurs, a situation that tends to be rapidly incorporated into the estimates made for the series analyzed and captured by the BP method. In the short time that elapsed between the occurrence of the crisis and its detection by the BP method, the mechanism of pay advances mentioned above can be used.

Finally, the BP method should be applied in other countries or regions not included in the present study where crises or disasters have occurred in order to test the robustness of the present method in the detection of structural breaks.

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⁸ The document is available here: [http://www.europarl.europa.eu/RegistreWeb/search/simple.htm?reference=P7_TA\(2013\)0003](http://www.europarl.europa.eu/RegistreWeb/search/simple.htm?reference=P7_TA(2013)0003).

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