An Econometric Analysis of the Impact of Terrorism on Tourism

WALTER ENDERS, TODD SANDLER and GERALD F. PARISE*

1. INTRODUCTION

In the 1980s, heinous terrorist events made tourists in the U.S. and abroad increasingly aware of the risks associated with travel to nations plagued by terrorism. Some well-publicized incidents include the downing of Air India flight 182 (with 329 deaths) over the Atlantic Ocean on June 23, 1985; the hijacking of the Achille Lauro cruise ship (with one death) off the Israeli coast on October 7, 1985; the simultaneous attacks at Vienna (with two deaths and 37 wounded) and Rome (with 16 deaths and 73 wounded) Airports on December 27, 1985; the bombing of TWA flight 840 (with four deaths) enroute to Athens on April 2, 1986; the attempted bombing of El Al flight LY-016 at Heathrow Airport, London, on April 17, 1986; the downing of Korean Air Lines flight 858 (with 115 deaths) enroute to Seoul via Abu Dhabi on November 30, 1987; and the downing of Pan Am flight 103 (with 270 deaths) over Lockerbie, Scotland, on December 21, 1988. On several occasions terrorists have aimed campaigns of terror at the tourist trade in the hopes that the public would pressure the government to capitulate to terrorist demands. Two specific examples involve ETA (a Basque separatist group) bombings of tourist hotels in Spain during 1985-87 and the Committee of Solidarity with Arab and Middle Eastern Political Prisoners bombings of tourist targets in Paris during 19861.

* WALTER ENDERS and TODD SANDLER are Professors of Economics and GERALD F. PARISE is a graduate student at Iowa State University, Ames, Iowa. The research for this study was funded by the National Science Foundation (NSF) grant no. SES-8907646. The views expressed here are solely those of the authors and should not be attributed to NSF.

1. Facts from this paragraph are taken from MICKOLUS, SANDLER and MURDOCK [1989], which contains detailed descriptions of each of these events.
Terrorists employ extra-normal violence or its threatened use to gain a political objective through intimidation or fear. Terrorists often unleash their attacks at targets, not directly involved in the decision-making process that terrorists seek to influence. Thus, terrorist incidents may harm pedestrians along a crowded street or passengers waiting to check in at an airline counter in an international airport. Terrorist campaigns succeed if they convince the government that the costs from capitulating are less than those from not capitulating.

The escalation of terrorism over the last two decades may have had a significant impact on the tourist trade in countries especially plagued with terrorist incidents. After the U.S. retaliatory raid against Libya on the morning of April 15, 1986, there was much speculation on the economic costs of terrorism on the tourist trade in Europe in the popular press. The purpose of this paper is to determine whether terrorism has had an impact on tourism. When an impact is discovered, we intend to quantify the present discounted value of this impact in terms of losses in tourism revenues. To accomplish this task, we estimate a forecasting equation for a country's (or a region's) share of tourism using an ARIMA model with a transfer function based on the time series of terrorist attacks in that country (or region). We focus our estimates on those European countries – Greece, Italy, and Austria – that have had high-visibility attacks (see above), for which experts have speculated that terrorism has hurt tourism [IGLARSH, 1987]. We also examine the impact of terrorism on tourism for a sample of Western European nations, for which data are available.

Our estimates indicate that terrorist attacks have adversely affected tourism in Greece, Italy, Austria, and throughout a sample of Western European nations. During the 1974-88 period, individual nations experienced losses ranging from 572-3372 million special drawing rights (SDRs) in present value terms, while the aggregate European sample has experienced losses of over 16 billion SDRs. The estimates developed here justify the concerns that some European countries have had about the negative externality that terrorism poses on their tourist industry. This concern explains why institutions like the Greek National Tourist Organization expended $3 million in a 1986 advertising campaign to entice American tourists back to Greece (New York Times, April 2, 1986, p. A1), following some high-profile terrorist incidents such as the hijacking of TWA

2. A Harris Poll conducted during April 5-8, 1986, prior to the raid, indicated that Americans already had some fears about foreign travel owing to terrorism (Business Week, April 21, 1986, pp. 27-28). Articles in The Washington Post (May 4, 1986, pp. F1, F9) and the New York Times (May 7, 1986, pp. D1, D5) indicated that many Americans were switching from foreign to domestic travel due to the terrorist threat.
THE IMPACT OF TERRORISM ON TOURISM

flight 847 on June 14, 1985. Moreover, one can better understand why some nations have tried to reach accommodations with terrorist groups (see, e.g., LEE [1988]; LEE and Sandler [1989]). These tourist revenue losses are an added incentive for nations to allocate resources to securing airports and other transportation infrastructure.

The body of the paper contains four sections. A simple model of consumer choice is displayed in Section II. This model depicts explicitly the necessary structure of preferences that underlies the use of tourism shares in our empirical analysis. In Section III, the statistical methods, the estimating equations, and the data are presented. Statistical results, including the estimates of lost revenues, are contained in Section IV. Concluding remarks follow in Section V.

II. THEORETICAL CONSIDERATIONS

Tourists are viewed as rational consumers who must allocate their income between various goods, which include tourist trips. To simplify the presentation, we view consumers as engaging in a two-stage budgeting decision. In the first stage, the consumer must allocate his/her expenditures between broad categories of goods, while, in the second stage, the consumer must allocate category-specific expenditures (determined in the first stage) among the goods of that category. Consumer preferences must possess a specific structure if the two stages are to be consistent. We intend to present briefly the theoretical structure for preferences behind this two-stage budgeting decision as it applies to the tourism choice, based upon the analysis of Pollock [1971], Varian [1984, pp. 148-49], and Blackorby, Prizont, and Russell [1978, pp. 196-205]. The assumptions of this consumer model are consistent with the econometric estimates presented in Section 3. In particular, the consumer preferences presented here permit the ratio of a consumer's demands for tourist activities in two different countries (or regions) to be independent of income considerations. The econometric model was chosen based on data availability, tractability, and degrees of freedom considerations. In contrast, the theoretical model is presented so that readers are aware of the implicit assumptions concerning consumer preferences implied by the econometrics.

Consumers, who are also tourists, have two broad categories of commodities: tourist activities and all other activities. We assume that consumers can engage in tourist activities in either country 1 or country 2. We denote these activities as $q_1$ and $q_2$, respectively, where $q_i$ represents, say, the number of day trips of a homogeneous type to country $i$. For simplicity, each country offers a single activity. All other goods are denoted by the composite good, $q_3$. Each consumer's preferences are weakly separable so that utility, $U$, is

$$U = U(t(q_1, q_2), q_3),$$

where $t$ is a composite quantity index for tourist activities. The utility function is assumed to be twice-continuously differentiable, strictly increasing in the $q_i$s, and quasi-concave. An immediate consequence of weak separability in (1) is that the marginal rate of substitution between tourist activities are independent of nontourist activities, $q_3$.

The use of weak separability operationalizes the notion that within broad groups of commodities (e.g., food, shelter, tourism) consumers partition their expenditures. Substitution effects resulting from relative price changes occur within commodity groups, but not between groups. A price change outside of a commodity group will, nonetheless, affect expenditure within the commodity group through an income effect since within-group expenditures, $I_t$, do depend on $p_3$.

The tourist's budget constraint is

$$p_1q_1 + p_2q_2 = I - p_3q_3 = I_t,$$

where the $p_i$s are the per-unit prices for the $q_i$s, $I$ is the consumer's total income, and $I_t$ is the consumer's income devoted to tourist activities in general. Prices of tourist activities depend on money outlay, the value of time, and risk factors. Alterations in travel risks, arising from increased terrorist incidents in country $i$ raise the price of $q_i$, thereby increasing relative prices as perceived by the consumer. Such increased activities would necessitate loss of time, owing to increased search activities on the part of authorities, and increased expenditure on protection. Terrorist groups have, at times, directed campaigns at tourists in hopes of discouraging tourism, thereby imposing costs and pressures on the government through loss of foreign exchange earnings. A recent example involved a Basque separatist group - Euzkadi Ta Askatasuna (ETA) – which attacked tourist hotels during 1985-87 [Mickolus, Sandler and Murdock, 534]
1989]. Prior to each year's campaign, the ETA sent letters warning of summer offensives. On June 10, 1986, for example, the ETA mailed two hundred letters to foreign embassies, travel agencies and foreign media in Spain warning tourists to stay away from hotels along the Mediterranean coast [MICKOLUS, SANDLER and MURDOCK, 1989, p. 409].

Consumers choose their expenditures by maximizing utility in (1) subject to the budget constraint in (2). If the associated bordered Hessian is positive definite, the resulting first-order conditions would, via the implicit function theorem, yield the following uncompensated demand function for the substitutable tourist activities:

\[ q_i = q_i(p_1, p_2, l_i), \quad i = 1, 2, \quad (3) \]

which does not explicitly depend on \( p_3 \). Nevertheless, the demands for the \( q_i \)s implicitly depend on \( p_3 \) through \( l \). A change in \( p_3 \) would have an impact on \( q_i \) \((i = 1, 2)\) proportional to the change in \( q_i \) that results from a change in income [POLLOCK, 1971]. The proportionality factor would be identical for both tourist activities.

Any increase in terrorist activities directed at one country that places tourists at a higher perceived risk would induce a standard substitution effect (i.e., less of the relatively more risky (expensive) tourist activity would occur). An income effect would take place as the change in real income is redistributed between commodities. Since the marginal rate of substitution between tourist activities is independent of \( q_3 \), the substitution effect is only between tourist activities, while the income effect impacts all commodities. A change in \( p_3 \) would, however, result in only a real income effect on tourism.

The demand for tourist activities, conditional on \( q_3 \) being fixed at \( q_3 \), is equivalent to the submaximization problem:

4. Partial differentiation of (3) gives

\[ \frac{\partial q_i}{\partial p_3} = \left( \frac{\partial q_i}{\partial l_i} \right) \left( \frac{\partial l_i}{\partial p_3} \right), \quad i = 1, 2 \]

and

\[ \frac{\partial q_i}{\partial l_i} = \left( \frac{\partial q_i}{\partial l_i} \right) \left( \frac{\partial l_i}{\partial l_i} \right), \quad i = 1, 2. \]

These two equations can then be used to show that

\[ \frac{\partial q_i}{\partial p_3} = k \frac{\partial q_i}{\partial l_i}, \quad i = 1, 2, \]

where \( k = \left( \frac{\partial l_i}{\partial p_3} \right) \left( \frac{\partial l_i}{\partial l_i} \right) \). The proportionality factor, \( k \), is identical for each tourist activity.
\[ \begin{align*}
& \max t(q_1, q_2) \\
& q_1, q_2 \\
& \text{subject to } p_1 q_1 + p_2 q_2 = I_t .
\end{align*} \]

The demand for tourist activities again corresponds to the equations in (3). The indirect utility function,

\[ u^* = v(p_1, p_2, I_t) , \tag{4} \]

associated with this submaximization problem, proves useful shortly.

We now place additional structure on the maximization problem to allow for two-stage budgeting and to facilitate the empirical specification that depends on the ratio of tourist demands. In particular, we assume that the tourism subutility function, \( t(q_1, q_2) \), is homothetic. Homotheticity ensures that the indirect utility function for the submaximization problem is separable as

\[ u^* = v(p_1, p_2)I_t , \]

where \( v(p_1, p_2) \) is linear homogeneous. Thus, the overall maximization problem in (1) and (2) can be rewritten as

\[ \begin{align*}
& \max u( v(p_1, p_2)I_t, q_3) \\
& \text{subject to } I_t + p_3 q_3 = I .
\end{align*} \]

If we define a scalar variable,

\[ T = v(p_1, p_2)I_t , \tag{5} \]

then \( T \) is a composite commodity for tourism with a price index of \( 1/v(p_1, p_2) \). By (5), the first stage of the budgeting process becomes

\[ \begin{align*}
& \max u(T, q_3) \\
& \text{subject to } [1/v(p_1, p_2)]T + p_3 q_3 = I .
\end{align*} \]

Hence, consumers allocate their budgets between tourism and other activities based on the price index of tourism and the price of other activities. This first

536
stage of the budgeting process determines \( I \). In the second stage, the submax-
imization problem divides the consumer expenditures on tourism between \( q_1 \) and \( q_2 \), based on the relative prices of tourism activities.

Weak separability when combined with homothetic subutility functions is not only sufficient for two-stage budgeting, but also for treating the ratio of uncompensated demands for tourism as independent of income. By applying Roy’s identity to the indirect utility function in (4), associated with the submax-
imization problem, we derive the uncompensated demands,

\[
q_i(p_1, p_2, I) = \frac{(\partial v/\partial p_i)I}{v(p_1, p_2)}, \quad i = 1, 2.
\]

The ratio of these demands yields \((\partial v/\partial p_1)/(\partial v/\partial p_2)\), which is independent of income as intended.

Aggregation over consumers can proceed in a few different ways. The simplest is to assume that all tourists have identical weakly separable preferences with homothetic subutility functions. Henceforth, we invoke this assumption, so that the ratio of aggregate demands for tourist activities is also independent of income, but would depend on factors affecting relative prices for traveling to different countries. These factors would include the threat of terrorism and other relative price considerations.

III. STATISTICAL METHODS AND DATA

1. Methodology

Equation (6) implies that the relative demand for trips to a region (i.e., the ratio of \( q_1/q_2 \)) should solely depend on the price of a trip to region 1 relative to that of region 2. With preferences given by (1) and the assumed homotheticity of the function \( t(q_1, q_2) \), relative demand does not depend on full income. If data on relative prices are available, a structural model of demand and supply, in which relative prices and quantities are determined simultaneously, could, in principle, be estimated. In such a model, tourist responsiveness to each component of the full price for tourism could be examined. After conversion into the appropriate currency, an increase in the relative price of airline fares, hotel charges, or restaurant prices in region 1 would, for example, be expected to lead to a substitution on the demand side towards vacationing in region 2. An
anticipated increase in terrorist activities in a region should similarly lead to a substitution towards vacationing in other regions.

Unfortunately, usable data on the full prices of travel and tourist services are not available. Moreover, there is no simple way to ascribe a monetary value of the perceived cost of terrorism to tourists. The alternative to estimating a structural model is to estimate an ARIMA model of tourism, capturing the effects of terrorism through a transfer function. Consider the following econometric model:

\[
y_i(t) = \alpha_i + \sum_{j=1}^{\infty} a_{ij} y_i(t-j) + \sum_{j=0}^{\infty} b_{ij} x_i(t-j) + \sum_{j=0}^{\infty} c_{ij} \varepsilon_i(t-j)
\]

where \(y_i(t)\) is the logarithm in period \(t\) of the share of tourist receipts of country \(i\) relative to that of all other countries; \(x_i(t-j)\) is the number of terrorist incidents occurring in nation \(i\) during period \(t-j\); \(\alpha_i\) is a constant for country \(i\); \(\varepsilon_i(t-j)\) is a normal i.i.d. disturbance; and the \(a_{ij}, b_{ij}, \text{ and } c_{ij}\) terms are constant coefficients. Equation (7) can be written more compactly as

\[
A_i(L)y_i(t) = \alpha_i + B_i(L)x_i(t) + C_i(L)\varepsilon_i(t),
\]

5. In the popular press, the nominal exchange rate is often reported as representing the relative price of tourism. Statements such as 'Mexico is a cheap vacation spot since the peso has depreciated', are not uncommon. This view implies a form of money illusion since nominal variables are not the equivalent of relative prices. Our dependent variable (the log-share of tourism revenues) is a real variable and should be solely dependent on other real variables. We attempted to use an available measure of the 'real' exchange rate to proxy the relative price of tourism; bilateral measures are unsatisfactory as we look at tourism revenues from all sources. Our preliminary estimations using International Monetary Fund's RMERM rates (the International Monetary Fund's estimates of the real multilateral exchange rate) were unsatisfactory. One problem is that the real rates are non-stationary while the tourism share series is stationary; it is inappropriate to regress a stationary variable on a non-stationary variable. The other problem with this procedure is that the RMERM (and all available real multilateral rates) are heavily weighted towards manufactures (as opposed to tourism services); we believe these series to be poor proxies for the relative price of tourism.

6. In practice, we estimated the model using shares of tourism receipts [i.e., \(q_1/(q_1 + q_2)\)] rather than ratios of receipts. The logarithmic specification is used to eliminate any potential heteroskedasticity problems. Moreover, the log specification is appropriate since tourist receipts cannot be negative. We note that \(x_i(t)\) is the number of terrorist incidents occurring in country \(i\) rather than the number of incidents in \(i\) relative to all other nations. The relative version of the \(x_i(t)\) series did not perform well since the number of incidents occurring in any country \(i\) was small relative to the total number of incidents.
where \( A_i(L), B_i(L), \) and \( C_i(L) \) are polynomials in the lag operator \( L \).

The interpretation of equation (8) is straightforward. The coefficients of \( A_i(L) \) yield the autoregressive (AR) components, and the coefficients of \( C_i(L) \) yield the moving average (MA) components of the ARIMA model. The coefficients of \( B_i(L) \) are of special interest to our study. The \( b_{i0} \) coefficient on \( x_i(t) \) shows the immediate impact of a terrorist incident on the log share of tourist revenues, received by the nation in question. If the first \( n \) coefficients on \( x_i(t) \) are insignificantly different from zero, there is then an \( n \)-period lag in the effects of terrorism on tourism behavior. If, after seasonally differencing, the \( y(t) \) series has a unit root, then a terrorist incident occurring at time period \( t \) will have a permanent effect on the share of revenues received by the nation. The absence of a unit root means that the effects of any particular incident will eventually die out.

For each country (or group of countries) under investigation, the estimation procedure was conducted using standard BOX-JENKINS [1976] methods. The strong seasonal pattern in international tourism necessitated that the \( y_i(t) \) series be seasonally differenced. DICKEY-FULLER [1979, 1981] tests were performed on the resulting tourism series to ensure that it did not contain a unit root. Rewriting (8) to account for the seasonal differencing, we obtain

\[
A_i(L)y_i^*(t) = B_i(L)x_i^*(t) + C_i(L)e_i^*(t) \tag{9}
\]

where the expression (*) denotes that a time series has been differenced by the operator \((1 - L^4)\).

The following steps were then performed on the transformed series:

i) The \( x_i^*(t) \) series were identified and estimated using standard ARIMA techniques. In choosing between alternative plausible models, we selected that with the lowest Akaike Information Criterion (AIC) and/or Schwartz Bayesian Criterion (SBC). These two criteria are:

\[
AIC = -2ln(\Omega) + 2k; \quad SBC = -2ln(\Omega) + k \cdot ln(n),
\]

where \( \Omega \) is the likelihood function evaluated at maximum likelihood estimators; \( k \) is the number of free parameters; and \( n \) is the number of residuals. When the two criteria selected different models, we chose the model indicated by the SBC, which, by imposing a greater cost for additional parameters, selects the more parsimonious model. Diagnostic checking included plotting the residuals and using the Box-Ljung test statistic to check that the residuals are not correlated.
ii) The \( y_i(t) \) series was pre-whitened using the model from step (i) and the crosscorrelations between the two series were analyzed. A preliminary model was estimated in which the transfer function [i.e., the function \( B_i(L) \)] was fitted to \( y_i(t) \). As detailed in Box and Jenkins (1976), the residuals of this fitted model were used to identify the \( A_i(L) \) and \( C_i(L) \) functions.

iii) Estimation of the full model was completed and the residuals analyzed. As in step (i), we used the AIC and SBC to aid in model selection. If any of the estimated coefficients in \( A_i(L) \), \( B_i(L) \), or \( C_i(L) \) were not significantly different from zero, the model was re-estimated, constraining these coefficients to zero. We used the Box-Ljung test statistic to test for the lack of autocorrelation in the residuals and for the lack of correlation between the residuals and the \( x_i(t) \) series. Finally, we did not constrain the intercept term of equation (9) to be zero; estimation of a statistically significant intercept would indicate that the 4-th differenced series was not stationary.

2. Data

The data on terrorist incidents were taken from coded data sets entitled International Terrorism: Attributes of Terrorist Events (ITERATE 2) and ITERATE 3. ITERATE 2 contains the attributes of international terrorist events from 1968 to 1977 and is described in MICKOLUS [1982]; ITERATE 3 contains these attributes from 1978 to 1987 and is described in MICKOLUS, Sandler, Murdock and Fleming [1989]. The data for 1988 were taken from a chronology update written by MICKOLUS and made available to us. We assembled time series of all coded transnational terrorist incidents that took place within each country in our sample during 1968-1988. In particular, we used the quarterly totals of terrorist events by country (region) as the \( x \) series. Two different quarterly totals were available and utilized: (1) the totals of all terrorist events, and (2) the number of terrorist acts actually directed at tourists—i.e., tourists or their property were affected by the incident. Each incident in the data set is written up in two chronologies of terrorist incidents [MICKOLUS, 1980; MICKOLUS, Sandler and Murdock, 1989]. These chronologies represent the most comprehensive data set publicly available and are compiled from newspaper accounts of events. In these chronologies, each transnational incident is coded based upon date; location, type of event, victim’s characteristics and many other variables. Transnational terrorism concerns incidents involving terrorists, institutions, national territories, or government participants from two or more nations. Incidents originating in one country and terminating in another
THE IMPACT OF TERRORISM ON TOURISM

(e.g., the hijacking of Kuwaiti Air flight 422 in April 1988) are transnational, as are incidents with demands made of a non-host nation. Consistency of definition, with respect to the transnational and other distinctions, are maintained for the two data sets by employing identical criteria. In addition, there was some overlap of coders for the two data sets since Mickolus was involved with both. Transnational incidents, rather than domestic incidents, are most relevant with respect to risks perceived by foreign tourists. By definition, domestic incidents cause no harm to foreigners, tourist or otherwise.

The data on tourist receipts are taken from the International Monetary Fund's *Balance of Payments Statistics* data tapes. Specifically, we obtained quarterly values of 'Travel: credit' (line 1D.A4) and 'Passenger Services: credit' (line 1C1A4) for as many nations as possible. The sum of these two series most closely approximates the total receipts of a nation from tourism. The series 'Merchandise exports' (line 1A.A4) does contain some purchases made by tourists; however, it is not possible to obtain merchandise exports disaggregated into purchases made by tourists and purchases made by others. Since the preponderance of merchandise exports are not associated with tourism, we chose to use the sum of lines 1D.A4 and 1C1A4 as the most appropriate measure of tourism receipts.

We were able to obtain quarterly data from 1970: I to 1988: IV for twelve countries: Austria, Canada, Denmark, Finland, France, West Germany, Greece, Italy, the Netherlands, Norway, the United Kingdom, and the United States. Unfortunately, adequate data were not available for several other countries of interest. Quarterly series on Spain and Mexico are not available until 1975: I; quarterly series are not available for the Caribbean nations or for Cyprus; and it is not possible to obtain data for Northern Ireland separately from that of the entire U.K. The IMF reports all tourist revenues in terms of SDRs; hence, it was not necessary for us to convert the figures into a common currency. Although some nations report the number of tourist visits each quarter, we consider the value of tourist revenues to be a more appropriate measure of the economic cost of terrorism.

IV. STATISTICAL RESULTS

The statistical results for the effects of terrorism on Greece, Italy, and Austria are reported in Table 1. There are several interesting features that all three estimates have in common. The intercept terms are all insignificantly different from zero at conventional significance levels; this result is supportive of the Dickey-Fuller tests concerning the stationarity of the differenced series.
Moreover, each estimate has a single autoregressive term (at lag 1) and a single moving average term (at lag 4). The estimated coefficients for Greece and Italy are quite similar, which is to be expected as both Mediterranean countries draw from the same pool of tourists.

The estimated transfer functions show a two-period lag for Italy and a three-period lag for Greece. Thus, tourism does not begin to respond to a terrorist incident until a full six to nine months after the incident has elapsed. This moderate lag is not unexpected, since it generally takes time for tourists

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean</th>
<th>Estimated ARIMA Model</th>
<th>Estimated Transfer Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>-0.001645</td>
<td>MA(4) .407633 (3.19)</td>
<td>$x^*(t-3)$ -0.006382 (-2.23)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AR(1) .708505 (7.39)</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>-0.015900</td>
<td>MA(4) .544874 (4.76)</td>
<td>$x^*(t-2)$ -0.002441 (-2.74)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AR(1) .762992 (8.90)</td>
<td>Denominator term .627555 (3.25)</td>
</tr>
<tr>
<td>Austria</td>
<td>-0.010294</td>
<td>MA(4) .526341 (4.33)</td>
<td>$x^*(t-7)$ -0.047215 (-2.33)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AR(1) .333476 (2.70)</td>
<td>Denominator term -0.636616 (-2.41)</td>
</tr>
</tbody>
</table>

All share variables are seasonally differenced. t-statistics are in parentheses.

$b$ variable includes all terrorist attacks.

$c$ variable includes terrorist attacks directed at tourists.

$d$ The transfer function for Greece is $-0.006382 x^*(t-3)$. The transfer function for Italy is $-0.002441 x^*(t-2) / (1 + 0.627555L)$, where $L$ is the lag operator. The transfer function for Austria is $-0.047215 x^*(t-7) / (1 - 0.636616L)$. 

Table 1
Log Share of Tourism: Greece, Italy, and Austria
ARIMA: Maximum Likelihood Estimates
(Quarterly Data)
THE IMPACT OF TERRORISM ON TOURISM

to revise their plans; many reservations on airlines and cruise ships cannot be altered without paying a sizable premium. For Austria, we are somewhat surprised that there is a seven-quarter delay between the onset of a terrorist incident and a statistically significant response of tourism to the incident. It might, of course, be the case that the ARIMA estimation techniques are not sufficiently sophisticated to pick-out the precise lag-length for the transfer function, especially since ARIMA estimations place such a high weight on parsimony.

Since each of the three models has an autoregressive term, the system has a memory regarding terrorist incidents; the effect of any particular incident decays at the rate given by the AR(1) coefficient. The transfer function for Greece has a straightforward interpretation: a terrorist incident in period $t$ has a direct impact on tourist revenues in period $t + 3$. Due to the autoregressive nature of the system, there is a diminishing effect on tourism in subsequent periods. The transfer functions for Italy and Austria are more complex inasmuch as the transfer functions are themselves autoregressive processes. In Austria, tourism in period $t$ is influenced by the number of incidents occurring in each time period prior to period $t - 6$. Since the autoregressive factor in the transfer function is negative (i.e., $-0.636616$), the importance of an incident declines over time. Italy has the shortest lag length: tourism in period $t$ is influenced by the number of incidents occurring in each time period prior to period $t - 1$. Since the autoregressive factor in the transfer function is positive ($0.627555$), the coefficients on lagged incidents alternate in sign. The oscillatory nature of the coefficients implies that tourism 'over-shoots' in response to terrorist incidents.

In the upper portion of Table 2, we report the estimated log-share of tourist revenues received by a sample of the continental European nations in our study (i.e., Austria, Denmark, France, West Germany, Italy, the Netherlands, and Greece). An AR(1)(4) model performed better than a model with an AR(1) and an MA(4) coefficient. The estimated transfer function is similar to that of Austria; there is a six-period lag between a terrorist incident and a significant reduction in continental Europe's share of tourist revenues. The transfer function is itself autoregressive. Since the coefficient is negative, the weights attached to past incidents are geometrically declining. Diagnostic checks indicated a correlation coefficient of $-0.171$ between terrorism and the second lag of the residuals of the estimated equation; however, incorporating the second lag of the terrorism series into the transfer function is not warranted by the SBC or the Box-Ljung statistic. Overall, the shorter lags experienced by Greece and Italy individually are not statistically significant for continental Europe as a
Table 2
Log Share of Tourism: Continental Europe\(^a\)
ARIMA: Maximum Likelihood Estimates\(^b,c\)
(Quarterly Data)

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean</th>
<th>Estimated ARIMA Model</th>
<th>Estimated Transfer Function(^e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continental Europe(^d)</td>
<td>-.016212</td>
<td>AR(1) .803613</td>
<td>(x^*(t-6)) -.001647</td>
</tr>
<tr>
<td>(Specification 1)(^f)</td>
<td>(-1.23)</td>
<td>(8.61)</td>
<td>(-2.23)</td>
</tr>
<tr>
<td></td>
<td>AR(4) -.427478</td>
<td>Denominator Term</td>
<td>-.741554</td>
</tr>
<tr>
<td></td>
<td>(-3.20)</td>
<td>(8.61)</td>
<td>(-3.83)</td>
</tr>
<tr>
<td>Continental Europe(^d)</td>
<td>-.017726</td>
<td>AR(1) .857484</td>
<td>(x^*(t-6)) -.001653</td>
</tr>
<tr>
<td>(Specification 2)(^f)</td>
<td>(-1.02)</td>
<td>(10.27)</td>
<td>(-2.28)</td>
</tr>
<tr>
<td></td>
<td>AR(4) -.433590</td>
<td>Denominator Term</td>
<td>-.683309</td>
</tr>
<tr>
<td></td>
<td>(-3.19)</td>
<td>(10.27)</td>
<td>(-2.56)</td>
</tr>
</tbody>
</table>

\(^a\)In our sample, Continental Europe includes Austria, Denmark, France, West Germany, Italy, Netherlands and Greece.
\(^b\)The log of the share is seasonally adjusted.
\(^c\)\(t\)-statistics are in parentheses.
\(^d\)The x variable includes only terrorist attacks directed at tourists.
\(^e\)The transfer function is \(-.001647x^*(t-6)\(/(1 -.741554L)\)\), where \(L\) is the lag operator, for Specification 1. The transfer function is \(-.001653x^*(t-6)\(/(1 -.683309L)\)\) for Specification 2.
\(^f\) Specification 1 includes 12 countries for the world (see Data Subsection); Specification 2 includes 11 countries for the world since the United Kingdom is omitted.

This suggests that, in the short term, tourists substitute away from these countries towards other continental countries.

For comparison purposes, we estimated continental Europe's share of tourist revenues relative to all countries in our sample of 12 less the U.K. This estimation, shown in the lower portion of Table 2, allows us to calculate the substitution between North America (i.e., the U.S. and Canada) and continental Europe. Again, an AR(1)(4) model performs better than an AR(1) model with an MA term at lag 4, and the coefficients of the transfer function are not significant until lag 6.
THE IMPACT OF TERRORISM ON TOURISM

The dynamic effects of a terrorist incident on tourism are quite difficult to visualize. As an aid, we use a slight modification of the impulse-response methodology, employed in a standard VAR analysis, to obtain the time paths of tourist responses to terrorist incidents. As a first-step, we identified and estimated each \( x(t) \) series as an ARIMA process. After extracting the mean, the raw data for Italy and continental Europe satisfied all our criteria for pure white noise processes; no parameters other than the mean needed to be estimated. The series for Greece and Austria were estimated as the following moving average processes:

\[
x_g(t) = 3.92893 + (1 - 0.232813L^6) \eta_g(t)
\]

(10)

\[
x_a(t) = 0.271386 + (1 + 0.308666L^7) \eta_a(t)
\]

(11)

where \( \eta_g \) and \( \eta_a \) are white noise disturbances; the subscripts \( g \) and \( a \) stand for Greece and Austria, respectively; and \( t \)-statistics are shown in parentheses.

In time period zero, we let there be a one-unit shock in each of the four terrorist series and then calculated the associated \( x_i^*(t) \) series. We used these series as the input values for our transfer functions and obtained the dynamic paths for the \( y_i^*(t) \) series represented by equation (9). Note that the results shown in Figures 1-4 are for seasonally differenced data and that Figure 4 shows the results for Specification 1 in Table 2. For all four series, terrorist incidents in country \( i \) initially reduce the log-share of tourism in country \( i \). Over time, the share begins to rise and eventually rebuilds to its initial level. All regions, except Italy, exhibit some degree of overshooting since the change in the log-share of revenues eventually becomes negative after the rebuilding period. The oscillations are particularly severe for continental Europe; the roots of the ARIMA process are complex with the real portion equal to 0.803613.

7. Diagnostic statistics are available from the authors.
Figure 1
Greece's Share of Tourism
(change in log-share)

Figure 2
Italy's Share of Tourism
(change in log-share)
THE IMPACT OF TERRORISM ON TOURISM

Figure 3
Austria's Share of Tourism
(change in log-share)

Figure 4
Continental Europe's Share of Tourism
(change in log-share)
1. Revenue Losses from Terrorism

In equation (8), the function $B_i(L)x_i(t)$ gives the change in country $i$'s log-share of tourism revenues that results from its terrorist incidents. Given our assumptions concerning preferences, the total amount of tourist expenditures can be treated as being independent of the number of terrorist incidents. Thus, the anti-log of $B_i(L)x_i(t)$ multiplied by the total of all tourist revenues can be used to estimate the actual revenue loss of country $i$ from terrorism for each period $t$.

Figures 5-8 show the time paths of the estimated tourist revenue losses from terrorism for Greece, Italy, Austria, and continental Europe. Since the height of any point represents the loss in period $t$, the area under each graph represents the total revenue losses attributable to terrorism. For Greece, Figure 5 indicates that the largest losses followed a series of incidents in 1985 and early 1986 that include the hijacking of TWA flight 847 on June 14, 1985 and the bombing of TWA flight 840 on April 2, 1986. After these incidents, the U.S. government issued a temporary travel advisory, warning tourists of lax security at Greek airports. Once the advisory was lifted, the Greek National Tourist Organization mounted its ad campaign to entice U.S. tourists back. Italian tourist revenue losses are much smaller than those of Austria. A cyclical pattern is evident in Figure 6. For Austria, Figure 7 shows that after some revenue losses during 1974-78 there were no losses until a series of incidents during 1979-1980, which were, in part, directed at Jewish interests and which represented 'spill-over' terrorism from the Middle East. Large losses occurred in recent years following three transnational incidents in 1985, five in 1986, and eight in 1987. The highest profile incident was the Abu Nidal attack on tourists at the Vienna Airport on December 27, 1985. Tourist revenue losses for our sample of European nations (using Specification 1) are shown in Figure 8, where a clear upward trend is evident.

These total revenue losses are reported in Table 3. Revenues lost in 1974 have, of course, a higher present value than those lost in 1988. Using a 5% real discount rate, we obtained the present value (in real 1988:IV SDRs) from the stream of losses; these estimates are also reported in Table 3. According to our calculations, Austria, Italy, and Greece lost 2.582 billion, 615 and 427 million of SDRs, respectively, since 1974. Continental Europe lost over 12.6 billion SDRs since 1974. Although large in an absolute sense, these losses are rela-

8. The oscillatory nature of coefficients of Italy’s transfer function makes for an unsatisfactory visual interpretation; for illustrative purposes only, we constructed the time series for Italy as a four-quarter moving average. Note that the figure for continental Europe shows the total loss for continental Europe (i.e., Specification 1), not the loss to North America.
THE IMPACT OF TERRORISM ON TOURISM

Figure 5
GREECE'S TOURISM LOSSES
(millions of SDR)

Figure 6
ITALY'S TOURISM LOSSES
(millions of SDR)
Figure 7
AUSTRIA'S TOURISM LOSSES
(MILLIONS OF SDR)

Figure 8
TERRORISM COSTS IN EUROPE
(millions of SDR)
THE IMPACT OF TERRORISM ON TOURISM

tively small when compared to total receipts from tourism (see the last column in Table 3 where we report the loss as a percent of 1988 tourist revenues). Continental Europe lost over 12.6 billion SDRs in total, but only 10.5 billion SDRs to North America. The direct implication of this breakdown is that the U.K., which is excluded from continental Europe, gained a share of tourist revenues resulting from terrorism on the continent.

Table 3
Revenue Losses Attributable to Terrorism: Millions of SDRs*
(Total since 1974)

<table>
<thead>
<tr>
<th></th>
<th>Total Loss</th>
<th>Present Value (5% Real Interest)</th>
<th>Loss/1988 Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>2,582</td>
<td>3,372</td>
<td>40.7%</td>
</tr>
<tr>
<td>Italy</td>
<td>615</td>
<td>861</td>
<td>6.0%</td>
</tr>
<tr>
<td>Greece</td>
<td>427</td>
<td>572</td>
<td>23.4%</td>
</tr>
<tr>
<td>Continental Europe</td>
<td>12,610</td>
<td>16,145</td>
<td>29.6%</td>
</tr>
<tr>
<td>Continental Europe to North America</td>
<td>10,570</td>
<td>13,544</td>
<td>—</td>
</tr>
</tbody>
</table>

*At the end of 1988, it was .7431 SDRs per U.S. dollar, and it was .8714 SDRs per ECU.

We tried to estimate the effects of terrorism on tourist revenues for each of the continental nations, but we were not able to detect any significant effects for a number of nations. For example, terrorism in France did not have a significant effect on French tourist revenues: the same can be said for Denmark, Germany, the Netherlands, Norway, and Finland. Since the sum of the effects of terrorism in continental Europe as a whole (12.6 billion SDR) is greater than the sum of the country-by-country effects, there is evidence of a strong transnational externality. That is, terrorism in any one continental nation, say France, may not have a strong effect on tourism within France, but it may deter tourists from visiting the continent in general.
V. CONCLUDING REMARKS

The analysis here demonstrates that European countries that depend on tourism for a source of foreign exchange may lose tourist revenues owing to terrorism. Using an ARIMA model with a transfer function based on terrorist incidents, we have developed a forecasting technique to investigate the impact of terrorism on tourism. This technique was applied to tourism shares for Greece, Italy, Austria, and a sample of continental Europe. Total revenue losses were estimated for each of these three nations and continental Europe; these estimates were also reported in present value terms and as a percent of 1988 tourist revenue. Some nations (e.g., France), which withstood recent terrorist campaigns specifically aimed at tourists, did not experience a significant impact on tourist revenues.

Our results show that terrorists have been successful in deterring tourism and that there is a generalization effect; an incident in one nation acts to deter tourism in neighboring nations. The negative externality has important consequences for the proper amount of expenditures used to thwart terrorism. In absolute amounts, the revenue losses appear sizable; using a 5% real interest rate, continental Europe lost over 16 billion SDRs in revenues since 1974. These costs must be added to the cost of lost lives and property resulting from terrorist incidents. Although the tourism losses are relatively small when compared to total tourism receipts (undiscounted, these losses were less than 30% of 1988 revenues), most of the losses have occurred recently. Austria and Greece show pronounced losses in tourist revenues in the latter 1980s, and there is a strong upward drift in the losses for continental Europe.

Our research leaves some important questions unanswered. First, we are not able to determine whether tourists' responses to terrorist incidents are rational or not. For Italy and for continental Europe as a whole, ARIMA estimations showed that incidents are truly independent, an incident at time t should not induce rational individuals to alter their plans for future periods. We may have uncovered another application of TVERSKY and KAHNEMAN'S [1981] prospect theory which explains why people may overreact to low probability events with high (catastrophic) losses. We are not able to characterize the governments' optimal responses to terrorism. Whatever these responses, the generalization effect implies a form of international cooperation. We are currently working on a project to ascertain the efficacy of various measures designed to thwart terrorism (e.g., metal detectors, embassy fortification, the retaliatory bombing of Libya). Finally, we have not been able to ascertain the tourist revenue losses from terrorism in some high terrorism nations such as Cyprus and Spain. In spite of these limitations, we hope that knowledge of the magnitude of the losses
allows for appropriate planning for governmental units involved in countering terrorism.

REFERENCES


WALTER ENDERS, TODD SANDLER AND GERALD F. PARISE


SUMMARY

This paper quantifies the impact that terrorism has had on tourism since 1970. To accomplish this task, we estimate a forecasting equation for a country’s (region’s) share of tourism using an ARIMA model with a transfer function based on the time series of terrorist attacks in that country (or region). Our results focus on three European countries—Greece, Italy, and Austria—that have experienced noteworthy terrorist attacks since 1970. We also calculate revenue losses for continental Europe. Since 1974 these losses are large, amounting to 16 billion SDRs in present value terms. Much of the loss occurred in the 1980s.

RÉSUMÉ


ZUSAMMENFASSUNG
