

Natural disasters – Blessings in disguise?

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Abstract

This study examines the impact of natural disasters on market returns and on several industries that are likely to be affected by the disasters. We find that different natural disasters have different impacts on the returns of the market and on those of industries. Our evidence suggests that while earthquake, hurricane and tornado could negatively affect market returns several weeks after the events, other disasters such as flood, tsunami and volcanic eruption may have limited impact on market returns. We also find that construction and materials industry is positively affected by natural disasters but nonlife and travel industries are likely to suffer when a natural disaster strikes.

Key words: Natural disasters, market returns, industry returns, cumulative abnormal returns

JEL Classification: G14, G22

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I. Introduction

Natural disasters, such as earthquake, flood, hurricane, tsunami, tornado or volcanic eruption, can have huge impacts on human lives or environment. The recent 2011 Japanese tsunami, for example, not only destroyed almost everything in its path causing billions of dollars of damages, but also killed thousands of human lives. Researchers from Oxford University and the Met Office believed that due to global warming, the magnitude and the frequency of occurrence of natural disasters are predicted to increase in the coming decade.

“...20th-century industrial emissions made the natural disaster almost twice as likely. ...It was concluded that the chances of floods occurring had increased by more than 20 percent, perhaps as much as 90 percent” (“Top end cleaning up after 600mm of rain in storm”, 2011).

Despite the massive damages on the economy of the affected country, natural disasters are, surprisingly, reported to have either short term or insignificant effects on stock markets. Worthington and Valadkhani (2004) report the impacts of a range of natural disasters in Australia and find that earthquakes, bushfires and cyclones have short term (2 to 5 days after the events) significant impact on Australian stock market returns. They observe, however, that floods and storms have no significant effects on the stock market. A recent study, however, report that earthquakes have insignificant effects on international stock markets (Broun and Derwal, 2010).

Few other studies investigate the effect of a particular natural disaster on a specific industry. The results however, are incomplete. For example, Shelor et al. (1990, 1992) find that Loma

Prieta earthquake in the US has a negative impact on local real estate firms but, interestingly, a positive effect on insurance companies. Cagle (1996) observes that insurance companies with greater exposure to Hurricane Hugo experience a negative price reaction. While Brunette (1995) reports that hurricane Andrew has no significant impacts on property return index, Lamb (1998) documents that property and casualty (P&C) companies react negatively to hurricane Andrew but not to hurricane Hugo. The impact of Boxing Day tsunami on travel and construction industries in Thailand is reported to be partially significant (Huang et al., 2007).

A potential problem that may arise when focusing the effects of natural disasters only on a stock market index is that an industry may benefit from a disaster while another one may suffer from it, causing the effects of the disasters on industries to offset each other, thus less significant impact on market returns. For example, firms in construction and materials industry is expected to benefit from natural disasters as demand for their products or services may increase while firms in other industries such as travel and insurance may suffer from it. Therefore, focusing only on market return may not give a clear picture of the effects of natural disasters on capital markets.

Our study is different from previous studies in several aspects. First, in our study we include several types of natural disasters, i.e., earthquake, hurricane, tornado, flood, tsunami and volcanic eruption, occurred in several countries. Second, in addition to market returns, we also investigate the effects of these disasters on the returns of several industries, such as construction and materials, nonlife insurance and travel industries, that are most likely to be affected by natural disasters. Construction and materials industry is expected to gain from natural disasters as damaged properties and infrastructures need to be replaced after the events. Evidence consistent with this view is documented by Skidmore and Toya (2002) who find that GDP generally increases following cyclones, hurricanes, floods and tornadoes. The

increase in GDP is expected as these disasters provide an opportunity to update the damaged capital stock (Skidmore and Toya, 2002, p. 665). The effects of disasters on nonlife insurance firms however, are unclear. While these firms are expected to incur large losses due to claims from policy holders, these companies may benefit from higher premiums (Shelor et al., 1992; Cagle, 1996). Similarly, while the number of travelling may decrease as people cancel their travel to the affected destination, travelling may also increase as people flee from the affected location. Third, while previous studies examine only 3 to 10 days after the events, we observe a longer time period (up to 40 days) as it may take longer time for the information of the full effects of the disasters is fully absorbed by market participants (Worthington and Valadkhani, 2004). Given the higher in the expectation of magnitude and of the frequency of occurrence of natural disasters in the coming years, the findings of our study are expected to contribute to the under-researched literature on the impacts of natural disasters on stock returns by giving more insights on the effects of several natural disasters on different industries occurring in several countries.

Our study finds that different types of natural disasters could have different effects on different industries. Except to flood and volcanic eruption, construction and material industry is observed to react positively to earthquake, hurricane, tornado and tsunami 30 days after the events. On the other hand, nonlife insurance and travel and leisure firms react negatively to these events but not to hurricane. Our evidence also suggests that market returns are negatively affected by earthquakes, hurricanes and tornadoes but may not be affected by floods, tsunami and volcanic eruption in the long term.

The rest of the paper is organised as follows. In section 2, we explain the data and the methodology employed. In section 3, we presented the results and our conclusions are provided in section 4.

II. Data and Methodology

Natural disasters in our study include earthquakes, hurricanes, tornadoes, floods, tsunamis and volcanic eruptions occurring in several countries. We do not include all of these disasters but only those that are reported to have substantial damages on infrastructures and properties. We also include only disasters that occurred in countries with relatively developed stock markets. Thus, natural disasters occurring in countries such as Haiti or Iraq are not included in the sample.

Data on natural disasters such as the types of, their event dates and the estimated amount of damages are sourced from newspapers and other published media such as US National Climatic Data Centre, City Council, US National Oceanic and Atmosphere Administration and Wikipedia.

We examine the returns of domestic market index and of firms in Construction and Materials, Nonlife Insurance and Travel and Leisure industries as these firms are expected to be mostly affected by natural disasters. Price data are collected from DataStream database.

Table 1 presents the descriptive statistics of selected natural disasters causing substantial damages occurred from 1974 to 2010.

Insert Table 1 here

There are 7 earthquakes in the US, India, Italy, Japan, Australia and New Zealand. Two earthquakes occurred in Mexico in 1973 and 1985 are not included as price data of Mexican

firms in those years are not available from DataStream. We also include nine hurricanes and five tornadoes occurred in the US, four floods in the US and one recently occurred in Australia in December 2010, the boxing day tsunami affecting India, Thailand and Indonesia¹, and one volcanic eruption in the US. These disasters caused at least 40 million dollars to more than 80 billion dollars of damages. It is difficult to estimate the precise date of when a hurricane starts to cause damages as it can last for days, therefore, the event dates for hurricanes are based on the estimates when the hurricanes made landfalls.

We exclude US small firms, i.e. US firms with stock price less than \$5, to avoid small firm effects and trim 1th and 99th of the sample². Table 2 presents the number of observations for each disaster in each industry. In total, there are 1,260 observations for earthquakes, 4,742 observations for hurricanes, 1,934 observations for tornadoes, 1,643 observations for floods, 315 observations for tsunami, 133 observations for volcanic eruption, 2,749 observations in construction and material industry, 2,532 observations in nonlife insurance and 4,746 observations in travel and leisure industries totalling to 10,027 firm year observations.

Insert Table 2 here

Studies in this literature usually use an event study to observe the impacts of natural disasters on a particular stock market index or industry. An exception is Worthington and Valadhkani (2004) who use an autoregressive moving average analysis. A disadvantage of using this

¹ This tsunami also affects Sri Lanka. However, we do not include this country as we believe that this country's stock market is relatively less developed than the other countries.

² Including these small firms and not trimming the sample would result in astronomical cumulative abnormal stock returns. Including returns of these small firms could also increase noise in abnormal returns. The results are qualitatively similar when these firms are included in the sample and available upon request.

analysis, however, is that this method is valid only when the time series is stationary which may be true in a very short period (2 to 5 days in their study). However, the information represented by these events may not be complete in such a short time period but may take a longer time period to be fully absorbed by the market (as suggested by Worthington and Valadkhani, 2004, p. 2185). As our study observes the effects of natural disasters up to 40 days after the events, therefore, we decide to employ an event study to examine the effects of natural disasters on these selected industries.

To estimate a stock's abnormal return, we do not employ a market model but a market adjusted return model as it is difficult to estimate the precise event date of such disasters as hurricanes and floods as it takes days for these disasters to start causing damages on properties and infrastructures. Moreover, small tornadoes may occur almost every year in certain parts of the US making it difficult to estimate the period of normal stock returns. Employing a market-adjusted return model is also expected to lessen the contamination effects from macroeconomic events that are independent of the disasters on the industries' returns (Worthington and Valadkhani, 2004). The market-adjusted return model is as follows:

$$AR_{it} = R_{it} - R_{mt} \quad (1)$$

where AR_{it} = abnormal return of stock I at time t,

R_{it} = return of stock I at time t,

R_{mt} = return of domestic stock market index at time t.

The market index used is a domestic market index in which country a disaster occurs and returns are calculated using local currencies. Following Brown, Harlow and Tinic (1988) and Shelor et al. (1992), the test statistics used to test the cumulative abnormal return (CAR) is:

$$t\text{-stat} = (CAR_t) / (\text{var } CAR_t)^{1/2} \quad (2)$$

III. Results and discussion

Table 3 presents descriptive statistics of the event day's returns and cumulative abnormal returns (CARs) of the market and the industries, 3, 10, 30 and 40 days after the events. On average, market reactions to natural disasters on the event day are positive except to earthquake and hurricane. Construction industry reacts positively to natural disasters on the event day except to volcanic eruption. Nonlife industry reacts negatively on the event day except to tsunami and travel industry reacts negatively except to earthquake.

Insert Table 3 here

Table 4 presents the CARs of the market, construction, nonlife and travel industries for each of the disasters. Panels A and C show that market reacts negatively to earthquakes and tornadoes. This is consistent with Worthington and Valadkhani (2004) who report negative reaction on the event day and positive market returns 5 days later. Our results however, show that market returns in relation to earthquakes are negative at least 30 days after the event. Similar reactions are observed for nonlife and travel industries. Cumulative abnormal returns

of these industries are negative at least 10 days after the events. Construction industry however, reacts positively up to 40 days after the events.

The market also reacts negatively to hurricanes (Panel B), but the cumulative abnormal returns of construction, nonlife and travel industries are positive more than 30 days later. Cumulative market returns, surprisingly, are positive in relation to floods, tsunamis and a volcanic eruption (Panels D, E and F). A possible explanation why market returns are positive is that market returns may be affected by other events unrelated to the disasters³. Another possible explanation is that these disasters may not have substantial impacts to influence market returns. Panels D, E and F also report that returns of nonlife and travel industries are mostly negative following these disasters. Construction industry's returns are observed to be positive after a tsunami but negative after floods and a volcanic eruption which could be due to not much replacement needed for properties and infrastructures after the floods and to a limited sample size for volcanic eruption (only one event).

Insert Table 4 here

The results are similar when cumulative abnormal returns are sorted based on country (Table 5)⁴. On average construction and materials industry benefits from natural disasters. The negative cumulative abnormal returns for flood reported in panel D of Table 4 are driven by negative returns of US stocks in this industry. Natural disasters negatively affected stock

³ Natural disasters however, occur randomly across time and countries. Thus, it is less likely that independent macroeconomic events affect market returns during window period.

⁴ All hurricanes and tornadoes in our sample occur in the US and have been reported in Table 4, therefore we do not report them again in Table 5.

price of nonlife insurance firms in all countries in the sample except for tsunami in India and Thailand (panel B). Flood and tsunami are observed to negatively affect travel and tourism industry (panel C). Earthquake however, is reported to have positive effects 40 days after the event, across all the countries, on the average abnormal returns of this industry.

Insert Table 5 here

IV. Conclusion

In this paper we examine the impacts of natural disasters on stock market returns and several industries' returns. We observe that natural disasters have different impacts on market returns and on different industry returns. These findings are important given the lack of research in this literature and that prior studies in this area usually study the impact of natural disasters only on market returns or on a specific industry or country.

We find that market returns are likely to be negatively affected by earthquakes, hurricanes and tornadoes but positively by floods, tsunamis and volcanic eruptions. A possible explanation for the latter is that market returns in the sample are probably affected by macroeconomics events unrelated to the disasters or that these disasters do not have substantial impact enough to negatively affect market returns. Our study also suggests that, on average, construction industry is likely to benefit when natural disasters strike while nonlife and travel industries are more likely to suffer from them.

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Table 1
Natural disasters by date

Event category	Event date	Name	Country	Estimated Damages
Tornado	3/04/1974	Super outbreak	US	\$3.5 billion
Flood	31/07/1976	Big Thompson	US	\$40 million
Volcanic eruption	18/05/1980	Mt. St Helen	US	\$1.1 billion
Earthquake	23/11/1980	Irpinia	Italy	Italian government spent 59 billion lire, and US and Germany spent USD102 million
Hurricane	9-Sep-89	Hugo	US	\$10 billion
Earthquake	17/10/1989	Loma Prieta	US	USD 6 billion
Earthquake	28/12/1989	Newcastle	Australia	A\$4 billion
Tornado	28/08/1990	Plainfield	US	\$165 million
Earthquake	20/10/1991	Uttarkashi	India	42,400 houses
Hurricane	24/08/1992	Andrew	US	\$26.5 billion
Hurricane	12/03/1993	Storm of the century	US	\$11 billion
Earthquake	17/01/1994	Northridge	US	USD 25 billion
Earthquake	17/01/1995	Kobe	Japan	200,000 buildings damaged or destroyed
Flood	8/05/1995	Lousiana	US	\$1 billion
Flood	5/02/1996	Willamette Valley	US	> \$1/2 billion
Flood	18/04/1997	Red River	US	\$3.5 billion
Tornado	31/05/1998	Late May Outbreak	US	\$83 million
Tornado	3/05/1999	Oklahoma tornado outbreak	US	\$1.9 billion
Hurricane	4/06/2001	Tropical storm Allison	US	\$5.5 billion
Hurricane	13/08/2004	Hurricane Charley	US	\$16.3 billion
Hurricane	2/09/2004	Hurricane Frances	US	USD12 billion
Hurricane	16/09/2004	Hurricane Ivan	US	USD18 billion

Table 1 (continued)**Natural disasters by date**

Tsunami	26/12/2004	Boxing day Tsunami	India	Hundreds of thousand people homeless
Tsunami	26/12/2004	Boxing day Tsunami	Thailand	Hundreds of thousand people homeless
Tsunami	26/12/2004	Boxing day Tsunami	Indonesia	Hundreds of thousand people homeless
Hurricane	23/08/2005	Hurricane Katrina	US	\$81.2 billion
Hurricane	21/09/2005	Hurricane Rita	US	\$10 billion
Earthquake	4/09/2010	Christchurch NZ	New Zealand	NZ\$ 4 billion
Tornado	9/3/ 2006	Outbreak Sequence	US	More than \$1 billion
Flood	27/12/2010	Quensland	Australia	A\$30 billion

Table 2**Firm year observations**

	Construction and Materials	Nonlife Insurance	Travel and Leisure	TOTAL
Earthquake	519	241	500	1,260
Hurricane	1,031	1,414	2,297	4,742
Tornado	522	374	1,038	1,934
Flood	401	452	790	1,643
Tsunami	228	24	63	315
Volcanic eruption	48	27	58	133
TOTAL	2,749	2,532	4,746	10,027

Table 3
Descriptive statistics of CAR

Panel A

MARKET											
EARTHQUAKE						HURRICANES					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	-0.12%	-0.46%	0.19%	-1.31%	1.48%	Mean	-0.15%	0.12%	-0.17%	-1.02%	0.14%
SD	0.90%	2.75%	5.02%	5.40%	11.61%	SD	0.72%	1.51%	2.44%	2.50%	3.61%
Min	-1.69%	-5.73%	-9.15%	-12.11%	-16.84%	Min	-1.00%	-1.61%	-4.18%	-4.49%	-4.42%
1st Quartile	-0.40%	-1.27%	-1.64%	-2.10%	-4.05%	1st Quartile	-0.86%	-1.19%	-1.30%	-2.52%	-2.37%
Median	-0.20%	0.58%	1.41%	-1.67%	2.92%	Median	-0.31%	-0.31%	-0.50%	-0.85%	0.29%
3rd Quartile	0.30%	1.20%	3.37%	2.49%	6.00%	3rd Quartile	0.28%	0.94%	1.21%	0.27%	2.27%
Max	1.24%	2.05%	5.63%	3.81%	20.38%	Max	1.12%	2.98%	4.13%	3.78%	5.68%
TORNADO						FLOOD					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	0.40%	0.25%	0.37%	-0.81%	0.40%	Mean	0.49%	1.48%	2.26%	4.64%	6.75%
SD	0.82%	0.84%	1.07%	5.97%	3.70%	SD	0.50%	1.21%	2.89%	4.39%	6.41%
Min	-0.49%	-0.77%	-1.21%	-6.54%	-4.44%	Min	-0.24%	0.40%	0.69%	0.53%	2.46%
1st Quartile	-0.03%	-0.20%	0.38%	-5.50%	-2.46%	1st Quartile	0.39%	0.71%	0.76%	2.09%	2.99%
Median	0.01%	0.37%	0.40%	-2.38%	1.47%	Median	0.67%	1.19%	0.87%	3.67%	4.17%
3rd Quartile	1.05%	0.38%	0.48%	2.58%	3.69%	3rd Quartile	0.77%	1.96%	2.37%	6.22%	7.92%
Max	1.46%	1.49%	1.81%	7.79%	3.73%	Max	0.88%	3.14%	6.59%	10.70%	16.21%
TSUNAMI						VOLCANIC ERUPTION					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	0.15%	0.48%	1.14%	5.58%	6.71%	Mean	0.30%	1.54%	2.94%	6.93%	10.99%
SD	1.05%	0.86%	3.42%	4.00%	4.91%	SD	N/A	0.56%	0.86%	0.82%	0.84%
Min	-0.97%	-0.33%	-2.76%	1.41%	1.04%	Min	0.30%	-0.05%	-1.60%	-1.60%	-1.60%
1st Quartile	-0.34%	0.02%	-0.10%	3.67%	5.27%	1st Quartile	0.30%	0.06%	-0.14%	-0.19%	-0.23%
Median	0.29%	0.37%	2.57%	5.93%	9.49%	Median	0.30%	0.20%	0.30%	0.25%	0.28%
3rd Quartile	0.70%	0.88%	3.09%	7.66%	9.55%	3rd Quartile	0.30%	0.52%	0.79%	0.65%	0.71%
Max	1.12%	1.39%	3.61%	9.39%	9.60%	Max	0.30%	1.20%	1.48%	1.90%	1.90%

Table 3 (continued)
Descriptive statistics of CAR

Panel B

CONSTRUCTION AND MATERIALS											
EARTHQUAKE						HURRICANES					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	1.39%	3.64%	8.00%	6.21%	7.12%	Mean	0.14%	0.51%	1.45%	1.78%	0.93%
SD	3.73%	6.86%	13.28%	12.48%	13.18%	SD	3.25%	4.37%	7.50%	11.47%	12.27%
Min	-11.33%	-11.01%	-22.48%	-29.89%	-28.22%	Min	-43.01%	-14.73%	-29.15%	-39.78%	-36.76%
1st Quartile	0.02%	-1.14%	-1.31%	-2.05%	-1.47%	1st Quartile	-1.09%	-1.74%	-2.31%	-4.67%	-5.89%
Median	0.46%	2.56%	5.68%	6.26%	7.20%	Median	-0.06%	0.28%	1.00%	1.24%	0.58%
3rd Quartile	2.44%	7.72%	15.81%	15.16%	16.64%	3rd Quartile	0.91%	2.40%	5.07%	8.05%	7.70%
Max	27.10%	29.48%	58.45%	42.04%	41.88%	Max	30.00%	24.42%	39.59%	44.34%	43.14%
TORNADO						FLOOD					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	0.15%	0.96%	0.94%	1.37%	-1.33%	Mean	0.13%	-0.56%	-0.89%	-0.95%	-1.60%
SD	3.05%	4.72%	6.28%	11.40%	14.51%	SD	3.25%	4.91%	7.20%	10.41%	11.30%
Min	-11.36%	-18.22%	-20.05%	-28.30%	-74.47%	Min	-13.42%	-16.34%	-25.66%	-30.85%	-32.52%
1st Quartile	-1.21%	-1.59%	-3.05%	-6.42%	-9.85%	1st Quartile	-0.88%	-3.10%	-5.17%	-6.83%	-9.02%
Median	0.24%	0.59%	0.56%	1.48%	-0.81%	Median	-0.07%	-0.92%	-0.75%	-1.79%	-2.30%
3rd Quartile	1.07%	3.13%	4.48%	8.88%	7.07%	3rd Quartile	0.88%	1.20%	2.89%	4.55%	4.80%
Max	27.76%	24.33%	21.79%	33.60%	42.46%	Max	24.40%	19.73%	22.69%	35.55%	34.12%
TSUNAMI						VOLCANIC ERUPTION					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	0.26%	1.06%	5.55%	7.69%	7.03%	Mean	-0.22%	-1.17%	-0.41%	-0.35%	3.17%
SD	2.03%	4.24%	7.93%	13.74%	13.11%	SD	2.39%	3.94%	4.77%	6.47%	8.04%
Min	-4.59%	-6.58%	-6.26%	-10.48%	-9.91%	Min	-3.38%	-7.89%	-10.81%	-12.41%	-12.39%
1st Quartile	-0.29%	-0.37%	2.76%	-1.41%	-1.04%	1st Quartile	-1.52%	-2.71%	-3.09%	-5.39%	-2.20%
Median	-0.29%	-0.37%	2.76%	0.50%	-0.28%	Median	-0.30%	-1.53%	-1.16%	-0.04%	2.65%
3rd Quartile	0.36%	1.23%	7.40%	14.30%	11.25%	3rd Quartile	0.14%	-0.45%	2.44%	5.46%	7.53%
Max	9.69%	17.71%	42.43%	62.92%	60.48%	Max	10.16%	15.95%	10.01%	12.75%	22.80%

Table 3 (continued)
Descriptive statistics of CAR

Panel C

NONLIFE INSURANCE											
EARTHQUAKE						HURRICANES					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	-0.06%	-0.12%	-0.14%	1.00%	-0.17%	Mean	-0.07%	0.03%	0.26%	1.92%	1.74%
SD	2.34%	3.44%	5.15%	8.88%	9.48%	SD	1.88%	2.86%	4.57%	7.75%	9.02%
Min	-6.30%	-9.33%	-13.41%	-27.90%	-22.79%	Min	-9.28%	-9.26%	-13.94%	-22.22%	-25.80%
1st Quartile	-1.17%	-2.35%	-3.42%	-4.19%	-6.23%	1st Quartile	-0.99%	-1.57%	-2.62%	-2.87%	-3.93%
Median	-0.52%	-0.39%	-0.27%	0.64%	-0.42%	Median	-0.07%	0.09%	0.08%	1.43%	1.35%
3rd Quartile	0.71%	1.62%	2.79%	6.58%	6.14%	3rd Quartile	0.75%	1.63%	3.11%	6.51%	7.50%
Max	14.48%	16.57%	12.32%	31.57%	24.25%	Max	13.62%	10.66%	15.46%	26.88%	29.03%
TORNADO						FLOOD					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	-0.36%	-0.19%	-0.49%	-1.45%	-3.34%	Mean	-0.25%	-1.02%	-1.08%	-1.24%	-1.25%
SD	2.32%	3.18%	4.91%	8.13%	8.95%	SD	1.82%	3.34%	4.96%	6.71%	7.72%
Min	-14.09%	-10.72%	-15.38%	-26.45%	-29.70%	Min	-7.72%	-10.68%	-15.48%	-16.58%	-19.80%
1st Quartile	-1.46%	-2.01%	-3.17%	-6.70%	-8.72%	1st Quartile	-0.98%	-3.04%	-4.33%	-5.46%	-6.25%
Median	-0.14%	-0.13%	-0.69%	-0.73%	-3.18%	Median	-0.52%	-1.32%	-0.84%	-1.64%	-1.25%
3rd Quartile	0.83%	1.37%	2.05%	3.76%	2.97%	3rd Quartile	0.52%	0.77%	1.80%	2.99%	3.88%
Max	8.72%	10.12%	16.13%	18.55%	17.73%	Max	9.02%	10.98%	14.95%	22.84%	22.36%
TSUNAMI						VOLCANIC ERUPTION					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	0.40%	1.41%	-0.88%	-4.07%	-3.84%	Mean	-0.50%	-1.91%	-2.64%	0.21%	-0.43%
SD	2.31%	6.07%	7.85%	9.90%	9.60%	SD	1.23%	1.83%	2.47%	5.02%	4.50%
Min	-2.84%	-3.46%	-7.35%	-14.54%	-13.28%	Min	-2.68%	-5.42%	-8.00%	-9.96%	-8.17%
1st Quartile	-1.02%	-1.43%	-4.91%	-10.19%	-10.09%	1st Quartile	-1.10%	-3.05%	-4.32%	-4.01%	-4.02%
Median	-0.04%	-0.17%	-3.61%	-8.59%	-8.42%	Median	-0.30%	-1.82%	-2.56%	0.50%	-1.06%
3rd Quartile	0.97%	0.42%	-0.05%	0.60%	-0.53%	3rd Quartile	-0.07%	-1.49%	-0.99%	3.14%	2.79%
Max	7.97%	22.46%	23.28%	18.93%	22.09%	Max	2.89%	2.24%	2.01%	10.06%	7.65%

Table 3 (continued)
Descriptive statistics of CAR

Panel D

TRAVEL AND LEISURE											
EARTHQUAKE						HURRICANES					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	0.21%	0.10%	-0.84%	-0.10%	0.67%	Mean	-0.27%	-0.04%	0.34%	1.27%	1.76%
SD	2.71%	4.42%	6.33%	10.58%	11.41%	SD	2.97%	4.54%	7.24%	12.40%	14.10%
Min	-12.54%	-18.82%	-19.76%	-28.56%	-33.62%	Min	-27.55%	-23.15%	-26.48%	-46.43%	-43.49%
1st Quartile	-0.99%	-2.06%	-4.78%	-6.91%	-6.06%	1st Quartile	-1.34%	-2.41%	-3.43%	-5.43%	-6.49%
Median	0.20%	0.06%	-0.84%	0.62%	1.32%	Median	-0.22%	-0.19%	0.39%	1.23%	1.38%
3rd Quartile	1.18%	2.56%	2.86%	6.03%	7.48%	3rd Quartile	0.86%	2.06%	3.90%	7.87%	9.54%
Max	11.98%	14.89%	19.83%	36.35%	30.74%	Max	41.08%	25.22%	29.36%	53.30%	53.57%
TORNADO						FLOOD					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	-0.13%	-0.30%	0.62%	-1.64%	-2.52%	Mean	-0.36%	-0.60%	-0.48%	0.58%	0.43%
SD	3.56%	5.48%	8.43%	14.60%	15.49%	SD	3.39%	5.23%	8.12%	12.52%	15.06%
Min	-20.01%	-21.13%	-26.15%	-52.68%	-47.02%	Min	-16.73%	-17.98%	-26.57%	-36.19%	-39.63%
1st Quartile	-1.46%	-2.80%	-4.26%	-9.33%	-12.13%	1st Quartile	-1.64%	-3.53%	-5.31%	-7.39%	-9.91%
Median	-0.01%	-0.61%	-0.20%	-1.44%	-2.64%	Median	-0.60%	-0.81%	-0.93%	-0.55%	-0.68%
3rd Quartile	0.94%	1.94%	4.82%	7.26%	7.20%	3rd Quartile	0.80%	1.91%	3.66%	8.39%	10.41%
Max	28.50%	28.21%	40.44%	47.28%	41.65%	Max	26.72%	21.13%	31.29%	42.84%	43.76%
TSUNAMI						VOLCANIC ERUPTION					
	Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40		Event day	CAR 0,+3	CAR 0,+10	CAR 0,+30	CAR 0,+40
Mean	-0.83%	-1.01%	-0.52%	-2.76%	-2.56%	Mean	-0.27%	-1.80%	-3.96%	-2.57%	-0.78%
SD	1.84%	4.65%	5.02%	6.01%	6.33%	SD	3.02%	4.11%	5.80%	10.11%	10.91%
Min	-7.27%	-9.45%	-10.68%	-17.04%	-13.55%	Min	-5.98%	-9.34%	-16.83%	-19.41%	-30.67%
1st Quartile	-1.12%	-3.35%	-3.61%	-6.98%	-7.89%	1st Quartile	-1.98%	-4.12%	-7.45%	-8.22%	-5.92%
Median	-0.29%	-0.37%	0.75%	-1.41%	-1.08%	Median	-0.30%	-1.96%	-4.41%	-3.48%	-1.89%
3rd Quartile	-0.20%	0.33%	2.76%	-1.39%	-1.04%	3rd Quartile	0.46%	0.42%	-1.09%	1.74%	7.68%
Max	2.79%	22.14%	20.96%	11.90%	15.39%	Max	12.20%	13.50%	12.74%	21.19%	20.56%

Table 4
Cumulative Abnormal Returns

Panel A. Earthquake				
CAR	Market	Construction	Nonlife	Travel
0,+3	-0.46%**	3.64%***	-0.12%	0.10%
0,+10	0.19%	8.00%***	-0.14%	-0.84%
0,+30	-1.31%***	6.21%***	1.01%**	-0.10%
0,+40	1.48%***	7.12%***	-0.17%	0.67%***
Panel B. Hurricane				
CAR	Market	Construction	Nonlife	Travel
0,+3	0.12%	0.51%***	0.03%	-0.04%
0,+10	-0.17%	1.45%***	0.26%	0.34%***
0,+30	-1.02%***	1.78%***	1.92%***	1.27%***
0,+40	0.14%	0.93%**	1.74%***	1.76%**
Panel C. Tornado				
CAR	Market	Construction	Nonlife	Travel
0,+3	0.25%	0.96%**	-0.19%	-0.30%**
0,+10	0.37%	0.94%***	-0.49%*	0.62%
0,+30	-0.81%*	1.37%*	-1.45%***	-1.64%**
0,+40	0.40%	-1.33%***	-3.34%***	-2.52%**
Panel D. Flood				
CAR	Market	Construction	Nonlife	Travel
0,+3	1.48%***	-0.56%*	-1.02%**	-0.60%***
0,+10	2.26%***	-0.89%**	-1.08%**	-0.48%**
0,+30	4.64%***	-0.95%*	-1.24%***	0.58%
0,+40	6.75%***	-1.60%***	-1.25%***	0.43%
Panel E. Tsunami				
CAR	Market	Construction	Nonlife	Travel
0,+3	0.48%**	1.06%***	1.41%**	-1.01%**
0,+10	1.14%*	5.55%***	-0.88%	-0.52%
0,+30	5.58%***	7.69%***	-4.07%***	-2.76%**
0,+40	6.71%***	7.03%***	-3.84%***	-2.56%**
Panel F. Volcanic eruption				
CAR	Market	Construction	Nonlife	Travel
0,+3	1.54%***	-1.17%**	-1.91%***	-1.80%***
0,+10	2.94%***	-0.41%	-2.64%**	-3.96%***
0,+30	6.93%***	-0.35%	0.21%	-2.57%*
0,+40	10.99%***	3.17%*	-0.43%	-0.78%

* Significant at 10%;

** Significant at 5%;

*** Significant at 1%

Table 5
Cumulative Abnormal Returns Sorted Based on Country

Panel A. Construction				
EARTHQUAKE	CAR _{0,+3}	CAR _{0,+10}	CAR _{0,+30}	CAR _{0,+40}
Australia	0.18%	-0.55%	1.34%	5.06%***
India	0.02%	2.39%***	2.50%	4.16%**
Italy	3.21%**	2.10%*	10.81%*	-5.25%
Japan	5.78%***	13.56%***	8.91%***	10.52%***
New Zealand	1.60%*	3.09%**	2.18%**	3.24%**
US	1.59%***	1.30%***	3.36%**	2.49%***
FLOOD				
Australia	0.89%***	2.28%***	0.27%	0.47%
US	-0.85%**	-1.53%**	-1.20%*	-2.03%***
TSUNAMI				
India	0.65%***	5.26%***	6.30%**	6.47%***
Indonesia	1.96%**	4.93%**	12.08%***	8.48%**
Thailand	3.97%**	10.36%**	14.66%***	10.57%***
Panel B. Nonlife Insurance				
EARTHQUAKE	CAR _{0,+3}	CAR _{0,+10}	CAR _{0,+30}	CAR _{0,+40}
Australia	-2.79%***	-5.25%***	-6.79%***	-4.49%
India	-5.42%**	-7.83%***	7.25%	2.62%
Italy	0.26%	-2.37%***	4.01%	1.53%
Japan	-2.35%***	-0.38%	-1.16%	1.73%
New Zealand	-2.88%***	-3.97%***	-4.66%***	-6.23%***
US	0.13%	0.14%	1.20%***	-0.25%

Table 5 (continued)
Cumulative Abnormal Returns Sorted Based on Country

FLOOD				
Australia	-1.07%	-1.89%	-2.28%	0.53%
US	-1.02%**	-1.07%**	-1.22%***	-1.28%***
TSUNAMI				
India	-1.62%	13.33%*	11.99%**	18.13%***
Indonesia	-0.53%	-3.96%**	-9.57%***	-8.09%***
Thailand	6.42%**	1.66%	3.14%**	-1.02%
<hr/>				
Panel C. Tourism and Travel				
EARTHQUAKE	CAR_{0,+3}	CAR_{0,+10}	CAR_{0,+30}	CAR_{0,+40}
Australia	0.66%	0.38%	-3.10%*	0.27%
India	0.02%	-2.38%	2.49%	4.70%*
Italy	3.23%***	4.73%***	29.08%**	19.74%*
Japan	0.38%	-1.37%	0.17%	3.98%**
New Zealand	0.52%	-0.81%	1.34%	5.41%**
US	0.09%	-0.75%	0.22%	0.96%**
FLOOD				
Australia	0.15%	-2.08%*	-5.01%**	-3.02%
US	-0.64%***	-0.38%	0.95%	0.66%
TSUNAMI				
India	-2.64%**	0.86%	0.38%	0.82%
Indonesia	-0.53%***	-3.58%**	-6.58%***	-6.61%***
Thailand	2.76%	0.28%	-5.69%***	-5.81%**

* Significant at 10%;
** Significant at 5%;
*** Significant at 1%