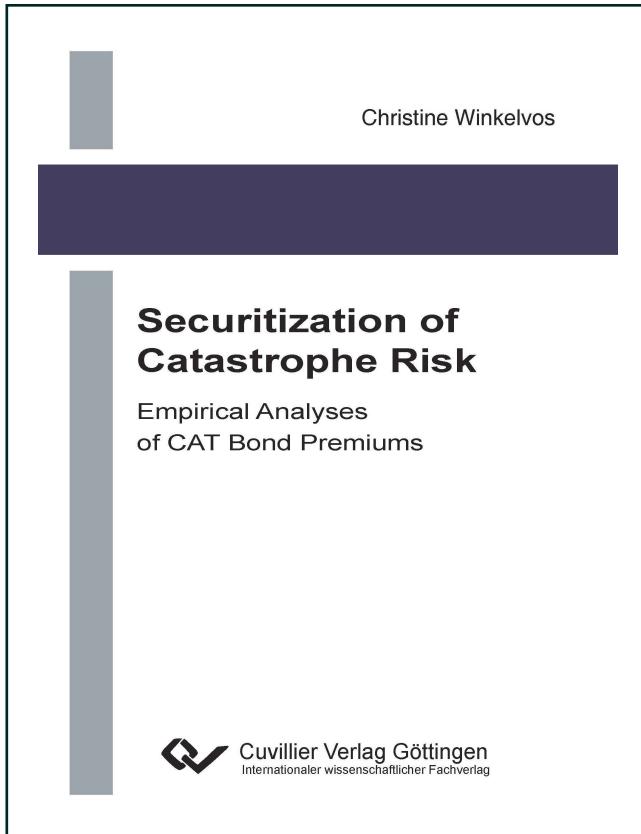




Christine Winkelvos (Autor)
Securitization of Catastrophe Risk
Empirical Analyses of CAT Bond Premiums



<https://cuvillier.de/de/shop/publications/6280>

Copyright:
Cuvillier Verlag, Inhaberin Annette Jentzsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen,
Germany
Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>



Contents

1	Introduction	1
1.1	Problem Definition and Objectives of This Work	1
1.2	Course of Investigation	3
2	Management of Catastrophe Risk	5
2.1	Definition and Impact of Catastrophes	5
2.2	Catastrophe Risk Management	9
2.3	Catastrophe Risk Insurance	11
2.3.1	Insurability of Catastrophe Risk	11
2.3.2	Traditional Reinsurance	13
2.3.2.1	Definition and Market Development	13
2.3.2.2	Proportional Reinsurance	14
2.3.2.3	Non-Proportional Reinsurance	15
2.3.2.4	Motivation for Alternative Risk Transfer	16
2.3.3	Alternative Risk Transfer	17
2.3.3.1	Definition	17
2.3.3.2	Alternative Risk Carriers	19
2.3.3.3	Alternative Risk Products	20
2.3.3.3.1	Hybrid Products	20
2.3.3.3.2	Financial Instruments	21
3	Catastrophe Bonds	25
3.1	Basic CAT Bond Structure	25
3.2	Market Development	27
3.3	Specifications of CAT Bonds	30
3.3.1	Peril	30
3.3.2	Trigger Mechanisms	31
3.3.2.1	Moral Hazard, Adverse Selection and Basis Risk .	31
3.3.2.2	Indemnity Trigger	33
3.3.2.3	Non-indemnity Trigger	35
3.3.3	Cash Flows	36
3.4	Risk Assessment	38
3.4.1	Catastrophe Risk	38
3.4.2	Counterparty Risk and Interest Rate Risk	39
3.4.3	Rating	41

3.5	Capabilities and Advantages of CAT Bonds	43
3.5.1	The Sponsor's View	43
3.5.2	The Investor's View	45
3.6	Challenges of CAT Bonds	46
3.7	Pricing of CAT Bonds	47
3.8	Appendix to Chapter 3	49
3.8.1	CAT Bond Rating Processes of Different Companies	49
4	Premium Calculation Principles	51
4.1	Motivation and Definitions	51
4.2	Premium Components	54
4.2.1	Net Risk Premium	54
4.2.2	Risk Premium	56
4.3	Properties of Premium Calculation Principles	57
4.4	Basic Premium Principles	60
4.4.1	Net Risk and Maximum Loss Principle	60
4.4.2	Expected Value, Variance and Standard Deviation Principle	61
4.5	Theoretical Premium Principles	62
4.5.1	Zero-Utility Principle	62
4.5.2	Distortion Premium Principle	64
4.5.2.1	Motivation	64
4.5.2.2	Definitions for Choquet Integral Representation . .	65
4.5.2.3	Choquet Integral	66
4.5.2.4	Distorted Probabilities and Distortion Premium Principle	67
4.5.3	Application of Distortion Premium Principles	69
4.5.3.1	Wang1 Transformation	69
4.5.3.2	Wang2 Transformation	71
4.6	Appendix to Chapter 4	73
4.6.1	Expected Value of Loss Variable X	73
4.6.2	Expected Risk Process in CLM	73
4.6.3	Expected Risk Process with Infinite Horizon	74
4.6.4	Properties of the Expected Value Principle	75
4.6.5	Properties of the Variance Principle	76
4.6.6	Properties of the Standard Deviation Principle	77
4.6.7	Distortion Operator Defines a Capacity	78
4.6.8	Necessary Criteria for Wang1 Transformation	79
4.6.9	Wang1 Transformation and Normally Distributed Risks . .	80
4.6.10	Student's t -Distribution	80
5	Accuracy of Premium Calculation Models	83
5.1	Fundamentals and Research Questions	83
5.2	Literature Review	84

5.3	Empirical Methodology	87
5.3.1	General Procedure	87
5.3.2	Predicting the CAT Bond Premium – the Test Environment	88
5.4	Data	90
5.4.1	Descriptive Analysis	90
5.4.2	Premium Determining Factors – CAT Bond Specific	92
5.4.2.1	Trigger Mechanism	92
5.4.2.2	Rating	93
5.4.2.3	Peril	94
5.4.2.4	Maturity	95
5.4.3	Premium Determining Factors – Macroeconomic	96
5.4.3.1	Reinsurance Cycle	96
5.4.3.2	Seasonal Effects	96
5.4.3.3	Capital Markets	97
5.5	Empirical Results	98
5.5.1	Reduced Data Set – Stable Market Environment	98
5.5.2	Complete Data Set – Consideration of the Financial Crisis	100
5.6	Interim Result	103
5.7	Appendix to Chapter 5	105
5.7.1	Linear1 and Loglinear1 Models	105
5.7.2	Linear2 and Loglinear2 Models	106
5.7.3	Wang1 and Wang2 Models	107
5.7.4	Assumptions of Linear Regressions	108
5.7.4.1	No Perfect Collinearity	108
5.7.4.2	Normal Distribution of Residuals	109
5.7.5	Goodness-of-Fit and Model Significance	110
5.7.6	Out-of-Sample Analysis	111
5.7.7	Reduced Data Set – Assumptions of Regression	112
5.7.7.1	Normal Distribution of Residuals	112
5.7.7.2	Collinearity of Variables	114
5.7.8	Complete Data Set – Assumptions of Regression	114
5.7.8.1	Normal Distribution of Residuals	114
5.7.8.2	Collinearity of Variables	115
6	Premium Determinants and the Impact of Catastrophes on Premiums	117
6.1	Fundamentals and Research Questions	117
6.2	Hypotheses	118
6.2.1	CAT Bond Specific Hypotheses	118
6.2.2	Macroeconomic and Event Hypotheses	121
6.3	Data	123
6.3.1	Sample Selection	123

6.3.2	Variables	125
6.3.2.1	CAT Bond Specific Variables	125
6.3.2.2	Macroeconomic Variables	126
6.3.2.3	Event Variables	127
6.3.3	Descriptive Statistics	128
6.4	Empirical Results	129
6.4.1	Benchmark	130
6.4.2	Analysis of the Expected Loss	132
6.4.3	Analysis of CAT Bond Specific Variables	132
6.4.4	Analysis of Macroeconomic Factors	135
6.4.5	Analysis of Catastrophe Events	137
6.5	Interim Result	140
6.6	Appendix to Chapter 6	142
6.6.1	Panel Data Set	142
6.6.2	Fixed Effects Models	143
6.6.3	Models with Intercept	144
6.6.3.1	Pooled Regression	144
6.6.3.2	Random Effects Models	145
6.6.4	Model Selection	146
7	Conclusion	149