Terrorism and the Stock Market

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This paper examines the stock price impact of terrorist attacks. Using an official list of terrorism-related incidents compiled by the Counterterrorism Office of the U.S. Department of State, we identify 75 attacks between 1995 and 2002 in which publicly traded firms are targets. An event-study analysis around the day of the attacks uncovers evidence of a statistically significant negative stock price reaction of -0.83%, which corresponds to an average loss per firm per attack of $401 million in firm market capitalization. A cross sectional analysis of the abnormal returns indicates that the impact of terrorist attacks differs according to the home country of the target firm and the country in which the incident occurred. Attacks in countries that are wealthier and more democratic are associated with larger negative share price reactions. Most interestingly, we find that human capital losses, such as kidnappings of company executives, are associated with larger negative stock price reactions than physical losses, such as bombings of facilities or buildings. We discuss the implications of these findings for existing research on terrorism and for current policy debates like the renewal of the U.S. Terrorism Risk Insurance Act (TRIA).

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"The terrorists want to attack our country and harm our citizens. They believe that the world's democracies are weak, and that by killing innocent civilians they can break our will. They're mistaken. America will not retreat in the face of terrorists and murderers. And neither will the free world. We will not yield. We will defend our freedom."

President George W. Bush
FBI Academy, Quantico, Virginia
July 11, 2005

1. Introduction

The unprecedented terrorist attacks in the U.S. on September 11, 2001 caused massive casualties and damage and ushered in an era of great uncertainty. The attacks also changed the way we think about terrorism and moved the topic to the front-burner of academic and public attention.[1] One important way in which we have changed our thinking about terrorism is as a geo-political risk that affects the global economy and financial markets. While there has been much written about the short-term macroeconomic impact of those attacks on investors' risk aversion, equity market valuations, bond yields, oil prices, aggregate consumption and investment activity and even the medium-term effects in the regulatory, trade and fiscal policy responses by governments and the private sector (OECD Report, 2002, Lenain, Bonturi and Koen, 2002, Blomberg, Hess and Orphanides, 2004, among others), much less is known about how this potentially long-lasting heightened terrorist threat affects the stock prices of individual firms. Some have suggested, for example, it may reveal itself in the psychological fear of terrorism that can affect economic behavior (Becker and Rubinstein, 2004). For instance, after 9/11, insurers reduced or even rendered inexistent the supply of terrorism insurance throughout the economy, delaying or preventing many projects from going forward – mostly construction in large cities- because of creditor or investor concerns. Ultimately, an understanding of the nature of terrorism and the magnitudes of its effects is a prerequisite for designing successful policies to prevent terror, to alleviate the costs of terrorism, or to reduce an economy's vulnerability to attacks.

[1] For instance, on June 6th, 2005, a search for papers on SSRN using the word 'terrorism' produced 341 results, 285 of which were written in the past three years. A similar search on Factiva for news and articles on terrorism since 1999 resulted in a bit more than 1,400,000 "hits" with 1,250,000 of those written after September 11, 2001.

The objective of this paper is to provide a new metric by which to gauge the economic impact of terrorist attacks. We employ event-study methodology to examine the stock price impact of 75 terrorist attacks on domestic and international publicly-traded companies that took place between 1995 and 2002. We propose the use of capital markets for this type of measurement because stock and bond prices arguably incorporate investor's beliefs and views about the future, and liquidity of financial markets provides an efficient conduit for these views to be quickly reflected in asset prices.

Ours is not the first study of the effects of terrorism on global capital markets, but it is unique on two important dimensions. Unlike previous papers that study the stock price impact of terrorism by focusing on the impact of a single terrorist event – such as, the attacks of September 11, 2001 (hereafter "9/11," Hon, Strauss and Yong, 2003, Poteshman, 2004) or the passing of 2002 U.S. Terrorism Risk Insurance Act (TRIA, Brown, Cummins, Lewis and Wei, 2004) -- we focus on multiple and firm-specific terrorism-related events spread out over an eight-year period, 1995-2002. Also, this paper is the first to study the reactions of individual firms from around the world in a variety of industries to terrorist events some of which occurred at home and some abroad. This contrasts with, for example, Chen and Seims (2004) who study the impact of six major events (e.g., 1941 Pearl Harbor attack, 1990 Iraqi attack on Kuwait) on national market index returns, Berrebi and Klor (2005) that focuses only on attacks of Israeli companies during 1998-2000 or Doherty, Lamm-Tennant and Starks (2004) that examines only TRIA-affected U.S. industries around the Act's passage in Congress. These two attributes of our experimental design contribute not only to build additional power for statistical tests to reliably uncover the economic magnitude of such terrorism events, but also allow us to evaluate the cross-sectional dispersion in the stock price reactions to test several key hypotheses about how markets react to terrorism. We draw out these hypotheses from related literature in Sociology, Psychology, and Political Science on the motives for terrorism and their risks. For example, we evaluate whether stocks react differently to terrorist attacks that destroy tangible assets, such as buildings or equipment, by

means of bombings that those that destroy intangible assets, like human capital resources, via kidnappings. We also investigate whether stocks of firms located in richer, more democratic and better-educated countries will react more or less negatively to terrorist attacks.

We uncover a statistically significant negative stock price reaction on the day of a terrorist attack of -0.83%, which corresponds to an average loss of $401 million in firm market capitalization.[2] Our attacks are obtained from an official list of terrorism-related incidents compiled by the Counterterrorism Office of the U.S. Department of State from which we identify 75 attacks between 1995 and 2002 in which publicly traded firms are targets. A cross-sectional analysis of the abnormal returns indicates that the impact of terrorist attacks differs according to the country in which the incident occurred. Attacks in countries that are wealthier and more democratic are associated with larger negative share price reactions. Most interestingly, we find that human capital losses, such as kidnappings of company executives, are associated with larger negative stock price reactions than physical losses, such as bombings of facilities or buildings. This last result is in line with previous research in corporate finance that document the effects on firm value of sudden deaths of key executives (Johnson, et al 1985), and also with the recent results obtained by Suarez and Pshisva (2005). Finally, our results establish a starting point necessary for the analysis needed to help the insurance industry understand better the economic consequences of terrorism risk.

This paper also aims to contribute to the ongoing policy debate surrounding TRIA. By computing a measure of the average stock market impact suffered by publicly-traded firms affected by terrorist acts, our results can help insurers to better quantify the expected losses associated with this particular type of risk. Also, both government and insurers can make better informed decisions with respect to their future respective roles in the provision of terrorism insurance. After 9/11, insurance companies agreed to pay all claims filed in connection to the

[2] Interestingly, this number compares favorably to the $500 million deductible that the U.S. Treasury Department is advocating if the Terrorism Risk Insurance Act (TRIA) is to be renewed (The Wall Street Journal, July 14th, 2005.) The full report can be found online at http://www.ustreas.gov/press/releases/js2633.htm

attacks (estimated between $30 and $80 billion). However, as mentioned earlier, in an effort to protect their capital reserves they reacted by either increasing dramatically the price of terrorism coverage or by declining to offer it altogether.[3] Although the passing of TRIA in 2002 supported the domestic insurance industry by temporarily providing reinsurance up to $100 billion at zero cost, no long-term scheme for obtaining the necessary reinsurance has been devised. From a supply-side perspective, before September 2001, domestic insurers had assigned a probability of zero to terrorist attacks in the U.S. (Cummins and Lewis, 2003). Once this was proven wrong, it became necessary to come up with terrorism models to compute expected attacks and their associated losses. All proposed alternatives for reinsurance, for instance, to securitize the risk via catastrophe bonds or through the creation of mutual insurance pools (Kunreuther and Michel-Kerjan, 2004), necessitate the creation of models that provide measures of expected losses critical to calculate premiums, deductibles and capital requirements so an orderly re-emergence of a liquid market for terrorism risk can take place. Kunreuther et al (2003) point out that a terrorism model, like catastrophe models in the recent past, should address three issues: frequency of occurrence of the event, likely locations where it could take place and severity of insured and non-insured losses. Our paper focuses on the third issue.

The remainder of this paper will proceed as follows. Section 2 will review the extant literature and will introduce our testable hypotheses. The data is described in section 3 and the methodology and results are discussed in section 4. Section 5 concludes the paper.

2. Literature Review and Testable Hypotheses

There is no single theory behind our intuition for conducting this exercise, but rather a confluence of research conducted in different, albeit related, areas. First, we ask ourselves why we expect a stock price reaction. We expect price changes to reflect updated market beliefs that the attacks might change firms' investment policies, that the company is forced into higher

[3] For example, Jaffee and Russell (2003) document that the price of terrorism insurance for Chicago's O'Hare airport went from $125,000 for $750 million of coverage to $6.9 million for $150 million of coverage after September 2001.

security costs, and also to reflect future cash flows forgone due to direct asset losses. In other words, the stock price effect should reflect the fact that costs incurred by the firm in the continuation of its normal activities differ from those before the attack(s). Alternatively, the stock price reaction could also reflect an increased likelihood of future attacks, since the firm has already been revealed to be one at least one terrorist group cares about. There is, however, some anecdotal evidence that this is not always the case, and, in fact, firms' values exhibit larger than expected drops. For instance, the New York Times reported a fall of more than 2% in the price of Lukoil shares after news of the kidnapping of the first vice president of finance were made public.[4] After the 9/11 attacks, United Airlines' shares experienced a price drop of 43% while American Airlines' parent company, AMR, registered a stock price drop of 39%. These negative returns reflected a loss in market value much greater than the actual asset losses experienced on that day by the airlines, and, in fact, they likely reflected fears from the investment community of the increasingly difficult to quantify effects and ramifications that the attacks would have on air travel. On top of these costs, terrorist acts increase the cost of terrorism insurance for firms worldwide.

There is recent literature documenting a significant share-price reaction to terrorist events that is consistent with this intuition. Brown, Cummins, Lewis and Wei (2004) explain how the U.S. government, by virtue of providing 'free' reinsurance to domestic insurers via TRIA, may have involuntarily delayed or prevented the reemergence of private insurance post 9/11. They conduct an analysis of the financial response to the TRIA from firms in different directly affected sectors of the economy, and find negative reactions to most relevant dates in the process of creation of the TRIA. Cummins and Lewis (2003) analyze the returns of 43 property-casualty insurers and also find evidence of strong negative reactions to 9/11. Doherty, Lamm-Tennant and Starks (2003) develop testable hypotheses about the cross-sectional variation in the price reaction of the stock of insurance companies following 9/11 from the capacity constraint, post-loss

[4] The New York Times, pp. W1, Sep 13th, 2002.

investment, and implicit insurance contracts models. They find results that support all their hypotheses. Abadie and Gardeazabal (2003) study the costs of the Basque Country conflict in terms of economic growth and lost market capitalization of public firms. They report a 10% gap in the per capita growth of the Basque Country and that of a synthetic benchmark and they also find that Basque firms did significantly worse than non-Basque firms during the 1998-2000 period. Based on this literature, we propose the following null hypothesis:

Hypothesis 1: *Firms that are affected by a terrorist act will experience a negative abnormal return around the date of the attack.*

Broadly speaking, terrorist attacks can damage firms by destroying two different types of assets: tangible assets like property, plant and equipment and intangible assets like human capital resources. The latter case has some similarities with existing literature that studies the stock price reaction to the sudden death of executives. Johnson et al (1985) document a small average stock price reaction to unexpected deaths by senior executives. They find, however, evidence of increased dispersion in stock returns. They interpret this finding as evidence that sudden deaths of executives produce a stock price reaction that is a function of the characteristics of each firm, and therefore, not the same for all firms. Slovin and Sushka (1993) analyze the effects of the death of insider blockholders – people owning 5% or more of a firm's shares - on ownership concentration, corporate control and firm value. They find that the stock price reaction is related to the deceased blockholder's equity stake. Past research in this area is relevant to our paper because we want to investigate whether the abnormal returns we document are better explained as a market's reaction to the loss of human capital. Recently, Suarez and Pshisva (2005) measure the impact of kidnappings on firm investment in Colombia and find that managers are reluctant to invest when their freedom and life are at risk, thus confirming the existence of a human capital channel through which crime affects investment decisions of firms as well as their values.

In the sample of terrorist attacks we use in this paper, there are many instances in which the attack involved the kidnapping or killing of company executives with no physical destruction of company assets, equipment, or plants. We have no prior as to whether events that involve

destruction of physical assets will be associated with any greater share price reaction than those involving only attacks on executives. Nevertheless, based on the literature on executive deaths above, we propose to investigate:

Hypothesis 2*: Firms that are affected by a terrorist act that involves only attacks on human capital will experience a negative abnormal return around the date of the attack.*

Terrorism is not a recent phenomenon. Earlier waves of religious- and politically-motivated terrorist activity in the 1970s and 1980s prompted a more disciplined and rigorous study of the dynamics of terrorism from a quantitative analysis perspective. Hamilton and Hamilton (1983) were among the first to study these dynamics from a formal perspective using stochastic models for social contagion. Not surprisingly, they find that more open societies have a harder time responding effectively to terrorism and reverting the tendency of terrorist acts to incite further violent acts. Cauley and Im (1988) use interrupted time series analysis – also known as intervention analysis - to study the effectiveness of increased security measures in airports and embassies and find that only the former were effective in deterring terrorist attacks. Enders and Sandler (1993) take this analysis one step further using intervention analysis and vector autoregressive models to find evidence of substitutes and complements among the attacks. In a more recent paper, Enders and Sandler (2000) study the time series properties of these terrorist attacks, distinguishing the stochastic from the deterministic components. Spectral analysis is used to investigate the presence of cycles, and a vector autoregressive framework is used to look for, among other things, structural shifts. Interestingly, they document a shift from politically-motivated terrorism to religious-motivated terrorism, based on changes in the number of casualties, around the takeover of the U.S. Embassy in Teheran.

Krueger and Laitin (2003) conduct a study to determine which countries are more susceptible to develop terrorists and which countries are these terrorists more likely to attack. They find that the origins of terrorism are in countries that suffer from political oppression; the targets are countries that enjoy economic well-being. (To the best of our knowledge, theirs is the only other paper that makes use of the report on Patterns of Global Terrorism from the U.S. State

department.[5]) Krueger and Maleckova (2003) continue the research initiated in the previous paper, focusing on finding variables that could reduce the creation of terrorists within a country. They do not find evidence that reductions in poverty or increases in education reduce significantly the exporting of terrorist activity. Further, on the relation between poverty and terrorism activity, they claim that 'any connection is complicated and weak.'

If one accepts that the exposures to the risk of terrorist attacks are positively related to the likelihood of an incidence of such attacks and if we accept that country attributes, such as political system, education and economic well-being, are significantly related to the incidence of attacks, then we can specify that:

> **Hypothesis 3:** *Firms domiciled in richer, more democratic and better educated countries will experience larger negative returns following an attack than firms located in poorer, less educated and less democratic countries.*

Finally, there are several recent papers that address issues that are partially related to the main topic of this paper. Melvin and Tan (1996) look at the effect of social unrest (riots, demonstrations, armed attacks) on exchange rate spreads and find significant increases in volatility. Choudhry (2003) explored unsuccessfully for evidence of changes after 9/11 in the market betas of selected U.S. companies. Hon, Strauss and Yong (2004) test if 9/11 changed the correlation structure between U.S. and European stock markets. Recent research in psychology by Slone (2000) studies the responses of people to media coverage of terrorism, providing a plausible explanation for the abnormal returns we document in this paper. We do not pursue this line of research in this paper.

3. Data

In the aftermath of 9/11, the White House defined homeland security as "the concerted effort to prevent attacks, reduce America's vulnerability to terrorism, and minimize the damage and recover from attacks that do occur" (Kunreuther and Michel-Kerjan, 2004). For an attack to

[5] Krueger and Laitin (2004) analyze in detail the errors and problems with the statistical appendix of the Patterns of Global Terrorism report by the U.S. State Department. Focusing on an embarrassing report released in 2004, they point to a lack of safeguards and consistent procedures in the data collection, analysis and disseminating process of these reports.

be defined as an 'act of terrorism' it has to result in damage within the United States (or outside the United States in the case of planes or ships operating under the U.S. flag), and to be certified as such by the Secretary of the Treasury, in concurrence with the Secretary of State, and the Attorney General of the United States.[6] In compliance with TRIA and also with Title 22 of the United States Code, the State Department provides Congress with periodical reports on terrorist activity. In these reports, the State Department lists all events worldwide considered as terrorist attacks.[7] It is the existence of such detailed reports by the State Department that enables us to construct a new database including all significant terrorist incidents that took place worldwide in the period from 1995 to 2002.

We started by collecting all data available on terrorist attacks. A problem we initially encountered is that there is no consensus for a definition of terrorism. The definition accepted by the United Nations reads:[8]

> "Terrorism is an anxiety-inspiring method of repeated violent action, employed by (semi) clandestine individual, group or state actors, for idiosyncratic, criminal or political reasons, whereby - in contrast to assassination - the direct targets of violence are not the main targets. The immediate human victims of violence are generally chosen randomly (targets of opportunity) or selectively (representative or symbolic targets) from a target population, and serve as message generators. Threat- and violence-based communication processes between terrorist (organization), (imperiled) victims, and main targets are used to manipulate the main target (audience(s)), turning it into a target of terror, a target of demands, or a target of attention, depending on whether intimidation, coercion, or propaganda is primarily sought"

U.S. agencies, on the other side, use the definition of terrorism contained in Title 22 of the US Code, Section 2656f(d):[9]

> The term "terrorism" means premeditated, politically-motivated violence perpetrated against noncombatant targets by subnational groups or clandestine agents, usually intended to influence an audience.
>
> The term "international terrorism" means terrorism involving the territory or the citizens of more than one country.

[6] Another requirement is that insurance losses from a terrorist attack exceed, in aggregate, $5 million.
[7] Acts of terrorism, as defined in TRIA, are a sub-sample of the events listed in these reports.
[8] United Nations Office on Drugs and Crime, http://www.unodc.org/unodc/terrorism_definitions.html
[9] Central Intelligence Agency, http://www.cia.gov/terrorism/faqs.html

> The term "terrorist group" means any group that practices, or has significant subgroups that practice, international terrorism.

In this paper we use a data source that, to our knowledge, has not been used for this kind of study before. We collect data from the annual "Patterns of Global Terrorism" report prepared by the Counterterrorism Office of the U.S. Department of State. This report is available since 1995 and includes a chronological appendix that lists details of all terrorist incidents classified by the Department of State. This report is submitted in compliance with Title 22 of the United States Code, Section 2656f(a), which requires the Department of State to provide Congress a full and complete annual report on terrorism.

We collected the information from all the appendixes available (1995 – 2002) to create Table A1.[10] This table shows all acts classified as terrorist acts world-wide since 1995. There are in total 881 acts of terrorism in the 1995 – 2002 period. This number includes politically-motivated, religious-based and non-attributed acts.

We obtain prices and market values from Thomson Financial's Datastream International and the Center for Research on Security Prices (CRSP, University of Chicago). Table 1 has descriptive statistics for acts where we could identify a specific firm(s) that suffered direct damage. We have a sample of 75 cases where a publicly-traded firm was specifically mentioned as being targeted by a terrorist act. These 75 attacks targeted 43 different firms. The firm that has suffered the greatest number of attacks is McDonald's with 10 attacks, followed by Royal Dutch Shell with 9 different attacks. Then mean (median) is 1.82 (1.00) attacks per firm. We also observe, as expected, that 45 attacked firms are U.S. firms (60%), while the rest belongs mostly to The Netherlands (9 attacks) and Canada and the U.K. (5 each).

The country where the most attacks took place is Nigeria (15), followed by Colombia (14). The National Liberation Army from Colombia claimed responsibility for the most attacks (10). Al-Qaida and the Liberation Tigers of Tamil Eelam claimed responsibility for 4 attacks

[10] Table A1 includes only excerpts for brevity but the full table is available upon request from the authors.

each. Thirty-four acts of terrorism were conducted against firms in the oil industry, twenty against food and fast-food firms, and five against firms in the banking industry. The rest of the acts were conducted against airlines, power generating firms, construction, media, and automotive firms.

4. Methodology and Results

We follow the event-study methodology of Brown and Warner (1985). The methodology developed in that paper has been successfully applied to a wide variety of events, for instance mergers and acquisitions and initial public offerings of stock. A common concern of those applications is that the event of interest is rarely a 'sudden' occurrence. Usually, news about a merger or a offering of shares is leaked or even publicly-announced prior to their taking place. In this paper, we are interested in the stock price reaction immediately after news of the terrorist attack is made public. Given the exogenous nature of the attacks, our analysis does not suffer from problems of partial anticipation that sometimes plague event studies. We must, however, be cautious and acknowledge the possibility of the existence of idiosyncratic effects. In traditional event studies, these effects wash out when the number of events with non-overlapping event windows becomes large so that the resulting event-specific abnormal return truly captures the economic impact of the event on stock prices. In this exercise we have 75 events spread out over eight calendar years with less than six clustered in time to yield overlapping windows.

Event studies are by definition joint tests of hypotheses. To be able to measure abnormal return, one has to define what a normal return is, i.e. make an assumption on the return-generating process. Most commonly, the market model, or CAPM, is used to compute normal returns.[11] Therefore, we compute abnormal returns according to the following specification:

$$A_{i,t} = R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i R_{m,t}$$

[11] Other measures of normal return used in the literature are mean adjusted returns (using the simple average of a security's daily return in some pre-defined estimation window), and market adjusted returns (where the return of the market is subtracted from each individual firm return). Brown and Warner (1985) showed that the OLS market model adjustment is well-specified in most cases and that it outperforms the other two return-generating processes when some assumptions (normality, autocorrelation, etc.) are relaxed.

where $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the OLS parameters obtained from the estimation window, $A_{i,t}$ is the abnormal return for firm i, $R_{i,t}$ is the return for firm i, and $R_{m,t}$ is the market return. We compute the significance of the average abnormal return for each date in the estimation window using a test statistic. The statistic is computed as the ratio of the mean abnormal return to the estimated standard deviation from the time series of mean abnormal returns. Whenever we could not find return data for the exact date on which an attack took place, we used the stock price of the following trading day. In all such cases the attack took place over the weekend, on a holiday, or when trading got cancelled (e.g, 9/11).

Table 2 reports the results from conducting the event study. Using an estimation window from -224 days to -11 days to compute normal returns, we document a negative return on the day of the attack (or the immediate trading day) of negative 2.2%, significant at the 5% level – consistent with our first hypothesis. Because of the very large stock price drops suffered by US Air and American Airlines affected by the 9/11 attacks, we run the event study again, but this time excluding the attacks of 9/11. Results are reported in Panel B of Table 2. The negative return on the day of the attack is smaller (-0.83%) but it is also significant at the 1% level. This number implies an annualized negative return of 8.02%. No other abnormal return in the (-10, 10) event window was found to be significant. We also looked at volume data but we could not find any evidence of abnormal volume trading. The median abnormal returns (not reported in Table 2) are -0.69% without considering the 9/11 attacks and -0.75% when they are included.

To get a better idea of the magnitude and importance of this number, we performed the following calculation. The mean market value of the firms targeted on the day of the attacks is $58.3 billion. Multiplying this number times the average stock market reduction experienced on the day of an attack, we obtain that each terrorist attack was associated with a loss of $484 million of market value. When we compute the average reduction in market capitalization per firm per attack, we obtain a loss of $401 million. Interestingly, the stock price reaction we document is four times as large as the impact documented by Abadie and Gardeazal (2003) for

bad news during the cease-fire truce in the Basque Country during 1998-2000, and in line with estimates of TRIA-related events for insurance companies found by extant studies.

Table 3 further shows four different ways of classifying the value destruction brought by terrorist acts by aggregating the losses by firm, country and terrorist group to reflect the impact of multiple attacks. We see in panel A that the firms that have cumulatively lost the most market value from terrorist attacks are Royal Dutch Shell ($10.2 billion dollars), British Petroleum ($7.2 billion), and Coca-Cola ($4.2 billion). Panel B lists the countries where the largest cumulative losses have been experienced. Colombia tops that list ($13.7 billion), followed by Nigeria ($11.2 billion) and Russia and the United States ($2.6 billion each). Finally, panel C displays the losses causes by the different groups that have claimed responsibility for the attacks. Beyond unclaimed attacks (which total cumulatively $6.2 billion), those that have caused the most cumulative damage are National Liberation Army ($11.7 billion), al-Qaida ($2.6 billion) and the Animal Liberation Front ($2.4 billion).

It was previously mentioned that one reason why we expect to observe a reaction in the stock price of affected firms is because investors consider tangible and intangible losses as well as the increased cost of doing business in a new 'terrorism-aware' environment. A constant across all the terrorism literature we surveyed is that there are no firms that benefit from terrorist attacks, except for some defense-related firms and/or firms that offer specific protection against terrorism (Berrebi and Klor, 2005). To ensure that our numbers are not biased by not considering potential positive spillover effects to the competitors of firms targeted, we analyze the stock reactions of a portfolio formed with the biggest competitors in a given industry using 4-digit Standard Industrial Classification (SIC) codes.

Table 4 displays the results of conducting an event study on the day of the attacks for all the U.S. firms that had the same SIC code in the CRSP universe. We computed this measure for an equally-weighted portfolio formed by taking the N largest firms (measured by market capitalization at the time of the attack) within an industry. If N equals 1, the portfolio included

only the largest U.S. competitor; if N equals 2, the portfolio includes the two largest competitors, and so on. We constructed portfolios for several values of N, ranging from 1 to 10, and found no significant abnormal returns. Our interpretation of the lack of positive spillover effects is that investors do not believe that growth opportunities lost by targeted firms, directly or indirectly due to the higher cost of doing business, are captured by competitors within the same industry. On the other hand, the lack of negative spillover effects across firms in the same industry suggests that terrorists do not target particular industries.

We now proceed to look at the cross-section of abnormal returns obtained earlier for the affected firms in order to investigate the predictions from hypotheses 2 and 3. Recall that our second hypothesis states that human capital losses should be an important determinant of the cross-sectional variation in observed abnormal returns. Johnson, et al (1985) showed that there is a significant price reaction to the sudden death of executives - the kidnapping of an executive by a terrorist group can be compared to the sudden death of an executive since it is an unexpected loss of human capital. More recently, Suarez and Pshisva (2005) measure how kidnappings – a human capital loss to the firm - affect investment decisions and ultimately, firm value. We create a dummy variable called 'Kidnapping', which takes a value of 1 when the terrorist incident includes the kidnapping of people. Other dummy variables are 'U.S. Firm' if the damaged firm is an American firm, and 'Responsibility', which takes a value of 1 when a group credibly claimed responsibility for an attack. We include a variable that counts how many times a firm was attacked during our sample period, to capture any trend in the market reaction to the news that a firm has been repeatedly targeted. We also included the market capitalization as of the day of the attack, or the immediate following trading day. All returns are in U.S. dollars.

As mentioned earlier, our third hypothesis proposes that the stock price reaction to terrorist acts should be larger (more negative) in more democratic, richer, and less well-educated societies. To test this idea, we collect different democracy indices used in the Political Science literature. The first one comes from the Polity4 database from The University of Maryland's

Center for International Development and Conflict Management (CIDCM). This index is measured on a scale from 1 (less democratic regime) to 10 (more democratic regime). The U.S. has a value of 10 on this index. We also collect civil liberties indices from the Polyarchy dataset compiled by Tatu Vanhanen from the University of Helsinki. Our proxies for education and wealth are the proportion of education expenses of public spending, and the Gross National Income (GNI) per capita, both from the World Bank Development Indicators database (WDI).

We show the results of our regressions in Table 5. The left hand side variable is the abnormal return (0, 1). The first nine specifications look at the effect of each variable plus a constant on the abnormal returns.[12] The regression with a dummy for kidnapping has a significant negative coefficient, consistent with the prediction of our second hypothesis that attacks that destroy human capital are associated with a larger negative stock price reaction than those that destroy physical property. Also, firms incorporated in the U.S. experience larger negative reactions than firms domiciled outside the U.S. as shown by the negative and significant coefficient.

The coefficients on the democracy index and the GNI per capita are consistent with our priors: the more democratic and wealthier a country, the larger the negative stock price reaction. The coefficients on the degree of democracy and wealth of a country are always significant, whether they are the only terms in the regressions or if they are used in conjunction with other explanatory variables. The coefficient on the education spending variable does have the expected sign; that is, attacks in countries where more resources are spent in education suffer larger negative effects of terrorist attacks. We also use the civil liberties index mentioned before to make sure the democracy index result hold. The civil liberties index measures countries in a reverse scale, where the U.S. gets a value of one and countries with worse civil liberties records get a higher number. The results obtained with this variable are similar to the results obtained with the democracy index and are omitted for brevity.

[12] Yearly dummy variables had no significant coefficients in any specification and thus are not included.

Specifications 10 to 14 in Table 4 show results for all-inclusive specifications. All key results hold. Kidnappings are considered by the market to be even more damaging than bombings, all else being equal. Evidence is mixed on whether it matters if a firm is a U.S. firm or not. This is because when macroeconomic variables are included, the U.S. firm dummy variable loses its statistical significance. The size of the targeted firm measured by market capitalization is not significant. We think our size proxy is not significant because these targeted firms are already quite large firms so there is limited dispersion. Interestingly, the market reaction seems to weaken as a firm is repeatedly attacked, as shown by the significantly positive coefficient on the variable that counts how many times a firm was attacked in the 1995 – 2002 period. Finally, the results previously discussed on the democracy, education and wealth measures hold in the multivariate regressions.

Overall, our results seem to support the predictions from our third hypothesis. We find that attacks on firms from richer and more democratic countries generate a larger negative stock return, and this is consistent with the work conducted by Krueger and Laitin (2003).

5. Conclusion

The passage of TRIA in 2002, with its backstop provision of up to $100 billion zero-cost reinsurance for terrorism events, was indeed an important U.S. legislative event. Unfortunately, it did not provide for any long-term scheme for terrorism insurance and, even today, it is not clear which course of action the industry and government is to follow once TRIA expires in December 2005. Some argue that "America cannot risk a gamble on terror insurance" and that "renewal of TRIA is critical as a private insurance market will never develop … catastrophic terrorism risk is uninsurable by the private market because its true dimensions are incalculable, whether you live in London, Madrid or New York".[13]

Faced with these dramatic views of the market for terrorism insurance, we argue that it is even more important now to develop new measures of the economic consequences of terrorism

[13] Wall Street Journal, September 21, 2005, editorial by Ewan Greenberg, CEO of ACE, Ltd.

events to guide policy. In this paper, we use the stock price reaction of publicly-traded firms that have been affected or targeted by a terrorist attack to provide average estimates of the losses caused by these events. Using a global sample of 75 individual firms, we estimate an average decrease in market capitalization of $401 million per attack. A subsequent analysis of the cross-sectional variation in the stock price reactions suggests that losses inflicted by terrorist attacks are larger when they take the form of kidnappings. We also show that these losses are greater when the firm is located in a richer country or in a country with a more democratic regime.

It is important, though, to remember that our results were obtained using only a subset of the universe of terrorist incidents classified as such by the State Department, since we are studying only the reaction associated with publicly-traded companies. Also, in this paper we opted for a simplified approach and we only study the short-term reaction of firms to these attacks and ignore potential longer-term effects on cash-flows or cost of capital (risk premium) effects.

The re-emergence of a market for terrorism risk insurance requires that insurers develop better models to assess the likelihood and potential losses derived from terrorism. Our results suggest that characteristics of the attack (kidnappings vs. property destruction) and characteristics of the country of the targeted firms provide help in assessing the losses. We hope the results presented here serve at least as a useful starting point in the current debate surrounding terrorism insurance, the renewal of TRIA and the characteristics of the legislation that will replace it.

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Table 1. Frequency Distribution of Acts of Terrorism against Firms around the World, 1995-2002.

Year of incident		Location of Incident		Firm Domicile	
1995	9	Africa	19	Canada	5
1996	12	Asia	11	China	1
1997	6	EMEA	12	France	2
1998	7	Europe	13	Korea	3
1999	11	Latin America	18	Netherlands	9
2000	11	North America	2	Portugal	1
2001	8			Sweden	1
2002	11			Switzerland	1
				Thailand	2
				UK	5
				US	45
Total	75	**Total**	75	**Total**	75

Table 2. Average Abnormal Returns for Equally-Weighted Portfolio of Underlying Stocks Targeted by Acts of Terrorism, 1995-2002.
This table shows estimates from an OLS event study regression model as in Brown and Warner (1985). The excess return for each day in the event period is computed using an OLS market model. The estimation window is defined from day -244 to day -11. Day 0 is the day of the attack, or the first trading day immediately after the attack. The market return is the S&P 500 for U.S. firms and the Datastream total market index corresponding to each foreign firm. All returns are U.S. dollar returns.

Event date	Mean abnormal return	t-statistic	p-value	% Positive	Binomial Z-statistic	Mean abnormal return	t-statistic	p-value	% Positive	Binomial Z-statistic
	Panel A: All Attacks					***Panel B: Excluding 9/11 Attacks***				
-10	-0.0025	-0.9918	0.3246	0.4533	-0.8064	-0.0025	-1.0164	0.3128	0.4384	-1.0542
-9	-0.0030	-1.3056	0.1957	0.4000	-1.7559	-0.0033	-1.3000	0.1976	0.4000	-1.7559
-8	0.0033	1.3602	0.1779	0.6000	1.7559	0.0026	1.3639	0.1767	0.6000	1.7559
-7	-0.0002	-0.0856	0.9320	0.4000	-1.7559	-0.0007	-0.0820	0.9348	0.4054	-1.6462
-6	0.0000	-0.0039	0.9969	0.4533	-0.8064	0.0000	-0.0249	0.9802	0.4306	-1.1818
-5	0.0024	1.1733	0.2445	0.6000	1.7559	0.0025	1.1741	0.2442	0.6027	1.7816
-4	0.0020	0.9519	0.3442	0.4533	-0.8064	0.0021	0.9504	0.3450	0.4533	-0.8064
-3	0.0026	1.0129	0.3144	0.5333	0.5748	0.0021	1.0252	0.3087	0.5405	0.6950
-2	-0.0043	-1.6832	0.0965	0.4667	-0.5748	-0.0039	-1.6913	0.0950	0.4595	-0.6950
-1	0.0028	1.6013	0.1136	0.6133	2.0020	0.0033	1.6143	0.1108	0.6164	2.0319
0	**-0.0224**	**-2.2333**	**0.0286**	**0.3200**	**-3.3194**	**-0.0083**	**-3.9930**	**0.0002**	**0.3151**	**-3.3779**
1	0.0011	0.4526	0.6522	0.4800	-0.3444	0.0011	0.4309	0.6679	0.4706	-0.4823
2	0.0016	0.8942	0.3741	0.5200	0.3444	0.0016	0.8809	0.3813	0.5068	0.1162
3	0.0007	0.3405	0.7344	0.4933	-0.1147	0.0006	0.3001	0.7650	0.4648	-0.5907
4	-0.0106	-1.1443	0.2562	0.5733	1.2755	-0.0114	-1.1399	0.2581	0.5811	1.4041
5	0.0041	1.2243	0.2247	0.5200	0.3444	0.0046	1.2351	0.2207	0.5135	0.2310
6	-0.0022	-1.1997	0.2341	0.3919	-1.8921	-0.0028	-1.2977	0.1985	0.3836	-2.0319
7	-0.0025	-0.9762	0.3322	0.4054	-1.6462	-0.0030	-0.9744	0.3331	0.4054	-1.6462
8	0.0030	1.4099	0.1628	0.5000	0.0000	0.0030	1.5861	0.1172	0.5139	0.2342
9	0.0026	1.0649	0.2904	0.4730	-0.4625	0.0030	1.0867	0.2807	0.4730	-0.4625
10	0.0015	0.7223	0.4724	0.5541	0.9291	0.0019	0.6785	0.4997	0.5694	1.1818

Table 3. Total Losses Inflicted by Terrorist Incidents on Public Firms.
This table shows rankings according to four different criteria. Panel A shows the five firms that have suffered the biggest cumulative losses from terrorist incidents. Panel B shows the five countries where the biggest cumulative losses have been experienced. Panel C shows the largest losses classified according to the organizations that claimed responsibility. Amounts are obtained from multiplying the daily abnormal return on the (0,1) period times the market value of the firm on the day of the attack. All amounts are in millions of dollars.

	Company		Amount
	Panel A: Total Losses by Affected Firm		
1	Royal Dutch Shell	$	(10,276)
2	British Petroleum-Amoco Corp.	$	(7,270)
3	Coca-Cola	$	(4,263)
4	McDonalds	$	(3,710)
5	American Airlines	$	(2,266)
	Panel B: Total Losses by Location		
1	Colombia	$	(13,792)
2	Nigeria	$	(11,202)
3	Russia	$	(2,676)
4	United States	$	(2,610)
5	Belgium	$	(2,428)
	Panel C: Total Losses by Terrorist Group		
1	National Liberation Army	$	(11,754)
2	al-Qaida	$	(2,678)
3	Animal Liberation Front	$	(2,428)
4	Sendero Luminoso	$	(2,392)
5	Revolutionary Armed Forces of Colombia	$	(2,018)

Table 4. Average Abnormal Returns for Equally-Weighted Portfolio of the Competitors of Firms Targeted by Terrorist Acts.
This table shows estimates from an OLS event study regression model as in Brown and Warner (1985) on portfolios formed using the N largest firms in the industry of the attacked firm. Targeted firms are not included. We used SIC codes from CRSP at the 4-digit level. The excess return for each day in the event period is computed using an OLS market model. The estimation window is defined from day -244 to day -11. Day 0 is the day of the attack, or the first trading day immediately after the attack. The market return is the return for the S&P 500. All returns are U.S. dollar returns.

Event date	Mean abnormal return	t-statistic	Mean abnormal return	t-statistic	Mean abnormal return	t-statistic
	For N = 1 Competitor Firm		For N = 5 Competitor Firms		For N = 10 Competitor Firms	
-5	0.07%	0.339	0.09%	0.513	-0.01%	-0.055
-4	0.30%	1.395	0.13%	0.715	0.19%	1.151
-3	-0.02%	-0.077	0.00%	0.018	0.02%	0.148
-2	-0.32%	-1.497	-0.10%	-0.545	-0.09%	-0.531
-1	0.10%	0.463	-0.20%	-1.093	-0.25%	-1.512
0	-0.17%	-0.795	0.25%	1.375	0.01%	0.085
1	0.21%	0.973	-0.02%	-0.129	-0.09%	-0.567
2	-0.16%	-0.745	0.02%	0.098	-0.05%	-0.289
3	0.13%	0.593	-0.30%	-1.657	-0.09%	-0.569
4	0.01%	0.027	0.21%	1.170	0.28%	1.478
5	0.15%	0.699	-0.13%	-0.710	-0.02%	-0.092

Table 5. Cross-sectional Regression Analysis of Abnormal Returns of Firms Targeted by Acts of Terrorism, 1995-2002.

This table shows estimates from an OLS regression model with heteroskedastic adjusted errors. Dependent variable is the mean abnormal return for the (0,1) period. Kidnapping, U.S. Firm and Responsibility are dummy variables. U.S. Firm takes a value of one when the firm is a U.S. based firm. Responsibility takes a value of 1 when a group takes credit credibly for an attack, and zero otherwise. Market capitalization is computed at the day of the attack, or the immediate following trading day. Polity4 is the democracy index from The University of Maryland's Center for International Development and Conflict Management (CIDCM). This index is measured in a scale from 1 to 10. More democratic regimes get a higher value, i.e., the U.S. has a value of 10. Education is a variable measuring elementary and secondary education spending and GNI per capita come from the World Bank Database. No. of attacks is the number of times a firm has been attacked during our sample period. All average abnormal returns are U.S. dollar returns. Absolute values of robust t statistics are in parentheses; *, **, *** denote significance at the 10%; 5%; and 1% level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Constant	**-0.0084**	0.0034	0.0027	-0.0055	-0.0006	**0.006**	0.0011	**0.0281**	-0.0085	**0.0137**	**0.0297**	0.0048	**0.0835**	**0.1115**
	(4.01)* **	(1.51)	(1.18)	(1.60)	(0.32)	**(1.70)***	(0.19)	**(1.98)***	(1.64)	**(1.76)***	**(3.91)*** **	(0.43)	**(4.86)*** **	**(4.15)*** **
Kidnapping		**-0.0112**								**-0.0129**	**-0.0265**	-0.0022	**-0.0295**	**-0.0399**
		(2.99)* **								**(2.05)** **	**(4.26)*** **	(0.20)	**(4.39)*** **	**(3.97)*** **
U.S. Firm			**-0.0096**							-0.0074	0.0003	**-0.0157**	0.0042	0.0075
			(2.51) **							(1.07)	(0.05)	**(1.68)***	(0.63)	(0.97)
Responsibility				0.0068						-0.0099	-0.0089	-0.0057	-0.0100	**-0.0151**
				(1.66)						(1.35)	(1.38)	(0.66)	(1.53)	**(2.22)** **
Market cap.					-0.1333					-0.1348	-0.0835	-0.0742	-0.0271	-0.3742
					(0.45)					(0.47)	(0.33)	(0.25)	(0.11)	(1.62)
Polity4						**-0.0015**					**-0.0032**			**-0.0039**
						(2.23) **					**(4.72)*** **			**(3.40)*** **
Education							-0.0003					0.0013		**-0.0065**
							(0.20)					(0.92)		**(4.32)*** **
GNI per cap								**-0.0044**					**-0.0104**	**-0.0083**
								(2.05) **					**(4.44)*** **	**(2.22)** **
No. of attacks									0.0069					**0.0094**
									(1.62)					**(2.56)** **
Observations	75	75	75	75	75	75	72	75	75	75	75	72	75	72
R-squared	<0.01	0.11	0.08	0.04	<0.01	0.06	<0.01	0.05	0.03	0.14	0.35	0.13	0.33	0.58

Table A1. Chronology of Selected Terrorism Attacks from the Annual "Patterns of Global Terrorism" Report of the Counterterrorism Office of the U.S. Department of State, Various Issues, 1995- 2002

Date	Location of Attack	Terrorist Attack	Affected Firm
31-Jan-95	Colombia	Suspected guerrillas kidnapped two Brazilian engineers at an abandoned hydroelectric dam. The engineers are employed by the Swiss Company, ASEA.	ASEA Brown Boveri
20-Oct-95	Turkey	A pipe bomb exploded outside a Coca-Cola Company warehouse in Istanbul, causing minor damage to the building and to a vehicle. No one has claimed responsibility for the attack.	Coca-Cola
24-Apr-96	Poland	A bomb placed at a Shell gas station in Warsaw detonated, killing one policeman who was preparing to defuse the device. A group calling itself GN 95 later claimed responsibility and demanded $2 million from the Royal Dutch Shell Group. The group justified the attack by stating its opposition to expansion of foreign investment in Poland.	Royal Dutch Shell
8-Apr-97	Colombia	FARC guerrillas bombed a rail line at a mining complex in El Cerrejon, derailing 27 railcars, spilling 2,700 tons of coal and 3,700 gallons of diesel fuel, and damaging 550 yards of rail line. The mine is operated under concession by Intercor, a subsidiary of Exxon Corp.	Exxon
3-Feb-98	Greece	Bombs detonated at two McDonald's restaurants in the Halandri and Vrilissia suburbs of Athens, causing extensive damage. Authorities suspect anarchists carried out the attacks in retaliation for the arrest of the alleged leader of the Fighting Guerrilla Formation (MAS).	McDonalds
5-Oct-98	Ecuador	Three employees of the Santa Fe Oil Company, two US citizens and one Ecuadorian, were kidnapped, according to local press accounts. One US citizen escaped the next day.	Santa Fe Oil Company
7-Apr-00	Nigeria	Armed militants kidnapped 40 persons--15 British, 15 French, and 10 Korean citizens--from residences belonging to the Elf Aquitaine Oil Company in Port Harcourt, according to press reports. The 40 hostages were released unharmed several hours later. Disgruntled landowners were suspected.	Elf Aquitaine Oil Co.
25-Dec-00	Greece	A bomb placed at a Citibank ATM in Athens exploded, causing major damage to the exterior ATM and to the bank interior, according to press reports. The Anarchists Attack Team claimed responsibility for the attack to show support for the dead prisoners in Turkey.	Citibank
21-Dec-01	Philippines	In Manila, according to press reports, authorities safely defused a bomb placed outside the Allied Bank building housing the Canadian Embassy and next door to the British Embassy. The bomb weighed between 50-60 pounds, was composed of ammonium nitrate soaked in gasoline, and contained two electric blasting caps. No one claimed responsibility.	Allied Bank
14-Jun-02	Pakistan	In Karachi, a vehicle bomb exploded on the main road near the US Consulate and Marriott Hotel, killing 11 persons, injuring 51 others, including a US and a Japanese citizen, and damaging nearby buildings. Al Qaida or Al-Qa'nun is possibly responsible.	Marriott