Impact of Catastrophe Events on Insurance Companies' Market Valuation

An Event Study Analysis

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Introduction

- Purposes:
  - examine the impact of selected shocks and their significance on the stock valuation of insurance companies
  - investigate the relation of companies characteristics and the effect caused by such events
  - compare different test statistics on the same set of events and firms
- Approach: event study analysis
- Application:
  - for academic literature: add to the understanding of the market stock valuation behavior of non-life insurers
  - for practitioners: improve companies in their risk, investment and crisis management strategies

Methodology (starting point)

- *N* securities (stocks of insurance companies)
- t_e: the day of the event
- Parameters:
  - Δ: the length of the estimation window
  - w_b: the # of days before the event
  - w_a: the # of days after the event

Estimation window   Event window

$t_e - w_b - \Delta$ $t_e - w_b$ t_e $t_e + w_a$
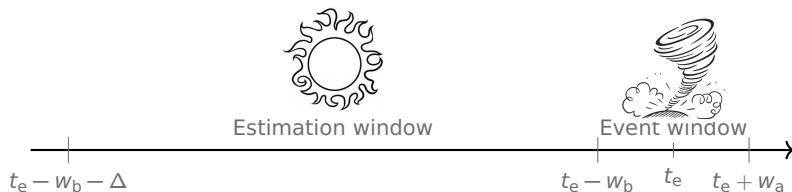
Methodology (market models)

- Adjusted mean-returns model
  $$R_{i,t} = \bar{R}_i + \epsilon_{i,t} \qquad\qquad A_{i,t} = R_{i,t} - \bar{R}_i$$

- Adjusted market-returns model
  $$R_{i,t} = R_{M,t} + \epsilon_{i,t} \qquad\qquad A_{i,t} = R_{i,t} - R_{M,t}$$

- Single-index market model
  $$R_{i,t} = \alpha_i + \beta_i \cdot R_{M,t} + \epsilon_{i,t} \qquad\qquad A_{i,t} = R_{i,t} - \hat{\alpha}_i - \hat{\beta}_i \cdot R_{M,t}$$

Methodology (statistical tests)

- Parametric tests:
  - Student's *t*-test
  - Brown and Warner (1980)
  - Brown and Warner (1985)
  - Patell (1976)
  - Boehmer et al. (1991)
  - Lamb (1995)
- Nonparametric tests:
  - Sign test
  - Generalized sign test
  - Corrado and Zivney (1992)
  - Rank test
  - Modified rank test
  - Wilcoxon signed-rank test

Methodology (regression analysis)

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} A_{i,t}$$

$$\widetilde{CAR}_i(t_1, t_2) = \gamma_0 + \gamma_1 \cdot \widetilde{MC}_i + \gamma_2 \cdot SUB_i + \gamma_3 \cdot \widetilde{GPWL}_i$$
$$+ \gamma_4 \cdot \widetilde{GPWNL}_i + \gamma_5 \cdot GEO_i + \epsilon_i$$

where:

- $\widetilde{MC}_i$: the market capitalization
- SUB_i: the categorical variable of the subsector
- $\widetilde{GPWL}_i$: the gross premiums written in life
- $\widetilde{GPWNL}_i$: the gross premiums written in non-life
- GEO_i: the dummy (binary) variable, which represents the geographical origin of the company Western Europe $\rightarrow$ 1, North America $\rightarrow$ 0

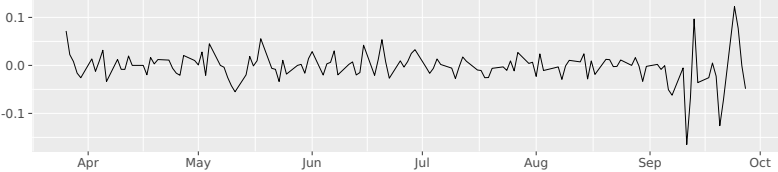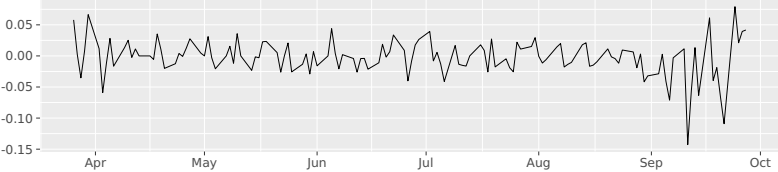# Reference case of 9/11 terrorist attacks
Setup

- 31 European non-life companies
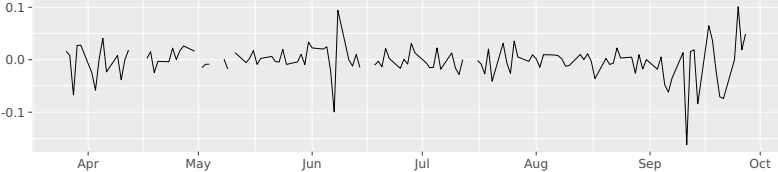 17 FL, 10 P&C, 4 Re
- $\Delta = 120$, $w_b = 0$, $w_a = 17$
- Single-index market model with
  STOXX Global 1800 as proxy is
  used

Ceteris paribus analysis :

- different test statistics
- different groups of companies
- different market models
- different estimation period lengths
- different market proxies (market indices)

Reference case: data

Reference case: time split
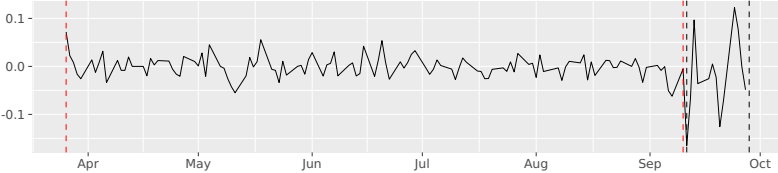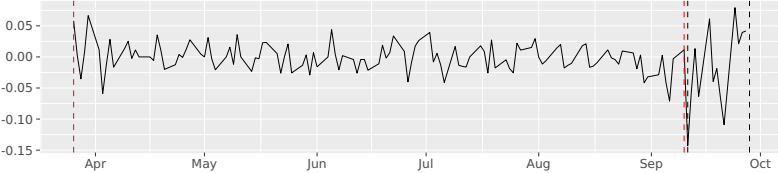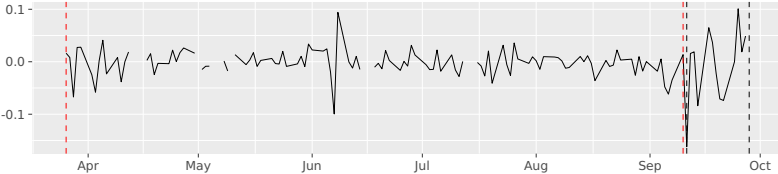
Reference case: market model & prediction

$R_{1,t} = \mathbf{-0.00017} + \mathbf{0.91709} \cdot R_{M,t}$
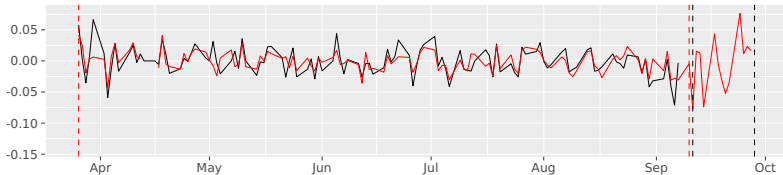
$R_{2,t} = \mathbf{0.00086} + \mathbf{1.17992} \cdot R_{M,t}$
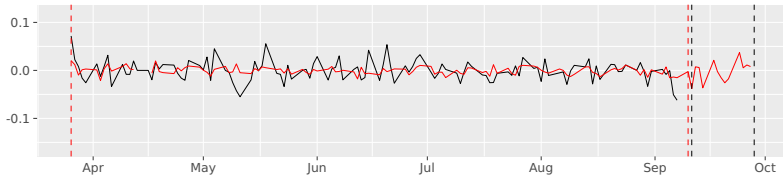
$R_{31,t} = \mathbf{0.00020} + \mathbf{0.57736} \cdot R_{M,t}$

Reference case: observed vs expected returns
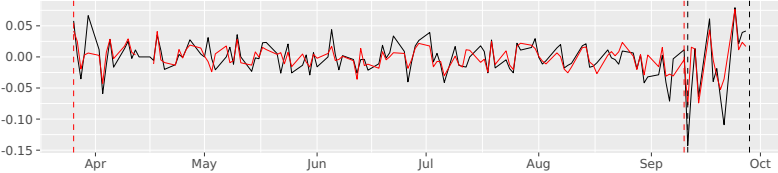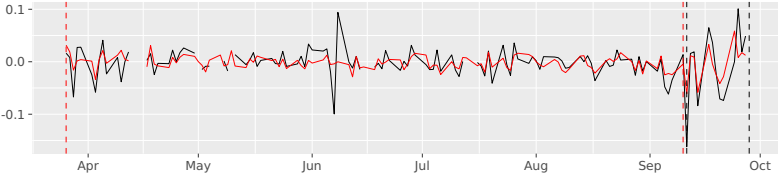
Reference case: abnormal returns
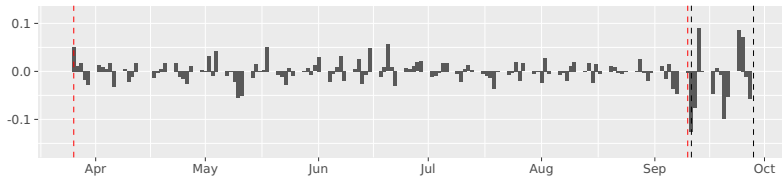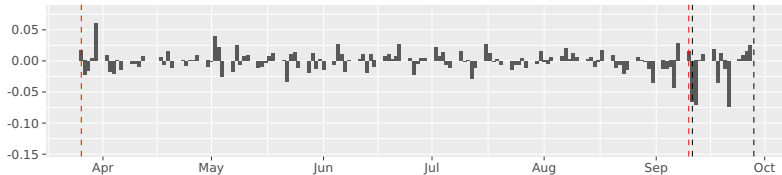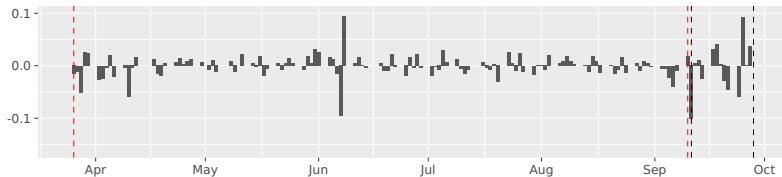
Reference case of 9/11 terrorist attacks
Parametric tests

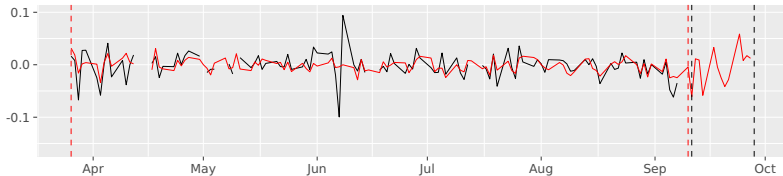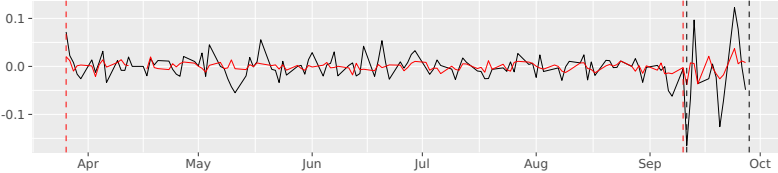| Date	W.day	A_t, %	BW1980		BW1985		t-test		Patell		BMP		Lamb	
09-11	Tues	-5.624	-15.090	***	-11.229	***	-4.961	***	-19.424	***	-4.855	***	-10.942	***
09-12	Wed	-3.664	-9.829	***	-7.314	***	-2.674	**	-11.190	***	-1.934	*	-7.280	***
09-13	Thurs	-0.286	-0.767		-0.571		-0.282		-1.344		-0.353		-0.568	
09-14	Fri	-3.097	-8.310	***	-6.184	***	-4.081	***	-10.881	***	-4.061	***	-6.111	***
09-17	Mon	0.673	1.806	*	1.344		0.763		2.767	***	0.993		1.302	
09-18	Tues	-0.512	-1.373		-1.022		-0.722		-1.266		-0.487		-1.016	
09-19	Wed	-1.061	-2.846	***	-2.118	**	-1.022		-1.560		-0.603		-2.101	**
09-20	Thurs	-5.064	-13.587	***	-10.111	***	-5.516	***	-15.608	***	-4.686	***	-9.814	***
09-21	Fri	-4.292	-11.515	***	-8.568	***	-4.401	***	-16.331	***	-4.829	***	-8.505	***
09-24	Mon	3.496	9.381	***	6.981	***	3.418	***	10.527	***	3.491	***	6.750	***
09-25	Tues	1.573	4.221	***	3.141	***	1.820	*	4.479	***	1.531		3.126	***
09-26	Wed	2.475	6.641	***	4.942	***	3.691	***	8.779	***	3.361	***	4.921	***
09-27	Thurs	0.400	1.074		0.799		0.396		1.905	*	0.525		0.792	
09-28	Fri	1.437	3.855	***	2.869	***	1.918	*	6.270	***	2.211	**	2.788	***

*, **, *** stands for statistically significant at the 10%, 5%, 1% percent level, respectively, for two-sided tests.

09/11 - 09/21: significantly negative abnormal returns
09/24 - 09/28: significantly positive abnormal returns

Reference case of 9/11 terrorist attacks
Nonparametric tests

Date	W.day	Sign		G.sign		C.sign		Rank		M.rank		Wlcx	
09-11	Tues	-3.413	***	-3.628	***	-2.019	**	-2.828	***	-2.907	***	48.000	***
09-12	Wed	-3.413	***	-3.628	***	-2.131	**	-2.242	**	-2.331	**	98.000	***
09-13	Thurs	-0.180		-0.392		0.336		-0.187		-0.199		240.000	
09-14	Fri	-3.413	***	-3.628	***	-2.131	**	-2.693	***	-2.789	***	52.000	***
09-17	Mon	0.180		-0.033		0.112		0.134		0.110		268.000	
09-18	Tues	-0.539		-0.752		-0.112		-0.568		-0.579		207.000	
09-19	Wed	-0.898		-1.111		-0.561		-0.510		-0.532		207.000	
09-20	Thurs	-3.413	***	-3.628	***	-2.131	**	-3.054	***	-3.152	***	33.000	***
09-21	Fri	-3.413	***	-3.628	***	-1.906	*	-2.873	***	-2.943	***	57.000	***
09-24	Mon	3.053	***	2.843	***	1.906	*	2.537	**	2.611	***	403.000	***
09-25	Tues	1.976	**	1.764	*	1.234		1.407		1.446		348.000	**
09-26	Wed	3.772	***	3.562	***	1.906	*	2.570	**	2.642	***	430.000	***
09-27	Thurs	-0.180		-0.392		-0.336		-0.071		-0.099		253.000	
09-28	Fri	1.616		1.405		1.009		1.244		1.286		347.000	**

*, **, *** stands for statistically significant at the 10%, 5%, 1% percent level, respectively, for two-sided tests.

09/11 - 09/21: significantly negative abnormal returns
09/24 - 09/28: significantly positive abnormal returns

Reference case of 9/11 terrorist attacks
Companies split according to subsector

		Overall			FL			P&C			Re		
Date	W.day	$\bar{A}_t$, %	Stat	Signif	$\bar{A}_t$, %	Stat	Signif	$\bar{A}_t$, %	Stat	Signif	$\bar{A}_t$, %	Stat	Signif
09-11	Tues	-5.624	-11.229	***	-4.915	-8.425	***	-2.394	-2.375	**	-16.715	-20.209	***
09-12	Wed	-3.664	-7.314	***	-1.852	-3.175	***	-8.641	-8.573	***	1.080	1.306	
09-13	Thurs	-0.286	-0.571		1.073	1.839	*	-3.256	-3.231	***	1.367	1.653	
09-14	Fri	-3.097	-6.184	***	-2.367	-4.058	***	-2.951	-2.928	***	-6.567	-7.939	***
09-17	Mon	0.673	1.344		0.828	1.419		-2.284	-2.266	**	7.409	8.958	***
09-18	Tues	-0.512	-1.022		-0.537	-0.921		0.312	0.310		-2.465	-2.980	***
09-19	Wed	-1.061	-2.118	**	-1.086	-1.862	*	-1.418	-1.406		-0.062	-0.075	
09-20	Thurs	-5.064	-10.111	***	-4.675	-8.013	***	-4.265	-4.232	***	-8.717	-10.539	***
09-21	Fri	-4.292	-8.568	***	-4.854	-8.321	***	-2.690	-2.669	***	-5.906	-7.141	***
09-24	Mon	3.496	6.981	***	4.409	7.558	***	0.794	0.788		6.374	7.706	***
09-25	Tues	1.573	3.141	***	1.324	2.270	**	1.820	1.806	*	2.014	2.435	**
09-26	Wed	2.475	4.942	***	1.697	2.908	***	2.178	2.161	**	6.528	7.893	***
09-27	Thurs	0.400	0.799		0.448	0.768		-0.373	-0.370		2.132	2.577	**
09-28	Fri	1.437	2.869	***	0.586	1.004		1.995	1.979	*	3.658	4.423	***

*, **, *** stands for statistically significant at the 10%, 5%, 1% percent level, respectively, for two-sided tests.
Brown and Warner (1985) test

Reinsurance firms generate the highest values of statistics, while P&C generate the smallest ones

Reference case of 9/11 terrorist attacks
Companies split according to MC

		Overall			Small			Middle			Large		
Date	W.day	A_t, %	Stat	Signif	A_t, %	Stat	Signif	A_t, %	Stat	Signif	A_t, %	Stat	Signif
09-11	Tues	-5.624	-11.229	***	-1.905	-2.857	***	-7.691	-9.678	***	-11.254	-13.169	***
09-12	Wed	-3.664	-7.314	***	-5.549	-8.321	***	-1.815	-2.284	**	-1.511	-1.768	*
09-13	Thurs	-0.286	-0.571		-2.719	-4.077	***	-0.474	-0.596		4.745	5.552	***
09-14	Fri	-3.097	-6.184	***	-1.999	-2.997	***	-4.359	-5.484	***	-4.191	-4.904	***
09-17	Mon	0.673	1.344		-2.335	-3.502	***	2.726	3.429	***	4.894	5.726	***
09-18	Tues	-0.512	-1.022		0.550	0.825		-4.254	-5.353	***	0.639	0.748	
09-19	Wed	-1.061	-2.118	**	-1.458	-2.186	**	1.261	1.587		-2.299	-2.691	***
09-20	Thurs	-5.064	-10.111	***	-4.175	-6.261	***	-4.876	-6.136	***	-7.006	-8.198	***
09-21	Fri	-4.292	-8.568	***	-3.055	-4.582	***	-7.660	-9.638	***	-3.817	-4.467	***
09-24	Mon	3.496	6.981	***	1.707	2.559	**	5.192	6.532	***	5.593	6.544	***
09-25	Tues	1.573	3.141	***	1.552	2.327	**	0.355	0.447		2.683	3.140	***
09-26	Wed	2.475	4.942	***	1.459	2.188	**	3.747	4.715	***	3.396	3.973	***
09-27	Thurs	0.400	0.799		0.189	0.283		-0.432	-0.543		1.552	1.816	*
09-28	Fri	1.437	2.869	***	2.362	3.541	***	0.553	0.695		0.361	0.423	

*, **, *** stands for statistically significant at the 10%, 5%, 1% percent level, respectively, for two-sided tests.
Brown and Warner (1985) test

Smaller companies and larger companies tend to have more significant dates

Reference case of 9/11 terrorist attacks
Different market models

Date	W.day	SIMM			Market-adjusted			Mean-adjusted		
		$\bar{A}_t$, %	Stat.	Signif.	$\bar{A}_t$, %	Stat.	Signif.	$\bar{A}_t$, %	Stat.	Signif.
09-11	Tues	-5.624	-11.229	***	-3.639	-3.610	***	-6.502	-10.267	***
09-12	Wed	-3.664	-7.314	***	-3.963	-3.931	***	-3.539	-5.589	***
09-13	Thurs	-0.286	-0.571		-0.355	-0.353		-0.262	-0.414	
09-14	Fri	-3.097	-6.184	***	-1.948	-1.932	*	-3.608	-5.698	***
09-17	Mon	0.673	1.344		2.907	2.884	***	-0.314	-0.495	
09-18	Tues	-0.512	-1.022		-0.046	-0.045		-0.723	-1.142	
09-19	Wed	-1.061	-2.118	**	-0.275	-0.273		-1.413	-2.230	**
09-20	Thurs	-5.064	-10.111	***	-2.896	-2.873	***	-6.022	-9.509	***
09-21	Fri	-4.292	-8.568	***	-3.562	-3.533	***	-4.619	-7.293	***
09-24	Mon	3.496	6.981	***	1.119	1.110		4.532	7.156	***
09-25	Tues	1.573	3.141	***	1.185	1.175		1.737	2.742	***
09-26	Wed	2.475	4.942	***	2.512	2.492	**	2.452	3.872	***
09-27	Thurs	0.400	0.799		-0.587	-0.582		0.826	1.305	
09-28	Fri	1.437	2.869	***	-0.721	-0.715		2.376	3.752	***

*, **, *** stands for statistically significant at the 10%, 5%, 1% percent level, respectively, for two-sided tests.
Brown and Warner (1985) test

SIMM and mean-adjusted produce similar results
Market-adjusted seem to weakly predict daily returns

Reference case of 9/11 terrorist attacks
Different length of estimation windows

		$\Delta = 50$			$\Delta = 100$			$\Delta = 150$			$\Delta = 200$		
Date	W.day	A_t, %	Stat	Signif	A_t, %	Stat	Signif	A_t, %	Stat	Signif	A_t, %	Stat	Signif
09-11	Tues	-5.750	-10.742	***	-5.724	-11.984	***	-5.692	-9.317	***	-5.907	-9.932	***
09-12	Wed	-3.446	-6.438	***	-3.611	-7.560	***	-3.611	-5.911	***	-3.617	-6.081	***
09-13	Thurs	-0.103	-0.192		-0.248	-0.520		-0.245	-0.402		-0.272	-0.457	
09-14	Fri	-3.098	-5.787	***	-3.141	-6.576	***	-3.121	-5.109	***	-3.259	-5.481	***
09-17	Mon	0.510	0.952		0.557	1.166		0.593	0.970		0.354	0.596	
09-18	Tues	-0.410	-0.765		-0.510	-1.068		-0.500	-0.818		-0.576	-0.968	
09-19	Wed	-1.007	-1.880	*	-1.080	-2.262	**	-1.065	-1.744	*	-1.171	-1.968	*
09-20	Thurs	-5.218	-9.747	***	-5.176	-10.836	***	-5.141	-8.416	***	-5.373	-9.035	***
09-21	Fri	-4.229	-7.900	***	-4.307	-9.018	***	-4.293	-7.028	***	-4.393	-7.387	***
09-24	Mon	4.026	7.521	***	3.688	7.721	***	3.657	5.987	***	3.843	6.462	***
09-25	Tues	1.804	3.370	***	1.632	3.417	***	1.630	2.669	***	1.633	2.746	***
09-26	Wed	2.642	4.936	***	2.506	5.247	***	2.510	4.109	***	2.474	4.159	***
09-27	Thurs	0.721	1.347		0.499	1.045		0.489	0.800		0.546	0.919	
09-28	Fri	1.934	3.612	***	1.614	3.378	***	1.586	2.597	**	1.752	2.945	***

*, **, *** stands for statistically significant at the 10%, 5%, 1% percent level, respectively, for two-sided tests.
Brown and Warner (1985) test

The statistics and the obtained significances are the same for all values of Δ
* We also investigate the sensitivity to the market index changes

Data (events)

#	Name	Victims	Insured loss in mUSD	Event start	Event end
1	Hurricane Katrina	1 836	78 638	2005-08-23	2005-09-02
2	Hurricane Rita	34	12 240	2005-09-19	2005-09-30
3	Hurricane Wilma	35	15 234	2005-10-17	2005-10-28
4	Hurricane Ike	136	22 258	2008-09-02	2008-09-12
5	Hurricane Irene	50	6 134	2011-08-20	2011-09-02
6	Hurricane Sandy	237	36 079	2012-10-22	2012-11-02
7	Earthquake in Chile	562	8 682	2010-03-01	2010-03-05
8	Christchurch earthquake	181	16 836	2011-02-22	2011-03-04
9	Tōhoku earthquake	18 520	36 828	2011-03-11	2011-03-24
10	Winter storm Kyrill	54	6 959	2007-01-17	2007-01-24
11	Winter storm Klaus	25	3 501	2009-01-23	2009-01-28
12	Malaysia Airlines Flight	298	—	2014-07-17	2014-07-25
13	Germanwings Flight	150	—	2015-03-24	2015-04-02

Data (companies)

	North America				Western Europe			
	P&C	FL	Re	Total	P&C	FL	Re	Total
Small	17	1	0	18	5	6	0	11
Mid	12	2	4	18	4	6	1	11
Large	12	3	3	18	3	5	3	11
Total	41	6	7	54	12	17	4	33

87 P&C, full-line, and reinsurance (excluding Life insurer
and Insurance Brokers) publicly-traded companies from
Western Europe and North America with more than 60%
of observations

Research summary and main findings

The impact of 13 major catastrophes on 87 listed non-life insurer have been analyzed:

- There is no clear pattern in stock responses to catastrophes
- North American and Western European companies behave differently
- Only for several events the market capitalization is the essential characteristic, which influence the reaction
- Reinsurance companies are the most sensitive to the catastrophe events
- As conclusion, from investors perspective, premiums of insurance companies are well-managed to incorporate the impact of catastrophes

Thank you!

github.com/irudnyts/estudy2