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Gabriel M. **Ahlfeldt**
Department of Geography and Environment & SERC
Houghton Street | London WC2A 2AE
g.ahlfeldt@lse.ac.uk | http://personal.lse.ac.uk/ahlfeldg
phone +44 (0)20 78523785
fax +44 (0)20 7955 7412

Bastian **Franke**
University of Hamburg | Department of Economics | Chair for Economic Policy
Von-Melle-Park 5 | 20146 Hamburg | Germany
BastianFranke@gmx.de
phone +49 (0)40 480970

Wolfgang **Maennig***
University of Hamburg | Department of Economics | Chair for Economic Policy
Von-Melle-Park 5 | 20146 Hamburg | Germany
w.maennig@econ.uni-hamburg.de
phone +49 (0)40 42838-4622
fax +49 (0)40 42838-6251

* Corresponding author

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INTRODUCTION

Tourism is among the world's biggest industry (Eilat & Einav, 2004). The annual growth rates of the number of international tourists averaged about 4.6% between 1975 and 2000, which roughly corresponds to 1.3 times the growth in global gross domestic product (World Tourism Organization, 2007, 2008, undated).

At the same time the tourism industry is susceptible to shocks, such as terror attacks or the incidence of infectious disease (Edmonds & Mak, 2006), which shape the risk perception of the destination countries. Against the background of the attacks on 11 September (9/11), where some 3,000 people died (Enders and Sandler, 2006), opening up a new dimension in terrorism, as well as a series of other terror attacks between 2001 and 2003, studies of the effects on the tourism industry are, indeed, warranted.[1]

Even before the 9/11 attacks there had been studies on the effects of exogenous shocks on touristic demand. For example, Brady & Widdows (1988) extrapolated the number of flight passengers from the US to Europe in the summer of 1986 on the basis of a time series from 1973 to 1985. By comparing actual numbers, they deduced

[1] Attacks with more than 40 dead attributable to terrorists since 11 September 2001 include 12 Oct 2002, Indonesia-Bali, 202 dead (bomb attacks on two nightclubs); 24 Oct 2002, Russia-Moscow, 129 dead (hostage-taking terminated in the Dubrovka theater); 16 May 2003, Morocco-Casablanca, 45 dead (five simultaneous attacks on Western and Jewish facilities); 16 Nov and 20 Nov 2003, Turkey-Istanbul, 45 dead (bomb attacks on synagogs and in the inner city); 6 Feb 2004, Russia-Moscow, 40 dead (suicide assassin in an underground train); 2 March 2004, Iraq-Baghdad, Kerbela, 271 dead (attacks during Shiite Ashura commemoration); 11 March 2004, Spain-Madrid, 191 dead (attacks on 4 commuter trains); 24 Aug 2004, Russia, 90 dead (two plane crashes); 1 Sep 2004, North-Ossetia-Beslan, 330 dead, among them 196 children (fatal end of a hostage-taking in a school); 7 July 2005, Great Britain-London, at least 56 dead (bomb attacks on an underground train and a bus); 23 July 2005, Egypt-Sharm el-Sheikh, up to 88 dead (bomb attacks on a bazaar, the Ghazala Gardens Hotel and a café) (Nonnenmacher 2001).

a sharp tumble of up to 70% (for Greece) due to terror attacks and the reactor meltdown in Chernobyl. To estimate the effects of terrorism on tourism, intervention models have been used predominantly since the 1990s, which are based on Auto-Regressive-Moving-Average (ARMA) methods. Alternatively, for example, classical regression models (Witt & Witt, 1995), exponential smoothing (Saunders, Sharp & Witt, 1987) or meta-analyses (Crouch, 1992) are used. Enders, Sandler & Parise (1992) present a theoretical model where consumers engage in a two-stage budgeting decision. Optimising their choice on trips to country (group) 1, country (group) 2, and all other goods, terrorist activities in a country (group) will increase perceived risk of consumers associated with trips to these countries. Also empirically, they identified substitution effects in the tourism behaviour of tourists with shifts away from countries suffering from terror attacks.

Similar effects were isolated later on by Vester (2001), who was also the first to demonstrate regional spillover effects. Pizam & Fleischer (2002) stress that significant effects of terrorism on tourism usually occur with a bit of a time delay within three to nine months following an attack and vary in length of time. This is contrasted by the conclusion drawn by Coshall (2003), who found that the effect on the number of flight passengers from the US to Europe is immediate, following an attack, and lasts only three to four months. From the mid-1990s there have also been more studies into the effects in other geographic regions, besides those regarding the tourist demand in Europe and the US, with most of the studies dealing with the conflict between Israel and Palestinians (Fleischer & Buccola, 2002; Mansfeld, 1999; Pizam & Fleischer, 2002). Pizam & Fleischer (2002) found that certain countries recover relatively quickly from terror attacks if they are not followed by additional attacks. Repeated terror attacks, however, can result in a lasting decline in tourist

demand or wipe it out entirely. The relevance of attack intensity for effects on demand has been confirmed by Drakos & Kutan (2003). Apart from studies of an economic and econometric nature, there are also ones that examine terror attacks on the basis of literature research and interviews (Pizam, 1999).

Bonham, Edmonds & Mak (2006) and Edmonds & Mak (2006) demonstrate that, following the 9/11 attacks, the total worldwide international tourist arrivals decreased in the same year, 2001, only by less than one percent compared to 2000. In 2002 they had already moved up again above 2000 levels. At the same time, though, some countries, such as the US, experience some extreme effects on tourist demand (Ready and Dobie 2003, Lee, Oh and O´Leary 2005, Rupp, Holmes and DeSimone 2005).

Bonham, Edmonds and Mak (2006) have found that, on the basis of growth trends before and after 9/11, a recovery effect is not to be expected in the near future. Edmonds & Mak (2006) arrive at heterogeneous post-9/11 effects also for the Asian-Pacific region. While certain countries can recover quickly — also due to simplified entry requirements (for example Singapore) — others suffer a sustained decline in tourist numbers (for example Malaysia) as a result of follow-up attacks, the infectious disease SARS and the uncertain geopolitical situation. Similarly, countries like Morocco and Tunisia took longer to recover from the 9/11 attack than other Islamic countries, because these two countries suffered additional attacks in 2002 and 2003, respectively. What is more, their tourism industries are geared to Western, especially European markets, which is why they were particularly hit by the substitution effect of European tourists choosing to stay away from Islamic destination countries, while there was no compensation from an increase in tourists from other Islamic countries (Al Hamarneh, 2004). Anecdotic evidence indicates that Islamic countries are

especially impacted by substitution effects that are caused by changes in risk perception (Leibritz, 2004).

The number of studies examining the effects of terror attacks on tourist demand on the basis of panel data is relatively small. The paper by Garin-Munoz & Amaral (2000) was published before the 9/11 attacks and examines the determinants of tourist demand in Spain, identifying a negative effect stemming from the Gulf War. Sequira & Nunes (2008) and Eilat & Einav (2004) have determined that a higher security risk produces significantly lower numbers of tourists.

The present work supplements previous publications in a number of respects. First, it studies a range of exogenous shocks on tourism that are of distinct magnitude. Besides regional effects of 9/11, it also looks at relatively minor terror attacks before and after the 9/11 attacks. It is also the first study which explicitly tests substitution and adaptation effects in the wake of terror attacks with regard to geographic as well as religious proximity while also taking into account substitution from long-distance to short-distance trips and distinguishing between long term and short term effects. In addition, it is the first multivariate work to study shock-based changes in the tourism demand of a regionally limited group (German tourists, who are among the largest tourist groups in the world). We study how those changes affect all the countries for which sufficient data were available — instead of examining for a selected number of target regions the changes brought on by the tourism behaviour of tourists originating in various possible source regions. This is interesting, because this approach allows for an explicit study of the substitution behaviour of consumers. It is also the first work which uses the Difference-in-Difference-Approach (DiD) in order to separate the effects of terrorism on tourism demand from unobserved macroeconomic shocks.

It has been shown that a decline in tourist numbers occurs not only as a consequence of terror attacks, particularly those of 9/11, in the countries affected as well as neighbouring countries, but also has global effects in countries with a predominantly Islamic population. A heightened risk expectation is, thus, transferred not only through geographic but also ethnic and religious proximity. Throughout the paper, our analysis concentrates on isolating relative effects on tourist demand from which adjustments in risk perception can be inferred while absolute changes in tourist demand and the respective determinants are not within the narrow focus of this study. Section 2 elaborates on data and methods, section 3 presents results, and section 4 concludes.

DATA AND EMPIRICAL STRATEGY

The empirical study is based on annual data on arrivals of German tourists in selected target countries between 1993 and 2005, which have been obtained from the German Federal Statistical Office (Statistisches Bundesamt Deutschland 2007).[2] German Tourists in our data base are defined as persons who live permanently in Germany (irrespective of their nationality) and leave Germany for no longer as 12 months, but stay at least one night abroad. It includes individuals travelling for business reasons as well as to visit relatives etc.

In total, the data cover 192 countries. By using growth rates, it was possible to account for the heterogeneity of the countries represented in the sample, while largely

[2] No further information on age brackets or other demographic variables are reported by German Federal Statistical Office (2007). For data limitations such as limited comparability across countries due to heterogeneous definitions of "tourist (arrivals)", diverse methods, sampling and procedures of data collection use the links at www.destatis.de > Publikationen > Qualitätsberichte > Binnenhandel, Gastgewerbe, Tourismus > Tourismus > Monatserhebung.

ruling out distortions due to different collection methods in determining the number of tourists. However, some countries, for example Turkey or Zimbabwe, changed the method of calculating tourist numbers in the period under review, which is why they have been excluded. 45 countries that were visited by fewer than 1,000 German tourists in at least one year were excluded from the study due to high volatility in the tourism volume and limited informative value regarding overall trends. The data for one or several years are missing for 72 countries. Because one missing raw level data point in general implies two missing growth rate observations they were excluded from the panel study as well. After filtering countries in this manner, a total of 82 countries remained for the purposes of the study.

Table 1 displays descriptive statistics. Average statistics do not highlight that Islamic countries have been hit more severely by any post 9/11 tourism crisis. By contrast, median values demonstrate that the growth of incoming tourism for Islamic countries had been higher than in non-Islamic countries before 9/11. After 9/11, this relationship had been reversed. Median growth rates had been especially negative for Islamic countries in 2002 and 2003.

Please insert Table 1 about here.

In the context of the study, the differentiation between Islamic and non-Islamic countries in regard to the effects of terror attacks on tourism volume depends on whether a country is perceived as an Islamic country by (German) tourists or not. The percentage of the Muslim population (The World Factbook of the CIA, 2008) is an obvious measure, while the definition of a threshold value is not that apparent from the start. In order to ensure the robustness of results, all estimates have been done

using two treatment groups defined as the percentage of the Muslim population at 50% and 85%, respectively. While results are qualitatively comparable for both specifications throughout our analysis, we present results corresponding to the latter specification since the respective definition ensures a perception as an "Islamic" country. Figure 1 shows the countries included in our analysis by proportion of Islamic population as well as the terrorist attacks considered in this analysis.

Please insert Figure 1 about here.

We use the DiD method, which essentially examines whether the development in certain countries (treatment group) before and after the event studied (treatment) is different from the control group, which represents a general macro-economic development. Demand in tourism is relatively strongly determined by economic cycles, seasons and trends, as well as susceptible to macroeconomic shocks, such as a rise in oil prices, which increases the cost of flying. The counterfactual provided by the control group should account for these macroeconomic conditions. Via the control group, a general effect of the 9/11 attacks on the propensity to travel will be absorbed. Previous research has shown, however, that the general effect on tourist arrivals was marginal, at least on a world-wide scale (Bonham, Edmonds & Mak, 2006, Edmonds & Mak, 2006). More critically, we expect that a regionally differentiated impact of a globally relevant terrorist attack will harm specific countries in particular, but benefit others via substitution effects. We refer to treatment and control groups to allow for an ease of comparability with a growing body of quasi-experimental literature, but we do not claim that the control group necessarily remained completely unaffected by the shock. In fact, our results are indicative of substitution effects away from the

countries in the group of treated (towards at least some of those in the comparison group). We argue that the substitution effect does not prevent us from achieving the main purpose of the analysis: uncovering the channels through which the risk perception of countries is altered following terrorism attacks. But the results should and will be interpreted as exactly what they are: conditional differences in growth rates in tourism into groups of selected destination countries relative the other countries in the sample.

The DiD specification employed here, differentiates annual growth in the tourism volume ($\frac{\Delta Tou_{it}}{Tou_{it-1}}$) between groups of countries (treat/control) and periods (before/after):

$$\frac{\Delta Tou_{it}}{Tou_{it-1}} = \beta(treat_i \times post_t) + d_t + \varphi_i + \varepsilon_{it} \quad (1)$$

Tou_{it} is the annual number of German tourist in country i in year t, $treat_i$ is a dummy variable denoting the treatment group consisting either of Islamic countries or countries of determined treatment regions. $post_t$ denotes the period after the event considered. Similar to and Redding & Sturm (2005), and Di Tella and Schargrodsky (2004) this approach controls for macro-economic shocks and general trends by means of a full set of yearly fixed effects (d_t) as well as country-specific fixed effects (φ_i). Since unobserved effects d_t can be taken into account for any point in time in this way, a parametric specification of the general market development is unnecessary. Long-term trends, short-term shocks and cyclical developments can be captured in a flexible manner. The country fixed effects φ_i capture cross-country heterogeneity in pre-intervention growth trends while ε_{it} is an error term satisfying the

usual OLS conditions (Hayashi 2000, ch. 1). Note that compared to standard DiD approaches a non-interacted *treat* term is missing due to perfect collinearity with country effects. The estimated coefficient $\hat{\beta}$ gives the average change in growth rates across the countries in the treated group relative to the average change in growth grates across countries in the control group.

$$\hat{\beta} = \left(\overline{\left(\frac{\Delta Tou_{it}}{Tou_{it-1}}\right)}^{treat}_{after} - \overline{\left(\frac{\Delta Tou_{it}}{Tou_{it-1}}\right)}^{treat}_{before}\right) - \left(\overline{\left(\frac{\Delta Tou_{it}}{Tou_{it-1}}\right)}^{control}_{after} - \overline{\left(\frac{\Delta Tou_{it}}{Tou_{it-1}}\right)}^{control}_{before}\right) \quad (2)$$

Note that by using growth rates as a dependent variable differences in pre-trends in tourism flows that would violate the classic DiD assumption are differentiated out. Prominent DiD analyses employing alternative specifications include Hotchkiss, Moore and Zobay (2003), Galster, Tatian and Pettit (2004) and Eissa and Liebman (1996).

In order to distinguish between short-term and long-term effects, we, similar to Ahlfeldt & Maennig (2009), extend specification (2) by an interactive term of the treatment identifier and a vector of yearly dummy variables denoting the first years after the considered terrorist attack ($SHORT_t$).

$$\frac{\Delta Tou_{it}}{Tou_{it-1}} = \beta(treat_i \times post_t) + (treat_i \times SHORT_t)b + d_t + \varphi_i + \varepsilon_{it} \quad , \quad (3)$$

where *b* is a parameter giving the difference in the treatment effect between the period immediately following the attack, and the long-term effect β. In a similar manner we employ an extended specification in order to account for a potential substitution effect from long-distance to short-distance journeys over the course of our study period, possibly owed to changes in preferences, for example due to climate change.

$$\frac{\Delta Tou_{it}}{Tou_{it-1}} = \beta(treat_i \times post_t) + (treat_i \times SHORT_t)b + (dist_i \times d_t)c + d_t + \varphi_i + \varepsilon_{it} \quad (4)$$

where $dist_i$ is the great circle distance between the geographic centroids of Germany and country *i* and *c* is a parameter to be estimated that gives the marginal effect on the expected growth rates for a 1.000 km increase in distance.

A common phenomenon in DiD approaches is serial correlation in the error terms, which causes inefficiency of estimated intervention effects. Since the LM test for serial correlation in a fixed effects model (Baltagi, 2001) clearly rejects the hypothesis of no serial correlation, we use an arbitrary variance-covariance matrix as recommended by Bertrand, Duflo & Mullainathan (2004).[3]

RESULTS

As a first step, the effects of the 9/11 attacks on the tourist demand of German tourists in African, American, Asian, Australian, European and Middle-East countries is examined on the basis of model specification (3). The delimitation of treatment groups is based on the official classification of the Federal Statistical Office (Statistisches Bundesamt, 2007). Since the 9/11 attacks occurred towards the end of 2001 and the literature points to a delay in the effects of between three and nine months after terror attacks (Bertrand, Duflo, and Mullainathan 2004; Enders & Sandler, 1991; Enders, Sandler, and Parise 1992; Tremblay, 1989), this study, based

[3] One of the anonymous referees clarifies that we estimate with the method of least squares using standard errors and t-values which are corrected for heteroskedasticity. He stresses that our results are valid asymptotically.

on annual data, defines the period following the attacks as the period from 2002. Results remain qualitatively unchanged if the post-period starts in 2001.

Please insert Table 2 about here.

For African and American countries as well as Australia (table 2, columns 1 to 3), no statistically significant deviations have been identified from general tourism trends following 9/11.[4] The results for countries in the Middle East (column 5), however, point to a considerable and significant decline during the two years after the 9/11 attacks, followed by recovery. Accordingly, the annual growth rates of the German tourist volume in the Middle East in 2002 and 2003 amounted, on average, to about |21.8-37.0| = 15.2 percentage points in each year below those for the reference group, which consists of all the countries not included in the treatment group. Recovery set in after 2003, with annual growth rates that averaged 21.8 percentage points above the average for the rest of the world. Similar, yet attenuated, effects occurred in the region of Asia. European countries exhibit an opposite pattern (column 5). In 2004 and 2005 the growth rates were about 8.9 percentage points below the other countries, while in 2002 and 2003 the median growth rates corresponded approximately to the average of the rest of the world.

It seems that mostly countries in Asia and in the Middle East suffered the negative effects of 9/11 on their tourist volumes. From 2004, however, we see significantly positive recovery effects, which go hand in hand with a considerable relative decline in the tourist volume in European, primarily Southern European, countries. These

[4] Tables and text concentrate on the variables of principle interest. Full results, including the coefficients of control variables are available upon request from the authors.

findings confirm the substitution effects in tourism behaviour discussed by, for example, Leibritz (2004) or Vester (2001), and demonstrated by Bonham, Edmonds, and Mak (2006), Edmonds & Mak (2006) as well as Enders Sandler, and Parise (1992).

Since the time after 9/11 in the US saw a significant reduction in tourist volume, especially in the Middle East, one must inquire about the underlying transmission mechanism. Obviously the risk perception of the tourist destination did not just change because of geographic proximity. Instead, the results point to a special decline in Islamic countries, which make up a disproportionate percentage of the Middle East. This special decline has been discussed in the literature, but has not been proved statistically (Al Hamarneh, 2004, Leibritz, 2004). In order to examine more closely a potential transmission process behind the risk perception of German tourists, which is driven not geographically but by ethnic-religious factors, in the second step of the study the effects on the tourist flows, particularly into Islamic countries, are examined.

We begin with a descriptive evaluation of the tourism trends in Islamic and non-Islamic countries, which we plot (in logs) in Figure 2. Prior to 2001 tourism increased in both groups. If at all different, growth was somewhat larger in Islamic countries. The 2001 numbers are slightly below, but not way off the pre-2002 linear long-run trend (dashed lines). This moderate decline might be an artefact of reduced tourism demand during the last four month of 2001 or attributable to macro-economic shocks unrelated to the 2001 terrorism. From 2001 to 2003, however, there is a remarkable decline in tourism numbers in Islamic countries by 0.24 log points, while tourism numbers remain virtually unchanged in non-Islamic countries. After 2003 there is a recovery in both groups. By 2004 tourism already exceeds the extrapolated prediction

based on pre-2002 trends in non-Islamic countries. In Islamic countries the 2001 volumes are already exceeded by 2005, although the recovery remains incomplete compared to the extrapolated pre-2002 trend. Overall, the trends are strongly suggestive of a negative short-run effect that disproportionally hit Islamic destinations and a subsequent recovery. This relative decline, furthermore, cannot be explained by pre-trends. If one believes that the linear extrapolations in Figure 2 provide a reasonable approximation of the counterfactual trends, the DiD estimates based on growth rates presented in the remainder of the paper slightly understate the true effect.

Please insert Figure 2 about here.

Column (1) of Table 3 summarizes the effects of 9/11 on a treatment group that consists of Islamic countries and is based on the DiD specification (1). It is interesting to note that there was no systematic deviation in Islamic countries from the trends in non-Islamic countries from 2002 to 2005 across the entire post period. But if a distinction is made between short- and long-term effects, it becomes clear that the growth rates in Islamic countries in 2002 and 2003 were approximately 10 percentage points below those of non-Islamic countries, while they exceeded the latter by an almost identical value after 2003 (Column (2)). If a further differentiation is made, between the individual years immediately after the attack, a somewhat more marked effect for 2003, compared to 2002, emerges (Column (3)).

Since we cannot reject that there is an ongoing substitution effect from long-distance to short-distance journeys owing to other determinants than perceived risk of tourism destinations, we repeat the estimates using specification (4). If the average Islamic countries were located at a larger distance from Germany compared to the countries

of the control group, then the respective substitution effect could have been erroneously attributed to the characteristic "Islamic". Indeed, over the course of our study period such a tendency for substituting short-distance for long-distance journeys is observable. For a number of years there is a significantly negative relationship between growth rates in tourist demand and distance to the respective destination, indicating a relative increase in demand for closer locations at the expense of farther destinations. This relationship is particularly significant for the year after 9/11, confirming the results by Enders, Sandler, and Parise (1992). Nevertheless, magnitude and precision of the key coefficients of interest remain almost unaffected by introduction of the geographic control variables, thereby discarding this substitution effect as a potential source of bias.

Please insert Table 3 about here.

ROBUSTNESS CHECKS

To check the robustness of the substitution effect in the tourism behaviour of German tourists, identified in the global sample, away from Islamic to non-Islamic countries, the results of regionally limited country groups are compared, which show similarities in factors important to tourists, such as climate, vegetation and the range of tourist opportunities. The study of the effects of the 9/11 attacks on the growth rates of tourist arrivals in Islamic countries is done in a manner analogous to Table 2 for Africa, Mediterranean countries and Asian countries. No countries in South or North America as well as Australia have been assigned to the Islamic treatment group. The Mediterranean region consists of countries in North Africa, Southern Europe and the Middle East.

Please insert Table 4 about here.

The findings for African countries and Mediterranean countries (Table 4, columns 1-4) confirm a significant, short-term decline in tourism in Islamic countries following the 9/11 attacks, which are characterized, as far as African Islamic countries are concerned, by an (overcompensating) recovery starting in 2004. The effects are greater in quantity both for Africa and the Mediterranean region than for the global study (Table 3), which, again, implies specific ethnic-religious effects of terrorism on tourism. The results for Asia show the same quality of pattern as those obtained from the global sample, but they are not statistically significant.

In order to compare the effects of the 9/11 terror attacks, which are geographically remote from Islamic countries, with the effects of the following — also islamically motivated — terror attacks, additional terror attacks have been analysed in a further step (CRP-Infotec, 2008a, 2008b): On 17 November 1997 70 people, among them 50 foreign tourists, were killed in Luxor (Egypt) in an attack by the group Gamaa al Islamiya. On 11 April 2002 the group al-Qaida killed 21 people, among them 14 German tourists, in Djerba (Tunisia). On 12 October 2002 202 people, among them 123 foreign tourists, perished on the island of Bali (Indonesia) in an attack by the group Jemaah Islamiya. On 16 May 2003 an attack by the group Salafiya in Casablanca (Morocco) resulted in 43 deaths.

The criteria for selecting attacks include the location of the attack (an Islamic country where data on arrivals of German tourists are available) and, above all, the significance of the attack for tourism. Therefore, attacks have been selected that focused on tourist targets and whose victims were primarily tourists. The attack in

Egypt in 1997 is an event that occurred before the 9/11 attacks. It was selected so as to have a framework for comparison with the effects of the 9/11 terror attacks. The Indonesia case allows for insight into the effects on predominantly non-Islamic neighbouring states. This should allow for conclusions about geographic proximity as a determinant in the transmission process of risk perception.

Similar to the 9/11 attacks, for the purposes of analysing the terror attacks in Table 5, the study looked at the periods after the attacks, with special emphasis on the short-term effects in the first two years. In the case of Egypt, the year 1998 has been marked as the start of the post period, because the attack occurred towards the end of 1997 (11 November). Column (1), analogous to column 3 in Table 3, has been controlled for tourism development in Islamic countries (*isl*) by isolating the years 1998-2000. Columns (2) to (6) are similarly controlled for the effects of 9/11 on Islamic countries. This way the treatment coefficients can be used to test for deviations in tourism development in the treatment countries in relation to the trends encountered in Islamic countries. Results remain qualitatively unchanged if controls for impact on Islamic countries are omitted.

Egypt experienced a considerable decline in tourist volume following the 1998 attack, but saw an almost complete recovery after one year. In the three years 1998, 1999 and 2000 it actually recorded significantly higher growth.

The attack in Tunisia occurred on 11 April 2002, which allowed for the effects on tourist numbers to be tested in the same year. In contrast to Column (1), the findings (2) point to a weaker development (yet only slightly significant) of Tunisia's tourist volume. Over the long term the growth rates were 9.2 percentage points below the reference group; in the short term the year of the attack saw an additional significant effect of minus 19.6 percentage points. While the short-term effect was less

pronounced than in the 1998 attack in Egypt, Tunisia did not see its tourist numbers recover over the medium term.

The attacks in Morocco occurred on 16 May 2003. As a result, the study looked at the effects from 2003 onwards. A (slightly significant) negative relative long-term effect has been identified on growth rates of a size similar to Tunisia. The short-term effects are not statistically significant. This could be explained by the fact that the attack in Morocco, unlike the attacks in Egypt and Tunisia, did not affect German tourists directly, which is why coverage in the German media was less comprehensive. In addition, there is the possibility of an "adaptation effect", which causes tourists to react less sensitively to attacks. Looking at the 2002 attack in Tunisia, the short-term decline in tourist numbers was already less than for the 1997 attack in Egypt.

The two attacks on Bali in Indonesia on 12 October 2002 were the most consequential terror attacks by an Islamic group after 9/11 and resulted in over 200 deaths. Unlike the attacks in Tunisia and Morocco, Indonesia, however, exhibited only a short-term, statistically significant, effect of approx. 13 percentage points (Column 4) in 2003 compared to the reference group of Islamic countries. It should be noted in this context that the Southeastern region of Asia was affected that same year by the infectious disease SARS (Severe Acute Respiratory Syndrome), which also shaped the risk perception of the region. Indonesia itself saw relatively little fallout from SARS. Therefore, the treatment group in Column (5) is expanded to include the Southeast-Asian countries Malaysia, Myanmar, the Philippines, Singapore and Thailand in order to test the joint impact of the terror attack and SARS in the region of Southeast Asia (SEA). The region exhibits only a barely significantly but somewhat stronger decline in tourism in 2003 than in Indonesia, which cannot be explained by regional spillover effects of the attack in Indonesia. To test for any

significant deviation in the development in Indonesia compared to the region, the specification in Column (4) is expanded in Column (6) to include interactive terms that capture the development in the entire region. While there was significant difference between the development of Indonesia and its neighbouring states in the long term as well as in the first year, 2004 saw the trend go into reverse. Thus the region without Indonesia shows a slightly significant recovery, while the tourist volume in Indonesia drops once again in relative terms, with this negative effect actually exceeding the positive regional effect. It follows therefore that the joint impact of the terror attack and SARS had longer-lasting effects in Indonesia than in its neighbouring states. Assuming that the effects of the terror attack on Bali diminish with distance, a conclusion can be drawn that the terror attack, compared to SARS, has produced a longer-term adjustment of tourists' risk perception.

Please insert Table 5 about here.

In summary, individual events, such as the terror attack in Egypt in 1997, led to considerable declines in tourist flows in the regions affected over the short term (about a year), but the regions were able to recover relatively quickly. It was not until the combination of the 9/11 attacks and further terror attacks in subsequent years that tourist volumes were reduced in a sustained fashion in the cases reviewed in the study. The findings in Table 4 have been visualized in Figure 3 for Egypt, Tunisia, Morocco and Indonesia) in relation to other Islamic countries. Figure 3 also depicts the effects of the terror attack 9/11 on Islamic countries compared to non-Islamic countries (9/11) (table 3, column (3)).

Please insert Figure 3 about here.

Finally it has to be noted that the east and south-east Asian region was subject to the 2004 tsunami catastrophe. In order to rule out that some of the previous findings for the region were driven by the natural disaster we investigate the effects of this shock on tourism demand. We found a statistically significant negative effect for the tsunami region relative to the rest of the world, but no significant within region differentials. Details are available in the appendix.

CONCLUSION

This study, the first to use a DiD approach, examines changes in tourism behaviour following 9/11 (2001) as well as the terror attacks in Egypt (1997), Tunisia (2002), Morocco (2003) and Indonesia (2003). As a result of the relative effects of 9/11 on tourist flows to Islamic and non-Islamic countries, changes in risk perception are not transferred exclusively by means of geographic but also ethnic-religious proximity. Islamic destination countries showed growth rates in tourist volume in 2002 and 2003 that were, on average, 16.9 and 22.4 percentage points, respectively, below those recorded by the non-Islamic control group. A recovery effect set in starting in 2004, so that at the end of 2005 tourist arrivals were only about 1,3% below those in non-Islamic countries relative to the starting position in 2001 (table 3, column (3)). This trend was accompanied by temporary substitution effects in favour of (Southern) European states. Moreover, in the course of the period under observation a substitution effect was identified, with tourists opting for trips within closer proximity

over long-distance tourism, which was particularly highly significant in the year following 9/11.

The findings of the study of the terror attacks in Egypt, Tunisia and Morocco confirm, as already discussed by Pizam & Fleischer (2002) regarding the tourism industry of Israel, that the frequency of terror attacks, as well as their intensity, can be decisive for the time during which effects are noticeable. The tourist volume in Egypt after the 1997 attack more than recovered within only two years, while Morocco and Tunisia, which both suffered additional attacks, did not exhibit any indication of a significant recovery after two and three years, respectively.

While attacks after 9/11 produced longer-lasting, stronger (negative) effects, a significant attenuation of the effects has been observed in the short term. These results provide initial proof of an adaptation effect, which was described by Blinda & Harms (2006), but had not been studied empirically yet. While the short-term effects of the 1997 attack in Egypt were very strong, the effects in Tunisia and Morocco in the aftermath of the attacks in 2002 and 2003 were relatively minor. Apparently the attack in Egypt was a surprising and novel intervention, which was followed by an especially strong adjustment in risk perception. An adjustment of such extent is not observed with any of the subsequent attacks.

Regional spillover effects of terror attacks have been examined for the region Southeast Asia on the basis of the Bali terror attacks in 2002. The study has found in its (non-Islamic) neighbouring countries a significantly negative relative trend in tourism volume in 2003. The short-term effects were at least as marked as in Indonesia, which cannot be explained by regional spillover effects, but instead points to an additional impact from the infectious disease SARS, which had devastated particularly the neighbouring countries in 2002. Over the long term, however,

Indonesia, when compared to its neighbouring countries, shows stronger effects on tourist volume, which may indicate that terror attacks tend, in relative terms, to produce longer-term adjustments.

Future research should extend the analysis by collecting and analysing the data for other countries or even using a world wide basis. In addition if tourists' subjective risk assessment following a terrorist attacks depends – besides economic and geographic considerations – on social, ethnic and religious determinants, then similar mechanisms are likely to apply also to other economic agents, for example, acting at financial markets. For instance, one might expect similar adjustments in the distribution of FDI. More research might lead to a more profound understanding on the transmission of a broader range of local economic shocks, which, with increasing integration, tend to affect more and more regional markets.

Appendix

The east and south-east Asian region, besides SARS and the 2002 terrorist attack in Indonesia, was subject to an additional major shock, which is of interest in the context of the present analysis: the 2004 tsunami catastrophe. In order to exclude that some of the previous findings for the region were driven by the natural disaster we investigate the effects of this shock on tourism demand. Therefore, two treatment groups of countries that were affected by this shock are defined. The narrow group (Narrow) consists of countries that were hit heaviest: Indonesia, Thailand and Sri Lanka. A broader group (Broad) in addition also includes India, Malaysia, Maldives and Myanmar. Due to data limitations, we are only able to assess the short term impact of this shock as revealed by the 2005 growth rates.

Columns (1) – (3) of Table A1 show results of separate regressions that point to a weakly significant inferior growth in countries belonging to the broader treatment group compared to the rest of the world, while there seems to be no significant differences between the strongly affected countries of the region and their neighbours. In columns (4), we set up a simple DiD strategy according to equation (1), where the study period covers the years 2004-2005 with 2005 representing the post-period. In columns (5) and (6) a control for the east and south-east Asian (ESEA) countries is included in order to test for a significant differential in mean growth between the countries in the treatment groups and the rest of the south-east Asian region. While there is a statistically significant negative effect of approximately 18 percentage points for the region relative to the rest of the world, there are no significant within region differentials. Although the estimated effect is strong even compared to the joint-impact of the 2002 terrorist attack in Indonesia and SARS, it is unlikely to be entirely attributable to the tsunami catastrophe, given that the decline in tourism also

occurred to countries unaffected by the shock. Tourists appear to have either excluded the possibility of a repetition of a similar natural disaster or associated the whole region with a higher risk of being hit.

Please insert Table A1 about here.

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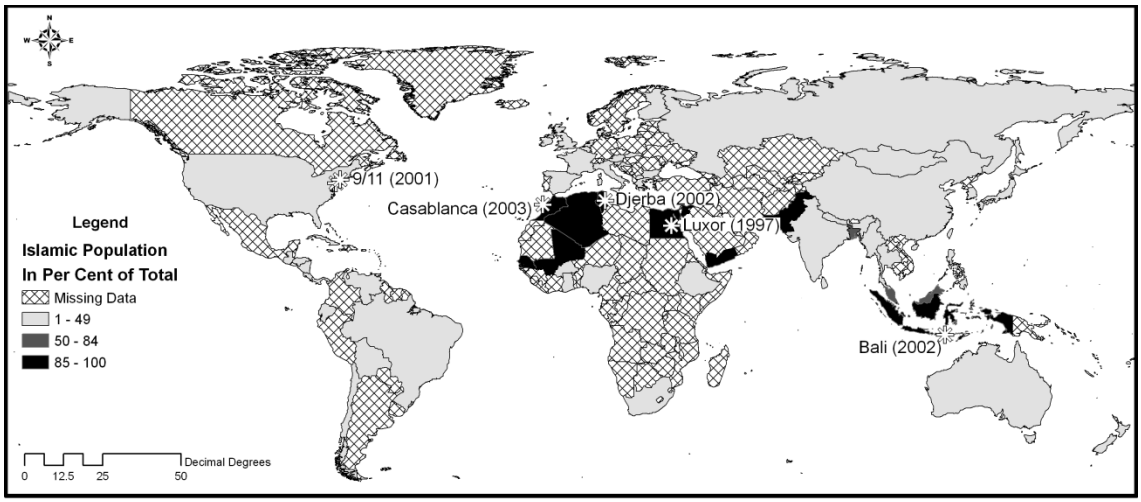
Figures

Figure 1 Share of Islamic population



Data source: CIA (2008)

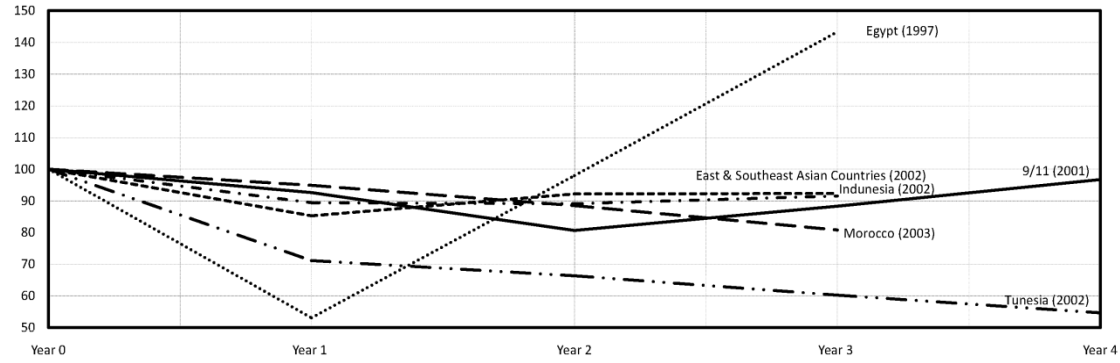
Notes: Own Illustration.

Figure 2 Tourism trends

Source: own calculations
Data Source: Statistical Office Germany, see data description

Notes: Red (black) solid lines show the mean across tourist numbers by year for Islamic and non-Islamic countries in the data set. Dashed lines are fitted into the pre-period (up to 2001) and extrapolated for the remaining years.

Figure 3 Estimated Impact of Terrorism Attacks on Tourism



Source: own calculations
Data Source: Statistical Office Germany, see data description
Notes: Figure shows indices of relative tourism development for years after intervention. For 9/11 index shows development of Islamic vs. non-Islamic countries (table 3, column (3)), other indices refer to tourism in the respective countries while controlling for 9/11 effect (exception: Egypt, 1998-2000) (table 5).

Tables

Table 1: Tourist arrivals, descriptive statistics

	Absolute No.		Growth Rates (unweighted)			
	1993-2001	2002-2005	1994-2001	2002-2005	2002	2003
Average						
All Countries (N=82)	733,504	775,628	5.6%	4.6%	-1.3%	-1.8%
Islam. Countries (N=12)	154,190	151,832	4.7%	4.5%	-5.1%	-6.6%
Non-Islam. Countries (N=70)	832,815	882,564	5.7%	4.7%	-0.7%	3.3%
Median						
All Countries	45,694	52,961	2.6%	2.8%	-2.1%	2.0%
Islam. Countries	25,391	17,725	3.5%	1.0%	-7.6%	-8.4%
Non-Islam. Countries	49,016	53,845	2.5%	3.1%	-1.6%	2.6%
Standard Deviation						
All Countries	2,339,260	2,437,635	14.0%	8.9%	21.9%	17.3%
Islam. Countries	252,262	258,916	6.9%	11.5%	25.3%	16.6%
Non-Islam. Countries	2,516,330	2,621,273	14.8%	8.4%	21.2%	17.1%

Source: own calculations
Data Source: Statistical Office Germany, see data description

Table 2: The effects of 9/11 on various (treatment) regions

	(1) Africa	(2) America	(3) Australia	(4) Asia	(5) Middle East	(6) Europe	(7) Southern Europe
post x *treat*	-0.0561	0.00946	-0.0293	0.120***	0.218*	-0.0889**	-0.196***
	(0.0473)	(0.0413)	(0.0323)	(0.0439)	(0.110)	(0.0435)	(0.0667)
short_1_2 x *treat*	0.0568	0.0450	0.0357	-0.172***	-0.370***	0.0878*	0.144**
	(0.0731)	(0.0549)	(0.0271)	(0.0590)	(0.108)	(0.0480)	(0.0610)
Year Effects	YES	YES	YES	YES	YES	YES	YES
Country Effects	YES	YES	YES	YES	YES	YES	YES
Control group	World	World	World	World	World	World	World
Observations	984	984	984	984	984	984	984
R^2	0.156	0.156	0.155	0.165	0.165	0.159	0.163

Source: own calculations
Data Source: Statistical Office Germany, see data description
Notes: *post* represents the period from the year following the attack to the end of 2005. short*_1_2* represents the two years following the attack. Robust standard errors (in parentheses) are adjusted for clustering on country. *, **, ***: significant at the 10/5/1% level. All models include country and year effects.

Table 3: Effects of 9/11 attacks on Islamic countries

	(1) Isl. Countries	(2) Isl. Countries	(3) Isl. Countries	(4) Isl. Countries
post x treat	-0.00338	0.0950*	0.0950*	0.1035*
	(0.0405)	(0.0500)	(0.0500)	(0.5226)
short _1_2 x treat		-0.197***		
		(0.0680)		
short _1 x *treat*			-0.169*	-0.191**
			(0.0860)	(0.8928)
short_2 x treat			-0.224***	-0.2202**
			(0.0659)	(0.0665)
dist x 1994				-0.0038
				(0.0064)
dist x 1995				-0.0078
				(0.0053)
dist x 1996				-0.0255**
				(0.0097)
dist x 1997				-0.0126***
				(0.0038)
dist x 1998				-0.0098**
				(0.0043)
dist x 1999				-0.0132*
				(0.0077)
dist x 2000				-0.0109*
				(0.0064)
dist x 2001				-0.0092*
				(0.0052)
dist x 2002				-0.0205***
				(0.0040)
dist x 2003				-0.0030
				(0038)
dist x 2004				-0.0044
				(0.0044)
dist x 2005				-0.0069
				(0.0046)
Year Effects	YES	YES	YES	YES
Country Effects	YES	YES	YES	YES
Control group	World	World	World	World
Observations	984	984	984	984
R^2	0.155	0.162	0.162	0.174

Source: own calculations

Data Source: Statistical Office Germany, see data description

Notes: *post* represents the period from the year following the attack to the end of 2005. *short_1_2* represents the two years following the attack, *post_1* the year immediately after the attack and short_*2* the second year after the attack. Robust standard errors (in parentheses) are adjusted for clustering on country. *, **, ***: significant at the 10/5/1% level. All models include country and year effects.

Table 4: The effects of 9/11 in Islamic countries in different regions (Basis: Regression model (3))

	(1) Isl. Countries Africa	(2) Isl. Countries Africa	(3) Isl. Countries Mediterranean	(4) Isl. Countries Mediterranean	(5) Isl. Countries Asia	(6) Isl. Countries Asia
post x treat	0.159**	0.159**	0.168	0.168	0.061	0.061
	(0.0723)	(0.0723)	(0.102)	(0.102)	(0.0962)	(0.0964)
short _1_2 x	-0.379***		-0.298**		-0.0810	
Treat	(0.0799)		(0.114)		(0.147)	
short _1 x		-0.364**		-0.309		-0.102
treat		(0.1326)		(0.1829)		(0.1673)
short_2 x		-0.394**		-0.288***		-0.060
treat		(0.0559)		(0.0586)		(0.1443)
Year Effects	YES	YES	YES	YES	YES	YES
Country Effects	YES	YES	YES	YES	YES	YES
Control group	Africa	Africa	Mediterranean	Mediterranean	Asia	Asia
Obs	156	156	180	180	276	276
R^2	0.176	0.176	0.207	0.207	0.278	0.278

Source: own calculations

Data Source: Statistical Office Germany, see data description

Notes: *post* represents the period from the year following the attack to the end of 2005. *short_1_2* represents the two years following the attack, *post_1* the year immediately after the attack and *short_2* the second year after the attack. Robust standard errors (in parentheses) are adjusted for clustering on country. *, **, ***: significant at the 10/5/1% level. All models include country and year effects.

Table 5: Terror effects in countries that suffered attacks
(Basis: Regression model (3), with additional dummy variables for country specific terror attacks and additional controls)

	(1) Egypt	(2) Tunisia	(3) Morocco	(4) Indonesia	(5) SEA	(6) Indonesia
post x treat	0.463***	-0.0924*	-0.0869*	0.0273	-0.0028	0.0265
	(0.0974)	(0.0490)	(0.0505)	(0.0510)	(0.0531)	(0.0780)
short_1	-0.932***	-0.196**	-0.0358	-0.133**	-0.146*	0.018
x treat	(0.960)	(0.0851)	(0.0657)	(0.0647)	(0.0702)	(0.1041)
short_2	0.382***	-0.025	0.0196	-0.0310	0.0612	-0.1049***
x treat	(0.0821)	(0.0643)	(0.0246)	(0.0246)	(0.0408)	(0.03177)
post x SEA						0.0178
						(0.104)
short_1x						-0.149*
SEA						(0.0828)
short2_ x						0.078*
SEA						(0.0411)
post x isl	-0.126					
	(0.1009)					
short_1 x isl	0.169					
	(0.1031)					
short_2 x isl	0.224**					
	(0.0943)					
2002-2005 x		0.103*	0.102*	0.094*	0.095*	0.096*
isl		(0.0535)	(0.0536)	(0.5412)	(0.0502)	(0.0547)
2002 x isl		-0.152	-0.176**	-0.168*	-0.169**	-0.171*
		(0.0535)	(0.0881)	(0.0885)	(0.0861)	(0.0889)
2003 x isl		-0.222***	-0.220***	-0.213***	-0.221***	-0.227***
		(0.0712)	(0.0711)	(0.0703)	(0.0651	(0.0708)
Year Effects	YES	YES	YES	YES	YES	YES
***Country** Effects*	YES	YES	YES	YES	YES	YES
Contr. group	World	World	World	World	World	
Observations	984	984	984	984	984	
R^2	0.180	0.163	0.162	0.162	0.164	

Source: own calculations
Data Source: Statistical Office Germany, see data description
Notes: *post* represents the period from the year following the attack to the end of 2005, or, in the case of Egypt, the period from 1998 to 2000. *short_1* represents the year immediately after the attack and *short_2* the second year after the attack. *2002*, *2003* and *2002-2005* are dummy variables describing the corresponding years. Given the short post period, no interactive term for the second year has been applied in the case of Morocco. *Isl* is dummy denoting countries with a proportion of Islamic population of above 85%. Robust standard errors (in parentheses) are adjusted for clustering on country. *, **, ***: significant at the 10/5/1% level. All models include country and year effects.

Table A1: Impact of 2004 Tsunami Shock

	(1) Broad [(a)]	(2) Broad [(a)]	(3) Narrow [(a)]	(4) Broad [(a)]	(5) Braod [(a)]	(6) Narrow [(a)]
Treat	-0.104*	-0.112	0.080			
	(0.0563)	(0.0795)	(0.105)			
post x *treat* [(b)]				-0.177**	-0.0191	-0.063
				(0.0.0818)	(0.131)	(0.0113)
post x ESEA[(b)]					-0.188*	-0.205**
					(0.112)	(0.0912)
Year E.	YES	YES	YES	YES	YES	YES
Country E.	YES	YES	YES	YES	YES	YES
Control group	World	ESEA	ESEA	World	World	World
Period	2005	2005	2005	2004-2005	2004-2005	2004-2005
Obs	82	19	19	164	164	164
R^2	0.032	0.091	0.027	0.673	0.708	0.709

Source: own calculations
Data Source: Statistical Office Germany, see data description
Notes:
(a) The narrow group consists of Indonesia, Thailand and Sri Lanka. The broad group in addition also includes India, Malaysia, Maldives and Myanmar.
(b) post indicates the year 2005. ESEA is the sample of east and south-east Asian counties.
Models (4) – (6) include year and country effects. Robust standard errors (in parenthesis) are adjusted for clustering on country.
*, **, ***: indicate 10/ 5/ 1%-significance levels.
All models include country and year effects.