RESEARCH ONLINE

Australasian Accounting, Business and Finance Journal

Volume 6
Issue 1 *Australasian Accounting Business and Finance Journal*

Article 15

Stock Market Reaction to Terrorist Attacks: Empirical Evidence from a Front Line State

Muhammad Tahir Suleman
Victoria University of Wellington, New Zealand, Tahir.suleman@vuw.ac.nz

Follow this and additional works at: http://ro.uow.edu.au/aabfj
Copyright ©2012 Australasian Accounting Business and Finance Journal and Authors.

Recommended Citation
Tahir Suleman, Muhammad, Stock Market Reaction to Terrorist Attacks: Empirical Evidence from a Front Line State, *Australasian Accounting, Business and Finance Journal*, 6(1), 2012, 97-110.
Available at:http://ro.uow.edu.au/aabfj/vol6/iss1/15

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

RESEARCH ONLINE

Stock Market Reaction to Terrorist Attacks: Empirical Evidence from a Front Line State

Abstract
The world financial markets have reacted in a highly consistent pattern to the incident of 9/11 in the United States, suicide blasts at night clubs at Bali in 2002, the Madrid and London train bombings in 2004-2005 and a series of continuous blasts and suicide attacks in Pakistan. In this study, we examined the effect of terrorist attack news on returns and volatility for the Karachi Stock Exchange. We employ the EGARCH model proposed by Engle and Ng (1993) as it allows good and bad news to have a different impact on volatility. Our results ndicate that terrorist attack news has negative impact on the returns of all the sector indices. However, news of these events increased the volatility of KSE100 index and financial sector index. Further it is concluded that the results of oil and gas, and industry are not statistically significant in response to terrorist attack news, indicating that such type of news does not affect the volatility of these two sectors. Moreover, volatility asymmetry is negative in all of the sectors including KSE100 confirming leverage effect.

Keywords
Terrorism, EGARCH, asymmetry, stock returns, Karachi Stock Exchange

This article is available in Australasian Accounting, Business and Finance Journal: http://ro.uow.edu.au/aabfj/vol6/iss1/15

Stock Market Reaction to Terrorist Attacks: Empirical Evidence from a Front Line State

Muhammad Tahir Suleman[1]

Abstract

The world financial markets have reacted in a highly consistent pattern to the incident of 9/11 in the United States, suicide blasts at night clubs at Bali in 2002, the Madrid and London train bombings in 2004-2005 and a series of continuous blasts and suicide attacks in Pakistan. In this study, we examined the effect of terrorist attack news on returns and volatility for the Karachi Stock Exchange. We employ the EGARCH model proposed by Engle and Ng (1993) as it allows good and bad news to have a different impact on volatility. Our results indicate that terrorist attack news has negative impact on the returns of all the sector indices. However, news of these events increased the volatility of KSE100 index and financial sector index. Further it is concluded that the results of oil and gas, and industry are not statistically significant in response to terrorist attack news, indicating that such type of news does not affect the volatility of these two sectors. Moreover, volatility asymmetry is negative in all of the sectors including KSE100 confirming leverage effect.

Keywords: Terrorism, EGARCH, asymmetry, stock returns, Karachi Stock Exchange

JEL Classification: G15

[1] Victoria University of Wellington
email: Tahir.suleman@vuw.ac.nz

1. Introduction

Financial markets have reacted in a highly meaningful pattern to September 11, 2001, the hijacked airliner attacks in the United States, the suicide blasts at nightclubs in Bali in 2002 and the Madrid and London train bombings of 2004 and 2005 and a series of blast and continuous series of attacks and blasts in Pakistan. The inside story provides a base of learning to the investors and risk managers about the drastic nature and fallacy of such events. Firstly, the initial market impact from terror attacks is likely to be overdone and to unwind over subsequent days. Second, once the initial panic eases, investors take a more rational look at the medium-term economic impact. Thirdly, the micro impact of attacks can be more serious than the macro. Finally, the extent to which attacks have a long-term market impact on industries and countries depends on whether they cause investors to re-evaluate their long-term risk assessments.

Frey and Kucher (2000) studied the impact of events during World War II on prices of government bonds of several countries traded in Zurich and Sweden, respectively. Although the economic causes and consequences of armed conflict have received widespread attention in the scientific study of war (e.g. Barbieri 2002; Mansfield & Pollins 2003; Schneider, Barbieri & Gleditsch 2003), we know relatively little about the costs of war despite some recent comparative studies (Collier 1999; Cranna 1994; Murdoch & Sandler 2002). We have not found much research on the impact of terrorism on the stock market. More recently, the war in Iraq has stirred interest in the consequences of war on financial markets. Rigobon and Sack (2005) studied the impact of war risk on several financial variables. They found that in the ten weeks before the start of the war with Iraq, the risk of war explained between 13 and 63 percent of the change in financial variables such as the S&P 500, oil prices, gold prices and the US dollar. Karolyi and Martell (2005) examined the impact of terrorist attack on stock prices by using an official list of terrorism related incidents. They identified 75 attacks between 1995 and 2002 in which publicly traded firms were targeted. They used event study analysis and found evidence of a statistically significant negative stock price reaction of -0.83%, which corresponds to an average loss per firm per attack of $401 million in firm market capitalisation. Furthermore, cross sectional analysis of the abnormal returns specified that the impact of terrorist attacks differs from firm to firm depending upon the firm and the incident occurrence.

Recent research has shown the market behaviour in response to the terrorist events. Ahmed and Farooq (2008) studied the effects of the terrorist attacks of September 11, 2001 and its impact on the stock market volatility. They used daily returns data from Karachi Stock Exchange and analysed the impact of 9/11 attacks by studying the returns in the pre 9/11 period and post 9/11 period. They found that the asymmetric response of the conditional variance to innovations, have changed during the post 9/11 period in comparison to these characteristics during the pre 9/11 period. In addition they also found that the volatility behaviour changed significantly after the terrorist attacks of 9/11. They also discuss that this sudden shift in the volatility behaviour cannot be explained by the implementation of regulatory reforms. One of the most considerable impacts is the timing of the attacks and blasts and their ultimate impact on the behaviour of the stock market. However, it is very difficult to measure the critical sensitivity about the issue on the day or next working day or how the series of capital flight reacts to these phenomena.

Terrorism has greatly affected foreign investment in Pakistan. Foreign investment had turned down to $910.20 Million from $1.4 Billion in the financial year 2008-09. Poverty level pushed to 41.4% from 37.5% in 2008-09. Similarly, terrorism increases the expenses of the defence forces to meet their requirements to fight against terrorism. Pakistan has obtained total compensation of $11,998 Million from the US under the Coalition Support Fund (CSF),

out of this amount $3,129 Million was economic related aid and security related aid amounted to $8,869 Million. In addition, the risk to the investors increase as more troop deployment by US in Afghanistan saw a rise in the risk of investors to invest in Pakistan which caused a serious downfall of deposits in the banking sector. Deposits fell from Rs.3.77 Trillion to Rs3.17 trillion in September 2009. In 2002, Karachi stock exchange (KSE) was awarded "The best performing stock market of the world for the year 2002". Similarly, On December 2007, KSE closed at index of 14,127 points with capitalisation of Rs.4.57 trillion. After war was declared by the government within Pakistan its index dropped to 4,675 points with a market capitalisation of Rs.1.58 trillion, a loss of over 65% from its capitalisation in 2007. [2]

The primary purpose and focus of this study is to examine the impact of terrorist attacks on stock exchange behaviour. This paper analyses the consequences of terrorist attacks on the stock market returns and volatility. For this purpose we used news related to terrorist attacks. We used the daily data from Karachi Stock Exchange to observe the effect of terrorist attacks on the stock market. Furthermore, we examined the returns of different sectors to determine whether or not they are also affected by the terrorist attacks. Additionally this helped us to identify which sector responds more to the political news. We used the univariate asymmetric GARCH model, to gauge the impact of terrorist attack news on the returns and volatility.

The organisation of this study is as follows. Section 2 presents the formulation of hypotheses and EGARCH modelling of financial returns and volatility. Section 3 describes the data. Empirical findings are discussed in Section 4. Further research areas and the conclusion are presented in Section 5.

2. Methodology

In the empirical framework, we first analyse the series to check whether they are stationary or non-stationary (random walk) with unit root. The behaviour of a time series naturally revolves around the assumption of stationarity, that is, I(0) and the degree of integration I(d). Robert Engle (1982) in his seminal work on inflation in the UK first introduced the idea of ARCH effect. Later on, Bollerslev (1986) generalised this type of model and introduced the GARCH model. However in this study our main focus is on exponential GARCH model. First of all we have to determine the characteristics of the series (stationary or non-stationary). The most commonly test used to determine the I(1) against I(0) is the Augmented Dickey- Fuller (ADF) test.

2.1 Augmented Dickey-Fuller (ADF) Test

The Augmented Dickey-Fuller (ADF) test is the most common test for the order of integration. This test assumes that the null of the data series is a random walk or an integrated AR model. We assume that x_t is a random walk process, $x_t = x_{t-1} + \varepsilon_t$. The regression model develops as $x_t = \rho x_{t-1} + \varepsilon_t$, where $\rho = 1.0$. We subtract x_{t-1} from both side of the equation to obtain a testable form of Dickey and Fuller test, which is given below

$$\Delta x_t = \alpha + \pi x_{t-1} + \varepsilon_t, \qquad (1)$$

where α (includes constant and a trend) and π are the parameters which are estimated through ordinary least square (OLS) and ε_t is assumed as innovation. The null hypothesis is $H_0 : \pi = 0$ and therefore,$\rho = 1$, of unit root which is tested against the alternative

[2] Statistics are obtained from State Bank of Pakistan and Ministry of Finance Pakistan

hypothesis of $H_1 < 0$ and $\rho < 1$, that is x_t is a level or trend stationary series. The expansion of the equation (1) to ADF test is written as equation 2, assuming that x_t is a AR (p) process, then subtracting x_{t-1} from both sides and adding p lagged differences terms of x_t on right side of equation (1),

$$\Delta x_t = \alpha + \beta t + \pi x_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta x_{t-i} + \varepsilon_t \,, \qquad (2)$$

where $\pi = (\rho - 1)$, null and alternative hypothesis described the same nature of series as under equation (1) the hypotheses are shown as follow, $H_0: \pi = 0 \; and \; \beta = 0$ and for the alternative is $H_1: \pi \neq 0 \; and \; \beta \neq 0$.

2.2 The Mean Equation

In order to model a variance equation, specifications for the mean equation need to be made. By estimating a mean equation, residuals needed to model the variance equation are retrieved. In this study returns are described by the following AR (p) process:

$$r_t = \Phi_0 + \sum_{i=1}^{p} \Phi_i \, r_{t-i} + \varepsilon_t \,, \qquad (3)$$

$$\varepsilon_t \sim idN(0, \sigma_t^2)$$

where Φ_0 is a constant, and Φ_i is the parameters, r_t is the return at time t and ε_t is the error term at time t. Equation (3) is an AR (p) model which explains returns as being dependent on previous values of returns. In order to select the order of an AR model for each index and determine which values of p describe the time series the best, different combinations of AR (p) models are being estimated. Estimation is done by using OLS regression (Ordinary Least Squares). The estimated variations of AR models are then compared to each other by observing values of some chosen information criterion. Since the Schwarz information criterion seemed to give consistent results, model selection was done by minimising this information criterion.

2.3 The GARCH Model

The ARCH (q) model was a major development in econometric modelling, however a higher length of q is needed to obtain good results from the data. Few years later after the introduction of the ARCH model by Engle, a model with different, more flexible lag structure was introduced by Bollerslev (1986). The model is a generalised form of ARCH (developed by Engle in 1982). The GARCH was discovered to be a better fit as it dealt well with non-negativity constraints and needed less number of lags to be included in the model. Furthermore, GARCH models differ from ARCH as it allows the conditional variance to be modelled by past values of itself in addition to the past shock. The GARCH model includes an ARCH component and also an element where the variance today can be explained by previous variances. The general GARCH (q, p) model is defined as:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \, \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \, \sigma_{t-j}^2, \qquad (4)$$

where p is the order of the GARCH terms and q is the order of the ARCH term. σ_t^2 is the conditional variance at time t, α_0 is the constant, $\alpha_i$and β_j are the parameters, $\boldsymbol{\varepsilon_{t-i}^2}$ is previous squared shocks and σ_{t-j}^2 is previous variances. In most of the studies GARCH (1, 1) is being employed. The GARCH models effectively capture a number of characteristics of

financial time series, such as volatility clustering and thick tailed returns. We can say that the GARCH (1, 1) process is covariance stationary if and only if the sum of alpha and beta are less than one ($\alpha + \beta < 1$). If $\alpha + \beta = 1$ then process is still stationary since the variance is infinite.

2.4 Asymmetric GARCH Models

Although GARCH performs well in explaining the volatility, its underlying assumption about the behaviour of the squared residuals is problematic. The model assume that the magnitude of positive and negative shocks have the same effects on variance. In order to capture the asymmetry evident by the data, a new class of models, in which good news and bad news have different impact on volatility, was introduced. In this study our focus lies only on EGARCH model.

2.4.1 THE EGARCH MODEL

Nelson (1991) introduced the Exponential GARCH which is more useful as compared to GARCH because it allows good news and bad news to have a different impact on volatility and it also allows big news to have greater impact on volatility. This model works in two steps, firstly it considers the means and secondly the variance. One way to define the EGARCH (p, q) model is:

$$log(\sigma_t^2) = \omega + \sum_{i=1}^{p} \alpha_j \left|\frac{\varepsilon_{t-j}}{\sigma_{t-j}}\right| + \sum_{i=1}^{q} \beta_i \, log(\sigma_{t-i}^2) + \sum_{i=i}^{k} \gamma_k \frac{\varepsilon_{t-k}}{\sigma_{t-k}}, \qquad (5)$$

where $\omega, \beta, and\ \gamma$ are parameters for conditional variance estimation. β_i indicates the impact of the last period measures on the conditional variance. If the β_i is positive that means a positive change in stock prices is associated with further positive change and vice versa. α_j is a coefficient which measures the effect of previous period in the information set and explains the past standardised residuals' influence on the current volatility. Furthermore, γ_k signifies the asymmetry effect in the variance, a negative γ_k means that bad news has higher impact on volatility than the good one with the same magnitude. Since EGARCH models the logarithmic time-varying conditional variance, the parameters are allowed to be negative. This means that the model does not require any non-negativity constraints in the parameters. The lack of non-negative restrictions makes the model more attractive than a GARCH and GJR. There is however a necessary constraint regarding the stationarity of the model that needs to be specified. The stationary restriction for an EGARCH (1, 1) model is that beta is less than one ($\beta < 1$). In the case of symmetry, where the magnitudes of positive and negative shocks have equal impact on the variance, γ will be equal to zero. $\gamma < 0$, means that the magnitude of a negative (positive) shock will cause the variance to increase (decrease) and vice versa.

After having measured the return and volatility linkages, we further analyse by measuring the effect of terrorist attacks news on the KSE 100 index and other selected sector indexes. We measure the return and volatility response to terrorist attack news by adding a dummy variable in our univariate EGARCH model that takes the value 1 on news[3] days, otherwise zero. It is important to note that we measure separately the response of each news category, i.e., our model is estimated independently for each news category. More

[3] This is for terrorist attack news.

specifically, the univariate EGARCH model with a dummy variable for stock market indexes is defined as follows:

$$r_{KSE,t} = \phi_0 + \phi_1 r_{KSE,t-1} + \phi_2 Dummy + \varepsilon_{KSE,t} \quad (6)$$

$$\log(\sigma^2_{KSE,t}) = \omega + \alpha_1 g_{KSE,t}(Z_{KSE,t-1}) + \beta \log(\sigma^2_{KSE,t-1}) + \alpha_2 Dummy \quad (7)$$

Where

$$g_{KSE,t}(Z_{KSE,t-1}) = (|Z_{KSE,t-1}| - E|Z_{KSE,t-1}|) + \gamma Z_{KSE,t-1}$$

And, $Z_{KSE,t-1} = \varepsilon_{KSE,t-1} / \sigma_{KSE,t-1}$

Equation (6) is the return equation and equation (7) represents the volatility equation, where dummy variables are 1 at the date of news related to terrorist attacks otherwise zero.

3. Data and Descriptive Statistics

The data used in this study was collected from the Karachi stock exchange and Thomson DataStream. It consists of the KSE-100 index and the three sector indexes of oil and gas, financial and industry. The data consists of daily closing prices, stated in local currency (rupee). For KSE-100 index and sector indexes data ranges from January 2, 2002 to December 31, 2009 and consists of 2088 observations. The software used in the study is E-views. The daily return series was generated as follow,

$$R_{KSE,t} = \ln (KSE_t / KSE_{t-1}) , \quad (8)$$

where $R_{KSE,t}$ is the return on KSE and KSE_t represents the closing value of KSE indexes on the day. It is important to mention here that the series is adjusted neither for dividends nor for risk free rate. We can ignore the dividends and interest rates as it does not create any significant error when we forecast stock market volatility (Nelson 1991). It is important to analyse the characteristics of the series. The variance is a measure of how much the variable deviates from its mean value. Skewness is a measure of the symmetry of the probability distribution curve. Zero skewness means a curve is symmetrical around its mean. The kurtosis describes the peak of the distribution curve. The normal distribution has a zero skewness and kurtosis equal to three. (Watsham & Parramore 1997: 49-63) Summary statistics for our returns series of KSE-100 index, and other sectors are as given in equation (8) are shown in Table 1.

Table 1 shows that the mean value of the KSE100's return is 0.000992 and the median is 0.00000. The standard deviation is about 1.60%. This is a quite high value, with respect to the mean return, indicating that the returns often deviate from the mean. The skewness in this case is nearly -0.32 which indicates a negative skewness and shows that the curve is more concentrated on the left hand side. Indexes usually have a weak negative skewness since the stock prices in the long range tend to increase with time. The kurtosis is around 5.22, which is high and explains that the curve has a high peak. There is, thus, excess kurtosis in the index suggesting that the distributions are leptokurtic. As noted earlier, a standard normal distribution should have a skewness of zero and a kurtosis of three. Based on these values we conclude that the data does not follow a normal distribution.

One way to confirm whether the data follows a normal distribution is to look at the Jarque-Bera. In this case, with respect to Table 1, the JB is 6243.621 with a p-value of 0, and

hence the H_0- hypothesis is rejected which means that the data is not normally distributed. According to the central limit theorem the lack of the normal distribution should not cause any problems here since the theorem states that the OLS regression is approximately normally distributed for large samples. (Luetkepohl, Kraetzig & Phillips 2004). Table 1 shows details of the descriptive statistics of the selected sector's indexes as oil and gas, financials and industry. All mean returns are positive. The skewness of the series indicates that all the series have a negative skewness and excess kurtosis. This is not surprising as financial return's distribution have a tendency of being leptokurtic due to volatility clustering. After studying the characteristics of the series, the next step is to check the correlogram of the returns to check if return series are correlated, hence leaving ground for being predictable and dependent. The correlogram reveals that there are no linear dependencies in either of the return series, thus these are white noise process.

Table 1
Descriptive Statistics

	KSE100	Oil & Gas	Financial	Industries
Mean	0.000992	0.001085	0.001160	2.40e-05
Maximum	0.085071	0.094033	0.091825	0.095296
Minimum	- 0.077414	- 0.107255	- 0.085842	- 0.160551
Std. Dev.	0.015971	0.020200	0.019774	0.017705
Skewness	- 0.324413	- 0.081043	- 0.17917	- 0.80707
Kurtosis	5.226069	4.869859	4.504617	9.033224
Jarque-Bera*	441.0856	306.1765	208.0097	3390.209
Probability	0.000000	0.000000	0.000000	0.000000
AC return	0.058	0.062	0.036	0.040
AC Sq. return	0.255	0.248	0.156	0.20
Observation	2088	2088	2088	2088

*Note. The Jarque-Bera statistics is computed from the following equation;

$$JB = \frac{n}{6}(S^2 + \frac{(K-3)^2}{4})$$

Where *n* is the number of observations, *S* the skewness and *K* the kurtosis.
The hypotheses for the JB-test are:
H_0 = normal distribution
H_1 = no normal distribution

In order to see the non-linear dependencies which are often found in financial returns, the correlogram of standardised squared residuals is analysed. We reported the Autocorrelation coefficients for simple and squared returns at first lag in Table 1.The first order return autocorrelation coefficient displays a significantly positive serial correlation for most of the return series. In addition, coefficients measuring the serial correlation in squared returns indicate a presence of volatility clustering effects for all sectors including the KSE 100 index. Thus, we can use GARCH models to capture these characteristics of asset returns. Furthermore all the series reject the H_0- hypothesis for JB test confirming that these are not normally distributed. Appendix I shows the return series of the data for KSE 100 and other

sectors for all the periods since January 2002 to December 2009. From the figures it appears that there are stretches of time where the volatility is high and at some time volatility is low.

3.1 News Data

On December 2007, KSE closed at index of 14,127 points with capitalisation of Rs.4.57 trillion. However, after war was declared by the government within Pakistan its index dropped to 4,675 points with a market capitalisation of Rs.1.58 trillion, a loss of over 65% from its capitalisation in 2007. In this paper we use terrorist attack news to test the impact on stock market returns and volatility. We collected news related to terrorist attacks from January 1, 2002 to December 2009[4]. Furthermore, we used the news in this paper which are more severe in comparison with each other. We also include almost all the news from large cities (Karachi, Lahore, Islamabad, Peshawar and Quetta) as it can affect the investor's decision about future investments more. We also find that there were only two terrorist attacks in 2002, however this number increased every year and the worst was in 2009 which was 130 incidents. Appendix II shows graphically the number of terrorist news incidents each year and also includes the attack list with respect to each city.

4. Empirical Results

Thissection demonstrates the empirical results of the stationarity test and those from the impact of good news and bad political news on returns and volatility.

4.1 Results from Unit Root Test

The first check for return series is to see if it is random walk. One of the implications of being random is that the series never returns to its mean value. We run the unit root test to analyses the distribution properties of the return series. Table 2 illustrates the testing results of the Augmented Dickey-Fuller (ADF) test and the critical values at 1%, 5% and 10% respectively. The result of KSE100 and sector for ADF test rejects the unit root at 1% significant level. This means that all the series are stationary by using the first order difference and we can implement models on the available series. The lag difference is 2, and is based on the minimum values of AIC and SBC.

Table 2
Unit Root Test

	Unit Root Test		**Critical Values**	
	ADF Test	1%	5%	10%
KSE 100	-23.20429***	-3.962716	-3.412095	-3.127963
Oil & Gas	-23.57175***	-3.962453	-3.411967	-3.127887
Financial	-23.55973***	-3.962453	-3.411967	-3.127887
Industry	-25.04381***	-3.962453	-3.411967	-3.127887

Note. The critical values are MacKinnon critical values, *** means significance at 1%.

[4] The main sources are: Dawn newspaper and Wikipedia.

4.2 Results from EGARCH

We justify the selection of EGARCH models by utilising the linear models on KSE 100 and other selected sectors with different lags and investigate the best fit model for the data according to Akaike information criterion (AIC) and Schwarz information criterion (SIC). We find the AR(1) model is the best fit model in most of the series in order to capture the first movement

4.2.1 IMPACT OF TERRORIST ATTACKS

In this section we test the impact of terrorist attack news on the stock returns and volatility. Generally speaking, these type of news items decrease the returns and increase the volatility. The empirical results from Univariate EGARCH model (6) & (7) are reported in Table 3. As it is perceived from Table 3, that the dummy ϕ_2 for terrorist attacks is statistically significant at 1% and has a significantly negative effect (- 0.00883***) on the returns of the KSE 100 index. We also reported the results of the sector indexes with respect to terrorist attack news. The financial sector shows more negative results (-0.013923***) with respect to other sectors. In addition we find statistical significant results (-0.008678*** and -0.003066***) to the terrorist attacks on oil and gas and industry sector respectively. Concentrating on the impact of news on volatility we find motivating results. Table 3 also divulges the coefficient of dummy α_2 in the volatility equation (6). Results show that terrorist attacks increase the volatility of the KSE100 index, and the financial sector index This type of news has more impact on the volatility of the financial sector (0.226618***) as compared to other sectors. However, we did not find significant statistical evidence of the impact of the terrorist attack news on oil and gas (-0.054457) and industry (-0.034857). Table 3 also reports the volatility asymmetry, which is negative in all of the sectors including KSE100 confirming leverage effect. Moreover negative asymmetry implies that the variance goes up more after negative shocks than after positive shocks. Furthermore, persistence parameter β is very large in most of the sectors including KSE 100 which indicates that the variance moves slowly through time.

The time period required for shocks to reduce to one half of the original size defined as $\ln(0.50) / \ln(\beta)$ is approximately 5.34 days for KSE100 index and 4.37 days for financial sector index. This is an indication that the shock persist is 5.34 and 4.37 days for KSE100 and financial sector index respectively. A shorter lasting persistence of shocks in the conditional variance implies more volatility. However, persistence of the shock is higher in the oil and gas sector and industry sector (7.37 and 5.74) as both these sectors are not statistically significant with respect to the terrorist attack news. The extent to which negative innovations increase volatility more than positive innovation, defined as $|-1+\gamma| / (1+\gamma)$ is about 1.27 times for KSE100 index, 1.25 times for financial sector index, 1.09 times and 1.16 times for oil and gas sector and industry sector respectively. Asymmetry effect of 1.27 means that the negative impact is 1.13 times more than the positive impact on the KSE100 index. Residual autocorrelation coefficients at 12th lag for both simple and squared standardised residuals are also reported in Table 3. The statistic of autocorrelation in residual and squared residual shows the absence of correlation.

In summary these results indicate that terrorist attacks have significantly negative effect on the returns of the KSE 100 index, oil and gas, financial and industry index sectors. Moreover terrorist attacks have increased the volatility of the KSE100 index, and financial sector index as well. Such types of news have more impact on the volatility of financial sector as compare to other sectors. However, we did not find significant statistical evidence regarding the impact of the terrorist attacks news on oil and gas and industry.

Table 3

Estimation results from AR - EGARCH with Terrorist Attack news

	KSE100		Oil and Gas		Financial		Industry	
	Coefficient	*Significance*	*Coefficient*	*Significance*	*Coefficient*	*Significance*	*Coefficient*	*Significance*
$\boldsymbol{\phi_0}$	0.002150***	0.0000	0.002115***	0.0000	0.002748***	0.0000	0.001157***	0.0001
$\boldsymbol{\phi_1}$	0.073084***	0.0021	0.020315	0.3637	0.124766***	0.0000	0.017588	0.4663
$\boldsymbol{\phi_2}$	- 0.00883***	0.0000	-0.008678***	0.0000	-0.013923***	0.0000	-0.003066***	0.0037
$\boldsymbol{\omega}$	-1.344694***	0.0000	-0.961682***	0.0000	-1.443023***	0.0000	-1.215171***	0.0000
$\boldsymbol{\alpha_1}$	0.390790***	0.0000	0.327618***	0.0000	0.322769***	0.0000	0.390792***	0.0000
$\boldsymbol{\gamma}$	-0.119606***	0.0000	-0.044131***	0.0021	-0.110357***	0.0000	-0.078002***	0.0000
$\boldsymbol{\beta}$	0.878311***	0.0000	0.910333***	0.0000	0.853255***	0.0000	0.886329***	0.0000
$\boldsymbol{\alpha_2}$	0.084505**	0.0180	-0.054457	0.1587	0.226618***	0.0000	-0.034857	0.3705
				AC (10) Residual				
	0.048		0.032		0.010		0.009	
				AC (10) Squared Residual				
	0.007		0.020		0.001		-0.006	

Notes: This table reports the estimates from the following AR - EGARCH model:

$$r_{KSE,t} = \phi_0 + \phi_1 r_{KSE,t-1} + \phi_2 \text{Dummy} + \varepsilon_{KSE,t}$$

$$\log(\sigma^2_{KSE,t}) = \omega + \alpha_1 g_{KSE,t}(Z_{KSE,t-1}) + \beta \log(\sigma^2_{KSE,t-1}) + \alpha_2 \, Dummy$$

We report the estimates for ARMA - EGARCH return and volatility for KSE 100 index and other selected indexes. The coefficients measuring the effect of dummy variable used as a proxy for the terrorist attacks on Karachi stock markets' returns and volatilities are also reported. Significant coefficients are denoted with***, **, * on 1%, 5 %, and 10 % significance level respectively. Residual autocorrelation coefficients at 12th lag AC (12) for both simple and squared standardised residuals are also reported.

5. Conclusion

Since the hijacked airliner attacks in the United States on Sept.11, 2001, to the suicide blasts at nightclubs in Bali in 2002 and the Madrid and London train bombings of 2004 and 2005 and a series of blasts and attacks in Pakistan, markets have reacted in a highly consistent pattern. Terrorism has greatly affected the foreign investment in Pakistan. Foreign investment has declined to $910.20 Million from $1.4 Billion in the financial year 2008-09. Poverty has reached 41.4% from 37.5% in 2008-09. Similarly, terrorism increases the cost of the forces to meet their needs to fight against terrorism. In 2002, Karachi stock exchange (KSE) was awarded "The best performing stock market of the world for the year 2002". Similarly, on December 2007, KSE closed at index of 14,127 points with capitalisation of Rs.4.57 trillion. But after war was declared by the government within Pakistan its index dropped to 4,675 points with a market capitalisation of Rs.1.58 trillion, a loss of over 65% from its capitalisation in 2007.

This study examined the impact of terrorist attack on the Karachi stock exchange. We studied the effect of terrorist attack news on the stock market returns and volatility. We used the daily data from the Karachi Stock Exchange to see the affect of terrorist attack news on the stock market. We also observed the returns of different sectors to test whether or not they are also affected by these types of news stories. Additionally this helped us to identify which sector responds more to the political news. We used the univariate asymmetric GARCH model, to gauge the impact of terrorist news on the returns and volatility. Our results demonstrate that terrorist attacks have significantly negative effect on the returns of the KSE 100 index, oil and gas, financial and industry index sectors. In addition, terrorist attacks increase the volatility of the KSE100 index and the financial sector index. These kinds of news stories have more impact on the volatility of financial sector as compared to other sectors. However, we did not find significant statistical evidence of the impact of the terrorist attack news on oil and gas and industry. Moreover, volatility asymmetry is negative in all of the sectors including KSE100 confirming leverage effect. Furthermore, persistence parameterβ is very large in most of the sectors including KSE 100 which indicates that the variance moves slowly through time.

This study could be extended by including more news such as economic, military and neighbouring countries. Additionally, we could include more sectors in the data to analyse the impact on each sector. We could also use more countries in our data such as South Asian countries and test the impact of terrorist attack news on the other countries. For this we may employ multivariate EGARCH model for studying the volatility.

6. References

Ahmed, S & Farooq, O 2008, 'The effect of 9/11 on the stock market volatility dynamics: Empirical evidence from a front line state', *International Research Journal of Finance and Economics,* no.16, pp71-83

Bollerslev, T 1986, 'Generalized autoregressive conditional heteroskedasticity', *Journal of Econometrics*, vol.31, no.3, pp307-327.

Barbieri, K 2002, 'The liberal illusion: Does trade promote peace? *Ann Arbor, MI: University of Michigan Press.*

Collier, P 1999, 'On the Economic Consequences of War', *Oxford Economic Papers,* 51: 168-183.

Cranna, M et al. 1994 'The true cost of conflicts' New York.

Engle, R F 1982, Autoregressive Conditional Heteroskedasticity with Estimates of Variance of United Kingdom Inflation. *Econometrica,* Vol.50, No. 4, pp. 987–1007

Engle, R F & Ng, V.K 1993, 'Measuring and testing the impact of news on volatility', *Journal of Finance*, vol.48, no.5, pp1749-78

Engle, R F 2001, 'The Use of ARCH/GARCH Models in Applied Econometrics. *Journal of Economic prospective',* Vol. 14, No. 4, pp 157-168

Frey, B S & Kucher, M 2000, ' World War II as reflected on capital markets', *Economics Letters* Vol. 69, pp 187-191

Karolyi, G A & Martell, R 2005, 'Electronic Reference Retrieved on September 15, 2010' ,http://fisher.osu.edu/fin/dice/papers/2005/2005-19.pdf

Luetkepohl, H, Kraetzig, M & Phillips, P C B 2004, 'Applied time series econometrics', *Cambridge University Press*.

Mansfield, E D & Pollins, B 2003, 'Economic interdependence and international conflict: New perspectives on enduring debate'*, Ann Arbor, MI: University of Michigan Press.*

Murdoch, J C & Sandler, T 2002 'Economic growth, civil wars and spatial spillovers', *Journal of Conflict Resolution,* 46(1): 91-110

Nelson, D B 1991, 'Conditional heteroskedasticity in asset returns: A new approach', *Econometrica* 59: 347-370.

Rigobon, R & Sack, B 2005, 'The effects of war risk on US financial markets', *Journal of Banking and Finance*, Vol. 29, No. 7, pp1769-1789.

Schneider, G, Barbieri, K & Gleditsch, N P 2003, 'Globalization and Armed Conflict', *Lanham, MD: Rowman and Littlefield*.

Watsham, T J & Parramore, K 1997, 'Quantative methods in finance', *Cengage Learning* EMEA

Appendix I. Graph of Daily Returns

Figure 1 KSE 100

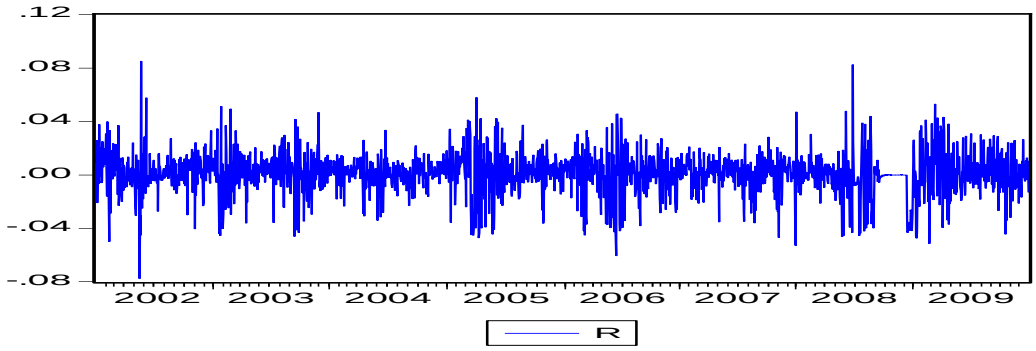


Figure 2 Oil and Gas

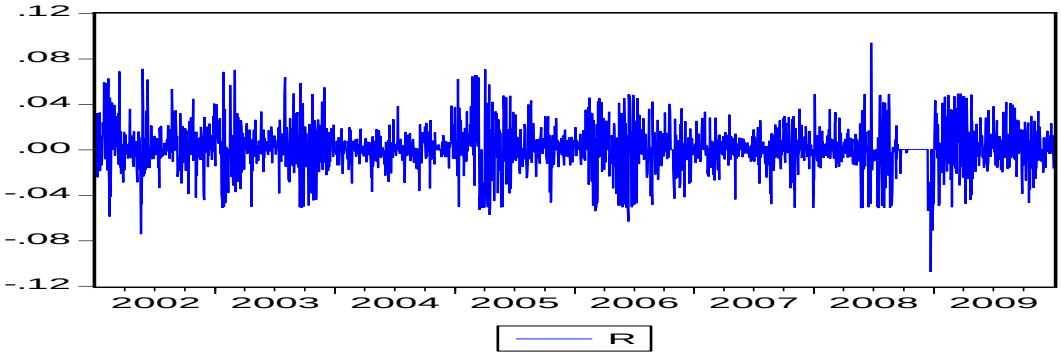


Figure 3 Financial

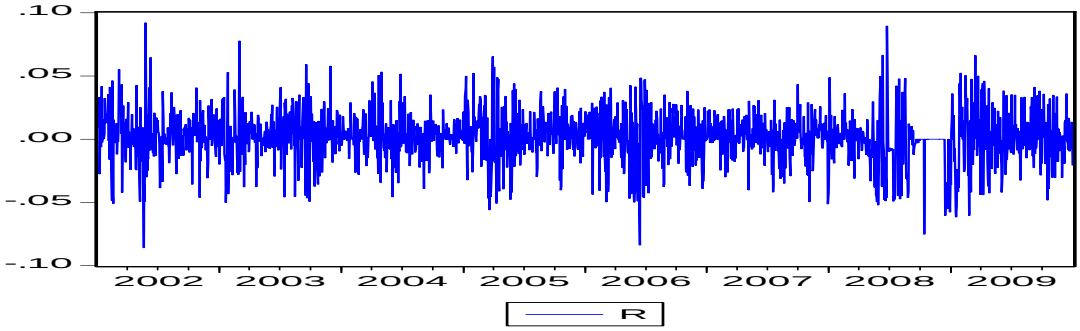
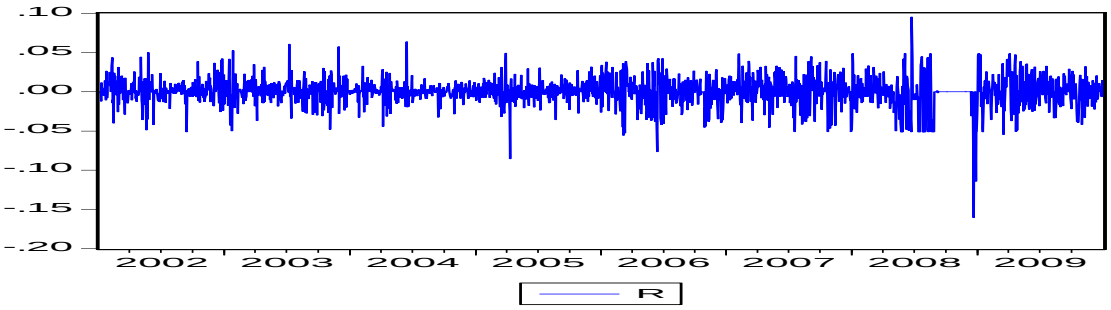
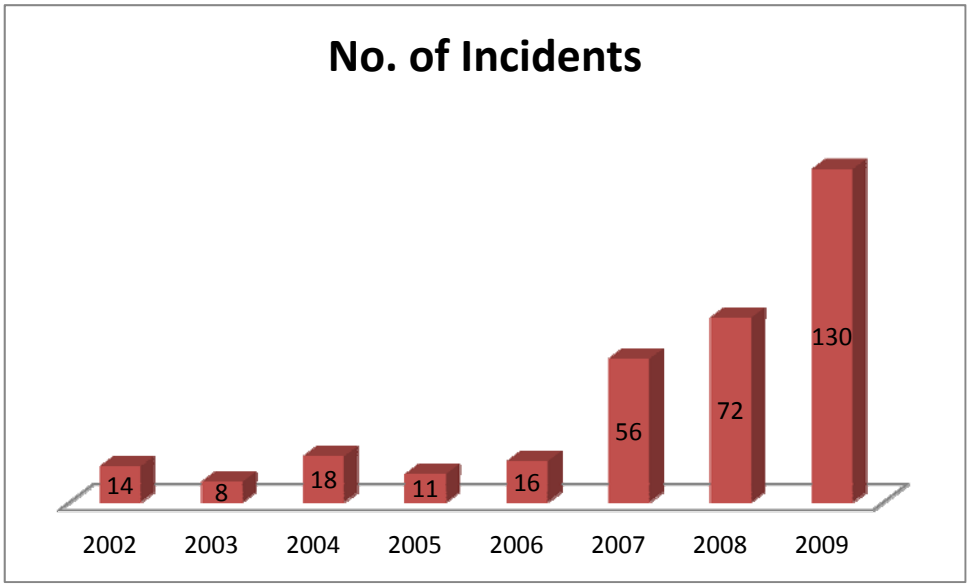
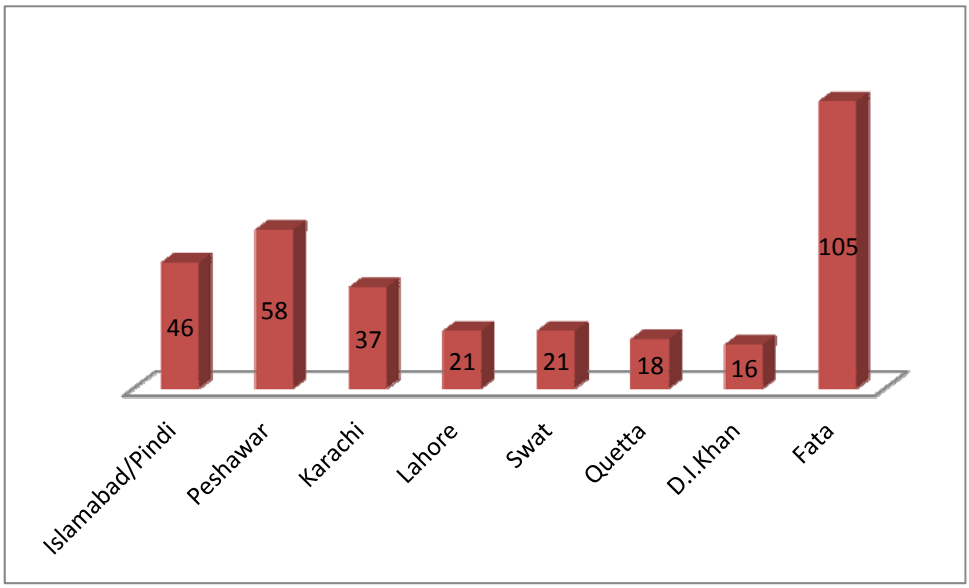


Figure 4 Industries



Appendix II. Graphical Representation of Terrorist Attacks

List of Terrorist Attacks from 2002 to 2009



List of Terrorist Attacks in different Cities