

R&D Investment, Terrorism and Firm Market Performance

Muhammad Usman

School of Finance, Zhongnan University of Economics and Law, Wuhan, P.R.China

Ammar Abid

Department of Management Sciences, CIIT, Lahore, Pakistan

Muhammad Shaique

School of Finance, Zhongnan University of Economics and Law, Wuhan, P.R.China

Sarfaraz Ahmed Shaikh¹

Faculty of Management Sciences, Khadim Ali Shah Bukhari Institute of Technology, Karachi, Pakistan

Abstract

Pakistan is facing a menace in the form of terrorism which has an adverse impact on both the social and corporate environment. This paper examines the impact of R&D investment on firm market performance in the non-financial sector of Pakistan from the year 2006 to 2012. We also consider the moderating role of terrorism on the relationship between R&D investment and firm market performance. After controlling for firm size, leverage and age, we found that R&D investment has a positive and statistically significant impact on firm market performance. Contrary to Ehie & Olibe (2010), we found a negative moderating impact of terrorism on the relationship between R&D investment and firm market performance.

Keywords: R&D, Firm Market Performance, Terrorism, Partial Moderation, Pakistan.

Introduction

Research and development (R&D) is an investment in a company's future. R&D activity conducted by a firm leads to the development of new products and an improvement in existing products and procedures (Teece & Pisano, 1994; Wang et al., 2013). The importance of R&D investment is evident from the fact that such investments in some high-tech firms are more than their earnings (Andi et al., 2011). It is widely believed that innovative firms gain a competitive advantage through innovation and R&D. As a result, firms attain a larger market share and higher profits. In other words, through successful R&D projects, firms can achieve their business objectives in the form of profitability and market performance (Xu &

¹Corresponding author: Sarfaraz Ahmed Shaikh; Email: sarfaraz.ahmed@kasbit.edu.pk

Zhang, 2004).

Investment in R&D is not only important for establishing a competitive advantage but also effective for improving firm market performance (Ehie & Olibe, 2010). Research and development helps a firm to learn modern technologies, improve its workforce and acquire relevant knowledge. R&D will also help a firm in achieving and sustaining a strong market position and economic well-being (Winter, 2003). In general, R&D activities involve long term investments with a long payback period (Hud & Hussinger, 2015). Decisions related to R&D investment may influence market value, growth and competitiveness (Morbey, 1988). Maximizing shareholder wealth is the core objective of every firm. Both market capitalization and stock prices are as important as profitability and revenues (Başgoze & Sayin, 2013).

Prior research indicates that major destructive events such as earthquakes, tsunamis, disease outbreaks, catastrophes and terrorist attacks have a negative influence on R&D investment as well as firm market value (Ehie & Olibe, 2010). Such events have adverse effects on capital markets in the short term, medium term and long term. Destructive events create a panic in the market in the short term and make investors apprehensive of the medium term. In the long term, investors re-assess their risks associated with capital markets (Suleman, 2012). After terrorist attacks on the World Trade Center on 9th September 2001, the United States retaliated against terrorists especially in Afghanistan. Pakistan is a major ally of the United States in the war against terror since 2001. As a result of this cooperation, the number of terrorist attacks in Pakistan have increased significantly.

Terrorist attacks have adversely affected the Pakistani economy. The total foreign direct investment had decreased from 1.4 billion dollars to 910.20 million dollars in 2008-09. The poverty level had increased from 37.5% to 41.4% in the same period. In addition, the stock market in Pakistan had also experienced increased volatility in the aftermath of the terrorist attacks (Suleman, 2012).

The paper has examined the relationship between R&D investment and firm market performance in Pakistan. In addition, terrorism was considered as a moderating variable. The sample includes financial data of firms listed on the Karachi Stock Exchange between 2006 and 2012. Pakistan is a developing country and its contribution towards innovation is nominal as compared to other developing countries such as Bangladesh, Sri Lanka, Thailand and Indonesia. According to the World Bank, Pakistan allocates only 0.29% of GDP on R&D activities which is quite low as compared to its regional partners (World Bank, 2013).

The impact of R&D investment on firm market performance has been widely explored.

Most of the studies are conducted on developed countries, e.g. US, UK, Germany, France, Italy, Japan, Canada, Spain and Sweden (Andi et al., 2011; Lewis & Bohumir, 1993; Sung & Dongnyoung, 2003). However, few studies have been conducted on developing countries e.g. India, Malaysia, Bangladesh, etc (Aimen & Waseem, 2014; Kumar et al., 2012). Previous studies have documented a positive relationship between R&D investment and firm market performance in both developed and developing economies. However, these studies have not examined the moderating role of terrorism on the relationship between R&D investment and firm market performance.

Perhaps, Ehie & Olibe (2010) is the only available study which has considered the impact of a terrorist attack on the relationship between R&D and firm market performance. The study has used a panel data approach to evaluate the impact of R&D investment on firm market performance. Moreover, we also examined the moderating role of terrorist incidents in Pakistan on the above mentioned relationship. After controlling for firm specific characteristics (size, age and leverage), the results exhibit a positive relationship between R&D investment and firm market performance. However, terrorist attacks in Pakistan have a partial moderating impact on the relationship. This study contributes to the existing literature by examining the impact of R&D investment on firm market performance and the moderating role of terrorism in Pakistan on the relationship. The results have several policy implications. For example, there is a need to control terrorism and invest in research and development activities.

The study is structured as follows. The next section presents the literature review on R&D investment, firm market performance and terrorism. This is followed by the hypotheses development, methodology, results and discussion. Finally, the conclusion is presented.

Literature Review

Investment in research and development is essential for promoting innovation and firm market performance. Lewis and Bohumir (1993) found a significant positive relationship between firms' R&D spending and market value. The results suggest that investment in R&D by a firm is a rational allocation of resources. Sung and Dongnyoung (2003) examined the relationship between R&D investment and market value of firms in the US, Germany and Japan. After controlling for cash flow, growth and risk, a positive and significant relationship was found between R&D investment and market value of firms in all three countries. R&D is crucial for the profitability and competitive advantage of a business (Wang et al., 2013). Gu (2015) conducted a research on product market competition, R&D investment and stock return from 1963 to 2013. The results indicate that in competitive industries, firms with high R&D investment get higher expected market value (market return) as compared to firms with low R&D investment.

Investment in R&D and physical assets are important for the market value of an entity. Chojnacki and Kijek (2014) investigated the impact of R&D investment (intangible asset) and capital investment (tangible asset) on market performance of 52 European biotech firms. The results indicate a positive and significant impact of both types of investments (R&D and capital) on firm market performance. The literature also provides evidence that R&D investment has a diminishing marginal return. Kumar et al., (2012) evaluated R&D intensity and market valuation among 326 firms listed on the Bombay Stock Exchange for the period of 2001 to 2010. They found a positive and significant relationship between R&D intensity and firm market value until an optimum point. Beyond the optimum point, additional R&D investment reduces the market value of a firm. Pantagakis et al., (2012) also found a positive relationship between R&D expenses and firm market value.

The stock return and market capitalization of a firm largely depends upon investor expectations towards future returns. Frolov and Lebedev (2007) studied firm market performance as an indicator of expected R&D investment. They worked on a dataset consisting of 2156 publicly traded firms in France, Germany, Italy, UK and USA for the period from 1989 to 1998. The study found a significant and positive relationship between market based performance and R&D investment in the above mentioned countries. Sara et al., (2012) also investigated the association between R&D and firm market value amongst Australian listed firms. Andi et al., (2011) conducted a study on a large data set consisting of thirteen European countries from 1999 to 2010. After using regression analysis, the study found that firms which invest more in R&D activities have a higher stock return and market value. Ismail (2013) also reported similar results among US firms.

Stokey (1991) examined the empirical relationship between market share, market value and innovation. Using 3551 firm-year observations from 340 manufacturing enterprises listed on the London Stock Exchange, they found a positive effect of innovation on the market value of firms with a higher market share. Liu and Lin (2005) elaborated the effect of R&D on corporate financial performance. The study considered revenue, equity, ROA, ROE and net income as financial performance indicators. It used data for 103 firms and found positive and significant results. Başgoze and Sayin (2013) investigated the effect of R&D expenditure on firm value of 40 firms which are listed on the Istanbul Stock Exchange from 2006 to 2010. The study found a significant relationship between firm value and R&D expenditure. In general, high-tech firms are more R&D intensive and also have higher stock return volatility. Sami et al., (2013) test the hypothesis whether increase in stock volatility is due to an increase in R&D investment. The study found a positive and significant relationship between stock volatility and R&D intensity in 162 French high-tech firms from 2002 to 2011 by controlling for firm size and financial leverage.

The pace of new product development and short product life cycle are the two main characteristics of high-tech firms. R&D efforts are a driving force for achieving these characteristics. Andi et al., (2011) studied the impact of R&D expenditure and residual income on firm market value. They found a significant positive influence of R&D expenditure and operating income on firm market value. More specifically, small firms working in a high-tech environment have more influence of R&D expenditure on market value as compared to large firms working in a low-tech environment. Wang et al., (2013) performed an empirical study for the period 2003 to 2007 on 65 high-tech firms listed on the Taiwan Stock Exchange. The study verified the relationship between R&D, firm market value and production activities. It found that R&D and production activities are the main determinants of the performance of high-tech firms.

Disruptive events like floods, earthquakes and terrorist activities have a negative impact on the financial and non-financial performance of firms. Terrorist attacks in New York, Madrid and London had an adverse impact on the stock market, investors and corporations. Ehie & Olibe (2010) investigated the impact of R&D investment on firm performance in 26,499 US firms. They found a positive relationship between R&D and firm performance. The study also explored the impact of the 9/11 terrorist attack on firm performance. Chesney et al., (2011) investigated the impact of terrorist activities in 25 countries over a period of 11 years. They found a negative impact of terrorist incidents on stock markets.

Gulley and Sultan (2009) examined the impact of terrorist attacks on stock and bond markets in a group of developed countries from 1968 to 2005. The study was based on developed countries which included the US, UK, Germany, Italy, Canada, Australia, France and Japan. The results suggest that a greater number of terrorist activities have a negative effect on stock returns, while bond markets generate a lower yield in such incidents. Onodera (2008) has examined the crowding out effect of terrorism. As a result of the crowding out effect, the private sector R&D investment substantially shifted toward the public sector (national defense and security) which ultimately decreased the rate of innovation in the economy.

Subsequent to the 9/11 terrorist incident, there has been a massive increase in the number of terrorist activities all over the world. Pakistan due to its geographical location and role in the war on terror faces continuing unrest. This has adversely affected its social, economic and political structure. Gul et al., (2010) examined the impact of terrorist activities on financial markets. They found that terrorist incidents had an adverse impact on the financial markets in Pakistan. Suleman (2012) investigated the impact of terrorist attacks in Pakistan on stock market performance during the period 2002 to 2009. The study found a negative impact of terrorist attacks on the stock returns of listed companies. Sara

et al., (2012) suggest that firms tend to decrease their R&D investments due to economic conditions. Terrorist incidents have a negative impact on market competition, profit, revenue and financial markets. Sandu and Ciocanel (2014) found that terrorist attacks had a negative impact on the economic growth of Pakistan.

Hypothesis Development

R&D investment and Firm Market Performance

R&D investment is an essential determinant of a firm's competitive advantage and profitability. Firms that invest in R&D are usually cost-effective and successful. In addition, firms with high R&D investment face greater risk and uncertainty. R&D investment may also result in higher return and monopolistic power. R&D promotes differentiation in products and services which has a positive effect on a firm's intangible assets. Innovative and competitive firms attract investors and tend to have high stock prices and market capitalization.

R&D investment makes the production process more efficient and effective. It also has a positive effect on revenue and market positioning. R&D intensive firms compete on the basis of product or process innovation. This allows them to substantially increase their earnings and sales while retaining customers and attracting new ones.

R&D also enables firms to innovate on a large scale and generate high market returns (Başgoze & Sayin, 2013). Past studies have found a positive impact of R&D investment on firm market performance. Lewis and Bohumir (1993), Sung and Dongnyoung (2003), Ehie & Olibe (2010) and Sami et al., (2013) have examined the impact of R&D investment on market performance of the firm. The studies are based on developed countries which found a positive and significant relationship between R&D investment and firm market performance. Moreover, the studies have argued that R&D intensity is positively related to profitability and stock volatility. The above discussion suggests that firm-level R&D encourages firms to innovate and perform efficiently in financial markets. Therefore, we hypothesize that:

H1: R&D investment has a positive impact on firm market performance.

The Moderating Role of Terrorism on the Relationship between R&D Investment and Firm Market Performance

Terrorist attacks and environmental catastrophes adversely affect organizational performance (Chesney et al., 2011). In recent times, terrorist attacks have shifted their focus from the military establishment to civilians and businesses (Chesney et al., 2011). Such events also have an adverse impact on both the national and international economy (Johnston & Nedelescu, 2006). Terrorism has three types of adverse effects on the economy, i.e. in the

short term (direct loss), medium term (confidence loss) and long term (productivity loss). There are also direct and indirect costs associated with terrorist attacks. The direct costs of terrorism include loss to human life, property and infrastructure. The indirect costs of terrorism reduces the confidence of customers and investors in the economy. In addition, it also adversely effects the general asset price level, borrowing cost and risk (Chesney et al., 2011).

Anecdotal evidence suggests that firms tend to reduce their R&D investment subsequent to terrorists' attacks (Ehie & Olibe, 2010). They also advocated that such destructive events have a severe impact on firm competitiveness. Hendricks et al., (2009) and Rice and Caniato (2003) found that stock markets adversely react to terrorist attacks which leads to a decrease in profitability and sales. Terrorist attacks such as 9/11 have greatly influenced economies all over the world. Onodera (2008) examined the impact of terrorism on the world economy and the allocation of resources to R&D. The author suggests that terrorist activities are affecting the US, Europe and Asian countries. If a country fails to address terrorism, it will adversely affect foreign direct investment and diminish firm value. In addition, Ehie & Olibe (2010) found that terrorist attacks have a negative impact on R&D investment and firm performance.

Suleman (2012) investigated the effect of terrorist attacks in Pakistan on stock returns. The study found a negative impact of terrorist attacks on stock returns of KSE 100 index firms. Czarnitzki and Wastyn (2010) reported a negative impact of terrorism on the stock market, sales and profits. Terrorism decreased R&D investment and adversely affected global competition. The Pakistani economy has been severely affected by terrorist attacks. These terrorist attacks have a significant negative effect on market capitalization and stock returns. Thus, we formulated the following hypothesis:

H2: Terrorism moderates the relationship between R&D investment and firm market performance.

Methodology

Data and Sample Selection

The sample includes non-financial firms listed on the Karachi Stock Exchange from 2006 to 2012. The data was collected from the KSE website, annual reports, Osiris Database and the Global Terrorism Database. The firms included in the sample belong to various sectors of the economy i.e., energy, materials, consumer products, health-care, real estate, information technology and telecommunications. The final dataset consists of 1692 firm-year observations.

Measurement of Variables

Dependent variable

The dependent variable of the study is firm market performance which was measured using firm market capitalization deflated by total assets. This measure has been widely used in the previous literature to estimate firm market performance (Lewis and Bohumir 1993; Sung and Dongnyoung, 2003; Ehie & Olibe, 2010). Market capitalization is calculated by multiplying the number of shares outstanding with the stock price. Market capitalization is an indicator of a firm's equity. Aboody et al., (1999) suggests that market capitalization represents investors assessment of a firm's assets and its future investments.

Independent variables

The main independent variable of the study is a dummy variable representing R&D investment. The dummy variable takes a value of 1 if the firm invests in R&D and 0 otherwise (Limanli, 2015; Lin et al., 2010; Majumdar, 2016). Further, to examine the moderating effect of terrorism on the relationship between R&D investment and firm market performance we used the methodology suggested by Hayes (2013). According to this approach, we have constructed two more independent variables i.e., terrorism and an interaction term of terrorism with R&D investment. To measure terrorism, we computed the logarithm of the total number of terrorist incidents in a year.

Control variables

Control variables used in the study include firm size, firm age and firm leverage. We measured firm size as the natural logarithm of a firm's total assets. Prior research suggests that large firms may perform better in the market due to their resources and expertise (Ehie & Olibe, 2010). Firm age was measured as the natural logarithm of the number of years since incorporation (Ehie & Olibe, 2010). In general, the market performance of older firms are better than younger firms due to their large customer base, availability of resources and experience. In addition, firm leverage was measured by dividing total debt with total assets (Kumar et al., 2012; Sami et al., 2013; Vanderpal, 2015).

Table 1: Measurement of Variables

Variable	Symbol	Measurement
Firm Market Performance	FMP	Market value of firms' outstanding shares/ total assets
R&D	RD	Dummy variable equal to 1 if the firm invests in R&D; 0 otherwise
Terrorism	TR	Logarithm of total terrorist incidents in a year
R&D*Terrorism	RD*TR	Interactive term of R&D and terrorism
Firm Size	SIZE	Logarithm of total assets
Firm Age	AGE	Natural logarithm of the number of years since firm incorporation
Firm Leverage	LEV	Ratio of total debt to total assets

Empirical Models

The study has developed two empirical models. Model 1 was used to examine the impact of R&D investment on firm market performance with control variables. In addition, Model 2 examines the moderating effect of terrorism on the relationship between R&D investment and firm market performance. The panel data regression models are as follows:

$$FMP_{it} = \beta_0 + \beta_1 RD_{it} + \beta_2 SIZE_{it} + \beta_3 AGE_{it} + \beta_4 LEV_{it} + u_{it} \text{ (Model 1)}$$

$$FMP_{it} = \beta_0 + \beta_1 RD_{it} + \beta_2 TR_t + \beta_3 RD*TR + \beta_4 SIZE_{it} + \beta_5 AGE_{it} + \beta_6 LEV_{it} + u_{it} \text{ (Model 2)}$$

As discussed above, the moderating effect of terrorism on the relationship between R&D investment and firm performance was based on Hayes (2013). According to this approach, we have introduced an interactive term (RD*TR) in the model. The moderating relationship only exists if the interaction term is significant. The coefficient (β) sign of interaction term describes the positive/negative moderating effect of terrorism. Moreover, the partial and full moderation of terrorism depends on the statistical significance of the terrorism variable.

Empirical Results and Analysis

Table 2 presents the descriptive statistics of the variables. It contains the number of observations, mean, standard deviation, minimum and maximum values of variables. The sample consists of 1692 firm-year observations from 2006 to 2012. The study used a dummy variable for R&D investment taking a value of 1 when a firm invests in R&D and 0 otherwise.

This variable shows a mean value of 0.07447. This suggests that only a small number of firms invest in R&D. Low investment in R&D suggests that firms consider R&D activities as a burden on their cash flows. Firm market performance has an average value of 0.4644.

Table 2: Descriptive Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
FMP	1,692	0.4644	0.85466	0	12.8956
RD	1,692	0.7447	0.26261	0	1
TR	1,692	709.4894	316.9440	144	1248
SIZE	1,692	15.0174	1.6902	9.3270	19.6660
LEV	1,692	0.4996	0.5495	0	5.8041
AGE	1,692	3.3529	0.5978	0	5.0239

Terrorism is also one of the main independent variables of the study. Table 2 shows that an average of 709 terrorist incidents occurred during the period 2006 to 2012. Firm size has an average value of 15.0174 with a minimum value of 9.3270 and a maximum value of 19.6660. Firm Leverage has an average value of 0.4995. Moreover, firm age has a mean value of 3.3529.

Correlation Analysis

Table 3 presents the Pearson correlation coefficients between the variables. Statistically significant results are marked with asterisks. None of the variables suffer from the multicollinearity issue. Moreover, most correlation coefficients are statistically significant.

Table 3: Pearson Correlations Matrix

	FMP	RD	TR	RD*TR	SIZE	LEV	AGE
FMP	1.0000						
RD	0.1194***	1.0000					
TR	-0.1822***	-0.0374	1.0000				
RD*TR	0.1095***	0.9971***	-0.0113	1.0000			
SIZE	0.1070***	0.1196***	-0.0120	0.1197***	1.0000		
LEV	-0.2068***	-0.0869***	0.0394	-0.0843***	-0.1537***	1.0000	
AGE	-0.0409*	0.0836***	0.0415*	0.0819***	0.0227	-0.0797***	1.0000

*FMP=Firm Market Performance; RD=R&D; TR=Terrorist attacks; RD*TR=Interaction term of R&D and Terrorism; SIZE=Firm Size; LEV=Firm Leverage; AGE=Firm age.*

Panel Regression Results

Table 4 presents the panel regression results from estimating model 1. The results suggest that firms that invest in R&D tend to have superior market performance as compared to other firms. This also implies that firms investing in R&D are innovative and attractive for investors. The results support the first hypothesis by suggesting that R&D has a positive effect on firm market performance. The finding is also consistent with the previous literature (Andi et al., 2011; Başgoze & Sayin, 2013; Chojnacki & Kijek, 2014; Frolov & Lebedev, 2007; Lewis & Bohumir, 1993; Sung & Dongnyoung, 2003; Vanderpal, 2015; Wang et al., 2013).

Table 4: Panel Regression Results

	Coefficient	Std.Error	t-value	P-value
RD	0.3289	0.0947	3.47	0.001
Size	0.0378	0.0153	2.48	0.013
Lev	-0.2922	0.0452	-6.46	0.000
Age	-0.1005	0.0438	-2.30	0.022
Constant	0.3270	0.2746	1.19	0.234

Dependent Variable: Firm Market Performance ($R^2= 0.0579$; Adjusted $R^2=0.0548$; $F= 18.75$, $p<0.05$).

Panel Regression Results: The Moderating Effect of Terrorism

Table 5 presents the panel regression results obtained from estimating model 2. The panel regression results suggest that there is negative moderating effect of terrorism. This implies that terrorist incidents in Pakistan reduce the impact of R&D investment on firm market performance. These results are contrary to Ehie & Olibe (2010) who did not find a moderating effect of terrorist attacks (9/11) on the relationship between R&D investment and market performance. The possible reason for contradictory results is that Ehie & Olibe (2010) had examined only one terrorist incident whereas this study has investigated several terrorist incidents. Moreover, Chen and Siems (2004) argue that authorities tend to intervene during crises due to which US stock markets have a greater capability to internalize terrorist incidents.

However, consistent with previous research the study has found that terrorism in Pakistan had an adverse impact on firm market performance (Gul et al., 2010; Suleman, 2012).

Table 5: Panel Regression Results: The Moderating Effect of Terrorism

	Coefficient	Std.Error	t-value	P-value
RD	4.3894	1.2804	3.43	0.001
TR	-0.2279	0.0675	-3.38	0.001
RD*TR	-0.6216	0.1948	-3.19	0.001
Size	0.0355	0.0151	2.35	0.019
Lev	0.0355	0.0447	-6.30	0.000
Age	-0.0971	0.0433	-2.24	0.025
Constant	1.8491	0.5267	3.51	0.000

Dependent Variable: Firm Market Performance

The results reported in Table 5 suggest that the control variables are statistically significant and have an effect on firm market performance. Table 5 shows that firm size has a positive impact on firm market performance. This implies that large firms due to greater resources and skilled labor have better performance. Firm leverage has a negative relationship with firm market performance. This implies that leveraged firms have weaker performance. In addition, firm age has a negative impact on firm market performance. In general, older firms tend to invest less on R&D activities as compared to younger firms. As a result, older firms are less innovative and may have weak performance. These results are also consistent with previous studies (Chen & Siems, 2004; Kumar et al., 2012).

Conclusion

The effect of R&D investment on firm market performance has been investigated in many previous studies. Most studies have reported a positive relationship of R&D investment on firm market performance (Gu, 2015; Sami et al., 2013; Sung & Dongnyoung, 2003). Past studies have also reported a negative effect of destructive events such as hurricane Katrina of 2005, Asian tsunami of 2004, World Trade Center attack of 2001, mad cow disease of 2001, Taiwan earthquake of 1999 etc., on financial markets and firm market performance (Czarnitzki & Wastyn, 2010; Sara et al., 2012). However, the empirical work of Ehie & Olibe (2010) found that R&D investment had a positive impact on firm value in the presence of a major terrorist incident such as 9/11.

This paper has examined the impact of R&D investment on firm market performance. It has also investigated the moderating effect of terrorism on the relationship between R&D investment and firm market performance. Therefore, the study is important in two ways. First, the case of Pakistan has not been extensively explored in previous research. This is mainly because only a few firms are investing in R&D projects. The concept of R&D and

other innovative activities is relatively new in Pakistan as compared to developed countries. Firms in Pakistan still consider R&D investment as a burden on cash flows. Second, Pakistan is engaged in a war against terror since 2001. Due to this war, the economy of Pakistan has suffered. The paper has also examined the moderating effect of terrorist attacks in Pakistan on the relationship between R&D and firm market performance. The results indicate a negative moderating effect of terrorism on the relationship between R&D and firm market performance.

This study has certain limitations. First, the study has used data only for non-financial firms. Second, this study has only focused on terrorist incidents in Pakistan. Future research may examine the relationship between R&D and firm performance. Researchers may also evaluate the moderating effect of other destructive events in a cross-country setting.

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