Small Investment and Large Returns: Terrorism, Media and the Economy

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By

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Abstract

The study investigates the role of the media in the impact of terrorism on the economy. A unique data set of the newspaper articles that reported terrorist attacks during 2002 is used to evaluate their impact on the Tel Aviv Stock Exchange. An econometric analysis is performed in order to understand how a newspaper decides to cover a terrorist attack, i.e. the number of articles, positioning of articles, whether to include photos and the size of headlines. It was found that media coverage is an important channel through which terrorism produces economic damage. The findings also showed that the economic damage caused by terrorist attacks increases monotonically with the amount of media coverage. It was also found that the economic impact of the media coverage diminishes over time.

JEL classification: G10, G14
Keywords: Terror; Terrorism; Media, Stock markets; September 11

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1. Introduction

Recent research on the economic effects of terrorism has shown that terrorist attacks have a relatively large impact on the economy, which is estimated to be of a macroeconomic magnitude. Abadie and Gardeazabal (2003) found that terrorism reduced per capita GDP in the Basque Country by some 10 percent while Eckstein and Tsiddon (2004) estimated a 5 percent decline in GDP for Israel. Eldor and Melnick (2004) (hereafter: EM) estimated a 30 percent decline in the value of the Israeli stock market.¹ (For an estimate of the cost of terrorism in terms of utility, see the survey by Frey, Luechinger and Stutzer, 2004.) However, a still unanswered question is why terrorism has such a large impact on the economy.²,³ The existing empirical evidence on the subject, obtained using a variety of methods and sources of data, has been produced by reduced-form econometric models and is therefore unable to shed light on this question. The purpose of this paper is to fill this gap by attempting to capture the mechanism at work.

A second motivation for the research is to explain why the magnitude of terrorism's effect on the economy is so disproportionate to the small amount of resources “invested” by the terrorists. One of the possible explanations for terrorism's success is its ability produce to sizeable economic "returns" on a very small “investment”. Understanding the mechanism that produces such a disproportionate impact may lead to a more efficient strategy to minimize the economic damage from

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¹ For other research in this area, see the special issue of the European Journal of Political Economy (2004). For a line of research on political issues related to terrorism see, Jaeger and Paserman (2006) and Berrebi and Klor (2008).
² Abadie and Gardeazabal (2008) address the same puzzle and attribute the possible large economic cost to the diversion of net foreign direct investment in an open economy model.
³ In 2002, which was the year used for our analysis, GDP in Israel declined by 0.6 percent and business sector product (which is a better measure of market performance in Israel given the relative large public sector) declined by 2.5 percent, compared with positive average growth rates of 5.3 and 6.3 percent, respectively, for the 1990s.
terrorism. This kind of strategy will thus reduce the motivation for terrorism and would constitute an important counter-terrorism measure.  

Many studies of terrorism have suggested that the media coverage of terrorism plays a key role in the ability of terrorist organizations to achieve their goals (Nacos, 2002; Ganor, 2005; and Fielding and Shortland, 2006). Indeed, it is difficult to imagine terrorism achieving its goals without the media. Our assumption is that the impact of terrorism is related to the quantity of its media coverage, which is basically provided to terrorist organizations "free" of charge. The approach which we adopt here, to measure the amount of media coverage produced by terrorism, is to evaluate the "opportunity cost" (hereafter OC) of the free media coverage produced in the wake of a terrorist attack. A media coverage variable was created by answering the following question: What would be the cost of buying the amount of media coverage obtained by terror organizations? It might be useful to think of how much Bin Laden would have had to pay to, for example, CNN for all of its TV coverage of the September 11 attack. 

To evaluate the impact of terrorism on the economy we continue the approach developed in EM, and represent the economy by the total value of the Tel Aviv Stock Exchange, which is the sole stock market operating in Israel. The discounted-cash-flow valuation model states that stock prices reflect investors' expectations of future corporate earnings and the cost of capital. Accordingly, if terrorist attacks negatively affect the expectations of firms’ profitability and increase the cost of capital due to increased uncertainty, then share prices would be expected to decline.

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4 Frey (2004) explores alternative policies aimed at reducing the motivation to commit acts of terror.
5 Since opportunity cost in economics is the cost of an alternative that must be forgone in order to pursue a certain action, we borrow the term here for the resources a terror organization would have to forgo in order to obtain the media coverage they are getting free.
6 Even many years after the September 11 attack, Bin Laden and al-Qaeda continue to obtain free media coverage for their terror campaign.
In this paper we analyze the impact of terrorism on the media and then the impact of the media coverage of terrorism on the stock market. We are interested in exploring the following:

1. Is media coverage the main channel by which terrorism produces economic damage?
2. Does the economic damage caused by terrorism increase monotonically with the amount of media coverage?
3. Does the economic impact of terrorism’s media coverage diminish over time?

The paper is constructed as follows: Section 2 describes the data for media coverage and terror and the construction of the OC variable. Section 3 explores the impact of terrorism on the media using an econometric analysis. The theoretical model and the econometric methodology are presented in Section 4. The hypotheses and results are presented in Section 5. Section 6 concludes.

2. The data and the "opportunity cost"

In order to test the hypotheses, a unique data set was collected consisting of 3,045 articles published in 2002 in Israel's major daily newspapers (hereafter referred to as "media coverage"). The data includes the number of total articles published (AP), the number of articles published on the front page (FP), the number of articles with large headlines (TI) and the number of photographs published (PI) on the dates of the terrorist attacks and on the following two days. The collection of data on the media

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7 Clearly the value of the stock market is an imperfect measure of the economic impact of terrorism but we will continue to use the term economic impact for two reasons: (a) For the purpose of our study we need a daily measure of the economy, and the stock market is the best economic indicator for this purpose. (b) The stock market is positively correlated with GDP, which is the accepted measure of economic performance. In fact, the stock exchange is considered a leading indicator of GDP in the business cycle literature (see Eldor and Melnick, 2006).

8 The most violent year in the wave of terrorist attacks in Israel that began in September 2000.

9 Yedioth Ahronoth, Maariv, Haaretz and Globes.
coverage was carried out in two stages: the first involved a computer search from the Ifat Communications database using key words and the dates of the terrorist attacks.\textsuperscript{10} In the second stage, the data was sorted so as to include only articles that reported directly on the given attack during the following two days. At this stage, we measured the size of the article, the position in the newspaper, whether a picture was added and whether large headlines were used. In addition, we deleted irrelevant articles and added articles that had not been identified in the computerized search. The terror data included 180 terrorist attacks that took place in 2002.\textsuperscript{11} The analysis here focuses on the characteristics of terror attacks that EM found to have the largest impact on the economy: the number of attacks per day (AT), the attacks that took place within the Green Line (GL),\textsuperscript{12} the number of suicide attacks (SU), the number of fatalities (KI) and the number of people injured (IN). In the final stage, the media data was merged with the terrorist attack data to form the database.

The treatment of timing is important in the empirical analysis. A terrorist attack can occur at any time\textsuperscript{13}, the media data relates to a given day, and the stock market data relate to the changes during a given interval. The database includes the exact time of the terrorist attack\textsuperscript{14} and therefore the observation for day \(t\) was defined as all the attacks that occurred between the close of stock market trading (at 5 pm) on \(t–1\) and the close of trading on \(t\). The stock market observation for \(t\) is the log difference in the TA100 index between the close of trading on \(t\) and the closing of trading on \(t–1\). The media observation for \(t\) is the number of articles reporting terror

\textsuperscript{10} The data on terrorist attacks was collected for EM and covered a much longer period; here we focus only on the attacks that took place in 2002. The main source of the data is the Institute for Counterterrorism (ICT) at the Interdisciplinary Center Herzliya.

\textsuperscript{11} The ICT data on terrorism is compiled using Ganor's (2005) definition "Terrorism is the deliberate use of violence aimed against civilians in order to achieve political goals (nationalistic, socioeconomic, ideological, religious, etc.)".

\textsuperscript{12} The Green Line represents Israel’s pre-1967 borders.

\textsuperscript{13} In the data, the terrorist attacks are evenly distributed over the days of the week.

\textsuperscript{14} The time of an attack is measured with a possible error of ± 20 minutes.
attacks on the morning of \( t \) prior to the opening of trading at 9:30 am. Since no trading takes place in the stock market on Fridays and Saturdays, the data on terrorist attacks were organized into 5-day weeks starting on Sunday and ending on Thursday.\textsuperscript{15} Terrorist attacks that occurred between Thursday at 5 pm and Sunday at 5 pm were included in the data for Sunday and are expected to have an effect on the change in the value of the stock market change between Thursday and Sunday. A similar problem arises with the media data since newspapers are published on Fridays (when there is no trading) and there are no newspapers published on Saturdays. The articles published on Fridays and Sundays are therefore included in the data for Sundays.\textsuperscript{16}

The empirical analysis also needs to take into account that the impact of a terrorist attack during trading hours on day \( t \) could be reflected in prices either on the same day or the following day, i.e. \( t+1 \).\textsuperscript{17} To overcome this, we included the date of the attack and its first lag in all the regressions. Additional lags were tried in the regressions but were found to be statistically insignificant, which is consistent with the findings in EM. A more serious problem exists for terrorist attacks that occur between the opening and closing of trade on \( t \) and which will not appear in the media data for \( t \). These attacks will be covered by the media in \( t+1 \) but could potentially affect the values of stocks in \( t \). There are 25 terrorist attacks that fall into this category and the econometric analysis will address this issue.

The total estimated OC of media coverage was obtained by summing the OC of the articles over all the newspapers, taking into consideration length, position in the

\textsuperscript{15} Jewish holidays were ignored.

\textsuperscript{16} A dummy variable did not find any special effect for Sunday, thus providing support for the way in which we treated the data.

\textsuperscript{17} This will be the case for attacks that take place in the late afternoon before the close of trading.
newspaper, size of the headline and whether photographs were included. The estimate obtained for 2002 was NIS 0.5 billion. Is this estimate to be considered as having a large magnitude? One way of answering this question is to consider the fact that a media campaign of similar relative size in the US would cost $11 billion. This sum is double the size of Proctor & Gamble’s advertising budget, three times that of GM (the two largest corporations in the world in terms of advertising budget) and ten times the advertising budgets of McDonald's and Coca Cola, two well-known global corporations that base their marketing on strong publicity campaigns. It is reasonable to assume that advertising on this scale is capable of producing a large macroeconomic impact.

Table 1 presents summary statistics for the media coverage of terrorism in 2002. The total number of articles published was 3,045; on average, each attack produced 16.9 articles. The number of articles appearing on the front page was 466, the number of photographs was 2,441 and the number of large headlines was 981. Thus, each terrorist attack produced, on average, 2.6 front page articles, 13.6 photographs and 5.5 large headlines.

Table 2 presents summary statistics for the terrorist attacks that occurred in Israel in 2002. Thus, 438 people were killed and 2,066 were injured in 180 attacks. Each attack resulted, on average, in 2.4 fatalities and 11.5 injuries. In attacks within the Green Line, the average number of casualties was 5.6 killed and 34.9 injured. Suicide attacks were the most lethal, resulting in 6.2 people killed and 40.3 injured, on

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18 Since we are including only newspaper coverage, the estimate represents only a certain proportion of the total OC, which should also include TV, Internet and other media. It is assumed that the OC of newspaper coverage is proportional to that of total media coverage.
19 Equivalent to about $105 million, which represents approximately 0.1 percent of Israel’s GDP in 2002.
20 Relative to GDP in 2002, NIS 0.5 billion in Israel is equivalent to $11 billion in the US.
22 Including the day after the attack and two lags.
average. Suicide attacks in 2002 caused 55 percent of the deaths and 76 percent of the injuries.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Summary Statistics for Daily Coverage of Terrorist attacks by Israeli Newspapers, 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AP</td>
</tr>
<tr>
<td>Mean</td>
<td>16.9</td>
</tr>
<tr>
<td>Maximum</td>
<td>128</td>
</tr>
<tr>
<td>Total²</td>
<td>3,045</td>
</tr>
</tbody>
</table>

¹ Media coverage in Israel's major daily newspapers: Yedioth Ahronoth, Maariv, Haaretz and Globes on the date of an attack and on the two following days. AP, FP, PI and TI denote number of articles printed, front page articles, photographs and large headlines, respectively.

² Annual totals.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Summary Statistics for Terrorist Attacks in Israel, 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IN</td>
</tr>
<tr>
<td>AT</td>
<td>11.5²</td>
</tr>
<tr>
<td>GL</td>
<td>34.9³</td>
</tr>
<tr>
<td>SU</td>
<td>40.3⁴</td>
</tr>
<tr>
<td>Total</td>
<td>2,066</td>
</tr>
</tbody>
</table>

¹ AT, GL, SU, IN and KI denote number of attacks, attacks within the Green Line, suicide attacks, number of injured and number of killed, respectively.

² Mean per attack.

³ Mean per attack within the Green Line.

⁴ Mean per suicide attack.

To construct the OC variable, we used the cost of advertising in each of the newspapers in our sample, which varies according to size and position.²³ The cost on the front page is from two to four times greater than that for inside pages.²⁴ A text-pricing function was constructed for each newspaper and applied to each article. Summing up the daily OC of all the newspapers, we obtained a time series that represents the economic value, in 2002 prices, of the media coverage of terrorist attacks, which is presented in Figure 1.

²³ These data were obtained from Ifat Communications.

²⁴ Some newspapers charge different rates for odd and even pages.
The cumulative OC of the published text was NIS 0.25 billion\textsuperscript{25} which represents a daily average of NIS 1.39 million. The maximum daily OC was NIS 8.7 million.\textsuperscript{26}

3. The impact of terrorism on the media

In this section, we estimate the OC production function and functions to explain newspaper editors’ decisions regarding how many articles to publish, whether to print the article on the front page, the size of the headline and the inclusion of photographs.

Let $T$ be a vector including all the terrorist attack characteristics (AT, GL, IN, KI, SU) and let $M_i$, $i = 1$ to 5, be each of the media coverage variables (OC, AP, FP, PI, TI). The estimated model is then:

\begin{equation}
A_i(L) M_{it} = B_i(L) T_t + \epsilon_{it},
\end{equation}

where $A_i(L)$ and $B_i(L)$ are polynomials in the lag operator and $\epsilon_{it}$ is a stochastic disturbance. The estimation results are presented in Table 3.

\textsuperscript{25} The OC of large headlines and of photographs is of the same magnitude, NIS 0.25 billion, so the total OC is NIS 0.5 billion.

\textsuperscript{26} This occurred on the eve of Passover on Wednesday March 27, 2002 and was known as the "Passover massacre". 30 Israeli civilians were killed and 150 injured in the attack.
The $R^2$ is relatively high for all the equations with the various terror characteristics capturing between 60 and 70 percent of the variance in media coverage. The DW statistics indicate the absence of serial correlation in the residuals.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>AT $^2$</th>
<th>GL $^2$</th>
<th>IN $^2$</th>
<th>KI $^2$</th>
<th>SU $^2$</th>
<th>R $^2$</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC</td>
<td>0.38</td>
<td>1.15</td>
<td>0.00</td>
<td>0.22</td>
<td>-0.04</td>
<td>0.65</td>
<td>1.86</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.449)</td>
<td>(0.000)</td>
<td>(0.888)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP</td>
<td>3.32</td>
<td>9.65</td>
<td>-0.05</td>
<td>3.46</td>
<td>3.87</td>
<td>0.71</td>
<td>2.19</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.004)</td>
<td>(0.463)</td>
<td>(0.000)</td>
<td>(0.256)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FP</td>
<td>1.32</td>
<td>0.88</td>
<td>0.00</td>
<td>0.30</td>
<td>0.12</td>
<td>0.64</td>
<td>1.93</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.103)</td>
<td>(0.986)</td>
<td>(0.000)</td>
<td>(0.828)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI</td>
<td>3.32</td>
<td>6.77</td>
<td>-0.06</td>
<td>3.04</td>
<td>1.93</td>
<td>0.71</td>
<td>2.29</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.013)</td>
<td>(0.260)</td>
<td>(0.000)</td>
<td>(0.499)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TI</td>
<td>1.64</td>
<td>4.87</td>
<td>-0.06</td>
<td>0.91</td>
<td>-0.59</td>
<td>0.59</td>
<td>1.51</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.000)</td>
<td>(0.633)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 AT, GL, IN, KI, SU denote number of attacks, attacks within the Green Line, number of injured, number of killed and number of suicide attacks, respectively. OC, AP, FP, PI, TI denote opportunity cost, number of articles, number of front page articles, number of photographs and size of headlines, respectively.

2 Sum of the corresponding lag coefficients. p-values appear in parentheses.

Only two lags were needed for the $B_i(L)$ polynomials and none for $A_i(L)$ in all the models. In other words, the editors’ decisions reflect the characteristics of the terrorist attacks during the previous two days attack. The terror characteristics that determine the editors’ decisions are AT, GL and KI; once they are included in the regression, IN and SU do not contribute to the equation. This finding indicates that since the number of people injured is almost proportional to the number killed and suicide attacks cause the greatest number of people killed, the KI variable statistically captures the effect of all three.

The OC equation can be interpreted as a production function, with media coverage representing the output produced by terror characteristic inputs. Under this interpretation, an additional terrorist attack produces NIS 0.38 million worth of media
coverage, NIS 1.15 million if the attack is within the Green Line and each person killed adds NIS 0.22 million.

4. The theoretical model and the econometric methodology

To test the hypotheses, we used an expanded version of the model developed in EM. The basic equation is given by:

\[ x_t = f_t + x_{t-1} + u_t, \]

where \( x_t \) is a non-stationary I(1) variable representing the log of Israel's stock market index (TA100), \( f_t \) is a possible drift represented by the log difference of the S&P500 index\(^{27} \) and \( u_t \) is a white noise innovation. This specification reflects the liberalization of Israel's domestic capital markets, the openness of the Israeli economy to capital movements and the relatively large number of stocks that are traded simultaneously in the Israeli and US markets. The market trends are presented in Figure 2.

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\(^{27}\) The trading day in Israel opens at 9:30 am, Israel time, which corresponds to either 2:30 am. or 3:30 am in New York and therefore the explanatory variable is the change in the S&P500 for \( t-1 \)
Tables 4 and 5 present empirical evidence to support this specification. Table 4 presents the results of augmented Dickey Fuller tests for unit roots using daily Israeli data and shows that the presence of a unit root cannot be rejected for the log levels and is rejected for the first differences. Table 5 presents the results of the Granger causality test, which indicate Granger causality from the S&P500 index to the TA100 index and, as expected, not the other way around.

The residual \( u_t \) is a white noise innovation. Denoting by \( D \) the first difference operator, equation (2) can be transformed into:

\[
Dx_t = f_t + u_t.
\]

The impact of terrorism is obtained by decomposing the \( u_t \) innovation into two components:

\[
u_t = \tau_t + \varphi_t,
\]

where \( \tau_t \) is the innovation associated with the terrorist attack and \( \varphi_t \) is pure noise.

By modeling \( \tau_t = \gamma T_t \), we can estimate the vector of parameters \( \gamma \), which capture the impact of the various characteristics of a terrorist attack on the economy through its effect on the stock market.
In efficient markets, information about a terrorist attack should be instantaneously incorporated in market prices so that the inclusion of additional lags is unnecessary. This feature was used in EM to test for the efficiency of the Israeli stock market. In the current model, we introduce a lag into the equation for two reasons: The first is technical, whereby if it is assumed that a terrorist attack has a transitory effect on the market, i.e. one which is not permanently incorporated in market prices, then the lagged effects will capture a reversal of the temporary impact of the terrorist attack without violating efficiency. The second reason is that if Israel retaliates or reacts in some way to a terrorist attack,\textsuperscript{28} this will introduce new information that will affect market prices and will therefore be captured in lagged effects.\textsuperscript{29}

The basic model for estimating $\tau_t$ is given by:

\begin{equation}
Dx_t = \alpha + \beta T + \gamma T_{t-1} + \varphi_t.
\end{equation}

To test the basic hypothesis, we augment (5) by adding the media coverage $\delta M$, where $\delta$ is a parameter capturing the impact of media coverage $M$ on the stock market:

\begin{equation}
Dx_t = \alpha + \beta f_t + \gamma_0 T_t + \gamma_1 T_{t-1} + \delta M_t + \varphi_t.
\end{equation}

$M_t$ represents the OC of the coverage of the attack the following morning, before the opening of trade.\textsuperscript{30} If we cannot statistically reject the hypothesis that $\delta=0$ and $\gamma\neq0$, then it can be concluded that the actual characteristics of terrorism explain its economic impact and not its media coverage. If, on the other hand, we cannot reject the hypothesis, i.e. that $\gamma=0$ and $\delta\neq0$, we can infer that the media coverage of

\textsuperscript{28} Zussman and Zussman (2006) explore the impact of Israeli counterterrorism policy using stock market data. They find that the reaction of the stock market depends on the rank of the target and whether the target is a political or military official.

\textsuperscript{29} A more sophisticated treatment of the strategic action and reaction of agents involved in this conflict is beyond the scope of this paper.

\textsuperscript{30} Globes is an evening paper and therefore its coverage is based on information from the previous day $t-1$, similar to the information of a morning paper on day $t$. 
terrorism is exclusively responsible for its economic damage rather than the actual terrorist attack.

Eisensee and Strömberg (2007) specify a similar model to study mass media's influence on the US government's responses to natural disasters outside the US. Their model requires instrumental variable estimation to overcome the simultaneity arising from the fact that "news coverage and policy decisions will be correlated even if news has no effect on policy since news coverage depends on unobserved issue salience on political agendas, both of which directly affect policy." Their simultaneity problem is acute since the variables (which are binary) are measured in overlapping intervals of time. In our model, the simultaneity problem is less of a concern for two reasons: The first is the nature of the dependent variable, which is the change in stock prices. In an efficient market, the value of stocks is affected only by unexpected and therefore uncorrelated shocks. The second is the time series nature of the data, such that the media variable is the pre-trading newspaper coverage of terrorist attacks while the dependent variable is the following change in stock prices. As a result, the regular predetermined time series argument is applicable here.

5. Testing the hypotheses

The first hypothesis was tested using the estimated equations presented in Table 6. In order to overcome multicollinearity, we first tested our hypotheses by running five different models, each with a different terror characteristic. Equations (6.2), (6.4), (6.6), (6.8) and (6.10) in Table 6 show that the effect of new information captured by the empirical characteristics of the terrorist attacks is statistically significant.

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32 We plan to further explore this issue in a future study.
Table 6
The Impact of Terrorism and its Media Coverage\(^1\) on the Stock Market
as represented by the TA\(^1\)\(^2\)
January 1–December 31, 2002

<table>
<thead>
<tr>
<th></th>
<th>S&amp;P500</th>
<th>OC</th>
<th>AT(^3)</th>
<th>GL(^3)</th>
<th>IN(^3)</th>
<th>KI(^3)</th>
<th>SU(^3)</th>
<th>R(^2)</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6.1)</td>
<td>0.10</td>
<td>0.02</td>
<td>2.02</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(6.2)</td>
<td>0.10</td>
<td>-0.22</td>
<td>(0.01)</td>
<td></td>
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</tr>
<tr>
<td>(6.3)</td>
<td>0.10</td>
<td>-0.15</td>
<td>(0.01)</td>
<td>-0.04</td>
<td>(0.74)</td>
<td></td>
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<td>(6.4)</td>
<td>0.11</td>
<td>-0.58</td>
<td>(0.004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.10</td>
<td>2.06</td>
</tr>
<tr>
<td>(6.5)</td>
<td>0.11</td>
<td>-0.14</td>
<td>(0.01)</td>
<td>-0.19</td>
<td>(0.44)</td>
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<td>0.09</td>
<td>2.04</td>
</tr>
<tr>
<td>(6.6)</td>
<td>0.10</td>
<td>-0.01</td>
<td>(0.03)</td>
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<td>(6.7)</td>
<td>0.10</td>
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<td>(0.82)</td>
<td></td>
<td></td>
<td>0.09</td>
<td>2.03</td>
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<tr>
<td>(6.8)</td>
<td>0.10</td>
<td>-0.06</td>
<td>(0.004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.06</td>
<td>2.09</td>
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<td>(6.9)</td>
<td>0.10</td>
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<td>0.01</td>
<td>(0.72)</td>
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<td>(6.10)</td>
<td>0.10</td>
<td>-0.52</td>
<td>(0.02)</td>
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<tr>
<td>(6.11)</td>
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<td>-0.04</td>
<td>(0.88)</td>
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<tr>
<td>(6.12)(^a)</td>
<td>0.11</td>
<td>-0.03</td>
<td>(0.78)</td>
<td>-0.41</td>
<td>(0.21)</td>
<td>0.00</td>
<td>-0.04</td>
<td>0.12</td>
<td>2.03</td>
</tr>
<tr>
<td>(6.13)(^b)</td>
<td>0.11</td>
<td>-0.15</td>
<td>(0.04)</td>
<td>0.02</td>
<td>(0.85)</td>
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<td>0.13</td>
<td>1.99</td>
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<tr>
<td>(6.14)</td>
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<td>-0.18</td>
<td>(0.01)</td>
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<td></td>
<td>0.09</td>
<td>2.04</td>
</tr>
</tbody>
</table>

Hypothesis Testing

\(^a\) In equation (6.12) - \(H_0: \gamma_{AT} = \gamma_{GL} = \gamma_{IN} = \gamma_{KI} = \gamma_{SU} = 0\)
\(H_1: \text{Otherwise}\)
The test statistic is \(F = 2.96\), with \(p=0.001\). Therefore \(H_0\) is rejected.

\(^b\) In equation (6.13) - \(H_0: \gamma_{AT} = \gamma_{GL} = \gamma_{IN} = \gamma_{KI} = \gamma_{SU} = 0\)
\(H_1: \text{Otherwise}\)
The test statistic is \(F = 0.12\), with \(p=0.99\). Therefore \(H_0\) cannot be rejected.

\(^1\) AT, GL, IN, KI and SU denote number of terrorist attacks, number of attacks within the Green Line, number injured, number killed and number of suicide attacks, respectively. OC denote opportunity cost.

\(^2\) All regressions include a constant. The dependent variable is Dlog(TA100) and the main explanatory variable is the first lag of Dlog(S&P500). None of the results are affected if the Passover massacre on March 27\(^{th}\) attack is omitted.

\(^3\) Sum of the corresponding lag coefficients; p-values appear in parentheses.
We report the F-test for $H_0: \gamma_0 + \gamma_1 = 0$; all were rejected as having the anticipated negative sign. These estimates qualitatively reproduced the results obtained in EM. After adding the OC variable to each of the equations, the results (for equations (6.3), (6.5), (6.7), (6.9) and (6.11)) indicate that the empirical characteristics of the terrorist attacks had become statistically insignificant, whereas the media coverage of terrorism became highly significant in all cases, with the correct negative sign.

In equation (6.13), we perform the same test in a model that introduces all the terror variables into the equation. Again, we cannot reject the hypothesis that all the $\gamma$’s are statistically equal to zero; only the OC variable remains statistically significant with the correct negative sign, thus capturing the impact of terrorism. None of the physical characteristics of a terrorist attack is statistically significant on its own; neither can we reject the hypothesis that they are all statistically insignificant as a group. Therefore, the interpretation that the individual variables are not significant due to multicollinearity can be discarded.

The findings presented in Table 6 show that the decline in stock market prices is proportional to the amount of media coverage. This result is illustrated in Figure 3,

33 Similar qualitative results were obtained using the various measures of media coverage.
where opportunity cost is plotted against the percent change in the TA100 index, after controlling for the impact of the US market. This illustrates the result obtained in equation (6.13), whereby a larger opportunity cost is associated with a larger decline in the stock market.

As mentioned previously, the data on terror attacks include 25 attacks that occurred during trading hours on day $t$ and which are therefore not covered by the media variable for that day. In order to test the impact of the attacks, a dummy variable was introduced for these attacks, together with an interaction term of the dummy with the terrorist attack characteristics. This was done for all the regressions in Table 6 and in none of them statistically significant. Clearly, the media variable captures most of the effect on the stock market. It is possible that this outcome reflects the fact that other media, which are not directly measured here, report terrorist attacks almost in real time.

The findings indicate that the correct model is given by equation (6.14). Only the OC variable is statistically significant and serves as a sufficient statistic containing all the information needed to capture the effects of terrorism on the stock market.

In Section 3, the results showed that media coverage is related to the characteristics of the terrorist attack. Thus, an alternative way of presenting the results is to decompose OC into two orthogonal components, i.e. the portion explained by the characteristics of terror (in our case AT, GL and KI) and the unexplained portion

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34 Clearly those attacks are covered by other media: TV, radio, Internet and others not measured here.
35 Many types of news items can have an impact on the stock market (see, for example, Zussman et al., 2008, who study the differential impact on asset prices of the escalation of violence and peace initiatives in the Israeli-Palestinian conflict). The present study is limited to the unilateral impact of terrorism on the economy.
represented by the residuals of that regression and denoted by $OC^{unex}$, and then estimate the following equation:\(^{36}\):

\[
(7) \quad D\log(TA100, t) = 0.10 + 0.10*D\log(S & P500, t_{-1}) - 0.15*OC^{unex}_{t-1} - 0.12*AT_{t} + 0.07*AT_{t-1} \\
- 0.47*GL_{t} + 0.15*GL_{t_{-1}} + 0.02*KI_{t} - 0.05*KI_{t_{-1}} \\
p - values in parentheses, R^2 = 0.13 \quad DW = 2.00
\]

The results for equation (7), clearly show that $OC^{unex}$ is statistically significant and capture other characteristics of media coverage that are not directly related to the characteristics of a terrorist attack\(^{37}\). These other characteristics may be attributable to the description of the attack (for example, sensational coverage may have a larger impact; see, for instance, the analysis of Becker and Rubinstein (2004)), the type of victims (assuming that children and the elderly produce a larger impact), the type of photographs printed (color or black and white; with or without showing the victims) and other aspects of the attack’s media coverage.\(^{38}\) It can therefore be argued that the actual physical damage caused by terror (which is small by any account; hence the puzzle regarding its large effect) is magnified by media coverage. The psychological and demoralizing aspects of such acts, even without media coverage, certainly have an additional impact and perhaps our media coverage variable is capturing some of those effects.

A measure of the relative importance of $OC^{unex}$ and the direct characteristics of a terrorist attack in the decline of the market can be obtained from their relative

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\(^{36}\) One might be tempted to interpret $OC^{unex}$ as excess media coverage. This could be incorrect however since the explained component may be large and possibly excessive. In order to address this issue one would need to define what is the "adequate" or "correct" amount of media coverage, which is beyond the scope of this paper.

\(^{37}\) IN the number of injured and SU the suicide attacks are omitted since they are not significant when KI the number of killed in an attack is included in the regression, see table 3.

\(^{38}\) This might be a promising area for future research, which would require overcoming the challenge of quantifying the characteristics of media coverage.
contribution to $R^2$ in (7), beyond the contribution of the change in the S&P500 index. This can be uniquely computed since $OC^{unex}$ and $T$ are orthogonal by construction and therefore their contribution to $R^2$ is additive\textsuperscript{39}. The combined joint contribution of $OC^{unex}$ and $T$ to $R^2$ is 0.106. $T$ contributes 0.089 or 84 percent while $OC^{unex}$ contributes 0.017 or 16 percent. The relatively small though statistically significant effect of the unexpected role of the media in this decomposition might lead to the conclusion that the additional impact of the media is not that important. On the other hand, this interpretation requires an assumption that the portion explained by $T$ representing the physical attributes of a terrorist attack is adequately captured by the media; however, this is not necessarily the case (see footnote 36). The definition of the "adequate" amount of media coverage is an interesting question, but is beyond the scope of this paper.

The second hypothesis we wish to explore states that a larger amount of media coverage will increase the economic damage of a terrorist attack. In principle, this hypothesis could be tested in an equation similar to those in Table 6; however, the results there show that once the $OC$ variable is included in the equation, none of the terror characteristics is statistically significant. We therefore turn to a less rigorous approach.

No two terrorist attacks are identical. We therefore classified the daily data on terrorist attacks into clusters with similar characteristics, each containing a minimum number of cases and explored the impact of the media on the stock market within each cluster.

\textsuperscript{39} The decomposition is obtained in two steps. In the first step we obtain the residuals of a regression of $D\log(TA100)$ on the first lag of $D\log(S&P500)$. In second step we run two separate regressions: in one we run the residuals obtained in the first step on $T$ (the $R^2$ of this regression is 0.089) and in the other we run the same residuals on $OC^{unex}$ (the $R^2$ of this regression is 0.017).
The clusters are mutually exclusive: Cluster 1 contains 16 cases of large-scale suicide attacks within the Green Line, each of which resulted in 5 or more people killed and more than 20 injured: Cluster 2 contains 16 cases of suicide attacks within the Green Line, but with fewer than 5 people killed and any number injured; Cluster 3 contains 72 cases of terrorist attacks that resulted in at least one person injured, but which do not belong to Cluster 1 or 2; and finally, Cluster 4 contains all the other trading days in 2002, during which there were 12 terrorist attacks with no one killed or injured, and days without a terrorist attack on which the media covered attacks that had occurred on previous days. The impact of the media on the stock market within each cluster is presented in Table 7.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Number of days</th>
<th>Simple correlation</th>
<th>Regression coefficient(^1)</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>16</td>
<td>-0.498</td>
<td>-0.235</td>
<td>(0.049)</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>16</td>
<td>-0.203</td>
<td>-0.247</td>
<td>(0.452)</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>72</td>
<td>-0.358</td>
<td>-0.225</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>156</td>
<td>-0.136</td>
<td>-0.122</td>
<td>(0.090)</td>
</tr>
</tbody>
</table>

\(^1\) p-values appear in parentheses.
\(^2\) Coefficient of OC in a regression on Dlog(TA100) while controlling for the effect of Dlog(S&P500) using an equation similar to (6.14) in Table 6.
\(^3\) Suicide attacks within the Green Line with more than 5 people killed and 20 injured.
\(^4\) Suicide attacks within the Green Line with fewer than 5 people killed and any number of injured.
\(^5\) Attacks with at least one person injured that do not belong to Cluster 1 or 2.
\(^6\) All other days. This cluster includes 12 attacks with no one killed or injured and days without a terrorist attack (on which media coverage was of previous attacks).

All clusters showed a negative correlation between OC and the change in stock market prices; the correlation was statistically different from zero at the 5 percent level for Cluster 1, at the 1 percent level for Cluster 3 and at the 10 percent level for
Cluster 4. In Cluster 2, the correlation is negative but not statistically different from zero. The last column presents the coefficient of OC in a regression on the change in the stock market index, controlling for the previous change in the S&P500 using an equation similar to (6.14) in Table 6. In this case as well, a negative coefficient was obtained for all clusters, which was significant at the 10 percent level for Clusters 1 and 4 and at the 1 percent level for Cluster 3 and not statistically different from zero for Cluster 2. These results constitute evidence in support of our hypothesis that other things being equal, i.e., controlling for the physical characteristics of a terrorist attack, the more extensive the media coverage of a terrorist attack, the greater will be the damage it causes to the economy.

The final hypothesis involves the impact of media coverage on the stock market over time. In other words, does a desensitization process occur over time, whereby a similar amount of media coverage will have a diminishing impact on stock market prices over time?

In order to test this hypothesis, we added a time trend and an interaction variable between the time trend and OC to equation (6.14) in order to obtain equation (8.2) (equation (8.1) is identical to equation (6.14)). The results are presented in Table 8. The results show a positive and statistically significant interaction term which indicates that the impact of the media coverage of a terrorist attack on the stock market diminishes over time.
The study has addressed the question of why terrorist attacks have such a large impact on the economy and its findings indicate that media coverage plays a major role in answering it. The value of the media coverage of terrorist attacks, which terrorist organizations receive free of charge, is of the same order of magnitude as the advertising budgets of some of the world's largest corporations and therefore has a correspondingly large macroeconomic impact. The findings indicate that the media coverage of terrorist attacks is an important channel through which terrorism achieves its goals, which is demonstrated through the effect of that media coverage on stock prices. When we decompose the effect of the media into the direct report of a terror attack and the extra media coverage, we find that the direct report explains 84 percent of the effect and the extra coverage explains the additional 16 percent.

We quantified the media coverage by evaluating the opportunity cost of the free coverage enjoyed by terrorist organizations. The construction of the media coverage variable was performed by answering the following question: What would be the opportunity cost of buying the amount of media coverage obtained free by terror organizations? This variable was successfully used in the econometric analysis. The analysis showed that the opportunity cost of the media coverage on the morning after

<table>
<thead>
<tr>
<th>Table 8</th>
<th>The Impact of the Media Coverage of Terrorism on the Stock Market Over Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: TA100</td>
<td></td>
</tr>
<tr>
<td>January 1–December 31, 2002</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>S&amp;P500</td>
</tr>
<tr>
<td>(8.1)</td>
<td>0.09</td>
</tr>
<tr>
<td>(0.24)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>(8.2)</td>
<td>0.20</td>
</tr>
<tr>
<td>(0.19)</td>
<td>(0.01)</td>
</tr>
</tbody>
</table>

¹ The dependent variable is Dlog(TA100); the main explanatory variable is the first lag of Dlog(S&P500).
² OC is opportunity cost; T denotes the time trend.

6. Conclusions

The study has addressed the question of why terrorist attacks have such a large impact on the economy and its findings indicate that media coverage plays a major role in answering it. The value of the media coverage of terrorist attacks, which terrorist organizations receive free of charge, is of the same order of magnitude as the advertising budgets of some of the world's largest corporations and therefore has a correspondingly large macroeconomic impact. The findings indicate that the media coverage of terrorist attacks is an important channel through which terrorism achieves its goals, which is demonstrated through the effect of that media coverage on stock prices. When we decompose the effect of the media into the direct report of a terror attack and the extra media coverage, we find that the direct report explains 84 percent of the effect and the extra coverage explains the additional 16 percent.

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the attack, i.e. before the beginning of trade, contains all the relevant information on terrorist attacks needed by stock market traders to make their trading decisions.

Statistical evidence supported the hypothesis that terrorist attacks affect stock prices, which suggests that the crucial variable is not the physical characteristics of a particular terrorist attack, but how it was perceived by the public via the media's coverage of the event.

The economic damage caused by terrorism increases monotonically with the amount of media coverage, which is shown through the effect of media coverage on stock market prices. Moreover, when one controls for the characteristics of terrorist attacks by grouping them in clusters, the relation between media coverage and economic impact is preserved within the cluster. We were also able to show that the impact of the media coverage of terrorist attacks on the economy diminishes over time.

A second motivation for this study was to gain insight into potential counter-terrorism measures by understanding the mechanism by which terrorist attacks produce such large economic effects. In this context, we were confronted with a dilemma: on the one hand, society benefits from a free press that satisfies the public's right to know, which is one of the basic values in a democratic society; on the other hand, the free media coverage is used by terrorist organizations to advance their goals. The questions that remain for future research: What is the optimal level of coverage the media should provide of terrorist attacks? Does the media coverage of terrorist attacks produce more information than that needed to satisfy the public's right to know? And finally, is it possible to design a covenant limiting the media coverage of terrorism in a democratic society?
References


