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DO SHARE PRICES OVERREACT WHEN TERROR ATTACKS ARE CONTINUOUS?

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Abstract

This paper investigates the effect of "routine" terror attacks (a terror attack every two days) on share prices. The empirical findings are based on a unique sample of 460 terror attacks experienced in Israel during the *Intifada* years, 2000-2003. Based on daily and intra-daily data of share prices, and a *Terror Index* we construct, we find that: i) share prices decline by about 0.4% on average following each terror attack; ii) the effect of these terror attacks is not characterized by an overreaction and subsequent correction, and its magnitude does not diminish significantly over time.

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Do Share Prices Overreact When Terror Attacks Are Continuous?

1. Introduction

If terror attacks negatively affect the expectations of firms' profitability, share prices are expected to decline. Unlike the 9/11 attack in NY and the two terror attacks in European capitals – Madrid (March 2004) and London (July 2005), in which local financial markets overreacted initially but rapidly recovered afterwards, in this paper we test the hypothesis that share prices respond differently when terror attacks are on continuous basis and not rare ones.

We use a unique sample of 460 terror attacks witnessed in Israel during the 2000-2003 *Intifada* that allows us to estimate the effect of terror attacks in an economy constantly afflicted by such attacks (an average of one attack every two days). The level of investor pessimism is assessed by a *Terror Index (TI)* that we construct. The *TI* is comprised of factors characterizing the attack, such as location (inside and outside of the green border), whether it was a suicide attack, the number of casualties (killed and wounded) and the scope of newspaper coverage.

One of the studies dealing with the way financial markets respond to continuous terror attacks was that conducted by Eldor, Hauser, Melnick and Levi (2007) on the effects of continuous terror attacks and anti-terrorism on the bond and stock markets and on

the risk premium required by investors, using daily data. Our study extends theirs by investigating the microstructure effects (intra-day share prices) of the stock markets.

This study also relates to Chen and Sims (2004) study, who analyzed 14 cases of terror- or war-related events that had taken place in the US since 1915.¹ They find that financial markets became more stable over time and that recovery became increasingly more rapid. Contrary to these findings, which were based on data from markets where terror attacks are rare, we analyze the effect terrorism on financial markets in Israel, where terror attacks are committed “routinely” and are not expected to stop.

Our hypothesis regarding share prices response to terrorism relates also to Bruck and Wickstrom (2004) argument that the economic effects of terror are felt in the period following the attack and that the extent of losses, depends on the attack’s characteristics – the number of killed and wounded people and the level of property damage. These arguments are also explored in this study.

2. Data and Methodology

Table 1 presents stock returns and GDP growth rates in periods surrounding the *Intifada al-Aqsa*. It shows that GDP growth rates and share prices during the *Intifada* are significantly lower than those prior to the *Intifada* and following it.

Table 1

¹ See also Chen and Sims (2004), Bruck and Wickstrom (2004) and Amihud, Y. Wohl (2004).

2.1 Data

The data include characteristics of terror attacks committed during the period of the *Intifada al-Aqsa* (September 2000- December 2003). During this period, 460 terror attacks were carried out, 837 people were killed and 3,916 were injured. Our sample includes data on all 460 terror attacks. For the event study, whenever more than one terror attack occurred on the same day or during the weekend, or when trading did not take place, the attacks were considered as single events which allow us to use only 280 terror events. Of them, only 47 events occurred during trading hours on the TASE (9:45-17:00).

We use daily share prices (TA-25 index) on days surrounding each date of the 280 terror events. With respect to the 47 events that occurred inside trading hours, we also use the intra-day data of the TA-25 stock index which is published by the TASE continuously. TA-25 stocks represent more than 60% of the volume traded on the TASE. Data on the characteristics of the terror attacks were culled from the databank of the Interdisciplinary Center in Herzeliya.

2.2 Methodology

To examine if share prices behavior is characterized by overreaction and subsequent correction, we use first an event-study analysis based on daily data (closing prices) and intra-day data (half minute prices) of the TA-25 index. Based on the daily data, we estimated rates of return of the TA-25 stock index on the day prior to the event (-1), the day of the event (0), the days following the event (+1, +2). If the rates of returns on the second day after the attack were either insignificant or exhibited a sign

different from the overshooting response, we consider it as an evidence of permanent influence on share prices. Similarly, intra-day data was used to estimate the rates of return on the TA-25 stock index for every 5 minutes from an hour before the attack until 2 hours following the event.

We also estimated the effect of investors' pessimism on the stock market via a *Terror Index (TI)* that was constructed as follows:

$$(1) \quad TI = D_1 + D_2 + D_3 + D_4 + D_5$$

where:

$D_1 = 0$ if the attack was beyond the green line and 1 if it was within the green line;

$D_2 = 0$ if the attack was not a suicide attack and 1 if it was;

$D_3 = 0$ if there were no deaths and 1 if there were;

$D_4 = 0$ if there were no injured and 1 if there were;

$D_5 = 0$ if the event was not reported on a newspaper's front page and 1 if it was.

Finally, following Eldor and Melnick (2004) we also use a regression analysis described in Section 3.2 to test permanency nature of share prices response to terrorism.

3. Results

3.1 The effect of terror attacks on stock prices

The main finding displayed in Table 2 and Figures 1 and 2 is an average decrease of 0.4% in share prices. The same rate of decline is observed with respect to terror attacks that occurring within trading hours. The findings for the latter are presented in

Table 2 (panel A) and Figure 1. It appears that investors respond almost immediately when the terror attack occurs within trading hours and that most of the change occurred within the first hour subsequent to the attack – a significant decline of 0.36% (median = 0.45%) in share prices.

Table 2 and Figures 1 and 2

Analysis of the effect of a terror attack on the basis of daily data depicts a similar picture (Panel B). At the end of the first trading day following an attack, stock prices declined by about 0.27%. An additional decline of about 0.15% occurred a day later.² We find that most of this decline occurred at the opening of trade $CR(0,Open)=0.14%$ of the 0.15% observed for the entire day.³ Figure 2 demonstrates that most of the correction on the day following the event has been incorporated at the opening phase of trading.

3.2 Effect of terror attacks on stock prices by severity of the attack

Table 3 presents the main findings regarding the effect of the attack's severity (measure by TI) on stock prices. The most salient finding is that as the attack's severity increases, the decline in share prices was more acute. The findings indicate a significant decline (p-value=0.012) of about -0.71% (when $TI \geq 3$) in comparison with a moderate decline of -0.01% (when $TI < 3$).

Table 3

The second finding is that investors' responses in the second sub-period of the sample (5/2001–12/2003) were more moderate than in the first sub-period (9/2000–4/2001). A significant difference was also found for the intra-day data, -0.46% during the first

² In the absence of accurate attack's time in some events, the estimated time of the attack may be inaccurate within about half an hour.

³ $CR(0,Open)$ represents the cumulative returns of share prices from the close of the day of the attack to the opening price at the start of trade on the day following an attack.

sub-period in comparison to only -0.27% during the second sub-period ($p = 0.059$). Similarly, when we used daily data, we found that the negative effect of terror attacks on stock prices remain significant at a level of about -0.27% during the second sub-period, which is insignificantly lower than the -0.54% obtained in the first sub-period (p -value = 0.182). These findings indicate that investors became “accustomed” to terror attacks only to a limited extent implying that the continued attacks did not cease to negatively affect investors’ expectations regarding firms’ future profitability.

Finally, we provide additional test on the permanency effect of terror attacks on share prices by means of a regression model (2) suggested by Eldor and Melnick (2004):

$$(2) \quad R_t = 0.0049 + 0.1610R_US_t - 0.0025TI_t - 0.0002TI_{t-1} + 0.0003TI_{t-2} + 1.0367Y_{t-1} + \varepsilon_t$$

p-value=(0.168) (0.055) (0.032) (0.840) (0.807) (0.000)

In this regression, R represents stock returns and R_US is a fundamental variable (S&P500 rates of returns).⁴ TI represents the level of pessimism, an index that receives values ranging from 0 to 5 (eq. (1)), where 5 indicates the highest level of attack severity. Y_{t-i} represents share prices on day $t-i$.

The results of this regression indicate that $\gamma_0 + \gamma_1 + \gamma_2 = -0.0029$ is significantly different from zero (p -value=0.058), and that $\gamma_2 = 0.0003 > 0$ is insignificant (p -value=0.807). These results imply that the effect of continuous terror attacks on share prices is permanent to the extent that is not characterized by overshooting with

⁴ Over 100 Israeli firms are listed in the US. 38 of them are traded in the United States, the majority on the NASDAQ as well as the Tel Aviv Stock exchanges. Some enjoy a very high volume of trade in Israel, which is affected by both markets.

subsequent corrections that characterized the 9/11 attack in NY, the terror attacks in Madrid and London or even the 2007 war in Lebanon.

References

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Table 1
Real economic activity share prices during the *Intifada*
in comparison with other periods

This table presents figures on annual returns (CR) on stocks represented by the TASE TA-25 index and GDP growth rates for different periods, where: $CR = \left(\frac{P_T}{P_{T-n}} \right)^{\frac{12}{n}}$ and n indicates the number of months in the period in which CR

Period	GDP annual growth rates	Annual stock returns
The whole period: 3/2005-1/1990	0.0462	0.0873
Prior to the <i>Intifada</i> : 1/2000-9/2000	0.0599	0.1024
<i>Intifada</i> : 10/2000-12/2003	-0.0050	0.0102
Following the <i>Intifada</i> : 1/2004-9/2005	0.0582	0.1858

Table 2
Effect of Terror Attacks on Stock Prices

$CR(T_1, T_2)$ is the cumulative rates in minutes for the intra-day data and days for the daily data. Numbers in parenthesis are p-values using t-test for the mean and Wilkison test for the medians.

Returns	Mean (%)	Median(%)
<u>Panel A - Partial sample: 47 terror events that occurred during the trading day</u>		
CR(-60,60) (p-value)	0.360- (0.000)	-0.453 (0.000)
CR(61,120) (p-value)	0.031 (0.580)	0.028 (0.548)
<u>Panel B – Entire sample: 280 terror events</u>		
CR(-1,0) (p-value)	0.269- (0.038)	-0.301 (0.049)
CR(0,1) (p-value)	0.147- (0.074)	0.243 (0.030)
CR(0,Open) (p-value)	0.140- (0.057)	-0.187 (0.027)
CR(-1,1) (p-value)	0.416- (0.006)	-0.453 (0.003)
CR(1,2) (p-value)	0.082 (0.380)	-0.162 (0.346)

Table 3
Effect of Attack's Severity on Stock Prices

$CR(-1,1)$ signifies cumulative rates of return on the 3 days surrounding the attack (-1,0,1), and $CR(-60,60)$ signifies rates of return for the 120 minutes surrounding the time of the attack of 47 attacks occurred during trading hours. P-value signify the significance level using ANOVA. In this Table, TI receives a value 1 if its score is higher then 3 and 0 otherwise.

		CR(-1,1)- Entire Sample		CR(-60,60) – Intraday	
		N	Average (%)	N	Average (%)
Terror Index (TI)	High	163	-0.705	31	-0.458
	Low	117	-0.013	16	-0.171
	p-value		(0.012)		(0.015)
Period	9/2000-4/2002	151	-0.543	23	-0.461
	5/2002-12/2003	129	-0.267	24	-0.264
	p-value		(0.182)		(0.059)
Newspaper's Covergae	1 st page	206	-0.634	38	-0.443
	Other	74	-0.106	9	-0.011
	p-value		(0.123)		(0.003)

Figure 1
Stock Rate of Returns When Terror Attacks Occurred Inside Trading Hours

TA-25 stock index at 5-minute intervals, beginning 1 hour prior to the attack until 2 hours after the attack (47 terror events).

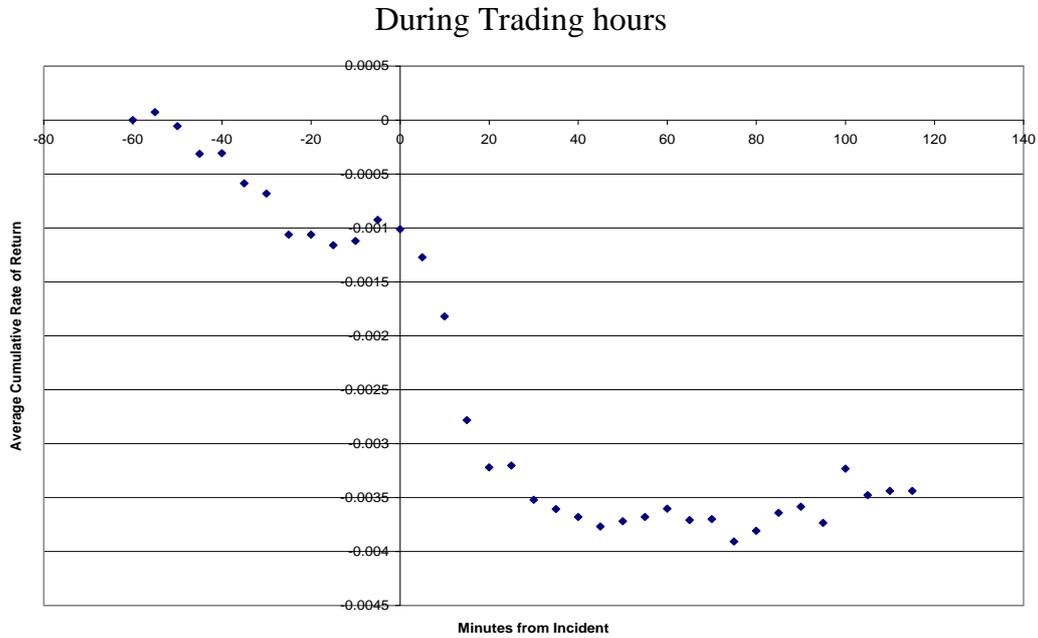


Figure 2
Stock Rate of Returns When Terror Attacks Occurred Outside Trading Hours

TA-25 stock index on the Day Following a Terror Attack (5-minute intervals from the opening hour of trading to closing) based on 280 terror events

