

# The Impact of Terrorism Across Industries: An Empirical Study\*

## 1. Introduction

Politically motivated violence in general and terrorism in particular have a strong negative effect on economic prosperity. This is, at least, the main message we obtain from a rapidly growing literature that analyzes the effects of terrorist acts on various aspects of the economy. Although there is no reason to believe that terror attacks have a homogenous impact across all economic activities, the extant literature seldom probes terrorism in terms of its impact on different industries.

This paper marks the first attempt to analyze systematically the impact of terrorism across different industries in a specific country. The main purpose is to determine whether terrorism affects defense and security-related industries differently than it does other economic sectors. Our hypothesis is intuitive: terror attacks dampen the activity of most economic sectors but, at the same time, may enhance expected business for companies in the defense and security industries.<sup>1</sup>

To test this hypothesis, we focus on Israeli companies that are traded in American markets and build, using matching score methods, a control group of

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\* We are grateful to Eric Gould, Alan Krueger, Saul Lach, Solomon Polachek, and Cecilia Rouse for very helpful remarks. The paper also benefited from the comments of participants at the ASSA/AEA annual meeting in Philadelphia and the 21<sup>st</sup> meeting of the Israeli Economic Association. Yaakov Garini and Hernán Meller provided invaluable help in the construction of the data set. Esteban F. Klor thanks the Maurice Falk Institute for Economic Research in Israel and the Israeli Foundation Trustees for their financial support. We bear sole responsibility for the content of this article.

This document has not been subject to formal review by the RAND Corporation. The opinions and conclusions are solely those of the authors and do not necessarily represent the opinions or policy of the RAND Corporation or its research clients and sponsors.

<sup>1</sup> Zussman and Zussman (2005) suggest, independently, the same basic idea. The section of their paper that deals with this hypothesis provides only an illustration, since it focuses on only two companies. Their exercise is not intended to identify and assess the differential effect of terrorism across economic sectors—the main objective of our study.

American companies. The stock-market valuations of each Israeli company and its assigned American control allow us to differentiate between the effect of terrorism on companies involved in or with the defense, security or antiterrorism industries and other companies. Additionally, we use panel data to perform a correlation analysis of countries' defense expenditures and defense imports from Israel with terror fatalities in Israel. The purpose of this analysis is to evaluate potential explanations of the effect of terrorism on Israel's defense industries.

The main results show that terrorism has no significant impact on the average stock-market valuation of Israeli companies vis-à-vis the valuation of the control group's stocks. However, after controlling for companies that belong to the defense or security industry, we observe that terrorism has a significant positive impact on these companies, and a significant negative impact on the rest of the companies. The results are robust to different samples of Israeli companies, different measures of terrorism, and different econometric specifications. We also observe that terror attacks in Israel are positively correlated with Israeli defense exports, even after controlling for the level of terrorism abroad and the observed defense expenditures of the importing countries.

This paper contributes to the growing number of studies that, focusing on the Israeli-Palestinian conflict, attempt to quantify the economic costs of terrorism. Naturally, the empirical literature quantifying the effects of conflict on the Israeli economy has used time series analysis. Fishelson (1993) studied the impact of the first *intifada* (Palestinian uprising) on the levels and trends of various real economic activities in Israel in 1987-89. Fielding (2003a, 2003b) investigated the impact of political instability on saving and investment, respectively, during 1987-99. Eckstein and Tsiddon (2004) conducted a similar analysis on consumption, investment, exports and per-capita GDP. And Eldor and Melnick (2004) studied the impact of terrorism on the valuation of companies that are traded in the Tel Aviv Stock Exchange (TASE) and on the Israeli foreign exchange rate.

A fundamental problem that arises in any attempt to quantify the effect of terrorism on economic fluctuations is that the estimates obtained may be biased due to a plausible interaction between the two variables. The aforementioned studies use different approaches to identify the effect of terrorism and politically motivated violence on the economic variable of interest from the effect of other macroeconomic distortions and shocks. Fishelson (1993) uses the years 1985-1987 that immediately preceded the first Palestinian uprising as his source of identification. Fielding (2003a, 2003b) isolates the effect of terrorism by relying on the relative stability of the Israeli economy after 1984 and including several control variables in his analysis. Eckstein and Tsiddon (2004) use a similar approach. Finally, Eldor and Melnick (2004) include in their analysis the S&P500 index as a control to help them identify the effect of terrorism on the valuation of an index that includes the 100 largest companies traded on the TASE.

These efforts to identify the impact of terrorism may not be enough to overcome the intrinsic difficulty of the task. To surmount these problems, we construct a control group and conduct an event-study analysis following the study of Abadie and Gardeazabal (2003, henceforth AG) on the Basque Country.

There are, however, several important differences between our approach and that adopted by AG. First, our proposed approach uses a matching method based on the most important characteristics of every stock to find the closest control stock for each Israeli stock, whereas AG use the stocks of all Spanish companies not identified with the Basque Country as their control variable. Second, we exploit the greater fluctuation in the number of fatalities of the Israeli-Palestinian conflict relative to the conflict in the Basque Country to better assess the economic impact of terror attacks. AG's results on the impact of conflict on the returns of Basque stocks relative to non-Basque stocks are based on two dummy variables that reflect whether the unilateral truce declared by ETA was credible or not. These variables neither quantify the marginal economic cost of an

additional terror attack nor account for the impact of small changes on the credibility of the truce. Our paper uses the available detailed data on the daily number of terror attacks to estimate the economic cost of terror attacks when measured on a daily, weekly and monthly basis.

Additionally, unlike AG, we decompose the impact of terrorism to identify the different effects of terrorism on defense-related as against non-defense-related companies. Given the large size of Israel's defense sector, this decomposition is crucial for an accurate determination of the overall effect of terrorism. In fact, a seemingly insignificant effect of terrorism on Israeli companies at large actually masks important differential effects across industries.

## **2. Impact of Terrorism on Individual Companies' Stock-Market Valuation**

### ***2.1. Data Description***

For the purposes of this research, we identified all Israeli companies that were traded on the Amex, NYSE and Nasdaq exchanges as of November 2001. The classification used was that of *Globes*, a leading financial Israeli newspaper that analyzes and monitors Israeli companies.<sup>2</sup> This results in an original sample of 125 Israeli companies. Table 1 lists all the companies identified as Israeli.

For each Israeli company, we built a set of prospective controls comprised of American companies traded in the same market and from the same industry. For all these companies (Israelis and their set of prospective controls) we collected daily end-of-the-day share prices for the sample period of January 1, 1998 – September 10, 2001.<sup>3</sup>

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<sup>2</sup> This classification is not based solely on the companies' registered addresses. Rather, it identifies all companies that were perceived to conduct a significant part of their business in Israel.

<sup>3</sup> Companies not traded before January 1, 1998, were deleted from our sample. Only companies traded both before and after September 28, 2000, were included, even if complete

The procedure used to find an American company that best corresponds each Israeli company based on the 1994-1997 period can be described in several steps. First, we calculated the size and book-to-market ratio (BE/ME) for each and every stock, as in Fama and French (1993). With these characteristics at hand we obtained the coefficients measuring the returns of the size and book-to-market equity factors for every stock from Fama and French (1993). The coefficient that measures each company's excess market return was obtained from *Security Risk Evaluation*, a quarterly publication of Merrill Lynch. We computed the excess-return coefficient of companies that lacked this parameter in *Security Risk Evaluation* following the methodology employed by this publication.<sup>4</sup> The market's benchmark factors ( $R_m - R_f$ , SMB, HML) for the 1994 – 1997 period were obtained from Fama and French's calculations.<sup>5</sup>

We then weighted each company's coefficients using the market benchmark factors to obtain the company's score. The score reflects the important characteristics of the company and allows us to compare different stocks. For every Israeli company, we chose as its American control the company in the prospective set of controls that had the closest score. The final sample of Israeli companies and their respective American controls—65 pairs of companies—appears in Table 2.

For the purposes of the empirical estimation, we further classified companies by main economic activities, differentiating between those that are substantially related to

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data for the entire sample period were not available for some. The September 11, 2001, terrorist attacks on US soil invalidate the use of American stocks as valid controls after this date.

<sup>4</sup> The necessary data to calculate these companies' excess return were obtained from the Center for Research in Security Prices (CRSP) data set.

<sup>5</sup> These calculations appear in French's website ([http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)). The data were collected for the entire 1994-2001 period for later use in the computation of the expected returns of the companies.

the defense, security or antiterrorism industries and all the others.<sup>6</sup> The classification was based on the companies' profiles by market analysts at *Yahoo Finance* and information provided by the companies at their website or at other financial sites. We found 23 Israeli companies in the sample that were involved in or with the defense, security, or antiterrorism industries. Table 2 separates these companies from the others.

Table 3 provides summary statistics differentiating between defense-related and non-defense-related companies. Both types of companies experienced, on average, lower abnormal returns than their controls during the analyzed time period. The main difference across sectors is observed before the Palestinian uprising that started on September 28, 2000. For that period, the defense-related companies had lower average abnormal returns than those observed for their controls, whereas the average abnormal return of the rest of the Israeli companies was higher than that observed for their controls. All four groups of companies exhibit negative average abnormal returns between January 1, 1998, and September 28, 2000, and positive average abnormal returns for the remainder of the analyzed period. This observation highlights the importance of the control group. Absent a proper control group, a statistically significant positive effect of terrorism on the stock-market valuation of the Israeli companies would have been wrongfully obtained.

To measure the level of terrorism we use the daily number of terror attacks and noncombatant Israeli fatalities from these attacks. The particular definition of terror attacks that we use for the construction of our data set is the one set forth by the US State Department, contained in Title 22 of the United States Code, Section 2656f(d).

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<sup>6</sup> We merged the companies in these three different but related industries into only one group in order to avoid conclusions based on very small samples.

Accordingly,

"-- The term "terrorism" means premeditated, politically motivated violence perpetrated against noncombatant targets by sub-national groups or clandestine agents, usually intended to influence an audience."

Specifically, our data set on terror attacks contains daily information on each and every *fatal* terror attack against *noncombatants* that occurred on *Israeli soil* between January 1<sup>st</sup>, 1998, and September 10, 2001.<sup>7</sup> Several explanations about the definition of terror attacks are in order.

a. Fatal: Due to constraints on the collection procedure, only attacks that claimed the life of someone other than the terrorist were included.

b. Noncombatants: This term is construed as including, in addition to civilians, military personnel who were unarmed and/or not on duty at the time of the incident.

c. Israeli Soil: This includes occupied territories when under Israeli control.

The main sources of the data are the Israeli Foreign Ministry, the National Insurance Institute, the Israeli Defense Forces and the archives of two newspapers (*Ma'ariv* and *Ha'aretz*). To the best of our knowledge, this is the most accurate and comprehensive unclassified data set that exists on fatal terror attacks against noncombatants on Israeli soil. Figure 1, which depicts the data, and Table 4, which presents the summary statistics, clearly reflect the impact of the second Palestinian uprising: On average, there was less than one attack per month between January 1, 1998, and September 28, 2000, whereas from September 28, 2000, to September 10, 2001, the monthly average climbed to 7.25.

Several potential problems with the data are worth emphasizing. First, the data on terror attacks indicate only attacks in which someone other than the terrorist died.

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<sup>7</sup> The available data set on terror attacks extends from 1949 until 2004. See Berrebi (2003) for a detailed description of the data set and its sources.

Thus, foiled attacks as well as "unsuccessful" attacks in terms of producing fatalities are not included. Terror attacks not on Israeli soil were also excluded. Since such attacks may affect the stock-market valuation of Israeli companies vis-à-vis their American controls, we may be omitting relevant events.

Second, some of the stocks of the Israeli companies are dually listed, i.e., traded in an American market and on TASE.<sup>8</sup> Since short-term arbitrage opportunities are generally not available, it has been shown that for this type of stocks the domestic country usually emerges as the dominant market and the foreign market as the satellite (Lieberman et al., 1999). Therefore, these companies' share prices are mainly determined on the TASE, casting serious doubts about the validity of the match with their American controls. In particular, differences in returns between stocks that are dually-listed and their respective control may be attributed to differences in the general performance of the TASE relative to the corresponding American market and not necessarily to the effect of terrorism, which affects only Israeli companies. We solved this problem by conducting the same analysis twice, first including all available companies and afterwards excluding arbitrage stocks.

A third potential concern about the data is that observed fluctuations on the returns on Israeli companies' shares may be caused by shocks to the Israeli economy that are unrelated to terrorism. If this is the case, we should observe an Israeli effect. According to our econometric specification, if such an effect exists it would be captured by the intercept. Similarly, every pair of companies may exhibit a specific permanent effect on the companies' abnormal returns due to particularities of the companies. For this reason, we repeat all our econometric estimations adding fixed effects for each set of companies.

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<sup>8</sup> Fifteen of the resulting 65 Israeli companies in the sample were dually-listed by January 1, 1999. These companies are identified in Table 2.

## 2.2. Methodology

This section describes the empirical strategy used to test the impact of terrorism on stock returns. For this purpose, we employ event study methods, whereby we treat a given event that occurs at a predetermined point in time as exogenous, and study the impact of this event on the realizations of a variable of interest (Campbell et al., 1997). For the current analysis, we defined terrorist attacks as the event of interest and measured their effect on the returns of Israeli companies' stocks relative to those of American companies.

The full econometric estimation proceeds in several steps. First, we compute the daily abnormal returns of every stock in the data set during the analyzed period. This step proceeds as follows. First, we obtain the expected returns of company  $i$ 's stock at date  $t$ ,  $\hat{R}_t^i$ , from the following equation:

$$(1) \quad \hat{R}_t^i = R_t^f + \beta_1^i R_t^m + \beta_2^i SMB_t + \beta_3^i HML_t,$$

where  $R_t^f$  is the market's risk-free rate,  $R_t^m$  is the excess return on the market portfolio,  $SMB_t$  is the difference between the returns on portfolios composed of small and big size stocks, and  $HML_t$  is the difference between the returns on portfolios composed on high and low book-to-market stocks, all measured at time  $t$ .

Thus, the abnormal return of stock  $i$  at time  $t$ ,  $AR_{i,t}$ , is given by the difference between observed returns and expected returns:

$$(2) \quad AR_{i,t} = R_t^i - \hat{R}_t^i.$$

We then subtract from the abnormal returns of every Israeli stock the abnormal returns of its American control. This yields the difference in abnormal returns for every pair of stocks,  $DAR_{i,t}$ . Finally, we estimate the following model:

$$(3) \quad DAR_{i,t} = \alpha_1 + \alpha_2 (Terror\ Attacks)_t + v_{i,t}.$$

The coefficient  $\alpha_2$  reflects the economic impact of an increase in the level of terrorism on Israeli stocks relative to their American controls.

Conventional wisdom has it that the economic impact of terror should be significantly negative. This is indeed the consensus reached by the constantly growing body of related research. Several studies, using mostly cross-country panel data sets, show that political factors (such as the extent of civil rights or local politically motivated violence) have a negative effect on investment and savings [Venieris and Gupta (1986) and Alesina and Perotti (1996)], and on economic growth [Barro (1991), Mauro (1995), Alesina et al. (1996) and Easterly and Levine (1997)].

Studies using Israeli data obtained similar findings. Fielding (2003a, 2003b) investigated the impact of political instability on saving and investment, respectively, during 1987-99. His results show that the savings ratio in Israel would almost double and investment would rise on average by 20 percent if politically related deaths in Israel were to cease. Eckstein and Tsiddon (2004) conducted a similar analysis on consumption, investment, exports and GDP per capita. They concluded that had Israel not suffered from terrorism during 2000-2003, its GDP per capita would have been 4 percent higher than its actual level. Perhaps more related to the variables of interest in the current paper, Eldor and Melnick (2004) studied the consequences of terrorism on stocks traded at the TASE and found that the Palestinian uprising caused a significant decrease of around 30 percent on a TASE market index.

In this study, we allow for the possibility that the effect of terror may be positive for some industries even if its overall effect is negative. In particular, the expected impact of terror is not constrained to be uniform across companies but rather to depend on the company's main economic activities.<sup>9</sup>

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<sup>9</sup> Fishelson (1993) performed an industry decomposition to study the impact of the first Palestinian uprising on the levels and trends of various real economic activities in Israel in 1987-89. He found that the uprising had a statistically significant effect on most economic

To account for this effect, we add in the second part of the econometric analysis a dummy variable that indicates whether a company is associated with defense, security or anti-terrorism products, services or clients. That is, we estimate the following model,

$$(4) \quad \begin{aligned} DAR_{i,t} = & \gamma_1 + \gamma_2 (Terror\ Attacks)_t + \gamma_3 (Defense)_i \\ & + \gamma_4 (Terror\ Attacks)_t * (Defense)_i + u_{i,t} \end{aligned}$$

where  $\gamma_2$  measures the effect of terrorism common to all companies,  $\gamma_3$  is a defense effect that controls for possible differences in the abnormal returns of companies in the defense sector as against non-defense companies, and  $\gamma_4$  is an interaction effect of terrorism on defense-related companies.

This specification allows us to explicitly test any systematic difference between the impact of terrorism on the returns of stocks of defense-related companies and that of all other companies. It also let us address the question of whether terrorism increases the abnormal returns of Israeli defense-related companies compared with the abnormal returns in the control group.

If our hypothesis is correct, i.e., if the effect of terror is not evenly distributed across industries, we should expect  $\gamma_2$  to be negative and  $\gamma_4$  positive. Moreover, if terrorism has a positive effect on the stock prices of Israeli defense companies vis-à-vis their American controls, the sum of  $\gamma_2$  and  $\gamma_4$  should be greater than zero.

### **2.3. Results**

Tables 5 and 6 provide parameter estimates for the two models shown above, using different time spans to account for the level of terrorism. The only difference between the tables is that Table 5 includes all the available stocks whereas Table 6 includes only stocks that are not dually-listed. The results of all specifications convey a similar

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activities, with the exception of some related to exports. He did not, however, study the specific effect of violence on defense-related industries.

message: terrorism has a positive effect on the stock returns of Israeli companies involved in or with defense, security or anti-terrorism products or clients, and a negative effect on the rest of the Israeli companies, irrespective of the time frame used to measure the level of terrorism.

Table 5 reports the results of our estimation of equations (3) and (4) by ordinary least squares. In the first two columns, we measure terrorism using a dummy variable equal to one from September 28, 2000, onward. In Columns (3) and (4), we measure terrorism using the number of monthly terrorist attacks. Columns (5) and (6) contain the results of the estimation when looking at the weekly number of attacks. Finally, the last two columns report the results obtained on the basis of attacks per day.<sup>10</sup>

According to all the results obtained, the data show a significant negative relationship between terrorism and abnormal returns of Israeli companies only when the estimation includes the defense effect and the interaction effect. In other words, since terrorism has a negative effect on some sectors of the economy and a positive effect on other sectors, the overall effect of terrorism is misrepresented when the sectors are pooled. Moreover, if the positive and negative effects cancel each other out one may reach the wrong conclusion, i.e., that terrorism has no significant impact on the abnormal returns of Israeli companies relative to their controls.

The terrorism effect, shown in Column (2), indicates that over 5 percent of the decrease in the valuation of an Israeli company not related to the defense industry may be explained by the Palestinian uprising that started in September 2000. Columns (4), (6) and (8) provide additional estimates of the impact of an increase in the level of

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<sup>10</sup> The time difference between Israel and the U.S. creates a problem when daily attacks are used. Attacks perpetrated before the closing of the stock markets may show an effect the same day, whereas the effects of attacks perpetrated after the closing of the stock market are captured the next trading day. Weekends and holidays create the same concern. To account for this possibility, we repeated the empirical analysis including lags of the daily attacks. The results, available from the authors upon request, are basically the same.

attacks on the abnormal returns of a non-defense-related Israeli company. These effects vary from 0.7 percent to 2 percent depending on whether attacks are measured on the basis of monthly, weekly or daily data. The effect of monthly attacks is significant at statistically accepted levels; that of weekly attacks is only marginally significant (at the 12 percent level).<sup>11</sup>

The defense effect, estimated in the even-numbered columns, is not consistently significant. This suggests that the behavior of the relative abnormal returns of Israeli defense-related companies is not significantly different from that exhibited by the other companies. The fact that the intercept, too, is not statistically significant for any of the different specifications implies that there isn't an Israeli effect on the companies' abnormal returns.<sup>12</sup>

According to the results of our estimation, it is terrorism that influences the abnormal returns of companies in the defense sector differently from the rest of the companies. The estimates indicate that the abnormal returns of Israeli defense-related companies increased by over 7 percent relative to their American controls as a consequence of the Palestinian uprising. The evidence regarding the overall effect of terrorism on defense-related Israeli companies in shorter time spans is also significantly positive: an effect of 1 or 2.5 percent was obtained using monthly and weekly data, respectively.<sup>13</sup>

As mentioned above, the fact that several of the Israeli companies are traded simultaneously at the Tel Aviv Stock Exchange and at one of the American markets

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<sup>11</sup> Daily attacks are not significant in any of the estimated models, even when we include lags of this variable. Given the aforementioned issues that arise when using daily data, we are reluctant to conclude that markets are not efficient.

<sup>12</sup> The fact that the intercept is not significant does not mean that there may not be specific fixed effects for each company. Table 7 addresses this alternative specification using a model with company fixed effects.

<sup>13</sup> The hypothesis that  $\gamma_2 + \gamma_4 = 0$  is rejected at the 10 percent significance level for all specifications except that using daily terror attacks.

could potentially bias the results. Table 6 addresses this issue by showing the results of the analysis with the sample restricted to Israeli companies that are traded only in American markets.

The findings using this subsample are essentially identical to those observed using the full sample. Namely, the observed effect of terrorism on abnormal stock returns is still insignificant when no differentiation across industries is made. Moreover, once we introduce the interaction variable for the defense sector, terror attacks show a significantly negative effect on Israeli companies overall, and a positive effect on defense related companies. From the table follows that the positive impact of terrorism on companies related to the defense sector is higher than that observed when the full sample is used. In particular, once we exclude dually-listed companies from the sample, the observed effect of terror on the defense sector is roughly one standard deviation higher than that obtained before, irrespective of the time frame used to proxy for terrorism. Furthermore, the overall effect of terrorism on the defense sector ( $\gamma_2 + \gamma_4$ ) is also higher under this restricted sample and is significantly positive (at the 5 percent level) for all specifications.

Table 7 provides estimates for equations (3) and (4) including companies' fixed effects. The results are basically the same as those obtained without the inclusion of fixed effects. Moreover, an F-test of the null hypothesis that all pairs of matched companies' specific fixed effects are equal to zero cannot be rejected at the 99 percent level. This provides empirical support for the matching procedure used to build the control group, as the particular characteristics of each company seem to cancel out with the particular characteristics of its control. In other words, the results of the F-test corroborate our finding that the behavior of the relative abnormal returns of every pair of matched companies is not significantly different from that observed among the rest of the pairs, once we control for the level of terrorism and whether or not these companies are related to the defense industry.

### 3. The Effects of Terror on the Israeli Defense Industry

This section investigates possible channels of positive influence of terror attacks in Israel on Israeli companies that are related to the defense, security or antiterrorism industries.

The Israeli defense sector expanded significantly during the period at issue, mostly due to an increase in exports. Indeed, Israel more than doubled its defense exports over the last decade, elevating its share in global defense exports to nearly 8 percent today (Defense News, 2004).<sup>14</sup> During the same period, despite the significant increase in terror attacks and the deterioration of the security situation in the Middle East, the share of orders by the Israeli Defense Forces fell to less than 30 percent of the domestic defense industries' output. Thus, more than 70 percent of Israeli defense manufacturing output is exported (Lavi, 2002).

It is therefore obvious that the successful performance of the Israeli defense industry in the past few years originates in changes in demand for its products abroad. Israeli defense exports are influenced by a variety of factors, e.g., the level of terrorism abroad and the level of defense expenditure that the importing countries wish to maintain. The main goal of the empirical exercise that follows is to establish whether fluctuations in Israeli defense exports also correlate with terror attacks in Israel, after controlling for the factors listed above. At this point, it is important to stress that the empirical analysis in this section is solely based on correlations; in itself, it cannot prove causality.

To study the determinants of the international demand for Israeli defense products we estimate the following model:

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<sup>14</sup> In view of this significant increase, *Defense News*, a leading magazine specializing in military issues, ranked Israel as the world's no. 3 exporter of defense products in 2002, behind only the U.S. and Russia.

$$(5) \quad (Def\_Imp)_{i,t} = \alpha + \beta_1 (Isr\_Ter)_t + \beta_2 (Def\_Exp)_{i,t} + \\ \beta_3 (Imp\_Ter)_{i,t} + \beta_4 (World\_Ter)_t + \varepsilon_{i,t}$$

where  $\alpha, \beta_1 - \beta_4$  are parameters to be estimated and  $\varepsilon_{i,t}$  is a random disturbance, for  $i = 1, \dots, N$  countries, and  $t = 1, \dots, T$  years.  $(Def\_Imp)_{i,t}$  denotes total defense imports from Israel by country  $i$  in year  $t$ ;  $(Isr\_Ter)_t$  denotes the number of terror fatalities in Israel in year  $t$ ;  $(Def\_Exp)_{i,t}$  denotes total defense expenditures by country  $i$  in year  $t$ ;  $(Imp\_Ter)_{i,t}$  is the number of terror fatalities in the importer country  $i$  in year  $t$ ; and  $(World\_Ter)_t$  is the worldwide total number of terror fatalities in year  $t$ .

For the purposes of the estimation we merged two distinct data sets. First, we use the data on military exports and expenditures published by the Stockholm International Peace Research Institute (SIPRI). This data base covers over 160 countries and provides consistent time series for the period at issue (see [www.sipri.org](http://www.sipri.org)). Specifically, we focus on the value of total military imports from Israel and the total military expenditure of each country.

According to the SIPRI data, 29 countries purchased defense products from Israel between 1994 and 2003.<sup>15</sup> We construct a balanced panel data set by confining our attention to countries that had a regular trading relationship with Israel during the entire period at issue; i.e., we abstract from countries' political considerations that might lead them to refrain from trading defense products.<sup>16</sup> This allows us to relate to fluctuations in the quantity of defense products traded as a reflection of the countries' reaction to their security concerns and their wish to acquire Israeli defense products as

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<sup>15</sup> The data set includes an additional entry for a country listed as "unknown". We decided to disregard this entry because we were unable to link it with any existing country.

<sup>16</sup> Among the 29 countries in the sample, only Sri Lanka (which renewed diplomatic relations with Israel in 2000) and the Southern Lebanese Army (which Israel stopped providing defense products when it withdrew all its troops from southern Lebanon in May 2000) did not have diplomatic relations with Israel during the entire time period. Adding these countries to our analysis does not affect our findings qualitatively.

against those of other potential exporters. Our final data set is composed of 27 countries.

To control for the effects of local and global terrorism, we use data on terror fatalities collected by RAND Terrorism Chronology 1968-1997 and RAND®-MIPT Terrorism Incident database (1998-Present).<sup>17</sup> The data on terror fatalities in Israel were described in Section 2 above. Here we use the updated series shown in Berrebi and Klor (2004).

Table 8a presents summary statistics classifying the data by country; Table 8b presents summary statistics differentiating between the years 1994-2000 and 2001-2003. As expected, individual countries' defense imports from Israel fluctuate severely over time even though their defense expenditures are relatively constant. Furthermore, the distribution of terror fatalities is extremely right-skewed, with India and the U.S. showing extreme values relative to the rest of the sample. Average annual fatalities during the period at issue were lower in Israel than in India and the U.S. but significantly higher than in the other countries.

Table 8b provides some preliminary evidence of the important increase of defense imports from Israel during the years 2001-2003. On average, annual defense imports from Israel between the years 2001-2003 increased by over 50% compared to the years 1994-2000, whereas the annual increase in defense expenditures of the same set of countries is slightly below 15%. That is, Israeli defense products captured a larger share of these countries defense expenditures during the last few years. We also observe from this table a highly significant increase over time in the number of fatalities from terrorism, either in Israel, the importer countries and worldwide.

Two important caveats about the data are worth mentioning. First, our data from SIPRI concern major conventional weapons transfers from Israel during the period at

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<sup>17</sup> See [www.tkb.org/RandSummary.jsp](http://www.tkb.org/RandSummary.jsp) for a description of the data as well as a precise definition of terror fatalities.

issue. Since weapon contracts are usually signed before the sale is made, the data may not be highly accurate in regard to the actual timing of the transaction. To solve this problem we also estimated equation (5) using a one-year lag for all terror variables as well. Qualitatively, the results are very similar; we present the results without the lag variables because this allows us to take advantage of additional observations, rendering a more accurate estimation.<sup>18</sup> Second, imports from Israel account for only a small fraction of these countries' defense expenditures (Table 8a). Since Israel supplied between 5 and 10 percent of worldwide defense exports during the period at issue, we must conclude that most defense expenditure consists of domestic manufacture. Therefore, it seems more likely that Israeli defense imports crowd out imports from other countries rather than substitute for local production. Consequently, total defense imports may be a better control than total defense expenditures. Unfortunately, we were unable to find the necessary information on this variable.

We initially estimate equation (5) using OLS.<sup>19</sup> The results appear in Column (1) of Table 9. The effect of terror fatalities in both the importer country and Israel is positive and statistically significant. We should interpret these findings with caution, however, since for OLS estimates to be efficient it is necessary to assume that all error processes have the same variance (homoscedasticity) and are independent of each other. In studies like ours, it is likely that these assumptions do not hold; namely, errors may be contemporaneously correlated because the scale of defense imports from Israel varies across countries. Moreover, errors may also be serially correlated if countries' choices of defense imports from Israel show some persistence over time.

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<sup>18</sup> Major transfers of conventional weapons between countries may be a consequence of bilateral agreements under which the two partners in the transaction exchange different types of weapons. If this is the case, defense imports from Israel are affected by defense exports to Israel. We also estimated model (5) using net defense imports from Israel as our dependent variable. The main conclusions from the two different estimations are basically the same.

<sup>19</sup> This and all subsequent estimated models include year-specific fixed effects.

To control for country-specific effects, we estimate model (5) using OLS with country fixed effects. The results appear in the second column of Table 9. Most variables have similar qualitative effects to those found above: Terror fatalities in Israel and in the importer country have a positive effect on defense imports from Israel. The F-test shows that there are significant country fixed effects on the level of defense imports from Israel. The estimated coefficients, however, are still inefficient since the error terms obtained from the fixed-effect estimation follow a first-order autoregressive process.

To solve this additional complication, we estimate equation (5) using a Prais-Winsten regression with panel-corrected standard errors (OLS-PCSE). This method uses the Prais-Winsten estimation and adjusts standard errors to account for heteroskedasticity and panel correlation in the error process, as recommended by Beck and Katz (1995). The results of this estimation are reported in Column 3 of Table 9.

According to this estimation, too, both measures of terror fatalities are positively associated with defense imports from Israel, confirming our earlier panel-data analyses. If one takes the results literally, it would mean that a marginal increase in the number of terror fatalities in Israel translates into an increase of over \$21,000 in defense exports, all else equal. A marginal increase in the number of terror fatalities in the importer country translates into an increase of over \$15,000 in defense imports from Israel. Note also that the coefficient for total expenditures is almost equal to zero. Thus, the evidence obtained partly supports the hypothesis that increases in Israeli defense exports crowds out local manufacture of defense products and/or imports from other countries.

The above estimation supports our hypothesis that an increase in the global demand for Israeli defense-related products is responsible for most of the growth observed in this sector. We are left wandering, however, how this process is carried out. For the time being, we lack a complete answer. As a conjecture, we suggest that the constant risk of war and terrorism has placed Israeli companies under continuous

pressure to create innovative defense products in order to thwart constantly evolving threats. As a consequence, these companies have become highly specialized in defense manufacturing. This specialization (highlighted constantly by continuous terror attacks) gives Israeli companies an advantage in global defense product and technology markets. In the words of Defense Minister Shaul Mofaz:<sup>20</sup>

"The Israeli defense industries are accustomed to providing the highest quality, innovative solutions to its most demanding clients – the Israel Defense Forces, including the Air Force and Navy. The technology we have to offer has been developed and tested by some of the world's leading defense experts. We are pleased to share our years of expertise with our partners in the war against terror and look forward to successful, cooperative mission."

#### **4. Conclusions**

This paper empirically assessed the impact of terrorism on the stock-market valuation of Israeli companies that are traded in American markets. Its main contribution was to show that the impact of terrorism varies across companies in different industries. Overall, the evidence obtained strongly suggests that terrorism has a positive effect on the stock-market valuation of companies involved with defense, security or antiterrorism products or clients, and a significantly negative effect on that of other companies. We also found that the most likely explanation for the observed gains traces to an increase in other countries' demand for Israeli defense products.

This paper marks the first step toward a better understanding of the differential impact of terrorism on different economic activities. The important economic ramifications of studies along these lines cannot be overstated in a world in which

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<sup>20</sup> The quote is from the Paris Air Show (2003) and can be found at the official website of the Israeli Ministry of Defense (<http://www.airshow.mod.gov.il/over.htm>).

terrorism has attained unexpected magnitudes. We conjecture that the differing effects of terrorism across industries should lead to a reallocation of resources in countries that expect to suffer lengthy periods of violence in the future. Specializing in antiterrorism products and technologies may not only be a natural way to cope with this threat but may also prove to be an efficient way to alleviate some of the economic costs of conflict. We hope to be able to assess our empirical conjecture in the near future.

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**Table 1. List of Israeli Stocks Traded at American Markets**

|       |                                |       |                                |
|-------|--------------------------------|-------|--------------------------------|
| ACSEF | ACS-Tech80 Ltd                 | KERX  | Keryx Biopharmaceuticals Inc   |
| ALDN  | Aladdin Knowledge Sys Ltd      | KOR   | Koor Industries Ltd            |
| AIP   | American Isreali Paper Mills   | LANTF | Lannet Data Communications     |
| ARLC  | Arel Communications & Software | LNOP  | Lanoptics Ltd                  |
| ATTU  | Attunity Ltd                   | LVEL  | Level 8 Sys Inc.               |
| AUDC  | Audiocodes Ltd                 | MAGS  | Magal Security Sys Ltd         |
| BWEB  | Backweb Technologies Ltd       | MGIC  | Magic Software Enterprises     |
| BTGC  | Bio Technology General Corp    | MATV  | Matav-Cable Sys Media –ADR     |
| BSI   | Blue Squire Israel Ltd - ADR   | MDSLF | MEDIS EL Ltd                   |
| BOSC  | BOS Better Online Solutions    | MEMCF | Memco Software Ltd             |
| BRZE  | Breezecom Ltd                  | MNTE  | Mentergy Ltd.                  |
| BVRT  | BVR Technologies Ltd           | MTSL  | Mer Telemgmt Solutions Ltd     |
| CAMT  | Camtek Ltd                     | MTLK  | Metalink Ltd                   |
| KML   | Carmel Container Sys -ORD      | MNDO  | Mind CTI Ltd                   |
| CHKP  | Check Point Software Techn     | FLSH  | M-Systems Flash Disk Pioneer   |
| CIMT  | Cimatron Ltd                   | NNDS  | NDS Group PLC -SPON ADR        |
| CKSW  | Clicksoftware Technologies Ltd | DDDDF | New Dimension Software Ltd     |
| CTCH  | Commtouch Software Ltd         | NXUS  | Nexus Telocation Sys Ltd       |
| CGEN  | Compugen Ltd                   | NICE  | Nice Systems Ltd -SPON ADR     |
| CMVT  | Comverse Technology Inc        | NOGAF | Noga Electro-Mechanical Inds.  |
| CREO  | Creo Products Inc.             | NVMI  | Nova Measuring Instruments Ltd |
| CRYS  | Crystal Systems Solutions Ltd  | NURM  | Nur Macroprinters Ltd          |
| DSSI  | Data Systems & Software Inc.   | OBAS  | Optibase Ltd                   |
| DELT  | Delta Galil Inds. Ltd -ADR     | OPTL  | Optisystems Solutions Ltd      |
| DDDC  | Deltathree Inc                 | ORFR  | Orbit/FR Inc                   |
| DSPG  | DSP Group Inc                  | ORBK  | Orbotech Ltd                   |
| ESIM  | E Sim Ltd                      | ORCT  | Orckit Communications Ltd      |
| ECIL  | Eci Telecommunications -ORD    | PGEO  | Paradigm Geophysical Ltd       |
| ECTX  | Ectel Ltd                      | PTNR  | Partner Comm. Co Ltd –ADR      |
| EDNTF | Eduentics Ltd                  | PARS  | Pharmos Corp                   |
| EDUSF | Edusoft LTD                    | PLCM  | Polycom Inc.                   |
| ELOFC | El De Electro-Optic Dev Ltd    | PRSE  | Precise Software Solutions Ltd |

(continued &gt;)

**Table 1. (continued)**

|       |                                |        |                                |
|-------|--------------------------------|--------|--------------------------------|
| ELBT  | Elbit Ltd                      | RADIF  | Rada Electronics Inds          |
| EMITF | Elbit Medical Imaging Ltd      | RDCM   | Radcom Ltd                     |
| ESLT  | Elbit Systems Ltd              | RVSN   | Radvision Ltd                  |
| EVSX  | Elbit Vision Systems Ltd       | RDWR   | Radware Ltd                    |
| EFCX  | Electric Fuel Corp.            | RTLX   | Retalix Ltd                    |
| EIL   | Electrochemical Indus Frutar   | RITT   | RIT Technologies Ltd           |
| EFII  | Electronics for Imaging Inc.   | ROBO   | Robo Group Tek Ltd             |
| ELRN  | Elron Electronics Inds -Ord    | 3RBMXF | Robomatix Tech Ltd             |
| ELT   | Elscint Ltd -ORD               | SPNS   | Sapiens Intl Corp N V          |
| ELTK  | Eltek Ltd                      | SCIX   | Scitex Corp. Ltd – ORD         |
| ENGEF | Engel General Developers Ltd   | SILCF  | Silicom Limited                |
| EQY   | Equity One Inc                 | 3SMPL  | Simplayer.com Ltd              |
| ESCM  | ESC Medical Systems Ltd        | SAE    | Super Sol Ltd –ADR             |
| ETZ   | ETZ Lavud Ltd                  | TAD    | Tadiran Ltd -SPON ADR          |
| FLRE  | Floware Wireless Systems Ltd   | TTELF  | Tadiran Telecommunications Ltd |
| FORTY | Formula Sys 1985 Ltd           | TARO   | Taro Pharmaceutical Inds Ltd   |
| FORS  | Forsoft Ltd.                   | TATTF  | TAT Technologies Ltd –ORD      |
| FNDT  | Fundtech Ltd                   | TCNO   | Tecnomatix Technologies Ltd    |
| WILCF | G Willi-Food Intl Ltd          | TFR    | Tefron Ltd.                    |
| GALT  | Galileo Technology Ltd         | TLDCF  | Teledata Communications Ltd    |
| GILTF | Gilat Satellite Networks Ltd   | TERM   | Terayon Comm. Systems Inc      |
| HCTL  | Healthcare Technologies Ltd    | TEVA   | Teva Pharm. Inds. –ADR         |
| HOMEF | Home Centers (DIY) Ltd         | TIGA   | Tioga Technologies Ltd         |
| ICTS  | ICTS International N V         | TISA   | Top Image Systems Ltd          |
| IISL  | IIS Intelligent Info -ORD      | TSEM   | Tower Semiconductor Ltd        |
| INDG  | Indigo NV                      | TTIL   | TTI Team Telecom Intl. Ltd     |
| IGLD  | Internet Gold -GLDN Lines Ltd. | VRYA   | Viryanet Ltd                   |
| IPLLF | Interpharm Labs Ltd -ORD       | VOCL   | Vocaltec Communications Ltd    |
| ISRL  | Isramco Inc.                   | 3WIZTF | Wiztec Solutions               |
| ISEFE | Istec Industries & Tech Ltd    | ZRAN   | Zoran Corp                     |
| JCDA  | Jacada Ltd                     |        |                                |

**Table 2. Final list of Israeli companies with their respective American controls**

|       | <b>Israeli Company Name</b>    |      | <b>Respective US Control</b> | <b>Industry</b>              |
|-------|--------------------------------|------|------------------------------|------------------------------|
| ACSEF | Acs-Tech80 Ltd                 | SOFT | Softech Inc                  | CMP INTEGRATED SYS DESIGN    |
| ARLC  | Arel Communications & Sftwre   | INGR | Intergraph Corp              | CMP INTEGRATED SYS DESIGN    |
| ATTU  | Attunity Ltd                   | TMBS | Timberline Software Corp     | PREPACKAGED SOFTWARE         |
| BOSC  | Bos Better Online Solutions §  | NPIX | Network Peripherals Inc      | COMPUTER COMMUNICATION EQUIP |
| BSI   | Blue Square-Israel Ltd -Adr §  | WMK  | Weis Markets Inc             | GROCERY STORES               |
| BTGC  | Bio Technology General Corp    | CYAN | Cyanotech Corp               | MEDICINAL CHEMS,BOTANICL PDS |
| BVRT  | Bvr Technologies Ltd           | DKEY | Datakey Inc                  | MISC ELEC MACHY,EQ,SUPPLIES  |
| CHKP  | Check Point Software Techn *   | TTWO | Take-Two Interactive Sftwr   | PREPACKAGED SOFTWARE         |
| CIMT  | Cimatron Ltd                   | TESI | Tangram Entp Solutions       | PREPACKAGED SOFTWARE         |
| CMVT  | Comverse Technology Inc *      | SYMM | Symmetricom Inc              | TELE & TELEGRAPH APPARATUS   |
| DSPG  | Dsp Group Inc                  | ADAP | Adaptive Broadband Corp      | RADIO,TV BROADCAST, COMM EQ  |
| DSSI  | Data Systems & Software Inc    | ANLY | Analysts International Corp  | COMPUTER PROGRAMMING SERVICE |
| ECIL  | Eci Telecommunications -Ord *  | ASPT | Aspect Communications Corp   | TELE & TELEGRAPH APPARATUS   |
| EFCX  | Electric Fuel Corp *           | CARD | Publicard Inc                | MISC ELEC MACHY,EQ,SUPPLIES  |
| EFII  | Electronics For Imaging Inc    | ESAN | Entrada Networks Inc         | COMPUTER COMMUNICATION EQUIP |
| ELT   | Elscint Ltd -Ord               | VAR  | Varian Medical Sytems Inc    | ELECTROMEDICAL APPARATUS     |
| ELTK  | Eltek Ltd *                    | SGMA | Sigmatron International Inc  | PRINTED CIRCUIT BOARDS       |
| ESLT  | Elbit Systems Ltd § *          | COMS | 3com Corp                    | CMP INTEGRATED SYS DESIGN    |
| ETZ   | Etz Lavud Ltd                  | II   | Intersystems Inc/De          | MISC PLASTICS PRODUCTS       |
| EVSN  | Elbit Vision Systems Ltd       | SOFT | Softech Inc                  | CMP INTEGRATED SYS DESIGN    |
| FLSH  | M-Systems Flash Disk Pioneer   | MTIC | Mti Technology Corp          | COMPUTER STORAGE DEVICES     |
| FORTY | Formula Sys 1985 Ltd -Adr § *  | QSII | Quality Systems Inc          | CMP INTEGRATED SYS DESIGN    |
| GALT  | Galileo Technology Ltd         | LOGC | Logic Devices Inc            | SEMICONDUCTOR,RELATED DEVICE |
| GILTF | Gilat Satellite Networks Ltd * | WRLS | Telular Corp                 | RADIO,TV BROADCAST, COMM EQ  |
| HCTL  | Healthcare Technologies Ltd    | MABA | Amer Biogenetic Sci -CI A    | IN VITRO,IN VIVO DIAGNOSTICS |
| HOMEF | Home Centers (Diy) Ltd §       | FAST | Fastenal Co                  | BLDG MATL,HARDWR,GARDEN-RETL |
| ICTS  | Icts International N V *       | TTEC | Teletech Holdings Inc        | BUSINESS SERVICES, NEC       |
| IISL  | Iis Intelligent Info -Ord      | NCDI | Network Computing Devices    | COMPUTER TERMINALS           |
| INDG  | Indigo N V                     | CTCQ | Check Technology Corp        | PRINTING TRADES MACHY, EQUIP |
| ISRL  | Isramco Inc                    | CRED | Credo Petroleum Corp         | CRUDE PETROLEUM & NATURAL GS |
| KOR   | Koor Industries Ltd -Adr § *   | SXI  | Standex International Corp   | CONGLOMERATES                |
| LNOP  | Lanoptics Ltd                  | CPCI | Ciprico Inc                  | COMPUTER COMMUNICATION EQUIP |
| LVEL  | Level 8 Sys Inc                | CVNS | Covansys Corp                | COMPUTER PROGRAMMING SERVICE |

(continued &gt;)

**Table 2. (Continued)**

|       | <b>Israeli Company Name</b>   |       | <b>Respective US Control</b> | <b>Industry</b>              |
|-------|-------------------------------|-------|------------------------------|------------------------------|
| MAGS  | Magal Security Sys Ltd §*     | NMRX  | Numerex Corp -CI A           | COMMUNICATIONS EQUIP, NEC    |
| MATV  | Matav-Cable Sys Media -Adr *  | CMCSK | Comcast Corp -CI A Spl       | CABLE AND OTHER PAY TV SVCS  |
| MGIC  | Magic Software Enterprises *  | EDGW  | Edgewater Technology Inc     | PREPACKAGED SOFTWARE         |
| MNTE  | Mentergy Ltd                  | EPRE  | Epresence Inc                | CMP PROGRAMMING,DATA PROCESS |
| MTSL  | Mer Telemgmt Solutions Ltd    | SIDY  | Science Dynamics Corp        | TELE & TELEGRAPH APPARATUS   |
| NICE  | Nice Systems Ltd -Spon Adr *  | CIEN  | Ciena Corp                   | TELE & TELEGRAPH APPARATUS   |
| NOGAF | Noga Electro-Mechanical Inds  | ABTE  | Able Telecom Holding Corp    | ELECTRICAL WORK              |
| NURM  | Nur Macroprinters Ltd         | PRST  | Presstek Inc                 | PRINTING TRADES MACHY, EQUIP |
| NXUS  | Nexus Telocation Sys Ltd *    | STCIA | Salient 3 Commun Inc -CI A   | RADIO,TV BROADCAST, COMM EQ  |
| ORBK  | Orbotech Ltd                  | CGNX  | Cognex Corp                  | INDUSTRIAL MEASUREMENT INSTR |
| ORCT  | Orckit Communications Ltd §*  | PCTL  | Picturetel Corp              | TELE & TELEGRAPH APPARATUS   |
| ORFR  | Orbit/Fr Inc *                | TLGD  | Tollgrade Communications Inc | ELEC MEAS & TEST INSTRUMENTS |
| PARS  | Pharmos Corp *                | BSTC  | Biospecifics Technologies Cp | PHARMACEUTICAL PREPARATIONS  |
| PLCM  | Polycom Inc §*                | AFCI  | Advanced Fibre Comm Inc      | TELE & TELEGRAPH APPARATUS   |
| RADIF | Rada Electronic Inds *        | KVHI  | Kvh Industries Inc           | SRCH,DET,NAV,GUID,AERO SYS   |
| RDCM  | Radcom Ltd                    | CPCI  | Ciprico Inc                  | COMPUTER COMMUNICATION EQUIP |
| RITT  | Rit Technologies Ltd          | CPCI  | Ciprico Inc                  | COMPUTER COMMUNICATION EQUIP |
| ROBO  | Robo Group Tek Ltd §          | IMCI  | Infinite Group Inc           | MISC ELEC MACHY,EQ,SUPPLIES  |
| SAE   | Super-Sol Ltd -Adr §          | SMF   | Smart & Final Inc            | GROCERY STORES               |
| SCIX  | Scitex Corp Ltd -Ord §        | PRST  | Presstek Inc                 | PRINTING TRADES MACHY, EQUIP |
| SILCF | Silicom Limited               | AESP  | Advanced Electr Support Pds  | COMPUTER COMMUNICATION EQUIP |
| SPNS  | Sapiens Intl Corp N V §       | PTEC  | Phoenix Technologies Ltd     | PREPACKAGED SOFTWARE         |
| TARO  | Taro Pharmaceutical Inds Ltd  | BLSI  | Boston Life Sciences Inc     | PHARMACEUTICAL PREPARATIONS  |
| TATTF | Tat Technologies Ltd -Ord *   | KRSL  | Kreisler Manufacturing Corp  | AIRCRAFT ENGINE,ENGINE PARTS |
| TCNO  | Tecnomatix Technologies Ltd   | IMIC  | Indusri-Matematik Intl Corp  | PREPACKAGED SOFTWARE         |
| TEVA  | Teva Pharm Inds -Adr §        | VPHM  | Viropharma Inc               | PHARMACEUTICAL PREPARATIONS  |
| TISA  | Top Image Systems Ltd *       | QMDC  | Quadramed Corp               | PREPACKAGED SOFTWARE         |
| TSEM  | Tower Semiconductor Ltd §*    | OPTI  | Opti Inc                     | SEMICONDUCTOR,RELATED DEVICE |
| TTIL  | Tti Team Telecom Intl Ltd     | DRCO  | Dynamics Research Corp       | CMP INTEGRATED SYS DESIGN    |
| VOCL  | Vocaltec Communications Ltd * | EGPT  | Eagle Point Software Corp    | PREPACKAGED SOFTWARE         |
| WILCF | G Willi-Food Intl Ltd         | PZZI  | Pizza Inn Inc/Mo             | GROCERIES & RELATED PDS-WHSL |
| ZRAN  | Zoran Corp                    | ISSI  | Integrated Silicon Solution  | SEMICONDUCTOR,RELATED DEVICE |

§ Arbitrage Stocks: Companies dually listed prior to January 1<sup>st</sup>, 1999.

\* Companies Involved in or with Security/Defense Related Businesses

Table 3. Stock's summary statistics

|   |             | Israeli firms involved in or with defense or security related businesses, products or clients |         |               |         |            | Other firms   |         |               |         |            |
|---|-------------|---|---------|---------------|---------|------------|---------------|---------|---------------|---------|------------|
|   |             | Israeli firms   |         | Control Group |         | Difference | Israeli firms |         | Control Group |         | Difference |
| Variable:                                 |             | Ri  | ARi     | Ri            | ARi     | DARi       | Ri            | ARi     | Ri            | ARi     | DARi       |
| Entire Period<br>1.1.98<br>to<br>9.10.01  | <b>Mean</b> | 0.001   | -0.054  | 0.002         | -0.052  | -0.003     | 0.001         | -0.059  | 0.002         | -0.055  | -0.002     |
|   | <b>STD</b>  | 0.063   | 1.741   | 0.065         | 1.705   | 1.127      | 0.079         | 1.680   | 0.070         | 1.692   | 1.044      |
|   | <b>Max</b>  | 1.727   | 13.757  | 2.556         | 21.579  | 8.894      | 7.7           | 22.464  | 2.175         | 12.958  | 10.586     |
|   | <b>Min</b>  | -0.611  | -11.234 | -0.800        | -18.408 | -8.374     | -1            | -19.570 | -1            | -13.540 | -10.767    |
|   | <b>Obs.</b> | 16813   | 16813   | 16569         | 16569   | 16569      | 30316         | 30316   | 29761         | 29761   | 29418      |
| Pre Uprising<br>1.1.98<br>to<br>9.28.00   | <b>Mean</b> | 0.002   | -0.081  | 0.003         | -0.069  | -0.012     | 0.003         | -0.075  | 0.002         | -0.078  | 0.005      |
|   | <b>STD</b>  | 0.061   | 1.621   | 0.065         | 1.582   | 1.042      | 0.083         | 1.573   | 0.068         | 1.563   | 0.946      |
|   | <b>Max</b>  | 1.727   | 13.757  | 2.556         | 21.579  | 7.642      | 7.7           | 22.464  | 2.175         | 12.958  | 9.614      |
|   | <b>Min</b>  | -0.496  | -11.107 | -0.800        | -13.849 | -8.374     | -0.590        | -16.097 | -1            | -11.332 | -9.946     |
|   | <b>Obs.</b> | 12512   | 12512   | 12319         | 12319   | 12319      | 22835         | 22835   | 22435         | 22435   | 22422      |
| Post Uprising<br>9.28.00<br>to<br>9.11.01 | <b>Mean</b> | -0.002  | 0.039   | 0.001         | 0.012   | 0.027      | -0.002        | 0.004   | -0.000        | 0.033   | -0.025     |
|   | <b>STD</b>  | 0.068   | 2.043   | 0.065         | 2.012   | 1.341      | 0.066         | 1.962   | 0.076         | 2.027   | 1.308      |
|   | <b>Max</b>  | 1.473   | 8.120   | 0.602         | 12.666  | 8.894      | 0.762         | 13.676  | 1.25          | 9.567   | 10.586     |
|   | <b>Min</b>  | -0.611  | -11.234 | -0.414        | -18.408 | -7.888     | -1            | -19.571 | -0.5          | -13.540 | -10.767    |
|   | <b>Obs.</b> | 4278  | 4278    | 4227          | 4227    | 4227       | 7439          | 7439    | 7284          | 7284    | 6954       |

**Table 4. Terrorism Summary Statistics**

|                          | Terrorist Attacks:<br>1-Jan-98 - 10-Sep-01 | Terrorist Attacks:<br>1-Jan-98 - 28-Sep-00 | Terrorist Attacks:<br>29-Sep-00 - 10-Sep-01 |
|--------------------------|--|--|---|
| <b>Daily Average</b>     | 0.0719                                     | 0.014                                      | 0.2392                                      |
| <b>Daily STD</b>         | 0.3009                                     | 0.1174                                     | 0.5244                                      |
| <b>Daily Max</b>         | 2  | 1  | 2   |
| <b>Daily Min</b>         | 0  | 0  | 0   |
| <b>No. of Days</b>       | 1349                                       | 1002                                       | 347   |
| <b>Weekly*** Average</b> | 0.5026                                     | 0.0909                                     | 1.68  |
| <b>Weekly*** STD</b>     | 1.0161                                     | 0.2885                                     | 1.3768                                      |
| <b>Weekly*** Max</b>     | 5  | 1  | 5   |
| <b>Weekly*** Min</b>     | 0  | 0  | 0   |
| <b>No. of Weeks</b>      | 193  | 143  | 50  |
| <b>Monthly** Average</b> | 2.2444                                     | 0.4242                                     | 7.25  |
| <b>Monthly** STD</b>     | 3.3585                                     | 0.7513                                     | 2.4909                                      |
| <b>Monthly** Max</b>     | 12   | 3  | 12  |
| <b>Monthly** Min</b>     | 0  | 0  | 4   |
| <b>No. of Months</b>     | 45   | 33   | 12  |
| <b>Yearly* Average</b>   | 30.25                                      | 6.5  | 54  |
| <b>Yearly* STD</b>       | 37.3753                                    | 3.5355                                     | 43.8406                                     |
| <b>Yearly* Max</b>       | 85   | 9  | 85  |
| <b>Yearly* Min</b>       | 4  | 4  | 23  |
| <b>No. of Years</b>      | 4  | 2  | 2   |
| <b>TOTAL</b>             | 97   | 14   | 83  |

\* Yearly data ending in 2001 include the entire year 2001; the entire year 2000 is included in the yearly statistics beginning in September 29, 2000 (2000 is omitted from the yearly statistics ending September 28, 2000).

\*\* Monthly data ending in 2001 include the entire month of September 2001; September 2000 is entirely omitted from the monthly statistics beginning in September 29, 2000 (September 2000 was included in the monthly statistics ending September 28, 2000).

\*\*\* Weekly data ending in 2001 include the entire week of September 9, 2001; the entire week of September 24, 2000 is included in the weekly statistics ending on September 2000 (this week is omitted from the statistics beginning in September 29, 2000); Weeks start on Sunday and end on Saturday.

**Table 5. The Effects of Terrorist Attacks on the Value of Stocks (includes all the available companies)**

Dependent Variable: Difference between the abnormal return of every Israeli company and its respective control,  $DAR_t^i$ .

|                 | (1)                 | (2)                  | (3)                 | (4)                   | (5)                 | (6)                  | (7)                 | (8)                 |
|-----------------|---------------------|----------------------|---------------------|-----------------------|---------------------|----------------------|---------------------|---------------------|
| Constant        | -0.0023<br>(0.0105) | 0.0098<br>(0.0126)   | -0.0034<br>(0.0111) | 0.0117<br>(0.0133)    | -0.0028<br>(0.0105) | 0.0054<br>(0.0127)   | -0.0039<br>(0.0102) | -0.0025<br>(0.0124) |
| Defense         |                     | -0.0343<br>(0.0226)  |                     | -0.0419*<br>(0.0237)  |                     | -0.0230<br>(0.0226)  |                     | -0.0040<br>(0.0218) |
| Uprising        | -0.0077<br>(0.0271) | -0.0556*<br>(0.0338) |                     |                       |                     |                      |                     |                     |
| Def*Uprising    |                     | 0.1288**<br>(0.0565) |                     |                       |                     |                      |                     |                     |
| Monthly Attacks |                     |                      | -0.0004<br>(0.0032) | -.0075**<br>(0.0040)  |                     |                      |                     |                     |
| Def*MonthlyAt.  |                     |                      |                     | 0.0189***<br>(0.0067) |                     |                      |                     |                     |
| Weekly Attacks  |                     |                      |                     |                       | -0.0030<br>(0.0103) | -0.0196<br>(0.0129)  |                     |                     |
| Def*WeeklyAt.   |                     |                      |                     |                       |                     | 0.0444**<br>(0.0215) |                     |                     |
| Daily Attacks   |                     |                      |                     |                       |                     |                      | -0.0045<br>(0.0380) | -0.0139<br>(0.0478) |
| Def*DailyAt     |                     |                      |                     |                       |                     |                      |                     | 0.0251<br>(0.0789)  |
| Obs             | 45987               | 45987                | 45987               | 45987                 | 45987               | 45987                | 45987               | 45987               |

Notes: Heteroskedasticity-robust standard errors are in parentheses. Sample period: January 1, 1998 – September 10, 2001.

\*\*\* Significant at the 1% level.

\*\* Significant at the 5% level.

\* Significant at the 10% level.

**Table 6. The Effects of Terrorist Attacks on the Value of Stocks (includes only companies that are not dually-listed)**

Dependent Variable: Difference between the abnormal return of every Israeli company and its respective control,  $DAR_t^i$ .

|                 | (1)                 | (2)                   | (3)                 | (4)                   | (5)                 | (6)                  | (7)                 | (8)                 |
|-----------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|----------------------|---------------------|---------------------|
| Constant        | -0.0041<br>(0.0124) | 0.0106<br>(0.0146)    | -0.0062<br>(0.0130) | 0.0119<br>(0.0154)    | -0.0064<br>(0.0125) | 0.0024<br>(0.0148)   | -0.0061<br>(0.0121) | -0.0053<br>(0.0145) |
| Defense         |                     | -0.0458*<br>(0.0273)  |                     | -0.0555**<br>(0.0287) |                     | -0.0271<br>(0.0273)  |                     | -0.0022<br>(0.0264) |
| Uprising        | -0.0080<br>(0.0324) | -0.0696*<br>(0.0400)  |                     |                       |                     |                      |                     |                     |
| Def*Uprising    |                     | 0.1832***<br>(0.0683) |                     |                       |                     |                      |                     |                     |
| Monthly Attacks |                     |                       | 0.0001<br>(0.0039)  | -0.0089*<br>(0.0048)  |                     |                      |                     |                     |
| Def*MonthlyAt.  |                     |                       |                     | 0.0265***<br>(0.0081) |                     |                      |                     |                     |
| Weekly Attacks  |                     |                       |                     |                       | 0.0007<br>(0.0124)  | -0.0188<br>(0.0153)  |                     |                     |
| Def*WeeklyAt.   |                     |                       |                     |                       |                     | 0.0575**<br>(0.0259) |                     |                     |
| Daily Attacks   |                     |                       |                     |                       |                     |                      | 0.0005<br>(0.0457)  | -0.0102<br>(0.0569) |
| Def*DailyAt     |                     |                       |                     |                       |                     |                      |                     | 0.0313<br>(0.0956)  |
| Obs             | 35183               | 35183                 | 35183               | 35183                 | 35183               | 35183                | 35183               | 35183               |

*Notes:* Heteroskedasticity-robust standard errors are in parentheses. Sample period: January 1, 1998 – September 10, 2001.

\*\*\* Significant at the 1% level.

\*\* Significant at the 5% level.

\* Significant at the 10% level.

**Table 7. The Effects of Terrorist Attacks on the Value of Stocks (Includes Companies Fixed Effects)**

Dependent Variable: Difference between the abnormal return of every Israeli company and its respective control,  $DAR^i_t$ .

|                 | All Stocks |           |          |          | Non Arbitrage Stocks |           |          |          |
|-----------------|------------|-----------|----------|----------|----------------------|-----------|----------|----------|
|                 | (1)        | (2)       | (3)      | (4)      | (5)                  | (6)       | (7)      | (8)      |
| Defense         | -0.1161*   | -0.0622   | -0.0524  | -0.0436  | -0.0660              | -0.1371** | -0.1136* | -0.0441  |
|                 | (0.0689)   | (0.0970)  | (0.0971) | (0.0972) | (0.0966)             | (0.0696)  | (0.0684) | (0.0973) |
| Uprising        | -0.0533    |           |          |          | -0.0664*             |           |          |          |
|                 | (0.0336)   |           |          |          | (0.0398)             |           |          |          |
| Def*Uprising    | 0.1276**   |           |          |          | 0.1816***            |           |          |          |
|                 | (0.0565)   |           |          |          | (0.0684)             |           |          |          |
| Monthly Attacks |            | -0.0072*  |          |          |                      | -0.0085*  |          |          |
|                 |            | (0.0040)  |          |          |                      | (0.0047)  |          |          |
| Def*MonthlyAt.  |            | 0.0188*** |          |          |                      | 0.0262*** |          |          |
|                 |            | (0.0067)  |          |          |                      | (0.0081)  |          |          |
| Weekly Attacks  |            |           | -0.0188  |          |                      |           | -0.0176  |          |
|                 |            |           | (0.0128) |          |                      |           | (0.0152) |          |
| Def*WeeklyAt.   |            |           | 0.0438** |          |                      |           | 0.0566** |          |
|                 |            |           | (0.0215) |          |                      |           | (0.0259) |          |
| Daily Attacks   |            |           |          | -0.0122  |                      |           |          | -0.0078  |
|                 |            |           |          | (0.0479) |                      |           |          | (0.0569) |
| Def*DailyAt     |            |           |          | 0.0236   |                      |           |          | 0.0291   |
|                 |            |           |          | (0.0790) |                      |           |          | (0.0957) |
| F-test          | 0.41       | 0.41      | 0.39     | 0.39     | 0.41                 | 0.42      | 0.38     | 0.39     |
|                 | [1.0000]   | [1.0000]  | [1.0000] | [1.0000] | [0.9999]             | [0.9999]  | [1.0000] | [1.0000] |
| Obs             | 45987      | 45987     | 45987    | 45987    | 35183                | 35183     | 35183    | 35183    |

*Notes:* Heteroskedasticity-robust standard errors are in parentheses. Sample period: January 1, 1998 – September 10, 2001.

F-test is an F test of the null hypothesis that all pair of twins specific fixed effects in the FE-specification are equal, with p-values reported in brackets.

\*\*\* Significant at the 1% level. \*\* Significant at the 5% level.

\* Significant at the 10% level.

**Table 8a. Defense Imports, Expenditures and Terror Fatalities,  
by Country, 1994-2003**

|                | Yearly Defense Imports from Israel |           | Yearly Defense Expenditures |            | Importer Yearly Terror Fatalities |           |
|----------------|------------------------------------|-----------|-----------------------------|------------|-----------------------------------|-----------|
|                | Mean                               | Std. Dev. | Mean                        | Std. Dev.  | Mean                              | Std. Dev. |
| Argentina      | 2,635                              | 3,167     | 3,807,000                   | 458,246    | 9.6                               | 30.36     |
| Australia      | 3,952                              | 8,333     | 6,877,100                   | 553,903    | 0.1                               | 0.32      |
| Belgium        | 395                                | 889       | 3,145,900                   | 111,589    | 0.1                               | 0.32      |
| Brazil         | 922                                | 2,916     | 7,887,400                   | 1,295,773  | 0                                 | 0         |
| Cameron        | 1,054                              | 2,222     | 112,400                     | 19,046     | 0                                 | 0         |
| Chile          | 33,729                             | 30,103    | 2,555,900                   | 392,619    | 0                                 | 0         |
| China          | 18,972                             | 9,999     | 20,700,000                  | 6,916,004  | 6.5                               | 15.73     |
| Czech Republic | 132                                | 417       | 1,007,300                   | 136,216    | 0                                 | 0         |
| Ecuador        | 6,588                              | 12,849    | 312,800                     | 47,632     | 1.1                               | 2.51      |
| Eritrea        | 395                                | 1,250     | 171,900                     | 71,441     | 0.8                               | 1.93      |
| Estonia        | 132                                | 417       | 68,770                      | 30,684     | 0.1                               | 0.32      |
| Finland        | 132                                | 417       | 1,521,600                   | 73,278     | 0                                 | 0         |
| France         | 791                                | 2,079     | 34,768,400                  | 1,109,277  | 3.7                               | 4.40      |
| India          | 30,039                             | 25,463    | 10,030,700                  | 1,490,561  | 193                               | 243.62    |
| Mexico         | 3,821                              | 12,082    | 2,899,500                   | 137,920    | 0.5                               | 1.27      |
| Romania        | 10,935                             | 6,777     | 1,055                       | 82,940     | 0.1                               | 0.32      |
| Singapore      | 41,634                             | 32,292    | 4,018,500                   | 711,483    | 0                                 | 0         |
| Slovenia       | 2,635                              | 5,692     | 264,000                     | 30,122     | 0                                 | 0         |
| South Korea    | 7,529                              | 10,169    | 1,963,143                   | 262,096    | 0                                 | 0         |
| Switzerland    | 527                                | 680       | 1,857,720                   | 1,269,014  | 0.1                               | 0.32      |
| Taiwan         | 1,186                              | 3,750     | 8,798,900                   | 1,204,502  | 0                                 | 0         |
| Thailand       | 395                                | 889       | 2,258,500                   | 421,333    | 4.5                               | 6.96      |
| Turkey         | 23,979                             | 36,895    | 9,107,600                   | 972,049    | 33.6                              | 37.80     |
| Uganda         | 2,240                              | 7,083     | 117,640                     | 27,975     | 15.7                              | 20.89     |
| Uruguay        | 1,845                              | 5,833     | 328,800                     | 82,166     | 0                                 | 0         |
| USA            | 32,543                             | 20,506    | 318,905,100                 | 38,838,531 | 307                               | 967.66    |
| Venezuela      | 4,875                              | 15,426    | 1,727,100                   | 262,887    | 3.1                               | 4.61      |

*Sources:* Defense Imports from Israel and Defense Expenditures are taken from SIPRI and measured in US dollars at constant 2000 prices (in thousands). Terror fatalities by countries were culled from RAND Terrorism Chronology (1968-1997) and RAND@-MIPT Terrorism Incident database (1998 – 2003).

**Table 8b. Summary Statistics**

|  | Yearly Defense Imports from Israel | Yearly Defense Expenditures | Yearly Israeli Terror Fatalities | Importer Yearly Terror Fatalities | Worldwide Yearly Terror Fatalities |
|--|------------------------------------|-----------------------------|----------------------------------|-----------------------------------|------------------------------------|
| For Years 1994 – 2000 (186 Observations) |                                    |                             |                                  |                                   |                                    |
| Mean                                     | 7473                               | 15,987,311                  | 39.88                            | 5.76                              | 761.54                             |
| Std. Dev.                                | 16,888                             | 57,579,741                  | 24.35                            | 27.79                             | 612.18                             |
| Max                                      | 89,592                             | 334,539,000                 | 72                               | 325                               | 2,160                              |
| Min                                      | 0                                  | 24,600                      | 6                                | 0                                 | 271                                |
| For Years 2001 – 2003 (81 Observations)  |                                    |                             |                                  |                                   |                                    |
| Mean                                     | 11,451                             | 18,311,030                  | 236.67                           | 58.32                             | 3103.33                            |
| Std. Dev.                                | 20,950                             | 67,443,642                  | 81.65                            | 351.70                            | 1138.1                             |
| Max                                      | 92,227                             | 417,363,000                 | 351                              | 3,061                             | 4,643                              |
| Min                                      | 0                                  | 91,400                      | 171                              | 0                                 | 1,958                              |

*Sources:* Defense Imports from Israel and Defense Expenditures are taken from SIPRI and measured in US dollars at constant 2000 prices (in thousands). Terror fatalities by countries and Worldwide Terror Fatalities were culled from RAND Terrorism Chronology (1968-1997) and RAND®-MIPT Terrorism Incident database (1998 – 2003). Israeli Terror Fatalities are taken from Berrebi and Klor (2004).

**Table 9. The Effects of Terrorist Attacks on the Level of Defense Imports from Israel**

Dependent Variable: Total Defense Imports from Israel by Country  $i$  in year  $t$ .

|                                   | (1)  | (2)   | (3)  |
|-----------------------------------|--|---|--|
| Estimation Method                 | OLS  | FE  | PCSE   |
| Israeli Terror Fatalities         | 31697**<br>(15115)                           | 32536**<br>(15035)                            | 21551***<br>(4430)                               |
| Total Defense Expenditures        | $5 \times 10^{-5}$<br>( $3 \times 10^{-5}$ ) | $-1 \times 10^{-4}$<br>( $1 \times 10^{-4}$ ) | $7 \times 10^{-5}$ ***<br>( $1 \times 10^{-5}$ ) |
| Importer Terror Fatalities        | 13406***<br>(4730)                           | 11480**<br>(4778)                             | 15259***<br>(5654)                               |
| Total Worldwide Terror Fatalities | 281<br>(1043)                                | 296<br>(1037)                                 | 512<br>(369)                                     |
| No. Observations                  | 267  | 267   | 267  |
| $R^2$                             | 0.1229                                       | 0.0150  | 0.4377   |
| F-test                            |  | 6.61  |  |
| $[p]$                             |  | [0.000]                                       |  |
| Wald $\chi^2$                     |  |   | 189.34   |
| $[p]$                             |  |   | [0.0000]   |

*Notes:* All the regressions include time fixed effects. Sample period: 1994 – 2003.

\*\*\* Significant at the 1% level.

\*\* Significant at the 5% level.

\* Significant at the 10% level.

Figure 1. Deadly attacks on a monthly basis

