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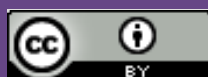
Department of Quantitative Methods



School of  
Business and Economics

University of Management and Technology,  
Lahore, Pakistan

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## Event Study and Impulse Indicator Saturation Analysis to Assess Reaction of Terrorist and Political Events: Evidence from Oil and Gas Sector of Pakistan

### Author(s)

Attiya Yasmin Javid<sup>1</sup>, Bilal Ahmad<sup>2</sup>

### Affiliations

<sup>1</sup>Pakistan Institute of Development Economics (PIDE), Islamabad.

Email: [attiyajavid@pide.org.pk](mailto:attiyajavid@pide.org.pk)

ORCID: <https://orcid.org/0000-0002-6243-4803>

<sup>2</sup>Pakistan Institute of Development Economics (PIDE), Islamabad

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## Event Study and Impulse Indicator Saturation Analysis to Assess Reaction of Terrorist and Political Events: Evidence from Oil and Gas Sector of Pakistan

Attiya Yasmin Javid<sup>1</sup>, Bilal Ahmad<sup>2</sup>

<sup>1&2</sup> Pakistan Institute of Development Economics (PIDE), Islamabad.

Email: attiyajavid@pide.org.pk

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### Abstract

*The objective of this study is twofold, first, to assess the impact of terrorist attacks and political events on returns and volatility oil and gas sector of Karachi Stock Exchange from the period of 2004 to 2014. Second, to compare the results of these events applying event study methodology, event dummy analysis and impulse indicator saturation. Results indicate that the oil and gas sector reacts on the occurrence of terrorism and political events and the results of two methodologies event study and event dummy analysis are almost similar. However, impulse indicator saturation is able to provide better results in comparison to event study and event dummy analysis because as it captures all breaks and co-breaks within a sample period, moreover it clearly helps in defining rebounding period of the market.*

**Keywords:** terrorist attacks, political event, volatility, event study, impulse indicator saturation, rebound period, Pakistan stock exchange

**JEL Classification Codes:** G12, G 14

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## 1. Introduction

It is a well-known fact that stock markets react over some factors even if they are not directly related to the firm's performance. These factors might be a social, economic or political disturbance and may increase or decrease the value of the stock. News reveals information on these

<sup>1</sup>**Authors' Acknowledgment:** We, hereby, declare that the given paper is extracted from Bilal Ahmad's MPhil thesis.

disturbances and leave momentous and historic chain reaction which creates disturbance in the stock prices. Stock returns could be very high, high, low or very low or might be negative. Greater the difference in the returns depicts greater the volatility (Sweeney, 1998). In response to the news, structural breaks occur which can alter a historic trend which is the depiction of efficient market (Fama, 1969). The event study that is the oldest and most commonly used is based on the efficient market hypothesis (Fama, 1969). This hypothesis states that as new information becomes available as the result of some unexpected event, it is fully taken into account by investors assessing its present and future impact. It is based on the overall assessment of many investors who quickly update all available information in assessing each individual firm's market value (McWilliams & Seigel, 1997). There are alternative methodologies for carrying out event study (MacKinlay, 1997).

Political decision makings, stabilities, and instabilities also play a major role in the economic structure of a country and in the same manners stock market also behaves in a different way. There are a number of major changes that have taken place the past 15 years regarding regime shifting between autocratic and democratic regime, privatization decisions, the arrest of the political leaders, calls for a strike, long marches, general and local body elections and foreign affairs against which the stock markets react (Clark, Masood & Tunaru, 2008).

Terrorism has become a serious problem in Pakistan since the incident of 9/11 World trade Centre incidence (Ahmed & Farooq, 2008). Therefore, the cost that it has to pay was the severe terrorist attacks, which were increased in 2004 when the United States of America declared Major Non-NATO Ally. According to the Global Terrorism Database, 9659 number of a terrorist incident have taken place in Pakistan from 2004 to 2014 with at least 16554 casualties and more than 29083 injuries, where from 1970 to 2000 the number of terrorist events was only 1863 with 3391 casualties. Moreover, sectarian and ethnic conflicts are also paying a major role in terrorism (Ahmar, 1996). One terrorist attack on a religious place gives birth to other sectarian attacks. These types of events are responsible for closing institutional activities as well as the business activities which will lead to the result in a harsh impact on the stock market.

In the light of all above discussion, Pakistan has chosen as a vehicle of empirical research work because it is among one of the most ideal place in the context of this study as there are a number of political fluctuations in the governing system and regime shifting are taking place from last decade. Moreover, Pakistan is also the major Non-NATO ally since 2004 that's why a number of terrorist attacks are taking place in Pakistan. KSE is leading stock market in the country and oil and gas sector is important that is why companies of oil and gas sectors listed with KSE are chosen as the sample.

The core objective of the present study is twofold: first, to examine the reaction of the oil and gas sector over the occurrence of political and terrorism events by carrying out event analysis on stock returns and volatility. Second, to compare the results of different methodologies: event study by abnormal returns, using event dummy analysis and impulse indicator saturation analysis. This analysis illustrates impact of the events along with reversion time of the oil and gas sector to the normal. Moreover, the co-breaks in returns and volatility are examined. This study can bring some new dimension in the literature by comparing the results of different methodologies used for investigation of the impact of events on stock returns and volatility. All events do not have same reaction so most of the events have event day effect only. It is important to capture the co-breaks because few events have effect on the returns and volatility at the same time and the impact of the events on volatility persists. Further, this analysis helps to define that how long an event can impact returns and volatility. This will increase the understanding of academicians, researchers and financial analysts, investors and regulator related to the behavior of returns and volatility of stocks during the presence of political instabilities and terrorism.

After introduction, the remainder of the study proceeds as follows. Section 2 presents briefly the literature review related to political event and terrorism events. The methodology and data is discussed in section 3. The section 4 presents empirical results and discussion and the last section offers conclusion and policy implications.

## **2. Literature Review**

A brief review of literature about impact of different events and literature relevant to methodologies used is presented in this section.

The impact of terrorism attacks are examined by several studies. Jhonston et al. (2005) elucidate the significant impact of 9/11 World Trade Centre terrorist attack on 14 different stock exchanges. Different stock exchanges rebounds in different number of days, Hong Kong stock exchange rebounds in 6 days which is earlier than any other market where, the Johannesburg rebounds in 162 days which is later than the all other markets. Nguyen and Enomoto (2009) find out the effect of terrorism on the two different stock exchanges located in Pakistan and Iran. The terrorist attacks relevant to World Trade Centre and Madrid have a significant impact on returns for both countries, where terrorist attack in London is significant against the volatility series for both of the countries. For Pakistan Yamin and Malik (2014) show that in past ten years number of violence significantly increased in areas located near the Afghan border, Khyber Pakhtunkhwa, Baluchistan and urban Sindh while Punjab faced the least numbers of violence. Sectarian's violence and terrorism has been observed all over the country. Ahmed and Farooq (2008) ascertain the significant reaction of 9/11 terrorist attacks on volatility in Karachi Stock Exchange.

Beaulieu, Cossat and Essaddam (2005) find significant impact of different political events in Canada on the volatility of the returns at Montreal Stock Exchange and Toronto Stock Exchange. Dangol (2008) concludes that good political events and bad political events are a reason to generate positive and negative abnormal returns respectively in Nepalese Stock Exchange. The rebounding period of the market against the new information related to the political events is 2 to 3 days. Karachi Stock Exchange reaction against political events is analyzed by using primary data from politicians, economists and stock markets analysts and it is observed that political risk has affected the Karachi Stock Exchange (Clark et al., 2008).

As regards the methodologies, event study methodology is among one of the oldest and widely used techniques all over the world. Binder (1998) discusses a number of event study situations to find out the weekend and option expiring effect. Most of the time a nonparametric event study methodologies are employed in which abnormal returns are calculated. Both, Capital Asset Pricing Model and Mean Adjusted Returns Model are employed for the calculation of the abnormal returns (Strong, 1992). Dangol (2008) uses this methodology to study political events. In case of Pakistan, event methodology is used

by Javid (2007) to examine the impact of earth quake of October 8, 2005 on the Karachi Stock Exchange. The results depict a rise in returns of cement, steel, food and banking as expected, however, no significant volatility has been observed. Javid and Ahmad (1999) by employing event day dummy examine the effect of nuclear detonation in India and Pakistan on stock returns, volume and the volatility of Karachi Stock Exchange. By applying event day methodology, Sohail Rehman, and Javid (2017) investigated the investment behavior of financial and non-financial sector in response to Global financial crises for Pakistan.

Impulse Indicator Saturation analysis is used to capture out the breaks in series and co-breaks in two series. Hendry (2001) used general to specific technique for modeling inflation UK. Hendry *et al.* (2013) used modified Impulse Indicator Saturation to capture the level shifts or multiple breaks. Russell, Banerjee, Malki, and Ponomareva (2010) used this technique to capture the structural breaks in US inflation and obtain meaningful and unbiased estimates of the Phillips curves in the United States. Reade and Volz (2011) applied impulse indicator saturation to uncover instabilities and to specify a very specific model for inflation in China. Jin and Ann (2019) used volatility impulse response function analysis to see the impact of global financial crises in emerging markets.

For modeling volatility ARCH/GARCH model have become much successful in event studies due to autoregressiveness and heteroskedasticity present in financial data (Lamoureux & Lastrapes, 1990; Engle, 2001). A number of researchers use univariate and multivariate ARCH/GARCH family models for volatility clustering and residual analysis. The GARCH model is used to capture the impact of event on volatility by Nguyen and Enomoto (2011) for Pakistan and Iran market while Javid (2007), Javid and Ahmad (2009), Aslam and Kang (2014) for Pakistan market. Karolyi (1995) employed multivariate GARCH model for international transmission of volatility and stock returns.

This discussion leads to test the hypotheses that different type of events has different impact on stock returns and volatility. Impulse Indicator Saturation is superior methodology as it captures all breaks and co-breaks within sample identify rebounding period of the market.

### 3. Methodology and Data

#### 3.1. Methodology

Since the study examines the impact of events on stock returns and volatility, the event study methodology, event day dummies analysis and impulse indicator saturation are applied.

##### 3.1.1. Event Study Methodology

The analysis begins with event study methodology to see the impact of the events on the stock returns (MacKinlay, 1997). Event window which basically defines that within that period an event has occurred, and compares its results with estimation window which provides us with the information of the pre event window, after that, calculate the abnormal returns which is the difference between expected returns and actual returns within the event window for an underlying sector than check for the significance of the abnormal returns. The index of oil and gas sector is calculated. The returns of oil and gas and KSE 100 index is calculated as follows:

$$R_t = \ln \left( \frac{P_t}{P_{t-1}} \right) \quad (3.1)$$

where  $R_t$ ,  $P_t$  and  $P_{t-1}$  are returns of index at time  $t$ , closing price at time  $t$  and  $t-1$  respectively.

The abnormal return exhibits the reaction over one specific event at a particular point of time. The daily abnormal returns are calculated as difference between actual returns and expected returns.

$$AR_t = R_t - E(R_t) \quad (3.2)$$

The capital asset pricing model (CAPM) is used for the estimation of expected return  $E(R_t)$  that is more precisely based on economic factors (MacKinlay (1997).

$$E(R_t) = R_{ft} + \beta (R_{m,t} - R_{ft}) \quad (3.3)$$

where  $E(R_t)$  is expected return of sector  $i$  on time  $t$ ,  $R_{ft}$  is Risk free rate,  $\beta$  is sensitivity of sector to market returns and  $R_{m,t} - R_{ft}$  Market risk premium.

Mean adjusted model is used to check how the events impact when the sector is independent of the market or specific is risk assumed to be zero and market risk is assumed to be equal to 1 is (Cable & Holland, 1999):

$$R_t = E(\bar{R}_t) + \varepsilon_t \quad (3.4)$$

In this equation expected returns calculated by taking the average of returns in the estimation window.

Average Abnormal Returns (AAR) gives overall impact of one type of events in the model. AAR is obtained by taking the average of all the abnormal returns related to a specific event:

$$AAR_t = \sum_{i=1}^N AR_t \times n^{-1} \quad (3.5)$$

where  $N$  is Number of events

### 3.1.2. Event Dummy Variable Analysis

In this methodology a multiple intercept of dummy variables is used to find the significance of the events on stock returns and volatility (Binder, 1998). The equation for the returns behavior over the occurrence of an event becomes:

$$R_t = \alpha + \sum_{i=-n}^n \beta_i D_{i,t} + \varepsilon_t \quad (3.6a)$$

where  $D_{i,t}$  is the dummy variable depicts occurrence of the event at time  $t$ . If the event occurs than  $D = 1$  and  $0$  otherwise. Where  $n$  depicts the number of events dummy including in the regression.

$$h_t = \alpha + \sum_{i=-n}^n \beta_i D_{i,t} + \varepsilon_i \quad (3.6b)$$

where  $h_t^2$  is the volatility of the sector at time  $t$ . Other variables remain the same as discussed above.

### 3.1.3. Impulse Indicator Saturation Modeling

Hendry et al. (2008) propose a methodology, General Unrestricted Model (GUM) in which presence of multiple structural breaks or level shifts are captured. In this methodology one dummy variable is generated against one observation, so in this way each observation holds its own dummy variable. In this way lift up one assumption of classical linear regression model that number of observations should be greater than number of parameters, but in impulse indicator saturation number of observations becomes equal or greater than the number of parameters. Dealing with this sample data is split in two or more than two parts, so that number of observations becomes greater than number of parameters. Only the significant dummies are captured. In present study, the data is split in eleven parts to check the significance of the events by comparing the results of multiple structural breaks or level shifts obtained by combining dummies. Impact of the selected events is checked on the series of return and volatility as follows:

$$R_t = \beta_0 + \beta_1 R_{t-1} + \sum_{s=1}^{250} \beta_2 D_{i,t} + \varepsilon_t ; \varepsilon_t \sim IIN[0, \sigma_t^2] \quad t = 1, 2, \dots, 250 \quad (3.7a)$$

---

<sup>2</sup>Volatility modeling is discussed in next sub-section 3.1.2. GARCH(1,1) is used for the analysis.



$$R_t = \beta_0 + \beta_1 R_{t-1} + \sum_{s=252}^{500} \beta_2 D_{s,t} + \varepsilon_t; \varepsilon_t \sim IIN[0, \sigma_t^2] \quad t = 251, 252, \dots, 500 \tag{3.7b}$$

.....

$$R_t = \beta_0 + \beta_1 R_{t-1} + \sum_{s=2501}^{2705} \beta_2 D_{s,t} + \varepsilon_t; \varepsilon_{i,t} \sim IIN[0, \sigma_t^2] \quad t = 2501, \dots, 2705 \tag{3.7k}$$

where the Equations from (3.7a) to (3.7k) are depicting that our sample divided into 11 splits. The variables are same as discussed above.

$$h_t = \beta_0 + \beta_1 h_{t-1} + \sum_{s=1}^{250} \beta_2 D_{s,t} + \varepsilon_{i,t}; \varepsilon_{i,t} \sim IIN[0, \sigma_t^2] \quad t = 1, 2, \dots, 250 \tag{3.8a}$$

$$h_t = \beta_0 + \beta_1 h_{t-1} + \sum_{s=251}^{500} \beta_2 D_{s,t} + \varepsilon_{i,t}; \varepsilon_t \sim IIN[0, \sigma_t^2] \quad t = 251, 252, \dots, 500 \tag{3.8b}$$

.....

.....

$$h_t = \beta_0 + \beta_1 h_{t-1} + \sum_{s=2501}^{2705} \beta_2 D_{s,t} + \varepsilon_t; \varepsilon_t \sim IIN[0, \sigma_t^2] \quad t = 2501, \dots, 2705 \tag{3.8k}$$

where the Equations from (3.8a) to (3.8k) are capturing that the sample divided into 11 splits for the volatility series, other variables remains the same as discussed above.

### 3.1.4. Modeling for Volatility

Since the stock prices has the characteristics of hetroscedasticity and autocorrelation and ARCH-LM test confirms this. Therefore, for capturing the volatility Autoregressive Conditional Hetroscedastic (ARCH) family models are more suitable (Engle, 1982). To handle the problems of non-convergence to estimate volatility models (Bollerslev, 1986) has proposed Generalized Autoregressive Conditional Hetroscedastic (GARCH) model. Conditional mean follow Autoregressive Moving Average (ARMA) and conditional variance equations specifies as generalized autoregressive conditional heteroscedasticity (GARCH) models are used. The general GARCH model is given as:

$$R_t = \alpha_0 + \sum_{t=1}^m \beta R_{t-i} + \sum_{t=1}^n \gamma \varepsilon_{t-1} + \varepsilon_t \tag{3.9}$$

$$h_t = \theta_0 + \sum_{i=1}^q \theta_i \varepsilon_{t-1}^2 + \sum_{i=1}^p \varphi_j h_{t-1}$$

where  $\theta_0 > 0, \theta_i \geq 0, \varphi_j \geq 0$

$R_t$  represents the returns in conditional mean equation and a linear function of ARMA in equation 1, where  $\beta$  represents the vector of AR term and  $\gamma$  is the vector of MA. Empirically its illustrate ARMA (m,n) process with different specifications. Coefficients of conditional

variance equation must be non-negative. Conditional variance is represented by  $h_t$  depends upon square of past values of process  $\varepsilon_t$  and lag of conditional variance  $h_{t-1}$ .

The condition of non-negativity of parameter is also applied in this model. GARCH (1,1) is frequently used in financial econometric literature for volatility modeling. The GARCH (1,1) provides most robust estimations than other volatility models (Bollerslev, 1986; Javid & Ahmad, 1999). In this study ARMA(1,1)- GARCH (1,1) model is applied to estimate conditional mean and variance equation volatility. Then GARCH variance series is extracted to measure the volatility of oil and gas sector.

### **3.2. Data Description and Sources**

The analysis is based on dataset of firms in oil and gas sector listed on Karachi Stock Exchange from January 1<sup>st</sup>, 2004 to December 31<sup>st</sup>, 2014. The selection of the firms is based on criteria of continuous listing and actively trading and availability of the daily data for time period of this study. The sample consists of 13 companies of oil and gas sector. Index of oil and gas sector is calculated that is the representation of the overall sector, as it was difficult to discuss all the companies individually event by event. The market capitalization weighted index is calculated in line with the KSE-100 Index.

The events data is categorized into terrorism and political. The terrorist events are selected according to definition of the terrorism in the international laws. 'Criminal acts intended or calculated to provoke a state of terror in the general public, a group of persons or particular, persons for political purposes are in any circumstance unjustifiable, whatever the considerations of a political, philosophical, ideological, racial, ethnic, religious or any other nature that may be invoked to justify them Walter (2004.)' Political events were also selected according to the definition of the political events given by Damster and Tassiopoulos (2005) as: 'We can define a political event as a carefully planned, organized, managed and implemented event by political office bearers in either government, civil society members or outsourced to event managers. Furthermore this event has a political or a public nature with a political purpose and message, with the intention to reach as many people as possible a variety of mean such as hosting an event and the intentions to reach a specific objective or number of objectives'. According to the definition of the events 377 are selected,

out of which 160 are political events and 217 are terrorism events. Events occurred on the weekends or on the holidays are considered on the next opening day of the market. Political and Terrorist events are taken separately for three analyses. In seven days of the week both type of events political and terrorist took place, therefore it is nearly impossible to say which event affected the market most because in overlapping of seven events cannot be captured through daily data. This can be said the limitation of the study, but if the events did not occur exactly on the same time then their impact or intensity may be captured by using hourly data.

Entire data of closing prices of oil and gas companies and KSE 100 index is collected from Business Recorder, where the data of terrorism, political and financial events has compiled from South Asian Terrorism Portal, DAWN Newspaper, Express Newspaper and Global Terrorism Database.

#### 4. Empirical Results

The analysis begins with calculating the stock returns and volatility. The summary statistics is provided in section 4.1. The results of event study, event day dummy analysis and impulse indicator saturation are discussed in section 4.2, 4.3 and 4.4 respectively.

##### 4.1. Summary Statistics of Returns and Volatility

This study calculated the prices index of oil and gas sector and log first difference is used to obtain the return of this index.

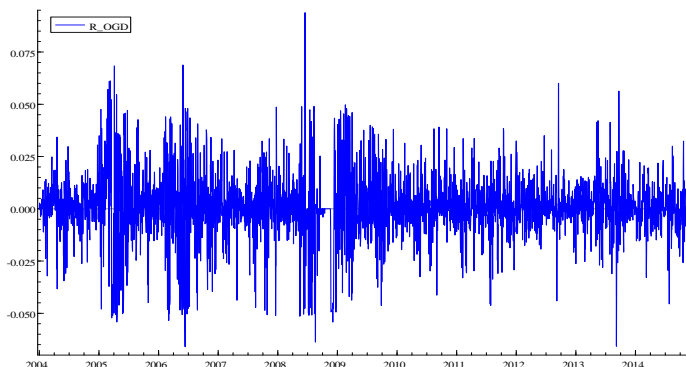
**Table 4.1 Returns and Volatility of Oil and Gas Sector**

	Returns	Volatility
Mean	0.00044	0.000276
Median	0.00000	0.00017
Maximum	0.09384	0.001977
Minimum	-0.06599	5.81E-05
Std. Dev.	0.01672	0.000275
Skewness	-0.14031	2.541708
Kurtosis	5.44487	10.0293
Jarque-Bera (p value)	0.000	0.000
Observations	2705	2705
Mean		0.00044

The descriptive statistics of the returns from oil and gas sector are provided below in table 4.1. The mean value of the returns for the prices index of oil and gas sector is 0.044%, variation from the mean

value is 1.67%, data series is negatively skewed, the distribution of return series is mesokurtic and significance of Jarque-Bera is stating that null hypothesis of the normal distribution has been rejected.

Graph 4.1 is acquainting the behavior of the daily returns series from 2004 to 2014. The spread of the returns lies between -6.60% to +9.38%. Large and normal fluctuations can be observed throughout the period from 2004 to 2014.



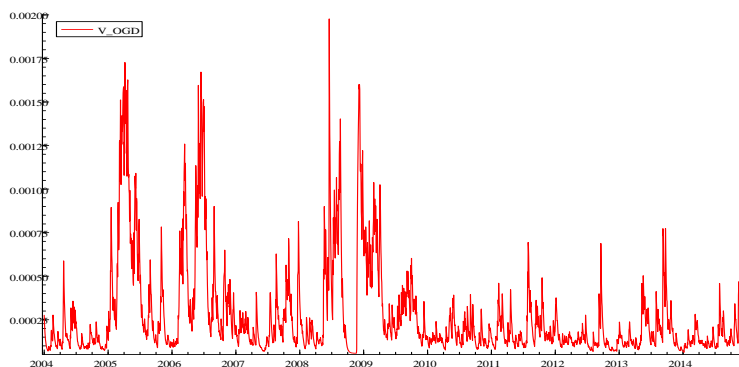
**Graph 4.1: Behavior of the daily returns series from 2004 to 2014**

The volatility of oil and gas sector returns is estimated by ARMA(1,0)-GARCH(1,1) based model selected by AIC criteria. The results of conditional mean and conditional variance equation is given below:

$$R_t = 0.0009 + 0.069R_{t-1}; \mathbf{h}_t = 0.109 + 0.1512 \varepsilon_{t-1}^2 + 0.809h_{t-1}$$

Conditional mean equation illustrates that the returns have autoregressive of order 1 showing inertia in return series. The conditional variance equation describes both previous square errors and pervious volatility impacts significantly the volatility behavior of oil and gas sector returns. The value of persistence is 0.92, depicting that persistence of a shock takes a long time to decay.

The GARCH variance series is obtained to measure volatility of oil and gas sector and descriptive statics of this series is presented in column 3 of Table 4.1. The mean value of volatility of the returns is 0.028%, the spread of the data from the mean value is 0.028%, data series is positively skewed, and the distribution of return series is leptokurtic while significance of Jarque-Bera is stating that null hypothesis of the normal distribution is rejected.



**Graph 4.2: The Volatility Series from 2004 to 2014**

The graph 4.2 is explaining the spread of the volatility series over the time and the spread of the volatility lies between -0.0058% to +0.20%. High fluctuations in the volatility observed in the first quarter of 2005, mid of 2006 and also in the last quarter of 2008.

**4.2. Results of Event Study**

This section discusses the response of daily returns against events by average abnormal returns (AAR) by applying Capital Asset Pricing Model (CAPM) and Mean Adjusted Returns Model (MARM). The pre-event window used for estimation of expected returns consists of days. The event window consists of 11 days, 5 days before the event and 5 days after the event.

**Table 4.2: Response of Oil and Gas Sector Returns for Terrorism and Political Events**

		Terror Events		Political Events	
		CAPM	MARD.	CAPM	MARD.
DAY		AAR	AAR	AAR	AAR
-5		-0.00009	0.0004	-0.000	0.0004
-4		-0.0003	0.0002	-0.003	0.0001
-3		0.00001	-0.0002	0.002	0.003
-2		0.002	0.001	-0.001	-0.0003
-1		0.001	0.001	0.001	0.002
0		-0.0021***	-0.001	-0.006***	0.0052**
1		0.0007	0.001	0.002	0.002
2		0.0001	0.0005	-0.002	-0.002
3		-0.0005	-0.0005	0.0009	0.0007
4	-0.0003	-0.0003	0.002		0.004
5	-0.0004	0.0006	0.002		0.003

*Note:* Significance Level is indicated by: \*10% \*\*5% \*\*\*1%

Results reported in column 2 and 3 in Table 4.2 are depicting that terrorist attacks are significant only on the event day under the CAPM model in 11 days event window. These results support the findings provided by Aslam and Kang (2014) that market reacts on the event day only for event day and market absorbs the risk of such shocks and recovers in a day from 1997 to 2011 and remains insignificant in rest of the days. While under the MARM model the terrorist attack are not significant for the oil and gas sector.

The Table 4.2, columns 4 and 5 are showing that political events are significant only on the event day both under the CAPM and MARM model. To investigate that impact varies with location, stock type and target type, this study undertakes analysis of returns and volatility of gas sector by using event dummy variables in next subsection.

### **4.3. Results of Event Day Analysis Using Dummies**

Tables 4.3 are acquainting the response of returns and volatility in oil and gas sector against the terrorist and political events represents the 5<sup>th</sup> day before the events, on the event day and the 5<sup>th</sup> day after the events day. The ARMA(1,0) with GARCH (1,1) model is used.

For terrorist events in the returns and volatility series are depending on their own first lag. The returns and volatility remains significant for event day for all other days it turns out to be insignificant against the terrorist attacks except the significance volatility on the event day. These results indicate that terrorist shocks are observed in the market. The results are in confirmation with the results of Hassan et al., (2014) and also Aslam and Kang (2014).

The impact of political events on the returns and volatility of the returns and volatility series are depending on their own 1<sup>st</sup> lag. Results show that in returns political events are significant on the event day and very next day of the event day but they remain insignificant in rest of the days. However, the political events are significant over the volatility of the returns for all 11 days that is 5 days before the event and 5 days after the event on the event day.

**Table 4.3: Impact of Terrorism and Political Events on Returns and Volatility Five Days Before and Five Days After Event**

Terrorism events													
	C	T-5	T-4	T-3	T-2	T-1	T0	T1	T2	T3	T4	T5	AR(1)
Returns													
Coefficient	0.027	0.045	0.0025	0.010	0.016	0.015	-0.017**	0.012	0.021	-0.011	-0.037	0.006	0.124***
t-Statistic	0.557	0.38352	0.21184	0.084	1.339	1.295	-1.740	0.965	0.174	-0.959	-0.307	0.053	6.481
VOLATILITY													
Coefficient	0.028***	-0.0008	-0.0012	-0.0007	-0.0016	-0.0021	-0.02***	-0.0011	0.0002	0.0003	-0.006	-0.001	0.959***
t-Statistic	7.627	-1.544	-1.653	-0.8609	-1.6433	-2.0867	-2.45	-1.0601	0.236	0.3058	-0.8343	-0.170	176.6313
Returns													
F-statistic	0.000	0.000	2.01		Volatility	F-statistic	Chi-squad	DW					Note: Significance: *10% **5% ***1%
P-value	0.000	0.000	0.000		0.000	0.000	0.000	1.93					
Political Events													
RETURNS													
Coefficient		0.0006			-0.00092		0.0021	-0.006***		0.003***	-0.001		0.131
t-Statistic		1.462			-0.684		1.603	-4.217		2.253	-0.978		6.901
VOLATILITY													
Coefficient		0.003***			-0.001*		-0.002***	-0.002***		0.003***	0.002***		0.960***
t-Statistic		7.38			-1.727		-2.218	-3.088		4.1120	3.702		179.368
RETURNS													
F-statistic	0.000	0.000	2.01		Volatility	F-statistic	Chi-squad	DW					Note: Significance: *10% **5% ***1%
P-value	0.000	0.000	0.000		0.000	0.000	0.000	1.93					

These results confirm that because political decisions are anticipated response on these events that appear on volatility of oil and gas before and after the event. These results are supported by the findings of Clark et al. (2008) for political events. In next section, the study moves to more rigorous analysis of Impulse Indicator Saturation to examine the impact of terrorist and political events on oil and gas sector of Pakistan.

#### **4.4. Results of Impulse Indicator Saturation Analysis**

In this methodology, one dummy variable is generated against each observation and a general unrestricted model runs for the both returns and volatility series. Further, significance of events has been gauged for returns and volatility. Table 4.4 is explaining the results of the returns and volatility series against political and terrorism events

The table 4.4 reports the results obtained through Impulse Indicator Saturation that indicates that out of total 217 terrorist attacks, 91 attacks were found to be significant in returns series on the event day, of these events 30, 13 and 8 number of events are significant on 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> day respectively after the event day. On average, persistence time of the significant terrorist attacks is 1 day and 61 minutes of a working day. There are 113 significant terrorist attacks in the volatility of the returns series of which 54, 17 and 9 number of events are significant on 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> day respectively after the event day. On average, persistence time of significant terrorist attacks is 2 day and 66 minutes of a working day. Moreover, 89 numbers of co-breaks captured against the terrorist events.

In political events, out of 160, there are 114 events that are significant on the event day under return series, of which 12, 5 and 2 are significant after the event day on 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> day respectively in return series. There are 112 political events that are significant in volatility on the event day, of which 34, 4 and 1 are significant on 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> day respectively after the event day. On average, persistence time of significant political events is 1 day and 1 minute in returns, and 2 days and 220 minutes in volatility of a working day. Moreover, 86 co-breaks captured against political events. In this methodology, effect of every single event for returns and volatility has captured and we found that not all terrorist events have significant impact on returns and volatility but almost less than the half terrorist events are significant on returns and more than half terrorist events are significant on volatility.



There are some events that have extended effect on returns and volatility of oil and gas sector up to 3 days. Further there are 89 political events that have effect before the occurrence of events on returns and volatility of this sector because these events are anticipated. In this analysis almost 2/3 political events have significant impact. These results suggest that different kind and of different intensity events may have different results and persistence of the impact may vary event to event. Co-breaks are points where events have impact on both returns and volatility. It is important to capture the co-breaks because few events have effect on the returns and volatility at the same time. Further, impact of the events on volatility remains longer than the impact on returns. These results are also confirmed by Aslam and Kang (2014) that all events do not have same reaction or different stock markets do not react in the same way and also most of the events have event day effect only. Therefore, for this kind of analysis when an uncertainty is over the variables choice and timing of multiple location shifts, for every single observation multiple breaks can be detected, Impulse Indicator Saturation is more suitable to capture such reaction (Castle, Doornik & Hendry, 2012).

To sum up the present study applies three different methodologies to check the impact of political and terrorism activities on the Oil and Gas Sector of PSX. Event Study and Event Day Dummy analysis provides a general overview of the events and are not that much capable of capturing the intensity (how quickly respond to these events and help in making group of events) and impact of the events. These methodologies are unable to capture the co-breaks in which events that impacts returns and volatility at the same time. However, Impulse Indicator Saturation captures the intensity and co-breaks and impact on both returns and volatility are separately observed. Further, this analysis helps to define that how long an event can impact returns and volatility.

**Table 4.4 : Impulse Indicator Saturation Oil and Gas Sector**

	Co-Breaks	Significance <sup>0</sup>	Significance <sup>1</sup>	Significance <sup>2</sup>	Significance <sup>3</sup>	Persistence
<b>Terrorism Events</b>	89	91	30	13	8	1 d
						61 mins
<b>Political Events</b>						2 d
						66 mins
						1 d
						1 min
						2 d
						220 mins

*Note:* <sup>0</sup> on day significant <sup>1</sup> after 1 day significant <sup>2</sup> after 2 days significant <sup>3</sup> after 3 days significant, at 5% level of significance

The present study adds new dimension by providing more details in identifying the impact of terrorist and political events on Oil and gas stocks traded in PSX. Most of the time prices of the shares are not determined by the demand and supply forces rather other factors/events also contribute. The political events and protests directly impact the prices and business activity therefore it is important to capture what kind of and how longer these events impacts. Terrorist events reaction with human psychology in making investment decision and terrorist events like attack on electric pylons, gas pipeline and oil pipeline are as directly related to the oil and gas sector so there impact was also need to study.

## **5. Conclusion and Policy Implications**

There is abundant instability that Pakistan is confronting from last one and half decade in the form of political instabilities and dreading terrorist attacks. This study observes the impact of terrorist attacks and political events on stock returns and volatility of oil and gas sector of Karachi Stock Exchange (KSE) from 2004 to 2014. To meet the objectives of this study, 217 terrorist attacks and 160 political events are considered. Different methodologies are employed to explore the reaction on daily frequency data of both returns and volatility of the stock returns.

In the event study methodology, terrorist attacks and political events significantly impact the returns oil and gas, although the impact of terrorist attacks turns insignificant right after a day.

In methodology when event day dummy is introduced in case of terrorist attack the returns and volatility of oil and gas sector is affected on event day. In political events returns are effected on the event day and a day after the event. However, the volatility shows significant impact before and after the announcement and on the event day. This is because political decisions are anticipated. These results are in confirmation with Clark et al. (2008) for response to political events. Firstly, both employed methodologies showing that oil and gas sector is more reactant to the political events as compare to the terrorist attacks which contradicts (Aslam & Kang, 2014) for KSE-100 index, this can be reasoned as might be financial sectors are more reactant to the terrorist attacks as compare to the non-financial sectors. The, impulse indicator saturation is being employed to capture the breaks,

co-breaks and level shifts. Moreover, it captures the persistence period in level shifts due to political events and terrorist attacks.

The results indicate that the oil and gas sector reacts on the occurrence of terrorist attacks and political events. The results under two different methodologies event study and event dummy analysis give less clear impact of the events. However, impulse indicator saturation is able to provide better results in comparison to the above said methodologies because as it captures all breaks and co-breaks within a sample period, moreover it clearly helps in defining the rebounding period of the market. This increases the understanding of response of the market to events for investors, financial analysts, researchers and academicians.

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<b><i>ORCID of Corresponding Author</i></b>	Attiya Yasmin Javid :0000-0002-6243-4803

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