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Disaster Shocks and Equity Market Behavior: Moderating Role of Asset Tangibility

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Abstract

Natural disasters affect the business activities and consequently investors' sentiments. The objective of the current study is to examine the effect of floods occurred in 2010 and 2022 on stock returns of manufacturing firms. Multiple regression analysis has been used to test the hypotheses. The results provide evidence of positive effect of 2010 flood and negative effect of 2022 flood on stock returns of manufacturing firms. Various factor contributing to these opposite effects have been described. Moreover, asset tangibility moderates the linkage between natural disasters and stock returns. These results emphasize the importance of flood resilient infrastructure. The results of the study provide valuable insights about the investors' behavior during different political and economic conditions and guide the policy makers regarding steps to minimize the effect of disasters on investors' sentiments.

Introduction

Climate change has resulted in a large number of losses and destructions around the world. Natural disasters being major consequence of climate change are causing both direct and indirect losses. Direct loss includes physical damages such as destruction of roads, homes, bridges, deaths and injuries of people, environmental degradation (Montero et al., 2024) damage to crops, livestock, and productive capital, physical and mental health (Botzen et al., 2019).

Indirect effects of disasters include damage to the financial system and economy of the country. According to Coelli & Manasse (2014), in addition to material, human, and environmental detrimental effects, local floods are believe to severely effect the economic structure of the country. Both macroeconomic indicators such as GDP, FDI (Benali, 2022;Neise et al., 2022) as well as microeconomic factors such as demand and supply (Samantha, 2018), household (Bharath & Cho, 2023), and businesses are affected by the disasters. According to Wang et al. (2020), Natural disasters affect the business activities by physically damaging buildings, infrastructure, means of transportation and communication, energy, and psychologically affecting people who suffer from post disaster stress (Wang et al., 2020).

The disruption in operations of the business due to damage of infrastructure, communication channels, and human resource cause decline in firms' revenue and profitability.

Therefore, natural disasters serving as negative news affect the confidence level and sentiments of investors, Investors sentiments refers to the forecasting of investors regarding investment risk and future cash flow (Baker & Wurgler, 2006). Negative sentiments of the investors and reduced investors' confidence again brought on bad performance that further make the business less attractive to the investors (Mackey et al., 2007) causing fall in future stock prices. There is strong evidence in literature that investors sentiment influences the investment decision and eventually linked with fluctuation in future stock prices (Shan & Gong, 2012).

However, the creative destruction hypothesis states the positive effect of disasters on economy because after natural disasters, the financial aids in form of donations and loans and increase in demand for goods and services may cause boost in short-term profit. Therefore, the literature also provides evidence of positive effect of natural disasters on firms' profitability. Examples are Bourdeau-Brien & Kryzanowski (2017) and Pagnottoni et al. (2022).

Due to disagreement in the literature, the study aims to analyze the influence of natural disasters on stock market performance in the context of Pakistan as Pakistan presents a persuasive case for studying this linkage due to its high vulnerability to natural disasters. It is placed at 18 out of 191 nations by 2020 Inform Risk Index. After 1950, Pakistan has faced catastrophic floods every decade that caused infrastructure destruction, interruption in means of livelihood, and a large number of deaths and displacement of people (Yaseen et al., 2023). Moreover, being an agriculture country, economy of the Pakistan is largely dependent on agriculture sector. The irrigation of crops is mainly reliant on Indus River and its tributaries' water. However, due seasonal variations and extreme weathers in the country, the availability of water is not same over the year. There are alternate waves of drought and flood that affect the growth of crops (Zakir-Hassan et al., 2021) which ultimately causes loss to the services and industrial sector of the economy.

The existing literature contains studies on the effect of natural disasters on economic growth. Example are Carrera et al. (2015)**;** Benali (2022)**;** Cavallo et al. (2021)**;** Anwar et al. (2020); Neise et al. (2022). The literature also highlights the impact of natural disasters on financial performance of organizations such as Hendricks et al. (2020); Pan & Qiu (2022); Cainelli et al. (2018); Hsu et al. (2018). However, less attention has been paid to the effect of natural disasters on stock markets (Mishra et al., 2021; Pagnottoni et al., 2022; Sakariyahu et al., 2023; Hussain et al.,2023) specifically on firm level returns (Bourdeau-Brien & Kryzanowski, 2017; Huynh & Xia, 2023). In the context of Pakistan, although the impact of natural disasters has been studied on tourism (mushtaq & sajid, 2018), PSX (javed & faraz, 2023.; najam & mehmood, 2019), economic growth (khan et al., 2023). But the linkage between floods and stock returns of individual firms is not yet explored. Therefore, the study contributes to the literature by investigating the link between floods and stock returns of manufacturing firms. The second contribution is finding the moderating role of intangible assets in the relationship between natural disasters and stock returns. The findings of the study provide valuable information to the investors regarding the stock market behavior during natural disasters. The findings also present information to the corporate managers and policy makers regarding the investors' reaction during natural disaster and role of tangible assets in the effect of natural disasters on stock market performance.

Literature Review

Natural disasters cause loss to the various factors of production. Loss or destruction of machinery and stock of the business cause temporary closure or slowdown of the business. Disruption in transportation, telecommunication and electricity supply compel the firms to hire emergency logistic services to operate the business uninterruptedly. Moreover, after floods, the

waterborne diseases also affect the human resource of the firms (Samantha, 2018). All these factors increase cost and decline revenue of the business.

Existing literature comprises of a handful of studies on the impact of natural disasters on economic growth. See for instance, Lima & Barbosa (2019); Carrera et al. (2015); Benali (2022); Cavallo et al. (2021); Anwar et al. (2020); Neise et al. (2022); Pan & Qiu (2022); Khan et al. (2023). Studies are also available that examine the influence of natural disasters on firms' performance. Such as Pan & Qiu (2022) found negative influence of flood on firms' performance in China. Hendricks et al. (2020) found the negative effect of Great East Japan Earthquake (GEJE) on Japanese and non-Japanese firms' financial performance due to disruption in supply chain. Cainelli et al. (2018) found reduced production, turnover, return on sales, and value added of firms. Hsu et al. (2018) also found the negative effect of earthquake occurred in Italian region of Emilia-Romagna on firms' performance. Conversely, Leiter et al. (2009) found short-term higher assets growth and employment in firms located in the flood region in Europe. Coelli & Manasse (2014) made a comparison in performance of firms in the region of Veneto that are exposed to natural disasters and that are not. Their results indicated that firms that are exposed to natural disaster perform better than others. This favorable effect can be attributed to the financial aid received after disaster.

Another aspect of literature focused on the impact of natural disasters on stock returns. Most of the studies are conducted on developed markets. For instance, Huynh & Xia (2023) found overreaction of investors in U.S. corporate bond and stock markets when firms are exposed to natural disasters causing downfall in the stock and bond prices of current period and rise in future period. Hussain et al. (2023) in their study on the relationship between natural hazards and financial system of 116 countries found negative impact of natural disasters on stock markets. Pagnottoni et al. (2022) studied the effect of various types of disasters (geophysical, climatological, biological, meteorological, and hydrological disasters) on 27 global stock markets and found negative effect of climatological and positive impact of biological disaster and weaker effect of other types of disasters. Moreover, more reaction of stock markets was found for calamities occurring in European countries. Bourdeau-Brien & Kryzanowski (2017) in their study on effect of natural disasters on returns and volatility of US companies' stocks, found that a small percentage of disaster had a significant effect on firms with almost half negatively affected and half positively affected by the natural disasters.

Kowalewski & Śpiewanowski (2020) found significant drop in market value of mining firms after potash mine disasters. Arndt & Buchmann (2018) revealed negative effect of earthquake and hurricanes on stock returns of firms constituents of S&P 500 Index. Worthington (2008) found no significant impact of natural disasters on Australian stock market returns. Seetharam (2017) in their study found lower stock market valuation of exposed firms than non-exposed firms in United State. Lee et al. (2018) studied the spillover effect of natural disasters and financial crises that occurred in overall world on neighboring countries and found most detrimental effect of 2008 Sichuan Earthquake and the financial tsunami due to secondary mortgage fallout in the United States. Luo (2011) found significant negative effect of Japanese earthquake 2011 on Japanese, Hong Kong, U.S., Canada, U.K., German Stock markets. Slothouber (2017) found significant negative abnormal return of firms, industries of U.S. during natural disaster.

Few researchers have given attention to the emerging markets such as Boungou et al. (2025) highlighted negative influence of natural disasters on stock returns of Chinese firms. Zhao et al. (2024) found a positive effect of natural disasters on publicly listed companies in emerging markets such as Philippines, Korea, Thailand, China, and Indonesia. Galido & Khanser (2013)

found no significant effect of natural disasters on Philippine Stock Exchange index (PSEi). Mishra et al. (2021) found negative tendency in abnormal returns after recurring landslides in Uttarakhand region of India and the most significant effect was found in top companies. Sakariyahu et al. (2023) studied the impact of Turkey earthquake on investors' sentiments and stock markets of 21 trading partners of turkey. They found negative impact of earthquake on stock markets of trading partners.

Although, most of the studies in literature review revealed negative association between natural disasters and stock returns. Still, literature is not conclusive as studies are still revealing the positive relationship. Therefore, it can be hypothesized that:

H_{01}: Floods in Pakistan have significant impact on stock returns of manufacturing firms.

Tangible assets are considered to be more vulnerable to disasters (Leiter et al., 2009; Pan & Qiu, 2022). According to Federation of Red Cross and Red Crescent Societies, physical capital and infrastructure are main victim of disasters (IFRC,2020). Fixed assets in a firm cause more financial loss due to natural disaster (Cavallo & Noy, 2011; Hallegatte, 2014) and require more time for recovery (Cavallo & Noy, 2011; Wang et al., 2020) causing significant revenue loss to the organization (Hallegatte, 2014). According to Resource-Based View (RBV), organizations attain the sustainable competitive advantage by employing the inimitable resources and capabilities (Barney, 1991). Thus, flood-resilient tangible assets or intangible assets may act as shield against disasters.

The literature contains evidence of role of physical assets in financial loss due to disasters to the organizations. Pan & Qiu (2022) found negative influence of flood on firms' performance in Chinese firms decrease with increasing the share of intangible assets. Leiter et al. (2009) found that during flood there was less effect on productivity of European firms that have less share of tangible assets. Therefore, it is hypothesized that:

H_{02}: There is moderating role of asset tangibility in the relationship among natural disasters and stock returns of manufacturing companies.

A review of literature provides evidence of link between natural disasters and stock returns. However, most of the studies have focused on developed countries. Developing countries due to lack of financial resources, health facilities, and limited environmental awareness are more prone to the consequences of natural disasters. Despite this fact, less evidence is available on this relationship in developing countries. Pakistan being a developing country has also received less attention of the researchers. Therefore, there it is need of hour to study the influence of natural disasters on stock market returns in the context of Pakistan. The findings will guide the corporate managers and policy makers regarding behavior of investors during the disaster period.

Methodology of the Study

Data Collection and Sampling:

The sample comprised of the manufacturing companies listed on Pakistan Stock Exchange. The criteria for selection sample are; first the company belong to manufacturing sector and is listed on Pakistan Stock Exchange, Second the data for the respective firm is available for the selected sample period. On the basis of this criteria, the sample contains 73 manufacturing companies. The reason for selecting the Punjab province is its major contribution to the agriculture production. Due to heavy rains and floods in monsoon season, a large crops area is affected each year. Second, the major cities of Punjab i.e. Lahore, Faisalabad and Sialkot are hub of manufacturing facilities of industrial sector. The data consist of two samples; As 2010 flood occurred from 28/07/2010 to 07/08/2010, the first sample comprised of data for the period covering 01/01/2009 to 31/12/2011. Similarly, 2022 flood occurred during 14/06/2022 to 14/09/2022, the second sample contains data

for the period 01/01/ 2021 to 31/12/2023. One year before and one year after the disaster year are taken as a reference period. The sources of data are following:

Table 1: Data Sources

Variables	Sources
Monthly returns	Investing.com
Floods	EM-DAT
Firm specific variables	Annual Reports

Variables Definitions:

The variables are operationalized on the basis of existing literature. The operational definitions of variables are described below.

Table 2. Definitions of Variables

Variables	Operational Definitions	References
Stock returns	Continuously compounded daily returns measure as: $$R_{it} = \ln \frac{P_{it}}{P_{it-1}}$$	(Khalid et al., 2021; Venturini, 2022)
Asset tangibility	Fixed assets/total assets	Borisova et al. (2012); Ducassy and Guyot (2017)
Size	Natural logarithm of total assets	Chauhan et al. (2016); Dah (2016); Saini and Singhania (2018)
Leverage	Total debt/total assets	Dah (2016); Pillai and Al-Malkawi (2018);
ROE	Earnings after taxes/total stockholder equity	Bhatt and Bhatt (2017); Minichilli, Brogi and Calabrò (2016)

Model of the Study:

The following model has been developed to analyses the influence of floods on returns of manufacturing industries.

$$R_{i,t} = \theta_1 + \theta_2\, FLOODS + AT + \theta_4 FLOODS*AT_{i,t} + \sum CONTROLS_{i,t} + \varepsilon_{i,t}$$

where $R_{i,t}$ represents monthly returns for the company i at the time t. $FLOODS$ represents the dummy variable having value 1 for the flood period and 0 otherwise. AT represents asset tangibility. $FLOODS*AT_i$ represents the interaction term which measures the moderating role of asset tangibility during flood period. $CONTROLS_{i,t}$ represents control variables that include firm size, firm age, leverage, return on equity. $\varepsilon_{i,t}$ represents error term.

Results

The selected data is analyzed using multiple regression analysis. To address the issue of heteroskedasticity and ensure reliability of results, the robust standard error estimates have been presented. Hausman test is employed for model specification (Arslan & Zaman, 2014; Rashid et al., 2020). Stata 12 is used for data analysis purpose.

Table 3: Descriptive Statistics

Panel A				
Variables	Mean	Std. Dev.	Min	Max
Returns	-.007	.198	-4.961	1.144
Flood	.139	.346	0	1
Firm Size	6.74	.619	5.02	8.219
Firm Age	39.772	22.915	14	150.917
Leverage	54.184	20.534	9.506	131.387
ROE	10.697	70.584	-745.082	427.707
Panel B				
Variables	Mean	Std. Dev.	Min	Max
Returns	-.002	.131	-.658	1.506
Flood	.194	.396	0	1
Firm Size	7.324	.647	5.377	8.991
Firm age	51.609	22.869	26	162.917
Leverage	51.656	19.217	0	151.67
ROE	15.364	37.154	-306.489	260.816

Table 3 shows the descriptive statistics of variables. Panel A comprised of sample 2009 to 2011. The mean value of returns is -0.007 which exhibits the dominance of negative returns during the sample period. Standard deviation is 0.198 which implies that values of returns deviate from mean by 19.8%. The mean value of floods is 0.139 showing that out of panel, 13.9% time period is covered by flood. The mean value of firm age is 39.772. About Asset tangibility, 46.73% assets on average are tangible. The average leverage is 54.184 and average ROE is 10.697%.

Panel B comprised of sample period 2021 to 2023. The mean value of returns is -0.002 exhibiting the dominance of negative returns in the panels. The standard deviation of returns shows 13.1% deviation from mean. 19.4% of time period is covered by the flood. The average age of firms is 51.609. 43.516% assets are tangible on average. The mean value of leverage is 51.656 and ROE is 15.

Table 4: Matrix of correlations

Panel A						
Variables	1	2	3	4	5	6
1) Returns	1					
2) Flood	0.064	1				
3) Firm Size	0.062	0.015	1			

4)	Firm Age	0.013	0.004	0.008	1		
5)	Leverage	-0.005	0.002	-0.044	-0.241	1	
6)	ROE	-0.008	0.011	0.103	-0.032	-0.041	1

Panel B

	Variables	1	2	3	4	5	6
1)	Returns	1					
2)	Flood	-0.079	1				
3)	Firm Size	0.007	0.016	1			
4)	Firm Age	-0.016	0.012	0.052			
5)	Leverage	0.009	0.007	0.022	1	1	
6)	ROE	0.05	-0.012	0.214	-0.141	0.146	1

Table 4 presents correlation matrix of variables. In panel A, floods are positively linked with returns and in panel B, floods are negatively correlated with returns. All coefficients of correlation are less than 0.5 which implies absence of multicollinearity in data.

Table 5: Multiple Regression Analysis

Dependent variable	Returns	Returns
Independent Variables	Panel A	Panel B
Floods	.0256087**	-.0294652***
Flood*At	.0012721	-.0002544**
Asset Tangibility	.000069	-.0003782*
Firm Size	-.0413866	-.0577238
Firm Age	.002428**	.016515***
Leverage	-.0009235	1.21e-06
ROE	-.0000994	.0004381***
Constant	0.440	-.4211463*
Wald Chi Square (p value)	2.58***	5.72***
R-squared	0.60	0.510

Tables 5 presents results of multiple regression analysis. According to findings, 2010 flood is positively linked with returns of manufacturing companies at 5% significant level exhibiting the favorable influence of flood on stock returns of manufacturing firms. The coefficient of Floods is 0.0256 indicating that flood cause 2.5 % increase in returns. Asset tangibility does not significantly moderate the relationship between flood and returns. Firm age is significantly positively associated with the stock returns. All other control variables have no significant effect on returns.

In 2022, flood caused negative variation in returns at 1% significance level which shows adverse effect of 2022 flood on stock returns. The coefficient value is -0.0294 indicating 2.9% decline in returns during the flood period. The moderating role of asset tangibility is also significant at 5% level demonstrating the vulnerability of the firms that have more investment in tangible assets. Firm age and return on equity are positively linked with returns at 1 % level. While the remaining control variables are not significantly affecting the returns.

Table 6: Results of Hausman Test

	Panel A	**Panel B**
Chi Square (p value)	0.3714	0.0026
Suitable Model	Random Effect Model	Fixed Effect Model

Table 6 presents the results of Hausman test applied for model specification. The benchmark for choosing the suitable model is p value of Chi Square test. If p value is greater than 0.05, random effect is appropriate and if it is less than 0.05, fixed effect is suitable. In panel A, the value is 0.3714 i.e. greater than 0.05 which implies that random effect is suitable and for Panel B, the p value is 0.0026 suggesting that fixed effect is appropriate.

Table 7: Variance Inflation Factor (VIF) Analysis

	Panel A		**Panel B**	
Variables	**VIF**	**1/VIF**	**VIF**	**1/VIF**
Floods	1.13	0.888600	1.18	0.847458
Asset Tangibility	1.11	0.899168	1.02	0.980392
Firm Size	1.08	0.924785	1.07	0.934579
Firm Age	1.08	0.924785	1.16	0.862069
Leverage	1.09	0.917431	1.21	0.826446
ROE	1.06	0.999893	1.61	0.621118
Mean VIF	**1.09**		1.21	

Table 7 shows the results of Variance Inflation Factor Analysis applied for checking the multicollinearity. All VIF values are less than benchmark 5 with mean value of 1.09 in Panel A and 1.21 in Panel B. It implies that there is no multicollinearity concern in regression model.

Figure 1: Average Stock Returns during the sample Periods

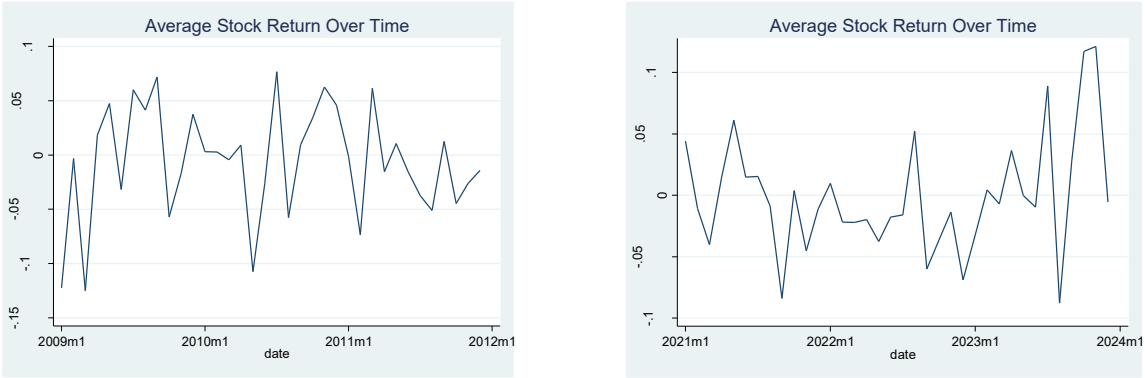

Figure 1 shows the variation of returns during the sample periods. The 2010 flood was occurred between 28/07/2010 and 07/08/2010. The graph is showing upward trend during this period as demonstrated by the regression results. Similarly, 2022 flood was occurred between 14/06/2022 to 14/09/2022 and the trend in this period is downward according to our regression results.

Discussion

The present study has considered the impact of two major floods in the Pakistan on stock returns of firms belonging to manufacturing sector. However, the results indicate opposite effect of two floods. The 2010 flood has a positive effect on stock returns while 2022 flood have a negative effect on stock returns of manufacturing sector. The positive effect of 2010 flood is confirming the results of Leiter et al. (2009); Coelli & Manasse (2014); Brien & Kryzanowski (2017) that provide evidence of favorable effect of natural disasters on stock returns. The positive effect could be attributed to various factors such as in 2010, rural areas in Punjab were affected and big cities may have benefited due to increase in demand of necessities like cloths, food. Economy was relatively in better condition; there was less inflation and more political stability. The results of 2010 flood are in line with the creative destruction hypothesis and confirm H_{01} but reject H_{02}.

Whereas 2022 flood cause negative trend in stock returns of manufacturing companies and there is moderation of tangible assets. The results are confirming the findings of Pan & Qiu (2022); Mishra et al. (2021); Pagnottoni et al. (2022); Huynh & Xia (2023); Sakariyahu et al. (2023) that shows that negative influence of natural disasters on stock returns and accepting both H_{01} and H_{02}. The plausible reasons are threefold among others. First, Although the effect of 2022 flood was pronounced in Sindh and Baluchistan, however, the supply chain of industries of Punjab was disrupted as a significant number of companies have their head offices in Karachi. Economic condition of the country was also not optimistic in 2022, there was rising inflation, political instability due to regime change operation and government was not in a condition to provide relief to the affected people due to debt crisis and IMF negotiations. Furthermore, the there was also effect of COVID-19 outbreak on investors sentiments. All these factors amplified the negative effect of natural disasters on investors sentiments.

Theoretical and practical contributions

The study contributes to the ongoing literature on integration between natural disasters and stock returns of firms. In the context of Pakistan, although the impact of natural disasters has been

studied on tourism, PSX, economic growth. But the linkage between floods and stock returns of individual firms is not yet explored. Our study has filled this gap and findings of the study highlights the different consequences of two floods on stock returns due to difference in affected geographical areas of two floods. Moreover, the study also highlights the importance of economic condition of the country and government support during the natural disasters. The results also provide insight into investors' behavior in two different economic and political condition. The prevailing unstable environment amplified the negative sentiments in investors. Therefore, the government should introduce timely relief programs and liquidity support for the registered firms to reduce the negative sentiments in the investors during disasters.

Moreover, the study has combined the resource-based view (RBV) with the natural disasters. The Resource-Based View (RBV) provide the importance of rare, unique, valuable, and non-substitutable resources in competitive advantage of the organization. The findings highlight the significance of intangible assets such as technology and intellectual capital and flood- resilient infrastructure in minimizing the severe consequences of natural disasters. The regulators and policy makers should incentivize the adoption of flood-resilient infrastructure for the organizations.

Limitations and Future Directions:

The study has some limitations. First, the sample comprised of only manufacturing sector and companies having geographical location in Punjab province. Other sectors and companies from other sectors may also be included. Second, the methodology used in the study is multiple regression analysis. Further, most advanced techniques may be employed by the future researchers to make the results reliable. Third, only two floods have been taken to test for the effect of natural disasters on stock returns. More disasters could be added by the future researchers.

Conclusion:

Natural disasters are affecting almost every part of the world. Pakistan being ranked 18th out of 191 nations by 2020 Inform Risk Index is considered as one of the most vulnerable countries to natural disasters. Therefore, the present study aims at finding out the influence of natural disasters on stock returns of manufacturing companies. For this purpose, we have taken two massive floods that occurred in 2010 and 2022. Purposive sampling has been employed to select the sample and 73 manufacturing companies have been selected. For analysis purpose, multiple regression analysis has been employed. Hausman test is used to identify the appropriate model for the analysis. The findings of the study indicated that 2010 flood has significant positive effect on stock returns of firms and 2022 flood has negative effect on stock returns of manufacturing firms. The difference between two may be attributed to the difference in geographical location of floods' affected areas, economic and political condition of the country. Moreover, the tangible assets moderate the negative influence of natural disaster on stock returns.

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Appendix

Multiple Regression Analysis:
This table presents detailed results of regression analysis by using both Fixed Effect and Random Effect model.

Dependent variable	Returns		Returns	
Independent Variables	Panel A		Panel B	
Floods	.0236859**	.0256087**	-.0294652***	-.0269102***
Flood*At	.0013042	.0012721	-.0002544**	-.0001458*
Firm Size	.0693293***	-.0413866	-.0577238	-.0006016
Firm Age	.0005279	.002428**	.016515***	-.000056
Leverage	-.000163	-.0009235	1.21e-06	.0000261
ROE	-.0000997	-.0000994	.0004381***	.0001988***
Constant	-.5106852*	0.440	-.4211463*	-.0026841
Wald Chi Square (p value)	27.05***	2.58***	5.72***	25.29***
R-squared	0.41	0.60	0.510	0.57
Model	Fixed Effect	Random Effect	Fixed Effect	Random Effect