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The impact of terrorism on industry returns and systematic risk in Pakistan

A wavelet approach

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Abstract

Purpose – This study aims to examine the impact of terrorism on return and systematic risk of Pakistan's equity industries. Daily data from 1 January 2000 to 31 December 2014 for 12 industries based on the specific types of companies listed on Karachi Stock Exchange are used for the empirical analysis.

Design/methodology/approach – A multiplicative (additive) term is introduced in the standard capital asset pricing model to examine the change in systematic risk (industry returns) in response to the terrorist activities. The authors use the multiscale beta approach (Yamada, 2005) and the maximal overlap discrete wavelet transform (MODWT) to test the heterogeneous market hypothesis.

Findings – Terrorism activities increase the systematic risk for most of the industries and the negative impact on returns of banks and the financial industry. It is noted that terrorism positively impacts (increases) the industrial systematic risk mainly in short-run (between two and four days-time horizon).

Originality/value – The paper examines the impact of terrorism on a broad list of industries' (banks, basic materials, chemicals, construction, consumer goods, consumer services, financials, industrials, minerals, oil and gas, textile and utilities) risk and return in Pakistan, using the multiscale beta approach (Yamada, 2005) and the MODWT methods.

Keywords Pakistan, Equity market, Terrorism, Systematic risk, MODWT, Wavelet-based test

Paper type Research paper

JEL classification – G1, H56, G11

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1. Introduction

Terrorism acts[1] aimed against the population with an objective to hinder certain types of activities in a country, which nevertheless affects the whole economy in general. The economic consequences of terrorism acts are not always consistent or straightforward. Obviously, the fear generated through terrorist attacks directly impinge investor confidence, create instability in the financial markets and deter economic progress.

Further, the degree of exposure to risk from terrorist attack varies across industries. Because the nature of business also determines the impact of terrorist activities on the overall risk of an industry, some businesses may be affected more than the others. The plausible factors explaining the variances in the impact of a terrorist attack on a business may include, inter alia, proximity or geographic location, raw material used, import and export orientation and product classification. For instance, a firm having plants and factories in areas that is a regular target of terrorist attacks will be perceived to have relatively more operational risk than the ones located in safer zones. Similarly, the degree of exposure to risk from terrorism can depend on the nature of business, that is, whether a company is oriented towards transportation, agriculture and technology.

In this paper, we examine the impact of terrorism on industry returns and systematic risk of stock market, with the focus on companies listed on Pakistan's Karachi Stock Exchange (KSE). There are a few studies which have examined the impact of terrorism on the KSE. For instance, Suleman (2012) examined the effect of terrorist attack news on returns and volatility for the KSE using the EGARCH model proposed by Engle and Ng (1993). The author noted that terrorist attack news:

- had a negative impact on the returns of all the sectors (KSE 100, Oil & Gas, Financial, and Industry) indices;
- increased the volatility of KSE100 and financial sector returns; and
- the impact was not statistically significant for oil and gas and industry indices.

Thus, he concluded that news of this type does not affect the volatility of these sectors. Alam (2013) examined the relationship between terrorism and stock market development in Pakistan using terrorism impact factor and the daily time-series data from 1 January 2001 to 30 June 2011 of KSE price index. The author found that there was no short-term impact of terrorism on stock market returns however, terrorism negatively influenced stock returns in the long-run. Thus, it was concluded that terrorist activities change the investor's mood and shift the economic outlook of the country. Aslam and Kang (2015) examined the impact of timing, location and type of terrorist attacks on the stock markets of Pakistan using daily time series data from year 2000 to 2011. Among other things, the authors show that each additional terrorist attack is associated with a negative return of −0.32 per cent on the day of the attack, −0.24 per cent a day before the attack thus indicating the market is sensitive to potential attacks and a positive return of 0.34 per cent a day after the attack which signals the quick recovery of the market.

Our study while focusing on the similar theme differs from the abovementioned studies in context and methodology. First, we examine the impact of terrorism on a relatively broad list of industries (banks, basic materials, chemicals, construction, consumer goods, consumer services, financials[2], industrials, minerals, oil and gas, textile and utilities)[3]. Second, we analyse the impact of terrorism using the multiscale beta approach (Yamada, 2005) and the maximal overlap discrete wavelet transform (MODWT) to test the heterogeneous market hypothesis. We decompose the market returns into "smooth" and "rough" components using the MODWT. Subsequently, we analyse the heterogeneous

market hypothesis to study the terrorism and stock market reactions. Further, we examine the impact of terrorism on industry returns in a country where terrorism is not a unique but has become a characteristic event to some degree. Further, we intend to highlight that some industries and hence the profitability of these industries are relatively more vulnerable to terrorist attacks than others.

The rest of the paper is outlined as follows. In Section 2, we discuss the literature highlighting the impact of terrorism on stock markets; in Section 3, we present the data and methodology; Section 4 documents the results; in Section 5, we present the conclusions.

2. Literature survey

The investors' choices and factors that drive high risk-adjusted returns are based on the assumption that every rational investor seeks to maximize her return on investments. However, stock prices, industry performance and profitability are sensitive to news (Hamao *et al.*, 1990, Arshanapalli and Doukas, 1993; Hon *et al.*, 2004; Kim *et al.*, 2004; Flannery and Protopapadakis, 2002; Nikkinen and Sahlström, 2001, 2004) and unforeseen or cataclysmic events such as (an indication of) terrorist attacks which can influence the expected returns of investors and hence alter their decision in different directions (Abadie and Gardeazabal, 2003; Chen and Siems, 2004; Maillet and Michel, 2005; Hon *et al.*, 2004; Charles and Darné, 2006; Carter and Simkins, 2004; Guzhva and Pagiavlas, 2004; Inglada and Rey, 2004; Ito and Lee, 2005; Blunk *et al.*, 2006; Khan *et al.*, 2015). Generally, terrorism has a negative impact on the stock market returns.

Further, there are evidences that the equity industry reacts in response to military conflicts. For example, according to McDonald and Kendall (1994), the defence industry exhibits abnormal positive returns during politico-military and politico-paramilitary scenario. Bradford and Robison (1997) noted abnormal (negative) equity returns during the Iraq war (2003-2011); however, they show that oil and defence sectors were not impacted by the war-like situation. Doherty *et al.* (2003) empirically examined the insurance companies' stocks of the USA after 9/11 and showed that stocks of insurance companies experienced a sudden drop in prices followed by a quick recovery in the later months (Cummins and Lewis, 2003; Doherty *et al.*, 2003).

Terrorism also affects the macroeconomic activities and bilateral trade between countries by damaging the investors' confidence (Liu *et al.*, 2003). Nitsch and Schumacher (2004) estimated the effects of transnational terrorism on bilateral trade flows using a standard trade-gravity model, where the trade flows between trading partners were explained by the terrorist attacks, the distance between two countries and the income per capita. Hence, it was concluded that terrorist attacks lead to an increase in perceived risk of losses for some firms and adversely impacts their stocks. Further, relatively risk-averse investors adjust their portfolios by selling risky stocks and hence protect themselves from abrupt price declines. For example, Chen and Siems (2004) highlighted that on 17 September 2001, the Dow Jones Industrial index reported 7.15 per cent losses. Although all stocks underperformed as a result of the terrorist attack, the impact was not the same across all the sectors and industries. According to Brück and Wickström (2004), some sectors can be more vulnerable to the nature of terrorist attacks than others. Drakos (2004) found that 9/11, Bali, Madrid and London attackers continuously utilized the vulnerabilities of transportation utilities to reach their objectives implying that the transportation industry was relatively more exposed to risks due to terrorism.

Additionally, terrorism can have different levels of impact on industries due to the very nature of the attacks. If a terrorist attack results in quasi-war-like scenario, such as 9/11, then it is possible that it would invigorate industries such as defence and security. However, an industry perceived to be safe haven, such as precious metals, may not be affected heavily by such attacks. On the other hand, the level of uncertainty caused by insecurity can curtail

the investors' confidence and also may cause a delay in the consumption of non-essential goods and services.

Eldor and Melnick (2004) analysed the daily stock market and foreign exchange markets reaction to terror by isolating the effects based on location, type of attack and target, number of causalities and the number of attacks per day between 1990 and 2003. The authors found that suicide attacks had a permanent effect on both the stock and foreign markets, whereas the location of terror attack had no effect. They further claimed that markets did not become desensitized to terror but continued to function efficiently due to the country's democratic regime, free markets and well-developed financial markets as a result of past market liberalization policies.

Worthington and Valadkhani (2005) suggest that two opposing hypotheses exist on the impact of unforeseen events on the financial institutions, especially on insurance companies. First, the financial institutions may incur losses to insurers due to the payments made to policyholders for their damages. Second, financial activities may increase provided the reinsurance facilities are available. However, the authors found that financial services industry has a higher sensitivity to changes in local and global uncertainty than other industries have. They empirically analysed the Australian market's reaction to the September 11 terrorist attack through a long-term regression analysis and found that financial sector was negatively affected and that the oil and gas industry showed a decrease of 0.19 per cent in returns due to terrorism. Rigobon and Sack (2005) explains that in war like situations, oil prices tend to rise and thus higher uncertainty induce a shift in investment strategy.

Cam (2008) studied the impact of Madrid, 9/11 and Bali attacks by analysing the equity indices of various industries. He noted an increase (decrease) in returns for telecommunications, water and defence (tourism, airline and hotel) industries. Similarly, Ramiah *et al.* (2010) noted an increase in the level of systematic risk for some sectors and thus concluded that the impact of terrorism activities on risk (return) differs across industries. Further, the authors highlighted that because investment in the stocks of risky industries requires a relatively higher compensation (returns), high perceived risk can result in a shift towards less risky equities thereby increasing their prices.

Arin *et al.* (2008) investigated the effects of terrorism on six different financial markets (Indonesia, Israel, Spain, Thailand, Turkey and UK). Their results showed that terror has a significant impact on both the stock markets and the stock market volatility, and the magnitudes of these effects are larger in emerging markets. The empirical results suggested that although the response to terror shocks varied across countries, there was evidence of statistically significant causality effects both in mean and in variance in all the six countries under examination. Further, the authors found that terror index volatility had an impact on the stock market returns and that the two European stock markets (Spain and UK) were generally less affected by shocks. Accordingly, the authors asserted that financial investors in these two countries are relatively more resilient to the impacts of terrorism.

Drakos (2010) explored whether terrorism exerts a significant negative impact on daily stock market returns in a sample of 22 countries using flexible versions of International Capital Asset Pricing Model (CAPM) and allowed for autoregressive conditional heteroscedasticity. The author noted from the results that terrorist activity led to significantly lower returns on the day of occurrence and the negative effect was substantially amplified as the level of psychosocial effects increased thus providing evidence of sentiment effect.

3. Data and method

3.1 Data overview

The present study uses daily data (3,913 observations) from 1 January 2000 to 31 December 2014 of 12 industries listed on KSE and the KSE 100 index, which is a proxy for overall stock market. The KSE 100 index is the major representative index of the Pakistan stock market. Data on industrial and market index is extracted from *DataStream International Thomson Financial 2015* database. The 12 industry indices (banks, basic materials, chemicals, construction materials, consumer goods, consumer services, financials, industrials, minerals, oil and gas, textile and utilities) are from the official *Thomson Reuters Global Equity Indices* database. The indices are free float adjusted, weighted for market capitalizations and are designed to serve as broad market benchmarks to track the performance of liquid equities[4]. The trend in industry-level equity indices are presented in Figure 1. Daily returns of industry equity indices and KSE-100 index are calculated as the difference of the logarithmized closing prices, $r_i = 100 * \ln(p_t/p_{t-1})$. Terrorism intensity is calculated as the sum of killings and injured at a given day. Table I reports the descriptive statistics of daily returns for industries, the market and terrorism intensity. The average daily returns are positive for all industries. Financials and Banks daily returns are highest, that is, 0.0828 and 0.0823 per cent, respectively. The lowest average daily retruns (0.0168 per cent) are reported for utilities industry. The average daily killings and injuries resulting from terroism are 3.5535. The normality test (JB) rejects the the null hypothesis of normality for all industry-specific and market returns. In Table I (columns 2-6), we provide the statistics on maximum, minimum, standard deviation, skewness and kurtosis.

The terrorism data are extracted from the National Consortium for the Study of Terrorism and Responses to Terrorism (START) (2014), Global Terrorism Index (2014) database. In Figure 2, we present the trend of terrorism (number of killing, injuries and both) in Pakistan on yearly basis from 2000 to 2014. Notably, terrorist activities significantly increased in Pakistan post 9/11 (Shahzad *et al.*, 2015).

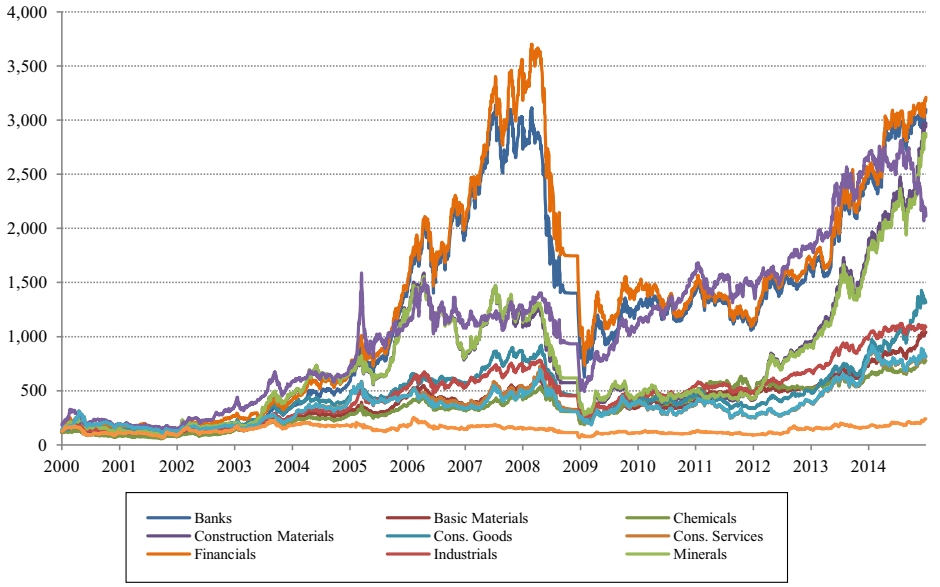

Figure 1.
Time trend of Pakistan sectoral indices over sample period

Industry, market index & terrorism intensity	Mean	Maximum	Minimum	SD	Skew	Kurt	JB stats
Banks	0.0823	10.201	−13.239	1.7320	−0.2583	6.5224	2066.5†
Basic materials	0.0567	11.214	−10.207	1.5355	−0.1462	7.8304	3818.2†
Chemicals	0.0499	15.163	−9.1246	1.5914	0.0769	8.3736	4711.8†
Construction materials	0.0790	18.935	−19.869	2.1837	0.0575	10.074	8161.0†
Consumer goods	0.0596	12.501	−11.632	1.5717	−0.0631	7.9869	4057.3†
Consumer services	0.0447	14.008	−12.014	1.8687	0.0119	6.3821	1865.1†
Financials	0.0828	9.1534	−19.314	1.7090	−0.5893	10.548	9516.9†
Industrials	0.0554	9.9648	−8.6433	1.4430	−0.2870	7.0336	2706.4†
Minerals	0.0781	18.935	−19.869	2.1449	0.0539	10.608	9440.6†
Oil and gas	0.0627	11.126	−10.370	1.7392	−0.0335	6.3046	1781.2†
Textile	0.0450	14.008	−12.014	1.8964	0.0002	6.2010	1670.6†
Utilities	0.0168	14.764	−18.179	2.2510	0.1528	10.312	8732.6†
KSE-100 Index	0.0799	8.5071	−8.6623	1.3912	−0.2978	7.2578	3013.7†
Terrorism intensity	3.5535	76.000	0.0000	5.5066	2.6324	16.757	3536.9†

Notes: Max. = Maximum; Min. = Minimum; Std. Dev. = Standard deviation; Skew. = Skewness; Kurt. = Kurtosis and JB Stats = Jarque–Bera statistics; † indicates rejection of null hypothesis of normality at 1% level of significance

Table I.
Descriptive statistics of industry-level, market index returns and terrorism intensity

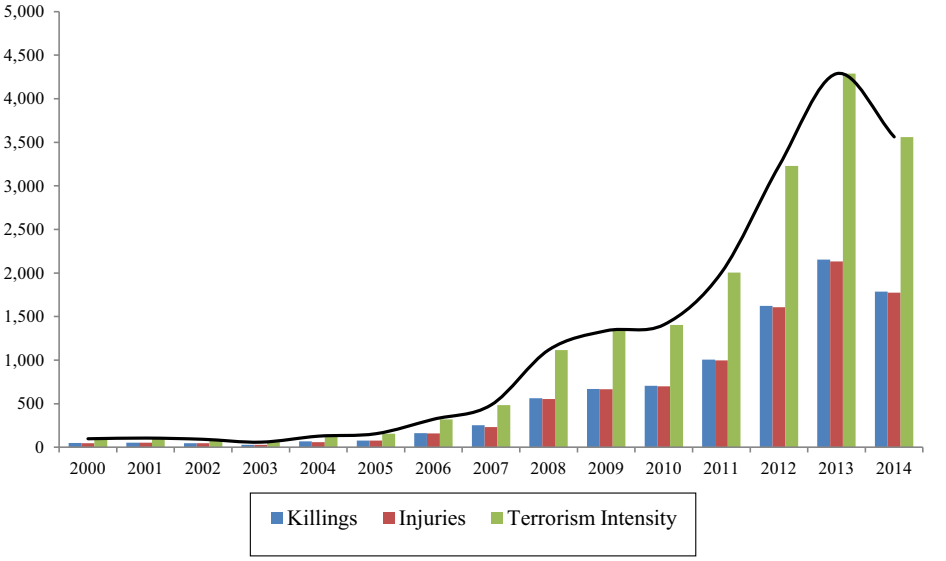

Figure 2.
Killing, injuries and terrorism intensity (killing + injuries) over sample period

3.2 Methodology

The study utilizes the framework proposed by Ramiah *et al.* (2010) to study the impact of terrorism on industry returns and systematic risk. The impact of terrorism on systematic risk is captured by adding a multiplicative term in the standard CAPM with the following specification:

$$\tilde{r}_{i,t} = \emptyset_i + \beta_i^1 . \tilde{r}m, t + \beta_i^2 . \left[\tilde{r}_{m,t} * TI_t\right] + \tilde{\varepsilon}_{it}, \quad (1)$$

where $\tilde{r}_{i,t}$ is the t^{th} industry return and $\tilde{r}_{m,t}$ is the market return at time t. TI represents the terrorism intensity. The coefficients β_i^1 and β_i^2 represent industry's systematic risk and sensitivity of industry's systematic risk to terrorism, respectively. The coefficient $\emptyset_i$ is the intercept term where (E(ϕ_i) = 0), and $\tilde{\varepsilon}_{it}$ is the error term assumed to be normally distributed. Next, the CAPM equation is re-specified through an additive terrorism term to measure the impact of terrorism on industry returns. Notably, the specification of the CAPM with both additive and multiplicative terms results in a near sigular term (Ramiah *et al.*, 2010) and hence the resulting equation takes the following from:

$$\tilde{r}_{i,t} = \varphi_i + \alpha_i^1 . \tilde{r}_{m,t} + \alpha_i^2 . TI_t + \tilde{\varepsilon}_{it} \quad (2)$$

The heterogeneous market hypothesis proposed by Müller *et al.* (1997) suggests that market participants may influence the market prices in different ways and therefore is in line with the notion that the market participants can have different beliefs, expectations and risk profiles. Subsequently, the short and long-run expectations may differ when faced with the terrorist activities. In this regard, estimation of risk-return nexus on an arbitrary scale may provide inappropriate statistical estimates. Yamada (2005) suggested that a time series can be decomposed into mutually orthogonal different periodicity series through multi-resolution method of wavelets proposed by Gençay *et al.* (2005). The time series transformation based on the time domain into scale (interval) domain can help to understand the different frequencies at which the activity in the time occurs. The transformed series is represented by the following linear combination of wavelet functions:

$$r(t) = \sum_k s_{J,k}\phi_{J,k}(t) + \sum_k d_{J,k}\psi_{J,k}(t) + \sum_k d_{J-1,k}\psi_{J-1,k}(t) + \ldots\ldots \sum_k d_{1,k}\psi_{1,k}(t) \quad (3)$$

where J indicates the number of scale crystals (frequencies) and k shows the number of coefficients; $\phi_{J,k}$ and $\psi_{J,k}$ are father and mother orthogonal wavelet pairs, respectively, and can be shown as follows:

$$\phi_{j,k}(t) = 2^{-j/2}\phi\left(\frac{t - 2^j k}{2^j}\right) \quad \text{for} \quad \text{j} = 1 \ldots . \text{ J} \quad (4)$$

$$\psi_{j,k}(t) = 2^{-j/2}\psi\left(\frac{t - 2^j k}{2^j}\right) \quad \text{for} \quad \text{j} = 1 \ldots . \text{ J} \quad (5)$$

The father wavelet $\phi_{j,k}(t)$ decomposed series indicates a low frequency or smoothed component of the original series and the mother wavelet $\psi_{j,k}(t)$ shows a high frequency or rough components. We decompose the market returns (r_m) into mutually exclusive short-term (r_m^s) and long-term (r_m^l) components using the MODWT function. The choice of using MODWT over conventional orthogonal discrete wavelet transform is because

the former has more desirable attributes with respect to economic applications. That is, MODWT:

- overcomes the restriction that input data must be in powers of two;
- is a transformation invariant, that is, a shift in the time series results in an equivalent shift in the transformation;
- has an increased resolution at lower scales as it oversamples the data[5]; and
- can be applied irrespective of the choice of a particular wavelet filter.

However, we use the orthogonal Haar wavelet transformation function to obtain a multi-scale decomposition (Masih *et al.*, 2010). The Level 2 smooth and rough wavelets are used in line with Yamada (2005) as long- and short-periodicity series, respectively. As a result, the two ordinary least square models for basic and decomposed CAPM can be written as follows:

$$r_{i,t} = \alpha_i + \beta_m . r_{m,t} + \varepsilon_i \tag{6}$$

$$r_{i,t} = \alpha_i + \beta_s . r_m^s + \beta_l . r_m^l + \varepsilon_i \tag{7}$$

In equation (7), β_s and β_l indicate the short- and long-term sensitivities of industry returns to the market. Hence, the impact of terrorism over the short and long term can be captured through the following specification:

$$r_{i,t} = \delta_0 + \delta_1 . r_m^s + \delta_2 . r_m^l + \delta_3 . \left[r_m^s * TI_t\right] + \delta_4 . [r_m^l * TI_t] + \xi_i \tag{8}$$

where δ_3 and δ_4 represent the short and long-term sensitivity of industry returns to terrorism. The KSE 100 index original returns and the associated decomposed (short and long periodicity) series are shown in Figures 3, 4 and 5, respectively. In Figure 4, we plot short-periodicity series (two-four days-time horizon) denoted by r_m^s, and in Figure 5, we plot the long-periodicity series denoted by r_m^l.

4. Analysis and results

We carry out the analysis of terrorism impact on 12 industries. We test the hypothesis that terrorist activities influence the systematic risk of industries returns using equation (1). The results of the multiplicative regression analysis are reported in Table II, Columns 2 to 5, respectively. The increase (decrease) in the systematic risk is identified by the positive (negative) coefficient of the multiplicative dummy variable (β_i^2). A significant change in the

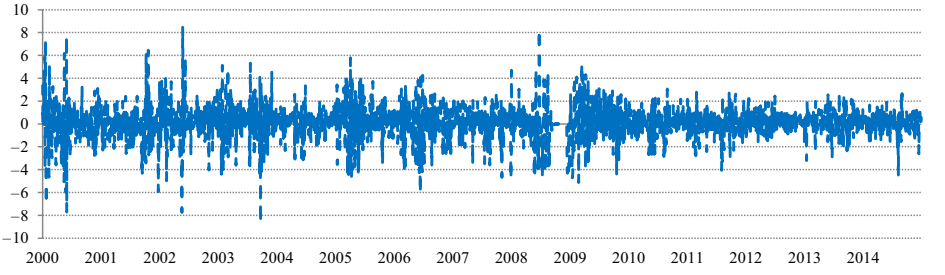

Figure 3.
KSE 100 Index returns

systematic risk of the industry is implied by the coefficient of the multiplicative variable that is statistically different from zero.

The sign of the coefficient (β_i^2) is positive and statistically significant (at the 1-10 per cent convention levels) for 9 out of 12 industries. The *p*-values within the conventional levels indicate that the systematic risk in response to terrorism acts is statistically increased in seven industries (banks, basic materials, construction materials, consumer services, financials, minerals and textile). We note that systematic risk declined for consumer goods and oil and gas industries. For example, the conventional systematic risk of Banks is 1.0144, and it increased by 0.0128 when the terrorism phenomenon is incorporated in the equation. The magnitude of increase (decrease) in systematic risk in response to the terrorist activities is noted to be different and varies across industries (Ramiah *et al.*, 2010; Drakos 2004)[6].

Next, we examine the impact of terrorism on the returns of the industries using an additive term as specified in equation (2). The regression results are reported in Table II, Columns 6 to 9. The negative sign of coefficient (α_i^2) indicates a decrease of industrial returns in response to terrorism activities. The results show a decrease in returns of Banks and Financials industry (2 out of 12 industries) by –0.0029 and –0.0026 percentage points, respectively.

Additionally, we estimated the conventional beta [using equation (6)] and short- and the long-periodicity components [using equation (7)] of stock market returns. The regression results are reported in Table III. We report the estimated coefficient of the conventional beta (β_m), the short-periodicity (β_s) and the long-periodicity (β_l) in Table III, Columns 3, 6 and 7, respectively. The results of *F*-test with the null hypothesis H_0: $\beta_s = \beta_l$ are tabulated in the last column of Table III. The results indicate that the conventional beta coefficients are between the wavelet based decomposed short- and long-term beta estimates and are approximately the average of both. The F-test results reject the null hypothesis H_0: $\beta_s = \beta_l$ for all industries at 1 per cent levels of significance. This implies that the returns of these

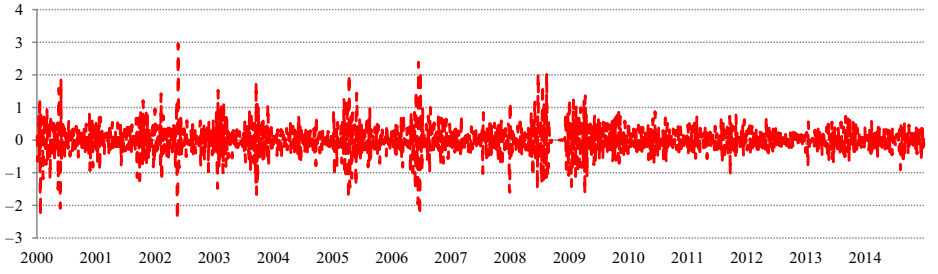

Figure 4.
Short-periodicity series (r_m^s)

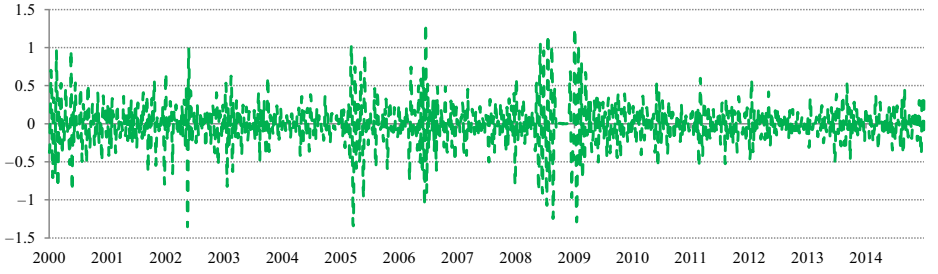

Figure 5.
Long-periodicity series (r_m^l)

Table II.
The Impact of terrorism activities on Pakistan industry indices

Equation	$\tilde{r}_{i,t} = \emptyset_i + \beta_i^1 \,.\, \tilde{r}_{m,t} + \beta_i^2 .[\tilde{r}_{m,t} * TI_t] + \tilde{\varepsilon}_{it}$				$\tilde{r}_{i,t} = \varphi_i + \alpha_i^1 \,.\, \tilde{r}_{m,t} + \alpha_i^2 .TI_t + \tilde{\varepsilon}_{it}$			
Industries	$\emptyset_i$	β_i^1	β_i^2	$\overline{R}^2$	φ_i	α_i^1	α_i^2	$\overline{R}^2$
Banks	−0.0028 (0.0151)	1.0144*** (0.0123)	0.0128*** (0.0027)	0.7015	0.0093 (0.0180)	1.0416*** (0.0109)	−0.0029** (0.0027)	0.6999
Basic materials	−0.0193 (0.0129)	0.9235*** (0.0105)	0.0072*** (0.0023)	0.7238	−0.0303** (0.0153)	0.9386*** (0.0092)	0.0033 (0.0023)	0.7233
Chemicals	−0.0246 (0.0148)	0.9238*** (0.0120)	0.0022 (0.0027)	0.6590	−0.0296 (0.0177)	0.9286*** (0.0106)	0.0015 (0.0026)	0.6589
Construction materials	−0.0094 (0.0251)	1.0709*** (0.0204)	0.0090** (0.0045)	0.4826	−0.0324 (0.0299)	1.0899*** (0.0180)	0.0068 (0.0045)	0.4823
Consumer goods	−0.0063 (0.0170)	0.8388*** (0.0138)	−0.0033** (0.0030)	0.5421	−0.0209 (0.0202)	0.8317*** (0.0122)	0.0122 (0.0030)	0.5422
Consumer services	−0.0343* (0.0206)	0.9546*** (0.0167)	0.0088** (0.0037)	0.5255	−0.0453* (0.0245)	0.9732*** (0.0148)	0.0034 (0.0037)	0.5249
Financials	0.0018 (0.0166)	0.9254*** (0.0135)	0.0220* (0.0030)	0.6307	0.0145 (0.0199)	0.9718*** (0.0120)	−0.0026* (0.0030)	0.6257
Industrials	−0.0253 (0.0054)	1.0052*** (0.0044)	0.0014 (0.0009)	0.9449	−0.0270*** (0.0064)	1.0082*** (0.0038)	0.0005 (0.0009)	0.9448
Minerals	−0.0089 (0.0246)	1.0577*** (0.0200)	0.0082* (0.0044)	0.4863	−0.0297 (0.0292)	1.0748*** (0.0176)	0.0061 (0.0044)	0.4861
Oil and gas	−0.0253 (0.0130)	1.1092*** (0.0105)	−0.0020** (0.0023)	0.7812	−0.0221 (0.0154)	1.1050*** (0.0093)	−0.0009 (0.0023)	0.7812
Textile	−0.0346 (0.0210)	0.9661*** (0.0171)	0.0077** (0.0038)	0.5197	−0.0465* (0.0250)	0.9823*** (0.0151)	0.0036 (0.0038)	0.5193
Utilities	−0.0620** (0.0286)	0.9849*** (0.0232)	0.0002 (0.0052)	0.3706	−0.0856 (0.0340)	0.9852*** (0.0205)	0.0066 (0.0051)	0.3708

Notes: The numbers in parenthesis are standard errors; ***, ** and * indicate significance at 1%, 5% and 10% level, respectively

Table III.
Results of conventional and wavelet-based beta estimates

Equation	$r_{i,t} = \alpha_i + \beta_m . r_{m,t} + \varepsilon_i$			$r_{i,t} = \alpha_i + \beta_s . r_m^s + \beta_l . r_m^l + \varepsilon_i$				
Industries	α_i	β_m	$\overline{R}^2$	γ_i	β_s	β_l	$\overline{R}^2$	F-test
Banks	−0.0009 (0.0151)	1.0415*** (0.0109)	0.6999	0.0824 (0.0251)	0.4491*** (0.0770)	2.3250*** (0.1186)	0.5728	115.47$^+$ [0.0000]
Basic materials	−0.0182 (0.0129)	0.9386*** (0.0092)	0.7232	0.0568 (0.0223)	0.6302*** (0.0683)	1.7585*** (0.1053)	0.6704	52.990$^+$ [0.0000]
Chemicals	−0.0242 (0.0148)	0.9286*** (0.0106)	0.6590	0.0500 (0.0234)	0.6469*** (0.0716)	1.6744*** (0.1103)	0.6511	39.990$^+$ [0.0000]
Construction materials	−0.0081 (0.0251)	1.0900*** (0.0180)	0.4822	0.0791 (0.0328)	0.7681*** (0.1003)	2.0337*** (0.1545)	0.4165	30.960$^+$ [0.0000]
Consumer goods	−0.0068 (0.0170)	0.8318*** (0.0122)	0.5421	0.0597* (0.0234)	0.4084*** (0.0717)	1.7492*** (0.1105)	0.5280	67.950$^+$ [0.0000]
Consumer services	−0.0330 (0.0206)	0.9733*** (0.0148)	0.5249	0.0448 (0.0278)	0.5060*** (0.0853)	2.0560*** (0.1313)	0.4280	64.240$^+$ [0.0000]
Financials	0.0051 (0.0167)	0.9718*** (0.0120)	0.6258	0.0829*** (0.0250)	0.3700*** (0.0765)	2.2708*** (0.1179)	0.5599	119.90$^+$ [0.0000]
Industrials	−0.0251*** (0.0054)	1.0082*** (0.0038)	0.9449	0.0555*** (0.0205)	0.5200*** (0.0628)	1.9901*** (0.0967)	0.9072	106.59$^+$ [0.0000]
Minerals	−0.0077 (0.0246)	1.0749*** (0.0176)	0.4860	0.0083* (0.0322)	0.7527*** (0.0985)	1.9928*** (0.1518)	0.4159	30.780$^+$ [0.0000]
Oil and gas	−0.0256** (0.0130)	1.1050*** (0.0093)	0.7812	0.0628** (0.0255)	0.5271*** (0.0782)	2.0783*** (0.1204)	0.6532	76.490$^+$ [0.0000]
Textile	−0.0334 (0.0210)	0.9824*** (0.0151)	0.5193	0.0452 (0.0283)	0.5247*** (0.0865)	2.0725*** (0.1333)	0.4280	62.200$^+$ [0.0000]
Utilities	−0.0619** (0.0285)	0.9854*** (0.0205)	0.3707	0.0169 (0.0343)	0.8488*** (0.1050)	1.6219*** (0.1617)	0.2894	10.550$^+$ [0.0012]

Notes: The numbers in parenthesis are standard errors; the number in [] are the *p*-values; ***, ** and * indicate significance at 1%, 5% and 10% level, respectively, and + indicate rejection of null hypothesis H_0: $\beta_s = \beta_l$

industries have different degree of impact in the short-run relative to the long-run. For all industries, we noted that $\beta_s < \beta_l$ which implies that these returns have low systematic risk in the short-run relative to the long-run. These empirical findings suggest that although conventional beta estimates are useful in most cases, the wavelet-based beta estimates provide a useful understanding of the sensitivity of industry returns to the market index over the short- and long-time horizon. The overall findings are consistent with the initial work of Yamada (2005).

Finally, we analysed the impact of terrorism activities on the short- and long-term sensitivities of the industry returns using equation (8). The estimated coefficients for the short-periodicity (δ_3) and the long-periodicity (δ_4) multiplicative variables are presented in Table IV, Columns 5 and 6, respectively. The results show a significant impact of terrorism activities on the short-term sensitivity of banks ($\delta_3 = 0.0051$), basic materials ($\delta_3 = 0.0062$), construction materials ($\delta_3 = 0.0018$), consumer goods ($\delta_3 = 0.0056$), consumer services ($\delta_3 = 0.0144$), financials ($\delta_3 = 0.0010$) and oil and gas ($\delta_3 = 0.0040$) industries. The effect of terrorism on the short-term sensitivity of industries and the overall market can also indicate future expected returns, which are higher than implied by the CAPM. On the other hand, we note that only the minerals ($\delta_4 = 0.0170$) industry is affected by the terrorism over the long term. Finally, the increase in systematic risk resulting due to terrorism activities mainly occurs over short-term (two-four days) horizon.

5. Conclusion

In this paper, we provide empirical evidence of the impact of terrorism on different industries in Pakistan. A multiplicative (additive) term is introduced in the standard CAPM to examine the change in systematic risk (industry returns) due to terrorism. We use daily data of 12 industry indices from 1 January 2000 to 31 December 2014. The multiscale beta approach (Yamada, 2005) and the MODWT is adopted to test the heterogeneous market hypothesis. The findings reveal that terrorist activities negatively affect the banking and financial sector equity returns. The increase in terrorism activities increases the systematic risk of all major industries of Pakistan equity market and in terms of magnitude, we note that the Banks and Financials (financial sector in general) exhibit a relatively higher systematic risk.

Based on empirical analysis it can be safely concluded that industries in Pakistan are affected differently by terrorism activities. Further, industries such as the banks and financials (financial sector) have a clear negative impact of terrorism activities on the returns. The decrease in the returns and the significant impact on the systematic risk of financial institutions due to increased terrorism attacks reflect the uncertainty and fear generated by these attacks. It can be argued that uncertainty generated by terrorism not only shifts the investments from risky to less risky sectors but also reduces the incentive to spending relative to saving (Barry Johnston and Nedelescu, 2006). Further, we conclude that systematic risk does not always increase due to an increase of terrorism activities and that the magnitude of the impact is significantly different across the industries. To what extent the impact of terrorism affects a particular industry or chains of industries largely depend on the operational nature of an industry. Moreover, the adverse impacts of terrorism on the financial sector also impresses the need for greater political efforts in resolving terrorism issues and finding ways to insure the vulnerable industries, strengthening free market operations and financial sector development (Marlett *et al.*, 2003; Eldor and Melnick, 2004; Arin *et al.*, 2008). Further, because the impacts of terrorism differ across industries which tend to have significant influence on the investment decisions and choices, it becomes a

Table IV.
The Short and long-term impact of terrorism activities on Pakistan industry indices

Equation $r_{i,t} = \delta_0 + \delta_1 . r_m^s + \delta_2 . r_m^l + \delta_3 . [r_m^s * TI_t] + \delta_4 . [r_m^l * TI_t] + \xi_i$						
Industries	δ_0	δ_1	δ_2	δ_3	δ_4	$\overline{R}^2$
Banks	0.0827* (0.0252)	0.4600*** (0.0876)	2.3177*** (0.1412)	0.0051** (0.0193)	0.0032 (0.0275)	0.5724
Basic materials	0.0563* (0.0223)	0.6181*** (0.0778)	1.7490*** (0.1253)	0.0062* (0.0171)	0.0022 (0.0244)	0.6701
Chemicals	0.0495 (0.0234)	0.6304*** (0.0816)	1.6771*** (0.1314)	0.0080 (0.0179)	−0.0020 (0.0256)	0.6508
Construction materials	0.0796* (0.0328)	0.7864*** (0.1142)	2.0276*** (0.1839)	0.0018* (0.0251)	0.0033 (0.0358)	0.4161
Consumer goods	0.0610*** (0.0234)	0.3865*** (0.0816)	1.9287*** (0.1314)	0.0056* (0.0179)	−0.0614 (0.0256)	0.5293
Consumer services	0.0446 (0.0279)	0.4723*** (0.0971)	2.1301*** (0.1564)	0.0144** (0.0214)	−0.0271 (0.0305)	0.5277
Financials	0.0828 (0.0250)	0.3736*** (0.0872)	2.2445*** (0.1404)	0.0010* (0.0192)	0.0090 (0.0273)	0.5595
Industrials	0.0562** (0.0205)	0.5326*** (0.0715)	2.0167*** (0.1151)	0.0019 (0.0157)	−0.0080 (0.0224)	0.8069
Minerals	0.0790** (0.0322)	0.7757*** (0.1122)	1.9924*** (0.1807)	0.0016 (0.0247)	0.0170* (0.0352)	0.4155
Oil and gas	0.0633* (0.0256)	0.5141*** (0.0890)	2.1588*** (0.1434)	0.0040* (0.0196)	−0.0278 (0.0279)	0.7531
Textile	0.0450 (0.0283)	0.4932*** (0.0985)	2.1477*** (0.1587)	0.0133 (0.0217)	−0.0273 (0.0309)	0.5277
Utilities	0.0149 (0.0343)	0.8399*** (0.1195)	1.4669*** (0.1924)	0.0087 (0.0263)	0.0511 (0.0375)	0.2899

Notes: The numbers in parenthesis are standard errors; ***, ** and * indicate significance at 1%, 5% and 10% level, respectively

challenging task to accurately model the terrorism risk. However, one must note that in countries like Pakistan where terrorism activities are not a one-off event but a characteristic phenomenon, investment decisions must be made with a focus to the existing and obvious risks which include the risks from terrorism. Future studies may consider the possibilities of examining the impact of terrorism using higher digit firm level data and split sample analysis[7].

Notes

1. We use the definition of terrorism proposed by (Enders and Sandler, 2006, 4), in that terrorism "is the premeditated use or threat to use violence by individuals or subnational groups to obtain political or social objective through the intimidation of a large audience beyond that of the immediate victims".
2. Excluding the banks, the financials include insurance, pension funds, hedge funds, investment companies and both banks and financials make-up entire the financial sector of the economy.
3. The industry breakdown closely follows the industry classification benchmark (ICB) developed by Dow Jones and FTSE, which is the most widely used global standard for company classification.
4. http://thomsonreuters.com/content/dam/openweb/documents/pdf/tr-com-financial/methodology/global-equity-index-methodology-oct-2015.pdf
5. This means that more information is captured at each scale which is not affected by the arrival of new information.
6. (Ramiah *et al*, 2010) argue that terrorist attacks do not always lead to an increase in systematic (risk and Drakos, 2004) finds that systematic risk of a major Australian airline company remained unchanged aftermath of the September 11 terror attack. Similar findings are reported by (Chan and Wei, 1996).
7. We thank an anonymous reviewer for highlighting this point.

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