Stock Price Responses to the September 11, 2001 Attack: Evidence From Amman Stock Exchange *

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Abstract

The objective of this study was to empirically examine the impact of September 11, 2001 event (the attack on the World Trade Centre and the Pentagon) on the stock price behaviour of the companies listed on the ASE. To achieve this objective, the study employed an event study methodology, which depends on monitoring stock prices for the sample companies right before and after the event for the purpose of determining the timing and scale of abnormal rates of return that accompanied the event. Using 44 companies whose stocks were traded in the market during the estimation and testing periods, the results of the study indicated that the event had a negative and significant impact on the stock prices of the sample companies. Specifically, the study found that the average abnormal returns for the sample companies were negative and significant at the 1% level at the trading days 3 and 4 after the event. The results of the study might suggest that investors in the ASE perceived the event as having negative future implications, political or otherwise, on the entire region of the Middle East, particularly, on the peace process in which the US is a major player.

1. Introduction

The impact of financial information on the stock market reaction has been a subject of a great deal of research. To less extent there has been research on the effect of world events (e.g. military and political events) on the stock market reaction. Earlier studies provide evidence that world events do indeed affect stock markets. For instance, Shapiro and Switzer (1999), among others, examined the impact of war- and peace-related news on the stock prices of 60 US defense firms. They found that war-related events positively affect defense share prices and that peace-related events have the opposite effect. Among the events examined by Shapiro and Switzer were three events which took place in the Middle East: the 1967 War, the October 1973 War, and the 1991 Gulf War.

On September 11, 2001, the United States was subject to an unprecedented attack, namely, the attack on the World Trade Center in New York and the Pentagon. It was pointed out by many that the attack has

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changed the world forever (Bellavance, 2001). One of the implications of the attack was on financial markets and investors around the world, in particular, in rich-world economies. For instance, the New York Stock Exchange was closed the longest period since World War II, and one week after the attack, the Dow Jones Industrial Average fell by its biggest amount since 1933. In addition, European stock markets indices have fallen and gone in a sales panic (Prusher, 2001).

The objective of this study is to examine the impact of the September 11th event on the stock price behavior of Jordanian firms listed on the Amman Stock Exchange (ASE). We apply an event study methodology to examine the response of companies’ stocks to September 11th event. We expect that such an event will have an impact on the stocks listed on the ASE. First, the US economy is the largest economy in the world and previous research provides evidence consistent with the fact that events originated in the US usually affect other nations (Cheung, 2000). Second, the event is so significant and extraordinary; thus, it is expected to have implications, political or otherwise, for our region, and particularly, for the so-called peace process in the Middle East, in which the US is actively involved. In addition, the ASE has been sensitive to political and military developments in the region.

The rest of the paper is organized as follows. The next section provides a review of the relevant literature. The third section describes the data and methodology. The fourth section discusses the results of the paper. The last section summarizes and concludes the paper.

2. Previous Research

A number of studies have attempted to examine the stock price reaction to political events, and/or the impact of an event originated in one country on the stock markets of other countries, and/or the link and the level of integration between financial markets. In his original work, Niederhoffer (1971) examined the impact of 432 events on the percentage changes in the Dow Jones Industrial Average (DJIA) during the period 1950-1966. Niederhoffer examined events of all types, such as political, natural disasters, military actions and legislative acts. The results of the study indicated that the market adjusts to the informational content of those events and discriminates between good news and bad news. He reported a negative reaction to bad news followed by a positive movement in return on the DJIA. His results suggest that the market overreacts to an event and then readjust in a positive direction.

In another study, McDonald and Kendall (1994) examined the effect of 17 political events involving military force on the stock price behavior of 16 US defense firms. According to the authors, the events selected for the study presented a high likelihood of a direct military involvement by the US or the former Soviet Union and, therefore, might affect the returns of firms in the
US defense industry. Using the cumulative prediction error (derived from the cumulative average return), the study found a statistically significant positive effect on the stock prices of the defense industry.

In a similar and more recent study, Shapiro and Switzer (1999) attempted to examine the impact of war- and peace-related news on the stock price behavior of 60 U.S defense firms. They hypothesized that war-related news would be associated with abnormal positive returns, while peace-related news would be associated with negative abnormal return. Based on 29 announcements, of which 21 war-related news and 8 peace related news, the results of the study provide evidence consistent with the hypothesis that war-related events positively affect defense share prices and that peace-related events have the opposite effect.

Najand (1996) attempted to investigate the link between three Asian stock markets and which stock market is more likely to lead the other stock markets. The three markets examined by Najand are Hong Kong, Singapore, and Japan. Based on 1551 daily stock returns collected from the three markets for the period from 1984 to 1989, the results of the study indicated that the relationship between the three markets increased substantially after the crash of October 1987 (US stock market crash). In addition, the study found that the Japanese stock market has a major influence on the Hong Kong and Singapore stock markets.

In another study, Marlett and Pacini (1999) examined the market reaction of investors in Property and Liability insurance companies to the creation of the California Earthquake Authority (CEA). Specifically, the study examined the relation between changes in the regulatory environment and insurer stock prices. Using both a generalized least squares portfolio approach and a nonparametric event study technique, the study found a significant positive association between insurer share prices and the release of new information favorable to the implementation of the CEA. This positive share price reaction was attributed to investors' expectations of reduced insurer risk and low variability in the insurer cash flows.

Ewing et al. (1999) examined the co-movement of the North American stock markets (US, Canada and Mexico) during the period 1987-1997 and whether the implementation of the North American Free Trade Agreement (NAFTA) has led to more integrated financial markets. They found that there is no cointegration present in these markets even when the passage of NAFTA is taken into consideration. The study concluded that the potential for international diversification across North American markets still exists.

Okeahalam and Jefferis (1999) attempted to investigate the extent to which three stock markets in southern Africa (Botswana, Zimbabwe, and South Africa) are integrated. According to the authors, one method to understand the level of integration between the three stock markets is to
examine the level of efficiency in each market and compare it to the other markets. Toward this, the authors tested the impact of earnings announcements on the abnormal return of a sample of banks and retail firms listed in the Botswana Stock Exchange (BSE), the Zimbabwe Stock Exchange (ZSE), and the Johannesburg Stock Exchange (JSE). The findings of the study indicated that both the BSE and the ZSE are not semi-strong efficient, while the JSE conforms to the semi-strong form of the efficient market hypotheses. The authors concluded that (p. 131) "The difference in the relative levels of efficiency of the three markets and the difference in the levels of efficiency of the BSE and the ZSE in comparison to the JSE make the current likelihood of regional stock market integration low".

In another study, Cheung (2000) examined the stock returns' volatility spillover from the US stock market to the stock markets of Australia, Hong Kong, Japan, Singapore, and the United Kingdom before, around and after the market crash of October 1987. The results of the study indicated that stock volatility increased substantially during the period around the October 1987 crash. In addition, the study found that the impact of other stock markets' volatility on the US stock market volatility is much weaker during the period around the crash. The study concluded that there is a co-movement between US stock volatility and other stock markets' volatility after the crash.

3. Research Design and Methodology

3.1. Sample of Companies and Data

The study covers all the companies listed on the Amman Stock Exchange during 2001. However, to be included in the study, the company must meet the following conditions:

(1) The company's stock must be frequently traded on the Amman Stock Exchange. Accordingly, a company with less than 75 trading days during the period from May 1, 2001 to August 31, 2001, was excluded from the study.

(2) The company did not make any stock split or increase its capital during the estimation or testing period.

(3) The company must be traded in every trading day during the period from September 1, 2001 to September 21, 2001.

The above conditions produced 44 companies. Daily stock prices for these companies and daily indices for the market were collected from the daily trading summary published by the ASE. After collecting the data, several steps we took before the statistical analysis was possible. The procedures were as follows:

(1) The companies were each assigned a code.
(2) The data were checked and rechecked to eliminate any errors.

(3) The data were manually put into machine-readable format for feeding into the computer.

(4) The data were again checked for fresh errors introduced by this procedure. This stage was very time consuming.

3.2. Calculation of Abnormal Rates of Returns

The methodology employed by the current study is commonly used in the event studies. It depends on monitoring stock prices for the sample of companies right before and after the event (September 11, 2001). The subject of interest is the timing and the scale of abnormal rates of return that accompanied the event. The most popular model used in calculating abnormal rates of return is the market model. According to this model, rates of return generated by an asset can be described by the following equation:

\[ R_{it} = \alpha_i + \beta_i R_{mt} + e_{it} \]  

(1)

Where:

- \( R_{it} \) = the return on stock \( i \) for day \( t \);
- \( R_{mt} \) = the return on the value-weighted market portfolio for day \( t \);
- \( \alpha_i \) = the regression intercept;
- \( \beta_i \) = the beta coefficient of the regression;
- \( e_{it} \) = the residual return on stock \( i \) for day \( t \).

Using the regression parameter estimates from equation (1), we made a prediction for each of the 14 days surrounding the event date. The parameters \( \alpha \) and \( \beta \) were estimated over the estimation period before the event date (i.e., 93 days). Abnormal rates of return for each individual stock (from 7 trading days before to 7 days after the event day) are calculated as:

\[ e_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \]  

(2)

The resulting residual terms (deviations between the 15 actual daily observations and the regression estimates) impound all the factors influencing the firm during the period surrounding the event independent of general market movements.

Next, the abnormal returns for the sample companies were averaged cross-sectionally to arrive at the average abnormal returns. Thus, this study focuses on the general effect of September 11th event and employs an averaging process to abstract the general trend from the individual firm
fluctuations. The average abnormal returns for day $t$, (AR), is defined as:

$$\overline{AR_t} = \frac{1}{N} \sum_{i=1}^{N} e_{it}$$

(3)

Where:

$e_{it} = $ the residual from the regression for company $i$ in day $t$.

$N = $ the number of firms in the study sample.

3.3. Estimation and Testing Periods

In the estimation period, the parameters of the market model were measured by regressing each stock's daily returns on the corresponding daily returns from the market daily index using the Ordinary Least Square (OLS) estimation method. The length of the estimation period varies significantly in previous studies. On the one hand, a long estimation period allows a higher number of observations and, in effect, a greater statistical precision. On the other hand, long estimation period might reduce the validity of the results since other events may occur in the market. In the current study, the length of the estimation period, which immediately precedes the testing period, is 93 trading days that approximately amount to four months (May 1-August 31, 2001). Therefore, each regression model used up to 93 daily observations immediately preceding the testing period as shown in Figure(1).

The testing period examined in detail for the purpose of this study includes 15 trading days (7 trading days before the event and 7 trading days after; the day of the event is identified as day zero). A period of this particular length was chosen to allow for the analysis of abnormal returns 7 trading days before the event and 7 trading days afterwards. The authors believe that a window of 15 trading days is sufficient to capture the impact of the event, if any, on the ASE. In addition, a longer window is not justified based on the fact that the event examined by the study could in no way be anticipated by the market.
Figure (1)

Estimation and Testing Periods

<table>
<thead>
<tr>
<th>Estimation Period</th>
<th>Testing Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>i - 93 days</td>
<td>Event day (Sept. 11th)</td>
</tr>
<tr>
<td>i - 7 days</td>
<td>i = 0</td>
</tr>
<tr>
<td>i + 7 days</td>
<td></td>
</tr>
</tbody>
</table>

3.4. Market Reaction Tests (Tests of Significance)

Each average abnormal return was t-tested to determine whether the return for that day was of an unusual size. Justification for the use of the t-test is provided by Strong (1992) who indicated that calculating abnormal returns using the ordinary least squares market model and using standard parametric statistical tests appears to be a well-specified procedure.

The t-test was of the form AAR_i / STD_i, where STD_t is the standard deviation of the abnormal returns (AAR_i) across time from -7 to 7 (testing period). The standard deviation is computed as follows:

$$STD_t(AARs) = \sqrt{\frac{\sum_{i=t}^{t-7} (AAR_i - \bar{AAR}_t)^2}{n-1}}$$  \hspace{1cm} (4)

The Average Abnormal Returns (AARs) are tested for significance using the methodology described in Brenner (1979) with a t-test:

$$t = \frac{AAR_{KL}}{STD_{KL}}$$  \hspace{1cm} (5)

Where:

- AAR_{KL} = Average Abnormal Return from day K to day L.
- STD_{KL} = Standard Deviation from day K to day L.

4. Results

To examine the response of the portfolio of sample companies shares to September 11th event, both visual and statistical analysis of average abnormal returns for each trading day constituting the testing period were undertaken. Figure (2) presents the AARs curve for the sample companies for each trading day of the testing period. As seen, the AARs curve starts to decline on day 2 after the event and shows a clear sign of abnormality at days 3 and 4. Thus, there is a noticeable negative share price reaction at days 3 and 4 after the event. However, to examine whether the AARs are statistically
significant, the t-test is used. Table (1) presents the t-test results for the average abnormal returns (AARs) for the study sample over the testing period. As seen from the table, the AARs at days 3 and 4 are negative and statistically significant at the 1% level. Again, these results indicate that, on average, the stocks of the sample companies responded to the event in the expected fashion. It is worth mentioning that although the AARs start to decline gradually at day 0, however, it took the market three trading days to respond to the event in a significant way. One possible explanation for this delay in the response of the market to the event could be the lack of information about the magnitude of the event and, maybe more importantly, who is behind it. Another possible explanation could be the timing difference between the US and Jordan (there is a seven-hour difference between New York and Jordan meaning that the event happened at the end of the second trading session in the ASE). Finally, this delay could be attributed to the speed at which new information is impounded in the stock prices of listed companies in the ASE (lack of efficiency).

The results of the study might suggest that investors on the ASE perceived the event as having negative implications for the stability in the region, and particularly, for the so-called peace process in the Middle East, in which the US is actively involved. The results might also suggest that the ASE is sensitive to international events that could be perceived to have political or possible military impact on the entire Middle East region.

![Figure (2)](image_url)

**Figure (2)**

Average Abnormal Returns
Table (1)

<table>
<thead>
<tr>
<th>Trading Days</th>
<th>Average Abnormal Returns</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-7</td>
<td>-0.0018</td>
<td>0.1421</td>
</tr>
<tr>
<td>-6</td>
<td>0.00127</td>
<td>0.7215</td>
</tr>
<tr>
<td>-5</td>
<td>0.00798</td>
<td>0.9468</td>
</tr>
<tr>
<td>-4</td>
<td>0.0085</td>
<td>0.9565</td>
</tr>
<tr>
<td>-3</td>
<td>0.000688</td>
<td>0.1120</td>
</tr>
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<tr>
<td>0</td>
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<td>-0.1221</td>
</tr>
<tr>
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<td>-0.9270</td>
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<tr>
<td>2</td>
<td>-0.0183</td>
<td>-1.1517</td>
</tr>
<tr>
<td>3</td>
<td>-0.03</td>
<td>-3.7541 *</td>
</tr>
<tr>
<td>4</td>
<td>-0.028</td>
<td>-3.1217 *</td>
</tr>
<tr>
<td>5</td>
<td>-0.0175</td>
<td>-0.9035</td>
</tr>
<tr>
<td>6</td>
<td>-0.012</td>
<td>-0.7665</td>
</tr>
<tr>
<td>7</td>
<td>-0.013</td>
<td>-0.6541</td>
</tr>
</tbody>
</table>

* Significant at .01 level

5. Summary and Conclusion

The objective of this study was to empirically examine the impact of September 11th, 2001 event (the attack on the World Trade Centre and the Pentagon) on the stock price behaviour of companies listed on the ASE. To achieve this objective, the study employed an event study methodology, which depends on monitoring stock prices for the sample companies right before and after the event for the purpose of determining the timing and scale of abnormal rates of return that accompanied the event. The results of the study which used 44 companies whose stocks were traded in the market during the estimation and testing periods indicated that the event had a negative and significant impact on the stock prices of the sample companies. Specifically, the study found that the AARs for the sample companies were negative and significant at the 1% level at the trading days 3 and 4 after the event. The delay of the
أثر الهجوم على مركز التجارة العالمي والنتائج في 11/9/2001
على أسعار الأسهم في بورصة عمان: دراسة ميدانية

مشيل سويدان و عمر جهماني

ملخص

يهدف هذا البحث إلى فحص أثر الهجوم على مركز التجارة العالمي في نيويورك ووزارة الدفاع الأمريكية (التي نشأت من الهجوم) على أسعار أسهم الشركات المدرجة في بورصة عمان. لتحقيق هذا الهدف، تم استخدام نهجية محلية لتلك المستخدمة في قياس ردة فعل أسعار الأسهم لحدث معين، والتي تعتمد على فحص أسعار الأسهم قبل وبعد الحدث. وقد أظهرت هذه الدراسة تأثر سلبي للحدث 11/9/2001 على أسعار الأسهم المدرجة في بورصة عمان. وجدت الدراسة أن متوسط العوائد غير العادية للشركات المدرجة كانت سلبية وذات دلالة إحصائية عند مستوى 1% وذلك في يوم التداول الثالث والرابع بعد الحدث. وقد خلصت الدراسة إلى أن المستثمرين في بورصة عمان أدركتوا مدى أهمية الحدث وإحتمالية تأثيره على استقرار المنطقة بشكل عام وعلى مفاهيم السلام بشكل خاص مما انعكس على أسعار الأسهم الشركات المدرجة في بورصة عمان.
References


