Title: Do Terrorist Attacks leave an identifiable ‘fingerprint’ on international tourist arrival data?

Abstract

This article empirically examines the postulated effects of at least a single terrorist attack on the measure of monthly international arrivals. The study uses the *tsoutliers* R package to detect outliers in time series data following terrorist attacks in five destinations. The contribution of this paper is found in the methodological approach that was implemented consistently across all five destinations. The findings suggest that there is no evidence to support the view that there is a consistent disturbance from a well-fitted time series (a data ‘fingerprint’) created by a terrorist attack across the five different destinations or even, in at least one case, in the same destination, at different times.

Keywords: terrorism, fear, international arrivals, fingerprint, tsoutliers

Introduction,

Tourism demand, although incredibly resilient at the global level, can be highly volatile at the destination level. The flow of international arrivals is susceptible to shocks, such as terrorist attacks (Coshall 2009, Bhattarai et al., 2005, Brooks 2004, Coshall 2003, Chavez and Tynon 2000, Gartner and Dhen 1992). Over the past two decades, the nature of terrorist attacks has changed, bringing with that change significant impacts and implications (Chomsky, 2008). Quantitatively, the changes can be seen in the increasing frequency of attacks and their resulting fatalities. Qualitatively, the changes are evident in some radical differences in terms of the objectives and motivations of the perpetrators. These attacks generated significant media coverage and attracted considerable interest from both the management point of view, dealing with the aftermath, and from researchers trying to understand the impacts on different economic sectors and indicators.

Numerous econometric studies over the past two decades have examined the quantitative impacts of terrorism on economic growth. For example, Enders and Sandler presented a number of studies looking at policy intervention and patterns of international terrorism being the pinnacle of these studies in 2000. The macroeconomic consequences of international terrorism was assessed in a study by Bloomberg et al. (2003) with Eckstein and Tsiddon (2003) looking at the effects on output per capita and the effects on international trade was evaluated by Nitsch and Schumacher (2004). Chen and Siems (2003) examined global capital markets and per capita GDP was studied by Abadie and Gardeazabel (2003). Eldor and Melnick (2004) focused on the impacts on stock and foreign exchange markets. Utility losses were examined by Frey et al. (2007) and effects on income per capita by Gaibulloev and Sandler (2009) while Choise (2014) evaluated whether or not economic growth exerts a dampening effect on terrorism. These studies used a wide range of statistical methods, including but not limited to; panel statistics, time series, and event study methods using excess returns approach, subjective well-being data, cross-sectional and panel growth regression analysis, structural VAR modelling, estimation methodologies (e.g.), the Blanchard-Yaari model, placebo studies and multiple regression, cross national, time series analysis. The results generate a mixture of results, with some reporting losses, others suggesting negligible or no loss at all.

In particular, there have been a number of studies investigating the impact of terrorism on tourism activities (i.e. Sandler 2015, Minton 2011, Coshal 2009, Fletcher and Morakabati 2008, Morakabati 2007, Drakos and Kutan 2003, Pizam and Fleischer 2002, and Sandler 1991). For example, Enders and Sanders [1](1991) suggest that terrorist attacks had significant effects on tourist arrivals in Spain. Pizam and Fleischer (2002) found the impact of an attack on the number of tourists entering Israel had a time lag of between three to nine months, whereas others, such as Coshall (2003) examining air travel, argued that the effect was immediate, but lasted only three to four months. Studies examining the conflict between Israel and Palestinian suggested one – off terrorist had no effect, or at worst a short term effect (Fleischer and Buccola 2002; Mansfeld 1999; Pizam and Fleischer 2002). The frequency and severity of attacks (Pizam 1999), their location and prevention all play an important part in determining the impact of a terrorist attack. However, the results of these studies and the methodologies employed have not been sufficiently consistent to identify whether or not there is any predictable effect of a terrorist attack on the flow of visitor arrivals and this makes it challenging to generalize from these findings.

The emergence of a growing literature on destination resilience illustrates that there is a considerable interest to understand the impact and recovery cycle and how preparedness and resilience may help reduce vulnerability. This study is unique in using a consistent methodology to test the disturbance to a time series of monthly arrivals created by at least a single, religiously motivated, terrorist attack (study hypothesis) in

[1] Their study however, examined different types of terrorism in early 90s.

both developed and developing countries. The study seeks to determine whether there exists a 'fingerprint' or 'signature' pattern of terrorist effects, using *tsoutliers* R package, to detect outliers in time series data (Lopez-de-Lacalle 2014). Although this feature has been modelled, generically, to understand how systems recover, following a terrorist attack (Haimes 2015), this has not been done specifically with respect to the recovery times of international tourist arrivals. Our main research question is: Do terrorist attacks affect the flow of international tourist arrivals in destinations in the same way? Therefore, this study looks for a data 'fingerprint' of terrorist attack effects, in international arrivals data as they fall and recover.

In the following section we provide an overview as to why demand might fall following a terrorist attack, before moving on to examine how it falls, in terms of the magnitude and the time needed for recovery. Therefore, terrorism, intergroup conflict and fear are examined, to reflect on the relationship between fear and travel behaviour. The paper then sets out the methodological approach used before moving on to the analyses to determine whether on to there is an identifiable fingerprint left in the changes in tourist arrivals data and the implications of the findings for policy-makers and planners.

Terrorism, intergroup conflict and fear

Prior to the millennium, terrorist attacks were responsible for around 2.4 fatalities per attack (Barros and Proenca 2005). However, 9/11 was a game-changer, driving up fatalities from 400-500 a year, to just under of 3,000 in a matter of minutes (US Department of State 1989-2000, in Enders and Sandler 2001). The 9/11 attack inspired a series of terrorist attacks (see table 1) and in cases where westerners or those who politically share close ties to westerners have attracted significant media coverage.

Table 1: near here

Religiously motivated terrorist attacks, towards the late 90s, introduced a major shift from nationalism, separatism, Marxist, nihilism and economics motivations (Mickolus et al. 1993, Hoffman 1997, Enders and Sandler 2000) to a more general religious-based platform. This type of terrorism is not novel and has a pedigree dating back to the 11th century, sharing similarities with the actions of Assassins. Ideologically they claim they are using an old approach (pure) towards religion. In this way it means that terrorist groups can recruit individuals to fight 'the modern day crusaders from a decadent western society' (Enders and Sandler 2000). In spite of their claim it is worth mentioning that they have killed more within the same religion that they suggest they are defending, than from other religions.

In terms of impact of their attacks, Fischer et al (2010:9) distinguishes between "attributes of terrorism (e.g., motives, socio-economic background, intentions, culture), attributes of the attack (e.g., type, weapons chosen, target, cruelty) and attributes of their recipients" (e.g. socio-economic and cultural background). They argue it is these attributes that form a picture in the minds of individuals and determines how they respond to it at a collective level.

In this context the motivation of attacks is important because those attacks based on religious motivations may have less risk averse perpetrators. Some suggest that these individuals see their role as martyrs and the death of 'non-believers' is justified, thus generating greater concern for travellers (Hinnant et al. 2015, Schmitt 2015, Sayare 2011).

Religiously motivated terrorist attacks bring significant social impacts (which may affect economic impacts), because perpetrators stamp 'religion' as their legitimacy for attacking and, in so doing, generating strong elements of "social identity". This social identity is not necessarily similar to their recipient's socio–cultural background, i.e. westerners, who tend to be the main generating markets for tourism. Social identity theory (Tajfel and Turner 1979) suggests that people define themselves according to the group(s) to which they belong and where they share the same perceptions. This not only creates a sense of belonging and self-image, but also provides a perspective towards 'other groups', referred to as "out-groups". Tajfel and Turner (1979) suggest that social identity theory holds three distinctive categories; social categorisation, social identification and social comparison. Tajfel (1974, 1978) used theories of social comparison, social psychological differentiation and social identity to hypothesise that behaviour is determined in terms of groups rather than self (Carins 1982, in Tajfel 1982). Humans are born categorisers, in the sense that they keep searching for patterns in the world around them, because it enables them to generalise and predict outcomes with limited information. Therefore, individuals tend to structure their social environment in terms of groupings of people, or social categories, in order to simplify the world in which they live (Tajfel 1978). In the absence of full information, the danger is that humans will categorise people or events into the same category to fill any gap in knowledge.

In conflict theory (Sherif and Sherif, 1953, Bruner and Perlmutter 1957, LeVine and Campbell 1972), the notion of social differentiation (in-group/out-group) provides fertile ground for conflict (Brewer 1999). Brewer (1999) argues that the foundation of in-group formation and loyalty could encourage notions of moral superiority, fear and distrust of out-groups, social comparisons and power politics. This then could lead to hatred, contempt, hostility and conflicts towards the out-group(s) (Sumner 1906, Allport 1954, Bewer 1999) thereby elevating fear levels.

Indeed, religious identity is a powerful social identity, underpinned by fundamental beliefs and values (Beit-Hallahmi 2015, Ysseldyk et al. 2010). The ability of religion to serve the human identity instinct might explain why, having a shared religion during a state of conflict, is an influential aspect of group perceptions (1972, Dion and Warn 1975, Seul 1999, Storm 2013). The literature suggests “political ambivalence of religion” (Ben-Nun Bloom et.al 2015) can induce both conflict and cooperation (i.e. encouraging contingent altruism) (Norenzayan 2014, Appleby 2000, Philpot 2007), suggesting religion has a tendency to increase the probability of outgroups being seen as threatening. This can create extra fear compared with similar act if committed within the group (Branscombe et al. 1999, Haslam and Reicher 2006, Norenzayan 2014).

The relationship between acts of terrorism and the level of fear generated is complex and non-linear. Scientific prediction employs series of rules to predict outcomes (Hayek

1967). The challenge of evaluating risk perception and fear levels, particularly at the individual level, is immense. Slovic and Weber (2002) identify three components of risk; identification, quantification and characterization of threats. The terrorism of the 21st century involves “intelligent and motivated opponent[s]” (Slovic and Weber, 2002:2) who target civilians indiscriminately. This not only makes prediction more challenging, it can elevate irrational and exaggerated fear in the minds of potential travellers. Because the event is unknown, the outcome cannot be predicted (Sayer 1984, Yeung 1997, De Roo 2012). For many, this means they bridge the ‘gap of uncertainty’ based on their cognitive understanding of the situation (Morakabati and Kapuscinski 2016).

Responses to the fear of terrorist attacks may vary between different psychographic groups (Morakabati and Kapuscinski 2016) or at least vary according to the level of risk perceptions between individuals. Overall, the impact of terrorist attacks on destinations is a trade-off between the force of a terrorist attack and the destination resilience, with individual factors acting as part of a destination’s resilience. In a study of a destination’s sustainability framework, Calgaro et al. (2014: 361) outlined a series of generic factors affecting destination’s vulnerabilities such as “geographical exposure, destination specific development characteristics, social structure and governance process”. Similarly, here we suggest that the destination resilience factors (Tierney 1997, Comfort 1999, Petak 2002, Rose 2004a, Rose et al. 2004b, Rose et al 2007, Fischer et al (2010, NRC 2011 and 2013, Hallegatte 2014) can be divided into three categories; terrorist-attack attributes; destination attributes, recipient attributes and destination management (See Figure 1).

Figure 1: near here

In spite of the fact that the multitude of factors makes it impossible to translate one's theoretical knowledge into a prediction, it is possible to deduce an indicative outcome, notwithstanding departures from normal responses by the agents involved, using a degree of explanation, by going from the known to the unknown (Hayek 1967). So going from known to unknown, the destination, terrorist attack, terrorist and recipient attributes plus destination management, can all affect destination resilience. However, the key question is what does the impact and recovery path of a single effect look like. The following section explains the methodology used to measure the impact and the recover cycle in five destinations.

Methodology

This study examines the effect of at least a single [1] terrorist attack on the measure of tourist arrivals over time. The hypothesis is that a terrorist attack will disturb a well-fitted time series, by creating a negative level shift and a temporary decrease in the number of international arrivals, followed by a gradual recovery. To put this into context, studies by Sandlers and Enders (1991, 2005) suggest there is a negative effect of terrorism on tourist arrivals. Darkos and Kutan (2005) claimed that both the severity and frequency of terrorist attacks are inversely related to tourism demand. Pizam and Fleischer (2002) suggest that the frequency of terrorist attacks has a longer lasting effect than their severity. These studies imply, to some extent, a level of predictability and relate to the 1990s (when the nature of terrorist attacks was different to what they are in the 21st century). They are also based on one or two case studies (as these were all that were available at the time). These studies provide useful, but insufficient, insight

[1] For the case of Bali we looked at the effect several negative events including two terrorist attacks.

to the effects on the flow of arrivals. Later on, Morakabati (2007) observed, but did not test, five tourist destinations, which were subjected to religious-related terrorist attacks. The absence of any systematic studies using a common framework encouraged us to seek examples of destinations where at least one terrorist attack had occurred since 2000.

Cryer and Chen (2008) showed that the effects of 9/11 on air miles can be modelled using a parsimonious ARIMA and a transfer function, which took on the profile of an initial negative level shift, followed by exponential recovery. The challenge of this approach is that the researcher either needs a hypothesis about a specific transfer function, or must engage in a protracted, heuristic, fitting process. Chen and Liu (1993) argued that if the location and dynamic pattern of an event are unknown, then an intervention model of the kind proposed by Box and Tia (1975) is appropriate. However, when these are imperfectly known, then disturbances to a time series might be better thought of, less specifically, as being outliers.

Building on the latter idea, this study explores if a terrorist attack creates a time series disturbance and leaves a recognisable data 'signature[2]' (referred to in this study as a fingerprint) in the form of a pattern of outliers, coeval with the time of its occurrence. This fingerprint might be detectable by an automatic procedure, removing some of the subjectivity of the more prescriptive approaches. Such a procedure is available using the '*tsoutliers*' R package (Lopez-de-Lacalle 2014), namely the automatic outlier

[2] By signature in this study we refer to a pattern of AO, TC and LS outliers initiated at the time of the event.

detection function, *tso*. This function (*tso*) examines disturbances from the mean value of the dependent variable (monthly international arrivals) which has been fitted using an ARIMA model. This procedure allows *tso to* distinguish these disturbances as AO (additive outliers, which show isolated spikes), TC (temporary changes, which are spikes that take a few periods to disappear) and LS (level shifts, which is where there is a step function) (Lopez-de-Lacalle, 2014). *tso* fits transfer function terms, corresponding to these outlier terms and includes them as independent variables in the ARIMA model. *tso* computes t-statistics for the coefficient associated with each of these terms and uses a threshold value (the argument "*cval*"), which a disturbance must exceed, to qualify as an outlier for inclusion in the model. This study initially used the default cval = 3.5 as Lopez-de-Lacalle suggests (see Lopez-de-Lacalle 2014: 8). In these analyses, *tso* identified several outliers exceeding the set threshold.

tso time-plots show the path of a disturbance in a way that is readily mapped onto the chronology of an event, or events. We define a terrorist attack fingerprint as a group of contiguous outliers, showing the general property of a rapid decrease in arrivals, followed by a relatively slow recovery, initiated soon after the date of the attack. The analysis used the default arguments but included first order, seasonal and non-seasonal difference terms to model the linear trend. Natural logarithms of monthly arrivals were taken in all examples to stabilize variance. A set of monthly international arrivals (IA) data were selected for analysis if they met all of the following criteria:

- At least one religious-motivated type of terrorist attacks since 2000
- Samples were tourist destinations

- Westerners and those politically similar, in particular media is significantly more reactive when westerns are targets, for many reasons such as because they are westerners, and importance of religious identity, the west is home to some of the media giants and overall because these are major tourism market.
- Availability of sufficient observations before, and after the event, to help establish a model, before the event and to examine recovery.

USA, Bali, Spain, UK and India met these criteria. Each analysis applied *tso* to the full time series available. The results of these analyses are in the following section.

Empirical Results

The results are shown using a model that demonstrates the effect, on a destination-by-destination basis, producing a plot and table of estimates to show the possible outliers, their types and location, to examine the 'fingerprint' of a terrorist attack on arrival numbers.

Figure 2 is based on USA data, the *tso* function plots monthly USA data over the period (Y= International Tourism Arrivals In (IA) from 1999[2]-2014. The top half of Figure 2 shows the original time series in grey; the blue curve shows what the model would have looked like when the effects of the detected outliers are removed (the fitted model) and the location of the detected outliers (red points). The lower half of the plot (figure 2) shows the AO, TC and LS which can be seen as the data fingerprint of the terrorist

[2] This means observation one will be January 1999 and observation 69 will be September 2001

attack on IA. AO is observed as an instantaneous down and up: decrease and recovery in a brief period of time (one unit of time – a month in this study). TC is shown as an instantaneous decrease, with exponential recovery characterised by the half-life (slowly decaying recovery with the property of an exponential function). Finally, LS is shown as a negative level, or step, change that lasts more than a month. Arrivals carry on at the new level until something else happens. This study identifies sequential combinations of these outliers, if their onset coincides with a terrorist attack (TA), as a pattern, or fingerprint of changes.

Figure 2: near here

Table 2, reports the ARIMA (0, 1, 2) (0, 1, 1) that best fits the series. The results suggest that the 9/11 effect is significant and produces a data 'fingerprint' effect with four negative TC and LS (see figure 2) being observed. A strong LS is detected at observation 69(2001:9).

Table 2: near here

In terms of International Arrivals (IA) the September 9/11 data (2.61 m, see table 2) show a drop of 32%, from the figure recorded the previous September (2000, 3.58 million) and the three months' average (months 9, 10, 11) shows a further drop of 35%. This is followed by a TC in the following month's at observation 70 (2001:10) and a second TC at 87 (2003:3), indicating the possible effect of the Iraq War led by the USA and the UK. The second LS, at 109 (2005:1), suggests substantive effects, where it starts regaining the losses as it moves towards January 2005. September 2005, four years after the attack, the data shows a healthy recovery (see figure 1 and table 2) where the number of IA exceeds the pre-event level. Figure 3 shows the *tso* function plot for Bali monthly IA data for the period from 1999-2014.

Figure 3: near here

ARIMA (1, 1, 1) (2, 1, 1) has been specified to fit the series. The results suggest that the effect of the Bali terrorist attack (12.10.2002) is significant and the fingerprint effect of the terrorist attack shows several LS and TC and AO (see figure 3 and table 3).

Table 3: near here

A strong TC was detected at 2002:10 (see Table 3), showing a drop of 15% over the same month the previous year. The three-month average comparison of post event 2002, suggests a decrease of 31% over the same months the previous year (in 2001). This was followed by five negative AOs during the next year. Observation 52 (2003:04) indicates a second TC related to the impact of SARS on Indonesia and the whole region, from this point the pattern of outliers suggests a positive decay effect with signs of recovery towards the end of 2003, indicating a recovery time of approximately 15 months from both the Bali bombing and SARS.   A third negative TC at observation 62 disrupted this trend (2004:02) which could reflect the attack in mainland Indonesia in December 2003. From this point on, no further outliers were found until the second attack in Bali in October 2005, suggesting that the Tsunami did not have any measureable effect on Bali. The second terrorist attack was followed by a strong negative LS at observation 82 in (2005:10). This was followed by two positive LS at respectively, 6 and 13 month periods, these figures suggest substantive effects where losses are regained between the mid and end of 2006. It is notable that the types of outliers differ from case to case, even within same the same destination, while first Bali bombing created AO and TC types of outliers, the second one created a level shift (LS). These results also show the cumulative effects of negative events on a destination.

For Bali, there are additional (subsequent) events across Indonesia that may have diluted the effect of the first and the largest terrorist attack in Bali in October 2002. The Indonesian government uses isolated marketing to sell Bali, distancing it from the rest of Indonesia and the region (similar to the way that the Red Sea has been marketed by Egypt), which has been subjected to two other major events, SARS in 2003 and the Tsunami in December 2004 (there were also 5 smaller terrorist attacks across Indonesia). Neither of the two major events directly affected Bali, but tourists tend to paint their geography with broad brushes and so some effect may occur. There was also a second terrorist attack in October 2005 in Bali and it would be naïve to claim the effects were isolated.

Figure 4 shows the *tso* function produces a plot for monthly IA data for India, for the period 2005-2013 with observation 36 presenting the IA in December 2008. The same ARIMA (1,1,1)(2,1,1) for Bali was found to fit the series. The results suggest that the effect of the Mumbai terrorist attack (26-29.10.2008) is significant, but short-lived, TC shows the data fingerprint effect of the attack.

Figure 4: near here

Table 4: near here

A moderate decaying function (TC) was detected at observation 36 (2008:12), with no other outliers following. This suggests IA starts to regain the losses in May 2008, less than 6 months after the attack, with an approximate loss of 265,273 tourists.

In examining the impact of terrorist attacks in Madrid (March 2004) and London (July 2005), no outliers were detected using this approach (see figure 5 and 6)

Figure 5: near here

Figure 6 : near here

To explore the data more closely in search of an effect, the default critical value (cval) was reduced from 3.5 to 2.9 but this did not uncover any evidence of disturbance from the mean value of the dependent variable (IA). This means there were no *t* statistics found that were above the lower threshold, in other words, there was no evidence of an effect.

Discussion

The literature suggests that the risk of a terrorist attack creates fear and the evidence suggests that fear is more profound when the perpetrators are from an out-group and that religion is a strong demarcation factor (Hinnant et al. 2015, Sayare 2011, Schmitt 2015). The findings of this study display that there are some predictable effects relating to a terrorist attack, but the effects of the attacks are unpredictable because they produce different data fingerprints in terms of the disturbance and recovery of international arrivals i.e. different types of outliers and different recovery periods.

The results show that an event as large as the attack in the USA required a long term recovery period, arrivals regaining their losses in around January 2005, a period of almost 4 years. The unprecedented scale and design of the attack, the shock factor, and subsequent ‘war on terror’ could all be responsible for this long-term recovery period.

The event of 9/11 and the resulting USA ‘war on terror’, which Bush also referred to initially as a ‘crusade’ only to later apologise for using that term (Bush 17.09.01) created a binary world of ‘them and us’. The terrorist attacks of the 21st century, combined with this binary stance taken by the USA and many European countries, including the UK, have led to a form of classical conditioning where there is a unifying front for the 'in-group' and a growing concern about the people seen as belonging to the 'out-group'. Arguably, the American response following the 9/11 attacks elevated the level of fear across the world, reducing tourism demand in some areas, and shifting demand to other destinations, creating some regionalisation in travel patterns (Scott and Jafari 2010).

While the overall turbulent period for Bali also took around 4 years, this was more likely the result of a succession of negative events, between 2002 and 2005. The 2002 attack in Bali directly targeted international tourists, the hospitality sector and the heart of tourism in Indonesia, where tourism acts like an engine for the economy of this developing island (Fletcher et al. 2013). Tourists are soft targets and attacks on them create greater reactions and publicity and hence greater perceptions of risk. Looking at destination attributes, although Bali is predominately governed by a non-Muslim majority, Indonesia as a whole is home to the largest Muslim population, globally. The distance between host and guest culture, particularly in the context of religious identity (Tajfel and Turner, 1979) can result in the perception of a struggle between ‘them’ and ‘us’ as reflected in the Travelzoo survey data (2015, see Paris 2015). Tourists to Bali arrive from culturally different backgrounds to the island's population and so the lack of familiarity and large socio-cultural differences may contribute to greater levels of the 'unknown' and lower “contingent altruism” and hinder destination resilience (Brewer 1999, Appleby 2000; Philpot 2007, Norenzayan 2014). This suggests that there is unlikely to be the rallying effect that was evident following the attacks in New York, London and Madrid. In addition, the Foreign and Commonwealth Office advice on not travelling to the island amplified the effects on the number of tourist arrivals even further. If this on its own was not enough to damage arrivals and recovery time, for Bali there was a composite sequence of both man-made and natural events that hindered recovery. The initial terrorist attack in Bali generated only a TC, however, the follow-on events with further terrorist attacks in 2005, created a significant level shift where it took a year for the recovery to occur in 2006.

The effect of the Mumbai terrorist attack in India was significant with temporary changes over a period of less than six months. In this case, although the perpetrators claimed to be Islamist, the media suggested this was a dispute between India and Pakistan (Ramesh et al. 2008). The fact that tourists were caught up in the event has been explained as people being in the wrong place at the wrong time, as opposed to tourists being the specific targets.

For the UK and Spain data, no outliers were found and therefore no significant effects. The attack in Spain targeted the capital city and its transportation system. Madrid receives business as well as leisure tourists and is the sixth most popular destination for international tourist arrivals in the country. As a major urban area, it receives a diverse portfolio of visitors, bringing greater resilience, and projects a greater image of safety and control, encouraging confidence and recovery. The ongoing terrorist threats, over many years, from the ETA campaigns, also means that Spain is more prepared and responsive to such events. Europeans account for 90% of the international arrivals to Madrid, from a range of source markets, the number of arrivals recovered quickly, and a rallying effect was evident such as that following the more recent attacks in Paris.

The case for the UK was similar to Madrid (European capital and transport system attacked) and no data fingerprint effect was detected. The major difference between the attacks in Madrid and London, from the point of view of the tourism industry, is that London is a major gateway for tourists coming into the UK, whereas Madrid receives only around 7% of the total tourist arrivals to Spain. There were also suggestions that, after the bombing in the UK, many people's attitudes hardened and became more resilient, since such attacks have become familiar and the bombings do not change the risk of travel (e.g. Rand Morimoto 2005, Frangialli 2005). The challenges of understanding how people perceive risk and fear, the complexity attached to a destination as an open system (Leiper 1995) makes it inherently challenging to predict the impact of a terrorist attack to a destination. Additionally, Kennedy 2005 and Esobles 2005 argued that the British emergency forces responded effectively to the attack (Kennedy 2005, Esobles 2005). The result in London was that within less than a month, the arrival figures were back to higher levels than the corresponding month the previous year.

The analysis suggests that terrorist attacks seem to have a larger effect in developing countries than in large European capitals. Industrialized economies often have more developed communication and security legislation in place, greater stability, and are better able to mitigate the damage and restore confidence because of that control (Pizam 1999, Darkus and Kutan 2001, Coombs 2004, Frey et al. 2004, Bruck and Wickstrom 2004, Morakabati 2007, Baker 2011, Philo 2012). This is partly because of their preparedness and history of planning for terrorist attacks and the diverse range of visitor markets. In terms of the impact and implication of such attacks, there is a greater economic implication for places like Bali where the contribution of tourism to GDP and dependence upon it is far greater than in industrialized and urban economies where there is greater level of control and a more diversified economy. Industrialized economies tend to be more robust, the economy is not dominated by tourism or a few sectors such as agriculture or oil and gas extraction, suggesting that terrorist attacks will have a much greater economic and long run effect where these industries dominate. There are other implications when terrorist attacks impact upon the availability of local jobs and where there are high levels of unemployment. Poverty and unemployment enhance the recruitment campaigns of terrorist groups (Lowen 2014, Muir 2016). Therefore, overdependence on tourism potentially creates vulnerability and so economic diversification needs to be viewed as part of place resilience strategies. Yet, diversification requires large sums of capital, which is often scarce in the developing world (Morakabati and Fletcher 2014).

Conclusion and implications

Fear is the bitter taste of risk and the seed of uncertainty, the fruit of which is harm avoidance, which brings with it economic consequences. The purpose of this study was to use a consistent methodology to examine the single effects of terrorist attacks on the measure of international tourism arrivals across five destinations. This discussion re-visited existing assumptions and assertions about the effects of terrorism on tourism, as suggested by some studies (e.g. Darkos and Kutan 2003, Fleischer and Buccola 2002, Mansfeld 1999, Pizam and Fleischer 2002). This study used the measure of international monthly arrivals across the five case studies (using *tsoutlier* R for detection of outliers in time series) to search for evidence that there is a consistent fingerprint in different destinations.

The findings show a mixture of results, supporting previous studies in some cases, but not all. The findings from this pilot study contribute to the literature and enhance our understanding of the impacts of a terrorist attack. The principal theoretical implication of this study is that no two-terrorism attacks leave the same data fingerprint. The study could find no evidence of a data fingerprint that was consistent across different destinations or even, in at least one case, in the same destination over time. A key strength of this study is found in the novel application of classical time series with a contemporary twist (Lopez-de-Lacalle 2014) and the introduction of the notion of a “*data fingerprint*“ in terms of the pattern of the data effects of terrorism on international arrivals in a set of case studies.

The arguments presented from a theoretical perspective, reveal the complexity associated with predicting and identifying effects (see figure 1), suggesting that the magnitude and recovery profile of effects varies depending on an array of variables with varying power, as explained in destination resilience. Overall, the findings show that European capitals tend to be more resilient than destinations in non-industrialised countries where the latter have a higher likelihood of experiencing significant effects.

Additionally from a theoretical point of view, the study suggests that the impact of a terrorist attack on the risk perception of a population could be greater, when the religious platform used to motivate the attack is the primary religion of the place, and is at odds with the religion of the majority of tourists. In 2015 Travelzoo found that 75% of British holidaymakers said they would avoid traveling to Muslim countries following the attack in Tunisia (based on a survey of 2,000 households). The combination of religious identity (Beit-Hallahmi 2015, Ysseldyk et al. 2010) with realistic conflict theory (Sherif and Sherif, 1953, Bruner and Perlmutter 1957, LeVine and Campbell) and suggestions by (Sumner 1906, Allport 1954 and Brewer 1999) can explain such a response. Contrary to the micro effects of terrorism and making the effect more place dependent , the macro effect of international terrorist 'brands', such as ISIS, have increased their media profile and associated uncertainty levels (Global Terrorism Index 2015) making fear less place dependent.

There are a number of implications for the industry. In particular this study suggests that when predicting the outcome of attacks on tourist arrivals and the recovery period, it is important to determine the power of each variable (figure 1) and their interdependence as well as their functional relationships (Calgaro, Lloyd and Dominey-Howes 2014, Bec and Dredge 2014). Familiarity plays an important role, especially in European destinations because they generate most of their own tourist arrivals as opposed to developing countries. Therefore, particularly in developing countries, efficient and effective, post-crisis communication and responses to restore confidence are important, but it also depends on a country's crisis history (Coombe 2004) and their political relationships with the generating countries, which may help avoid, don't travel warnings. Demonstrating an infrastructure of safety and control from evacuation, to identification, reparation (of casualties and fatalities) and demonstrating the ability to bring order back to the country can help build confidence and hence resilience (Morakabati, et al. 2016).

There are limitations to this study from both the theoretical points of view and data measurement. A major problem with the in-group out-group approach is that the categorisation tends to be executed on the basis of observation, whereas in reality, such induction cannot be defended (Popper 1957). Popper (1957) argued that observation is selective and that one can rarely confirm anything, describing induction as more of a myth than a scientific approach. From the data analysis point of view, the countries and periods used in this analysis were determined by data availability and the fact that tourist arrival data were aggregate, instead of looking at nationality specific arrivals that could bring better light to understanding the effects on each generating market. However, the initial data from Tunisia and Egypt following the terrorist attack suggest the hallmark of fear responses taking its toll as people chose to keep away rather than fly to these destinations.

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List of tables

Table 1: Some of the major terrorist attacks targeting westerner civilians, 2000-2016

Attacks	Types of attack	Date	Fatalities
New York and Washington	Public transport	09.11.1	2996
Bali (Indonesia)	Suicide and car Bomb	12.10.02	202
Kenya*	All-train vehicle	28.11.02	13
Madrid	Public transport	11.04.04	191
London	Suicide attack-Public transport	07.07.05	52
Bali	Suicide Bomb	01.10.05	20
Sharm el-Sheikh, Egypt**	Truck bomb explosion	23.07.05	88
Mumbai	Shooting and bombing attack	26.11.08 to 29.22.08	164
Paris	Super market and Charlie hebdo , shooting	07.01.15	15
Paris	Shooting and suicide attacks	13.11.15	89
Brussels	Suicide attacks	22.03.16	32
Total			3862

* The majority of fatalities were Israelis

**The majority of fatalities were Egyptians

Table 2: USA, table of estimate and list of outliers

USA y = (IA) model specification: **ARIMA(0,1,2)(0,1,1)$_{(12)}$**	**Parameter**	**Ind**[3]	**Estimate**	**Standard error**	**Monthly IA ($x10^6$)**	**Three-monthly mean IA**[4] **($x10^6$)**	**Event date**
Standard Terms	ma1		-0.6427	0.0740			
	ma2		0.1539	0.0814			
	sma1		-0.6587	0.0552			
Outlier Terms	Additive Outlier (AO)	48	-0.1436	0.0352	NA[5]		1999:12
	Level Shift (LS)	69	-0.3203	0.0392	2.61	2.31	2001:09
	Temporary Change (TC)	70	-0.1672	0.0398	2.24	2.28	2001:10
	Additive Outlier (AO)	75	0.1253	0.0355	NA		2002:03
	Temporary Change (TC)	87	-0.1513	0.0351	2.60	2.63	2003:03
	Level Shift(LS)	109	0.2675	0.0330	3.45	3.68	2005:01
Pre-event					3.87	3.58	2000:09
Disappearance of effect					4.15	3.93	2005:09

[3] Ind= observation number
[4] Starting at the outlier event date
[5] Not interpreted as part of the event profile

Table 3: Bali, table of estimate and list of outliers

Bali Y = (IA) model specification: ARIMA(1,1,1)(2,1,1)$_{(12)}$	Parameter	ind	Estimate	Standard error	Monthly IA (x104)	Three-monthly mean IA (x10^4)	Outlier date
	Ar 1		0.3918	-0.4117			
Standard Terms	ma1		-0.8428	-0.3282			
	sar1		-0.7644	0.1579			
	sar2		-0.3135	0.1309			
	sma1		-0.2791	0.1575			
Outlier Terms	Temporary Change	46	-0.5402	0.0669	8.11	5.87	2002:10
	Additive Outlier	47	-0.9014	0.0616	3.14	5.19	2002:11
	Additive Outlier	48	-0.3191	0.0677	6.33	6.39	2002:12
	Additive Outlier	49	-0.4117	0.1215	6.08	6.69	2003:01
	Additive Outlier	50	-0.3282	0.0745	6.74	6.45	2003:02
	Additive Outlier	51	-0.4065	0.0714	7.22	5.78	2003:03
	Temporary Change	52	-0.7339	0.0721	5.38	6.09	2003:04
	Additive	53	-0.2585	0.0531	4.79	8.03	2003:05
	Temporary Change	62	-0.2324	0.0602	8.43	9.84	2004:02
	Level Shift	82	-0.5636	0.0518	8.11	7.32	2005:10
	Level Shift	88	0.2047	0.0513	10.34	10.51	2006:04
	Level Shift	95	0.2399	0.0489	11.39	11.53	2006:11
Pre-event					9.65	8.63	2001:10[6]
Disappearance of effect					11.39	11.53	2006:11

[6] It is notable that this is right after 9/11 attack in the USA and travel disruption across the world, this figures seems to be down when compared to the same period in 2000.

Table 4: India, table of estimate and list of outliers

India Y = (IA) model specification: ARIMA(1,1,1)(2,1,1)$_{(12)}$	Parameter	ind	Estimate	Standard error	Monthly IA (x10^5)	Three-monthly mean IA (x10^5)	Outlier Date
Standard Terms	ma1		-0.3412	0.1361			
	ma2		-0.3846	0.1449			
	sma1		-0.5295	0.1582			
Outlier Terms	Additive Outlier	26	0.1664	0.0346	NA		2008:12
	Temporary Change	36	-0.1537	0.0398	5.34	5.02	2008:12
Pre-event					5.97	5.73	2007:12
Disappearance of effect					3.05	3.63	2009:05