The Influence of Sponsor Characteristics and (Non-) Events on the Risk Premia of CAT Bonds

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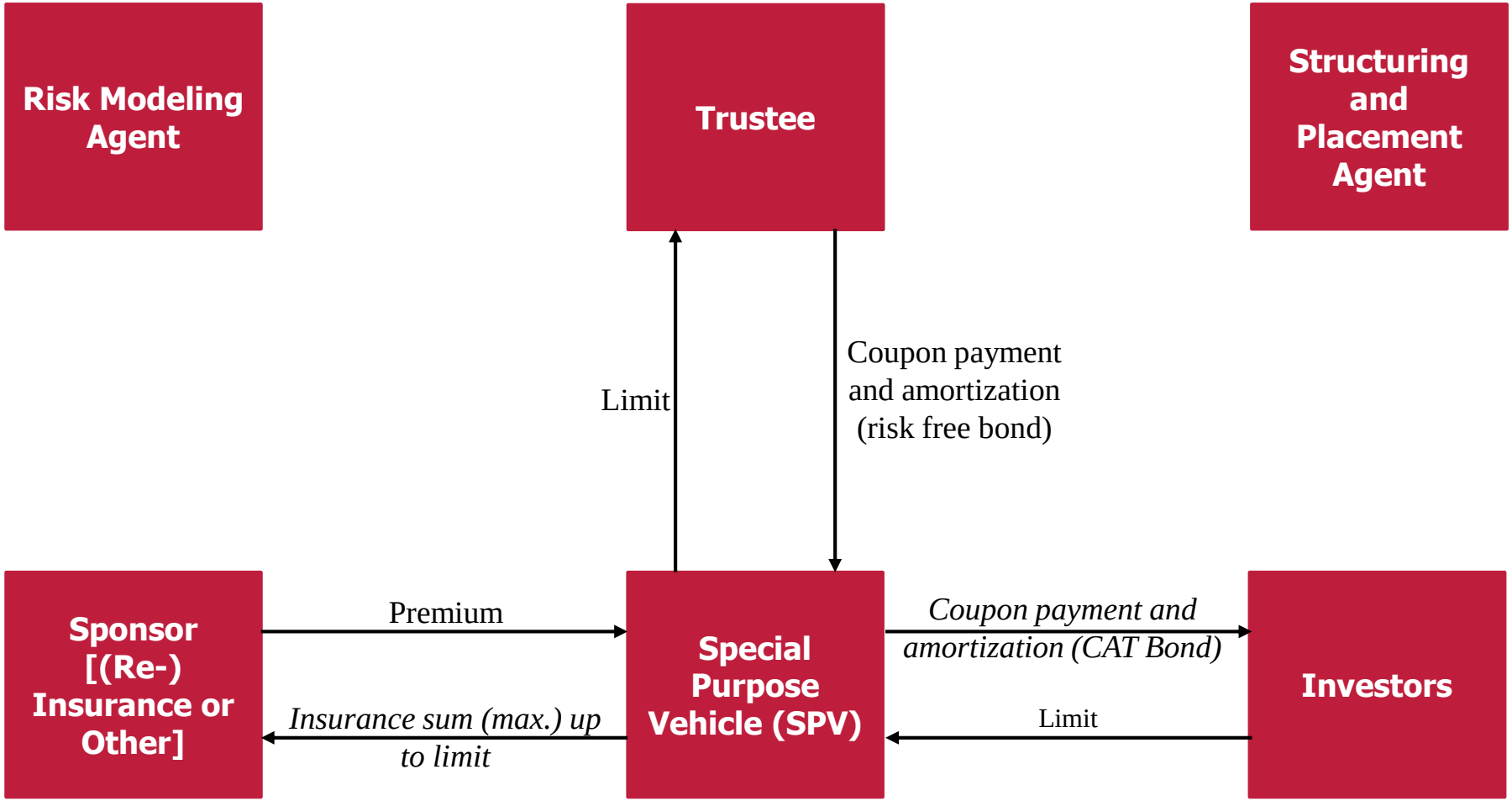
CAT bonds represent an alternative instrument to transfer catastrophic risk



Cash flows in italics are dependent on the (non-)occurence of a trigger event.

Evidence on some determinants of CAT bond premia is sparse

- Increasing alternative transfer of catastrophic risk via CAT bonds.
- Bond-specific determinants of the spread identified in empirical studies (Gürtler et al., 2016; Braun, 2016).
- Evidence on further determinants of the spread is sparse or controversial.

Sponsor characteristics (Braun, 2016)	*1.Are sponsor characteristics relevant for the pricing of CAT bonds?*
Trigger mechanism (Berge, 2005; Dieckmann, 2008; Lei et al., 2008; Papachristou 2011; Braun, 2016; Gürtler et al., 2016)	*2.How can diverging results on the trigger mechanism be explained?*
(Catastrophic) events (Gürtler et al., 2016)	*3.Can the CAT bond market also be affected by events occurring outside the US?* *4.Are event-induced downward shifts of premia equally possible on the CAT bond market?*

1. Introduction
2. **Hypotheses**
3. Data
4. Empirical Results
5. Conclusion

Literature and anecdotal evidence lead to sponsor-specific hypotheses

Evidence

- Anecdotal evidence (Spry, 2009): CAT bond investors reward sponsors with strong track records with lower spreads.
- ABS market: Faltin-Traeger et al. (2011) and Faltin-Traeger and Mayer (2012) show positive effect of sponsor diversification on ABS performance.

Experience and diversification hypothesis (H1):

Sponsors with greater experience/diversification in the CAT bond market have to pay lower risk premia.

Evidence

- Major CRAs consider sponsors' financial strength in the bond rating itself (S&P, 2012).
- Rationale: Investors possibly take into account credit risk beyond consideration by CRAs.
- Faltin-Traeger et al. (2011) and Faltin-Traeger and Mayer (2012) find that a better sponsor rating increases the time period over which ABS retain their initial rating.

Rating hypothesis (H2):

CAT bond risk premia are higher for sponsors without a rating or with a speculative grade rating than for sponsors with an investment grade rating.

Literature and anecdotal evidence lead to sponsor-specific hypotheses

Evidence

- In many CAT bond deals, sponsor is also participating in structuring and placement process or is affiliated with structuring and placement agent.
- Mixed evidence on vertical integration from the ABS market (Faltin-Traeger et al., 2010, 2011; Faltin-Traeger and Mayer, 2012).
  - ➢ Effects on the CAT bond market might also be ambivalent.
  - ➢ Positive effect of additional other structuring and placement agent.

Vertical integration hypothesis (H3):

In CAT bond deals, in which the sponsor adopts the role of the structuring and placement agent together with one or more other agents, risk premia are lower.

Evidence

- Mixed results of empirical literature on trigger type's effect on premia (Berge, 2005; Dieckmann, 2008; Lei et al., 2008; Papachristou, 2011; Braun, 2016; Gürtler et al., 2016).
- Rationale: Trigger effect might depend on the level of losses in the market/company.

Trigger hypothesis (H4):

CAT bonds with indemnity trigger reveal higher risk premia, and this effect is most pronounced when the CAT bond market faces large losses.

Literature and anecdotal evidence lead to sponsor-specific hypotheses

Evidence

- Investors take into account the sponsor's actual exposure and loss experience (in the primary insurance market).
- Sponsors' loss experience determines if investors perceive moral hazard risk for CAT bonds with indemnity trigger.

Loss experience hypothesis (H5):

The sponsor's loss experience in the insured region has a significant positive effect on the risk premia of CAT bonds with indemnity triggers.

Literature and anecdotal evidence lead to event-specific hypotheses

Evidence

- Magnitude of earthquake damages in Japan comparable to that of Hurricane Katrina, but:
  - Japan earthquake is a 'non-peak peril'.
  - ➢ Consequences of event might have been less severe.
- Muteki, a Japan earthquake bond issued by Zenkyoren, defaulted with a total principal loss of 300m USD.

Tohoku hypothesis (H6):

After the Tohoku Earthquake, CAT bond risk premia increased significantly.

Evidence

- Faias and Guedes (2017): positive performance surprise during a devastating event attracts new investors to the CAT bond market.
  - ➢ Lower risk premia.
- Anecdotal evidence of a fast market recovery after Hurricane Sandy.

Market performance hypothesis (H7):

After a large catastrophic event that did not cause defaults on the CAT bond market, risk premia decrease.

Literature and anecdotal evidence lead to event-specific hypotheses

Evidence

- US hurricane is the most meaningful event for the CAT bond market.
- 2009 season was passed without any event causing catastrophic losses.
- Great variance in the damages from succeeding hurricane seasons.
  - ➢ Do investors' learning processes also take into account positive performance experiences after the non-occurrence of natural catastrophes?

No event hypothesis (H8):

If the Atlantic hurricane season passes without the occurrence of any major event and without large losses, CAT bond risk premia decrease.

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Analysis employs panel data set on CAT bond spread

- Panel data set
- Measure for the risk premium: **quarterly average spread over LIBOR**
- Time period: Q2/2002 – Q1/2017
- Data Sources:
  - Lane Financial LLC
  - Artemis Deal Directory
  - Aon Benfield
  - Thomson Reuters Eikon
  - National Association of Insurance Commissioners (NAIC).

➢ **1,951 observations from 461 CAT bonds**

- Variables:
  - CAT bond- and sponsor-specific
  - Macroeconomic
  - Event variables

Summary Statistics – Nominal and Ordinal Variables

	Obs.	Percentage
Trigger		
Indemnity	154	33.41
Non-Indemnity	307	66.59
Peril type		
Hurricane (HU)	281	60.95
Wind	167	36.23
Earthquake (EQ)	297	64.43
Peril region		
North America (NA)	347	75.27
Europe (EU)	133	28.85
Japan (JP)	83	18.00
Other	43	9.33
Rating		
AA	4	0.87
A	4	0.87
BBB	18	3.90
BB	218	47.29
B	105	22.78
No Rating	112	24.30
Sponsor Rating		
Investment Grade	1623	83.19
Speculative Grade	176	9.02
No Rating	152	7.79
Structuring and Placement		
Other only	288	62.47
Sponsor	173	37.53
thereof Sponsor and Other	37	8.03

Summary Statistics – Cardinal Variables

	Obs.	Mean	Std. Dev.	Min.	q25	q50	q75	Max.
CAT-bond-specific variables								
Premium (in %)	1951	5.98	4.11	0.67	3.20	4.96	7.36	35.67
Expected Loss (EL) (in %)	461	2.26	2.22	0.00	0.86	1.40	2.98	14.75
No. of Locations	461	1.44	0.90	0.00	1.00	1.00	2.00	4.00
No. of Perils	461	1.77	1.12	1.00	1.00	1.00	2.00	5.00
Volume (in USD million)	461	122.92	120.95	2.10	50.00	100.00	155.00	1500.00
Maturity (in years)	461	3.01	0.97	1.00	3.00	3.00	3.50	5.08
TTM (in years)	1951	2.06	1.11	-0.75	1.00	2.00	3.00	5.08
Sponsor-specific variables								
Diversification	1951	5.83	4.40	1.00	1.00	5.00	8.00	16.00
Experience	1951	12.06	12.88	0.00	3.00	6.00	18.00	52.00
Loss Ratio (in %)	461	50.84	16.48	3.25	38.91	50.10	62.46	92.47
Reinsurance Ratio (in %)	461	4.51	8.25	0.00	0.46	1.51	2.86	63.81
Macroeconomic variables								
Reins. Index (yearly) (in %)	16	-0.06	13.78	-11.20	-8.82	-6.76	6.42	36.59
S&P500 (quarterly) (in %)	60	1.53	7.92	-22.56	-2.10	2.05	5.78	15.22
Corp. Spread (in %)	1951	5.41	2.60	0.39	3.54	5.31	6.84	17.57

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Random effects estimation confirms sponsor-specific hypotheses

	(I.1)	(I.2)
Experience	0.004	
	(0.7421)	
Diversification	-0.127***	-0.123***
	(0.0002)	(0.0000)
Sponsor Rating		
Speculative Grade	0.492*	0.487*
	(0.0322)	(0.0338)
No Rating	0.613*	0.612*
	(0.0218)	(0.0216)
Sponsor in Structuring and Placement	0.332	0.414
	(0.2900)	(0.1725)
Sponsor and Other in Struct. and Plcmt.	-0.809*	-0.826*
	(0.0231)	(0.0175)
Trigger Indemnity	0.410*	0.407*
	(0.0271)	(0.0280)
Bond-specific controls	yes	yes
Year fixed effects	yes	yes
EL × year	yes	yes
Observations	1951	1951
μ_a	3.117***	3.070**
σ_a	1.3569***	1.3572***
LM statistic	497.14	507.54
σ_u	1.0530	1.0559
R^2	0.8527	0.8529
Adjusted R^2	0.8485	0.8488

Experience and Diversification Hypothesis (H1): ✓

Rating Hypothesis (H2): ✓

Vertical Integration Hypothesis (H3): ✓

Trigger Hypothesis (H4): ✓

Fixed effects estimation confirms loss experience hypothesis

	(II.1)	(II.2)	(II.3)
TTM	1.344*	1.366*	1.365*
	(0.030)	(0.028)	(0.028)
Macroeconomic variables			
S&P500	0.017†	0.017†	0.017†
	(0.089)	(0.083)	(0.071)
Corp. Credit Spread	0.290***	0.301***	0.297***
	(0.000)	(0.000)	(0.000)
Exposure variables			
Loss Ratio		0.001	0.001
		(0.804)	(0.821)
Reinsurance Ratio		0.022	0.022
		(0.217)	(0.208)
(Trigger Indemnity or Hybrid) × Loss Ratio			0.018**
			(0.004)
Trigger Indemnity × Loss Ratio		0.018**	
		(0.005)	
Constant	-7.159	-8.241	-8.203
	(0.188)	(0.126)	(0.128)
Year fixed effects	yes	yes	yes
EL × Year	yes	yes	yes
Observations	461	461	461
Within-R^2	0.847	0.850	0.850
Adjusted within-R^2	0.838	0.840	0.840

Loss Experience Hypothesis (H5): ✓

Fixed effects estimation confirms event-specific hypotheses

	(III.1)	(III.2)	(III.3)	(III.4)	(III.5)	(III.6)
TTM	0.029	-0.010	0.020	0.439***	0.432***	0.430***
	(0.856)	(0.950)	(0.902)	(0.000)	(0.000)	(0.000)
Event dummies						
Season 2005				1.814***	1.164***	1.279***
				(0.000)	(0.000)	(0.000)
Lehman				4.064***	3.712***	3.637***
				(0.000)	(0.000)	(0.000)
Season 2009				-1.839***	-1.264***	-1.213**
				(0.000)	(0.001)	(0.010)
Sandy				-2.263***	-0.574†	-0.720†
				(0.000)	(0.058)	(0.090)
Interaction effects						
EL × Season 2005					0.533*	0.251
					(0.047)	(0.276)
EL × Lehman					0.211	0.149
					(0.223)	(0.480)
EL × Season 2009					-0.343*	-0.330†
					(0.012)	(0.060)
EL × Sandy					-0.849***	-0.736**
					(0.000)	(0.007)
Trigger Indemnity × Season 2005						-1.049
						(0.417)
Trigger Indemnity × Lehman						0.445
						(0.534)
Trigger Indemnity × Season 2009						-0.257
						(0.670)
Trigger Indemnity × Sandy						0.322
						(0.577)
EL × Trigger Indemnity × Season 2005						2.111***
						(0.000)
EL × Trigger Indemnity × Lehman						0.221
						(0.504)
EL × Trigger Indemnity × Season 2009						-0.093
						(0.695)
EL × Trigger Indemnity × Sandy						-0.259
						(0.387)
Constant	7.143***	4.539**	4.109**	2.989***	2.674***	2.277***
	(0.000)	(0.003)	(0.004)	(0.000)	(0.000)	(0.000)
Year fixed effects	yes	yes	yes	no	no	no
EL × Year	no	yes	yes	no	no	no
Trigger Indemnity × Year	no	no	yes	no	no	no
EL × Trigger Indemnity × Year	no	no	yes	no	no	no
Observations	1951	1951	1951	1951	1951	1951
Within-R^2	0.428	0.491	0.520	0.488	0.522	0.538
Adjusted within-R^2	0.423	0.483	0.504	0.487	0.519	0.534

Tohoku Hypothesis (H6): ✗

Market Performance Hypothesis (H7): ✓

No Event Hypothesis (H8): ✓

Trigger Hypothesis (H4): ✓

Results prove stable in a range of robustness checks

Variable(s)	Robustness check	Result
Sponsor rating	Alternative inclusion of dummy variables for the rating classes "AAA", "AA", "A", "BBB", "BB and worse" and "No rating".	No systematic differences between rating classes within the investment grade segment or the speculative grade segment.
Experience	Alternative specification, also taking into account whether a sponsor participated in the structuring and placement of another sponsor's bond.	No significantly different results from those for the original version of this variable.
Tohoku	Including a Tohoku dummy (and the corresponding interaction terms).	None of the Tohoku-related terms is significant.
Event variables	Isolated event analysis (e.g. comparison of pre-Sandy to post-Sandy risk premia).	Confirmation of the results obtained in the overall sample.

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Sponsor characteristics and (non-)events significantly influence CAT bond premia

1.Are sponsor characteristics relevant for the pricing of CAT bonds?	▪ Investors also consider sponsor characteristics for pricing CAT bonds in the secondary market. ▪ Investors are aware of the loss experience of sponsors of fully or partly indemnity triggered CAT bonds and consider this as a factor in pricing the bonds.
2.How can diverging results on the trigger mechanism be explained?	▪ The indemnity trigger has a positive effect on risk premia when loss levels are high.
3.Can the CAT bond market also be affected by events occurring outside the US?	▪ Events in the USA seem to have the most dominant effect on the CAT bond market.
4.Are event-induced downward shifts of premia equally possible on the CAT bond market?	▪ Events that incur only minor damages on the CAT bond market (Sandy) are considered as a signal of market strength. ▪ The non-occurrence of (expected) events causes downward shifts of risk premia in the CAT bond market.

Questions? Remarks?

Backup

Data

- Measure for the risk premium: **quarterly average spread over LIBOR**
- CAT bond data from Lane Financial LLC
- Time period: Q2/2002 – Q1/2017
- Exclusion of
  - observations with missing or implausible data,
  - distressed/defaulted bonds
  - for hurricane and windstorm bonds: observations, where term to maturity ≠ multiple of a year

➢ **1,951 observations from 461 CAT bonds**

Variables

Dependent variable

- Average quarterly secondary market spread over LIBOR

Bond-specific variables

- Expected loss
- Bond rating: Dummy variables for rating classes AA, A, BBB, BB and B
- Maturity
- Time-To-Maturity
- Number of covered regions
- Number of covered perils
- Dummy variables for trigger types (indemnity vs. non-indemnity)
- Dummy variables for US/EU/JP and other perils
- Dummy variables for hurricane and wind bonds

Variables

Sponsor-specific variables

- Sponsor rating: Dummy variables for rating categories investment grade, speculative grade and no rating
- Diversification: Number of combinations of peril type and region covered by CAT bonds of the same sponsor
- Experience: Number of already issued CAT bond tranches by a sponsor
- Sponsor in Structuring and Placement: Dummy variable equal one if sponsor participates in structuring and placement
- Sponsor and other in structuring and placement: Dummy variable equal one if sponsor and other agent participate in structuring and placement
- Loss experience of previous year:

$$loss\ ratio = \frac{losses\ incurred}{premiums\ earned}$$

- Reinsurance ratio of previous year:

$$reinsurance\ ratio = \frac{reinsurance\ ceded}{reinsurance\ assumed + direct\ premiums}$$

Variables

Macroeconomic and event-specific variables

- Time dummies for selected events
- Quarterly return of the S&P500
- Annual return of „Rate-on-Line Reinsurance Index"
- Credit spreads of corporate bonds with the same rating class

Table of Correlations

	Prem.	EL	No.Lc.	No.Pe.	Vol.	Mat.	TTM	Div.	Exp.	Rein.	S&P	Sp.Cp.
Premium	1.00											
EL	0.79	1.00										
No. of Loc.	0.31	0.32	1.00									
No. of Perils	0.29	0.22	0.36	1.00								
log(Volume)	-0.15	-0.15	-0.05	0.07	1.00							
Maturity	-0.25	-0.19	-0.07	0.08	0.11	1.00						
TTM	-0.03	-0.05	0.02	0.09	0.11	0.54	1.00					
Divers.	0.21	0.26	0.12	0.06	-0.41	-0.31	-0.27	1.00				
Exp.	0.16	0.28	0.04	-0.02	-0.30	-0.23	-0.29	0.82	1.00			
Reins. Index	0.25	0.04	-0.00	-0.03	-0.16	-0.10	0.03	0.13	0.05	1.00		
S&P500	-0.01	0.04	0.03	0.06	0.01	0.07	0.07	-0.07	-0.04	0.09	1.00	
Corp. Spread	0.31	0.23	0.04	0.06	0.15	0.01	0.03	-0.09	0.04	-0.16	-0.32	1.00

Regression model

Random effects estimation of the influence of (largely) time invariant factors (bond-specific factors, **rating, experience and diversification, structuring and placement, trigger**)

$$Spread_{i,t} = \beta' \cdot X_i + \gamma' \cdot Y_t + \delta' \cdot Z_{i,t} + \alpha_i + \varepsilon_{i,t}$$

Fixed effects estimation of the influence of time-variant factors (reinsurance price index, corporate bond spread, S&P500 return**, catastrophic events, loss ratio**)

$$Spread_{i,t} = \gamma' \cdot \hat{Y}_t + \delta' \cdot \hat{Z}_{i,t} + \hat{\varepsilon}_{i,t}$$

Effect of Event Variables

	(IV.1)	(IV.2)	(IV.3)	(IV.4)
TTM	0.433***	0.304***	0.301***	0.294***
	(0.000)	(0.000)	(0.000)	(0.000)
Macroeconomic variables				
Reins. Index		0.021***	0.021***	0.022***
		(0.000)	(0.000)	(0.000)
S&P500		0.003	0.002	0.004
		(0.476)	(0.598)	(0.349)
Corp. Credit Spread		0.130***	0.129***	0.102***
		(0.000)	(0.000)	(0.000)
Event dummies				
Season 2005	1.216***	0.441	0.049	0.012
	(0.000)	(0.212)	(0.893)	(0.974)
Lehman	4.050***	2.989***	2.963***	2.202***
	(0.000)	(0.000)	(0.000)	(0.000)
Season 2009	-1.373***	-0.803*	-0.378	0.133
	(0.000)	(0.015)	(0.229)	(0.806)
Sandy	-0.572†	-0.473	-0.180	-0.187
	(0.058)	(0.115)	(0.596)	(0.578)
Interaction effects with Season 2005, Season 2009 and Sandy				
EL × Season 2005	0.281	0.262	0.428†	0.424†
	(0.217)	(0.245)	(0.058)	(0.061)
EL × Sandy	-0.849***	-0.853***	-0.364*	-0.366*
	(0.000)	(0.000)	(0.018)	(0.017)
EL × Season 2009	-0.279*	-0.281*	-0.347**	-0.332**
	(0.016)	(0.012)	(0.001)	(0.003)
EL × Trigger Indemnity × Season 2005	1.672***	1.694***	2.113***	2.096***
	(0.000)	(0.000)	(0.000)	(0.000)
Season 2005 × Hurricane			2.141*	2.132*
			(0.027)	(0.027)
Season 2009 × Hurricane			-1.207**	-1.144*
			(0.009)	(0.010)
Sandy × Hurricane			-0.890†	-0.895†
			(0.051)	(0.050)
EL × Season 2005 × Hurricane			-1.239*	-1.220*
			(0.015)	(0.016)
EL × Season 2009 × Hurricane			0.277†	0.254
			(0.094)	(0.136)
EL × Sandy × Hurricane			-0.459*	-0.457†
			(0.050)	(0.050)
Interaction effects with Lehman				
Corp. Credit Spread × Lehman				0.082*
				(0.036)
Corp. Credit Spread × Season 2009				-0.054
				(0.357)
Constant	2.246***	2.750***	2.858***	3.067***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	1951	1951	1951	1951
Within-R^2	0.533	0.562	0.580	0.582
Adjusted within-R^2	0.531	0.559	0.576	0.578

Tohoku Hypothesis (H6): ✗

Market Performance Hypothesis (H7): ✓

No Event Hypothesis (H8): ✓

Trigger Hypothesis (H4): ✓