



Insurance-Linked Securities

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ETH Risk Day

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Insurance-Linked Securities

Typical Structure

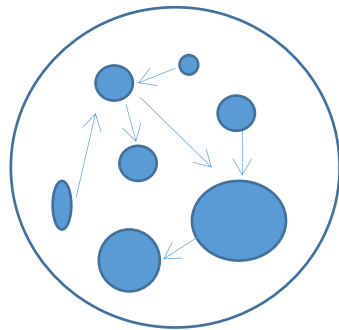


Organisations involved in such transactions:

- Cedants: (Re)insurance firms, governmental entities, corporates.
- Investors: Specialized funds, hedge funds, asset managers, pension funds, family offices, banks.
- Arrangers and Market Makers: Investment banks, securities houses, (re)insurance brokers, trading units, etc.
- Governance: Regulators, legal firms, auditors.
- Research: Natural scientists, engineers, mathematicians, economists, etc.

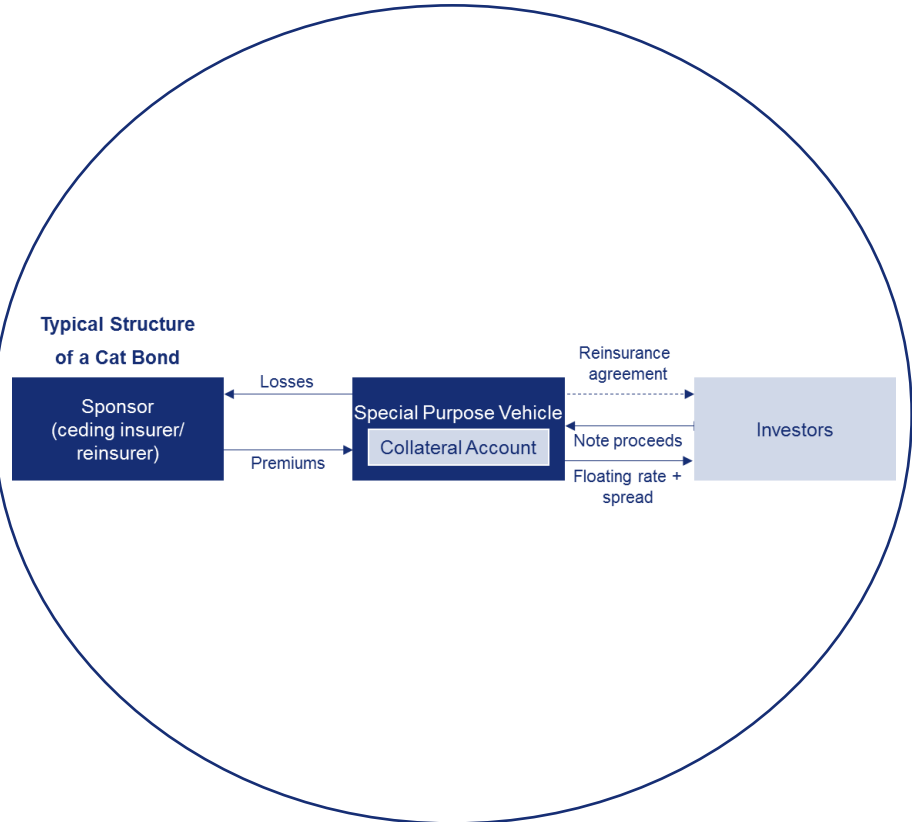
Insurance-Linked Securities Genesis

Traditional (re)insurance
market risk transfer
(Global market size: USD 4'613bn)



Need for new pool of capital required!
'Alternative' Risk Transfer!

Capital Markets (Global market size: USD 288'762bn)



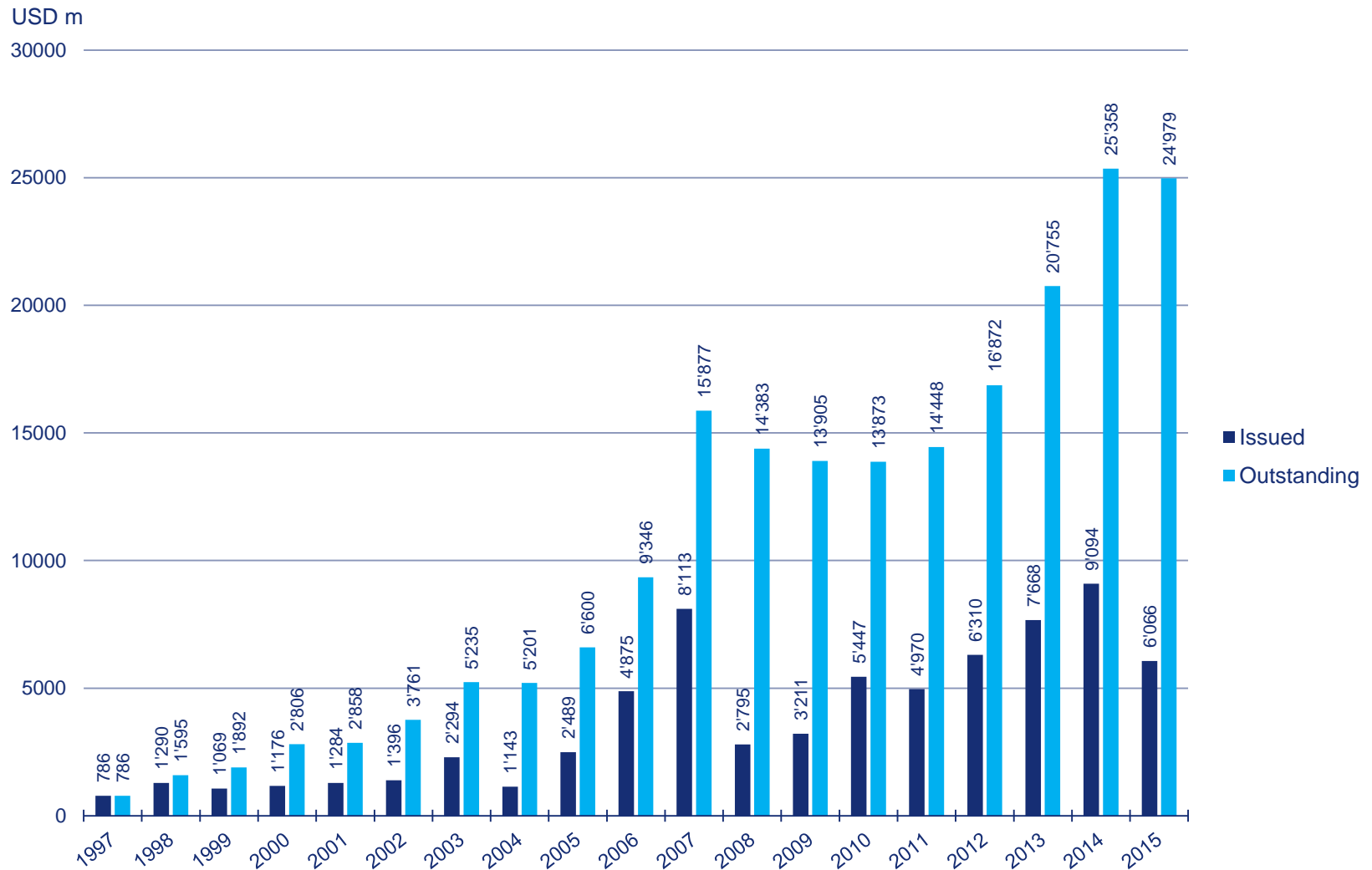
- Hurricane Andrew (1992)**
- Caused Insured **industry loss of c. USD 16bn** in Florida
 - Several Insurance companies **bankrupted**
 - Prompted **shortage of reinsurance** capacity and hardened pricing.
 - Facilitated **new methodologies** of insurance risk transfer.
 - Accelerated emergence **of scientific models** for assessing catastrophe risk



First ILS Transaction

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Catastrophe Bonds: Market Development



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Why did the market experience such a growth?

Supply (Cedants)	Demand (Investors)
Multi-year hedge	Short risk period, low duration risk
Diversification of capacity pool	Diversification and little correlation
Potentially regulatory capital relief	Well-defined risk, idiosyncratic
Reduced credit Risk	Reduced counterparty risk
Fully funded coverage	Fully collateralised
Flexible risk transfer structure	Properly structured securitization
Exposure management	Scientificallly modeled transactions

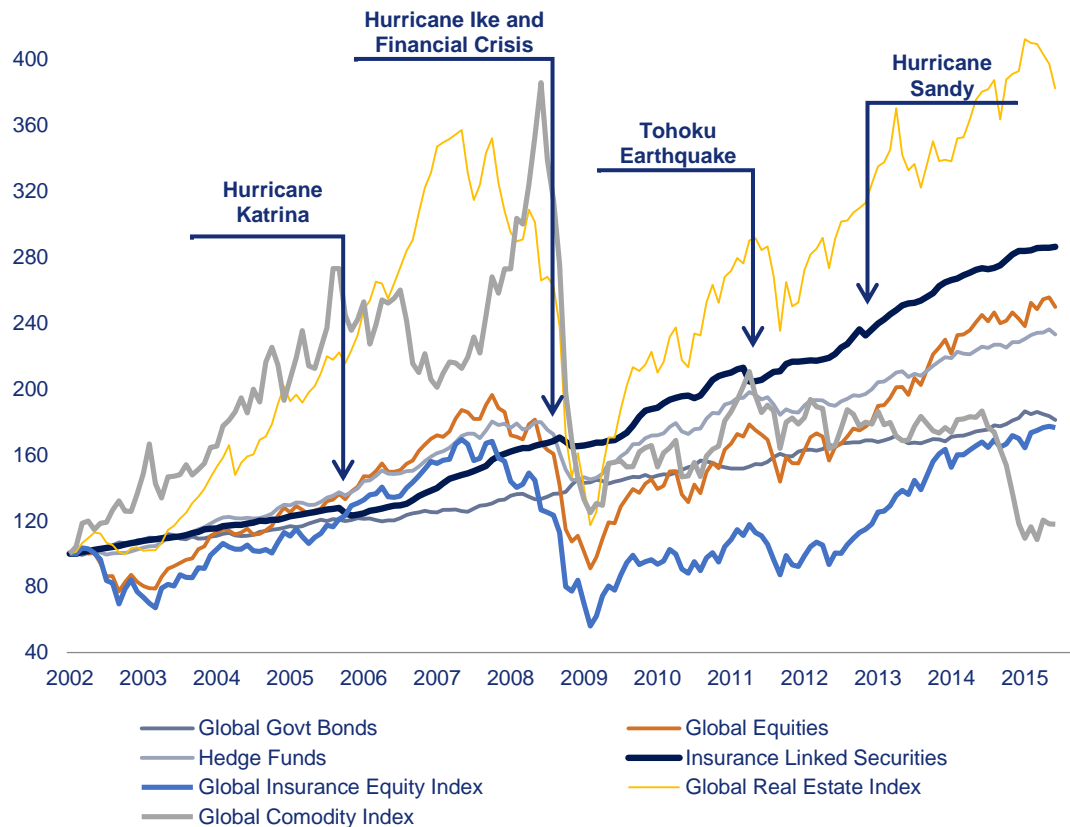


Win Win



Insurance-Linked Securities

Performance of this asset class



Index	Annualised returns	Annualised volatility
Insurance-Linked Securities ¹	8.16%	2.83%
Global Govt Bonds ²	4.63%	3.10%
Global Equities ³	7.20%	15.90%
Hedge Funds ⁴	6.58%	5.36%
Global Insurance Equity Index ⁵	4.59%	22.45%
Global Real Estate Index ⁶	10.79%	20.25%
Global Commodity Index ⁷	0.10%	24.61%

¹ Swiss Re Cat Bond Total Return Index

² JPMorgan Hedged USD GBI Global

³ MSCI World USD

⁴ Dow Jones Credit Suisse Hedge Fund Index

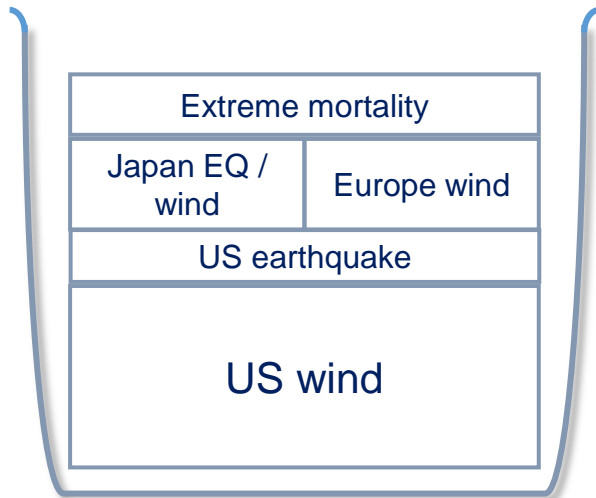
⁵ MSCI World/Insurance USD Gross Total Return

⁶ EPRA/NAREIT Dev. TR USD

⁷ S&P GSCI Official Close Index TR

Insurance-Linked Securities Investment Universe: risk type

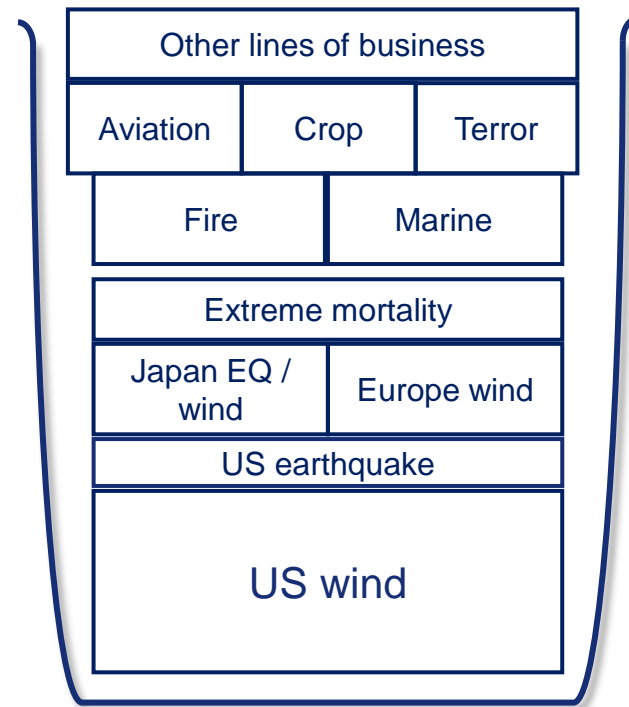
Cat Bonds
Market size USD 23bn



Non Catastrophe lines of business

Catastrophe lines of business

Private ILS
Market size USD 39bn



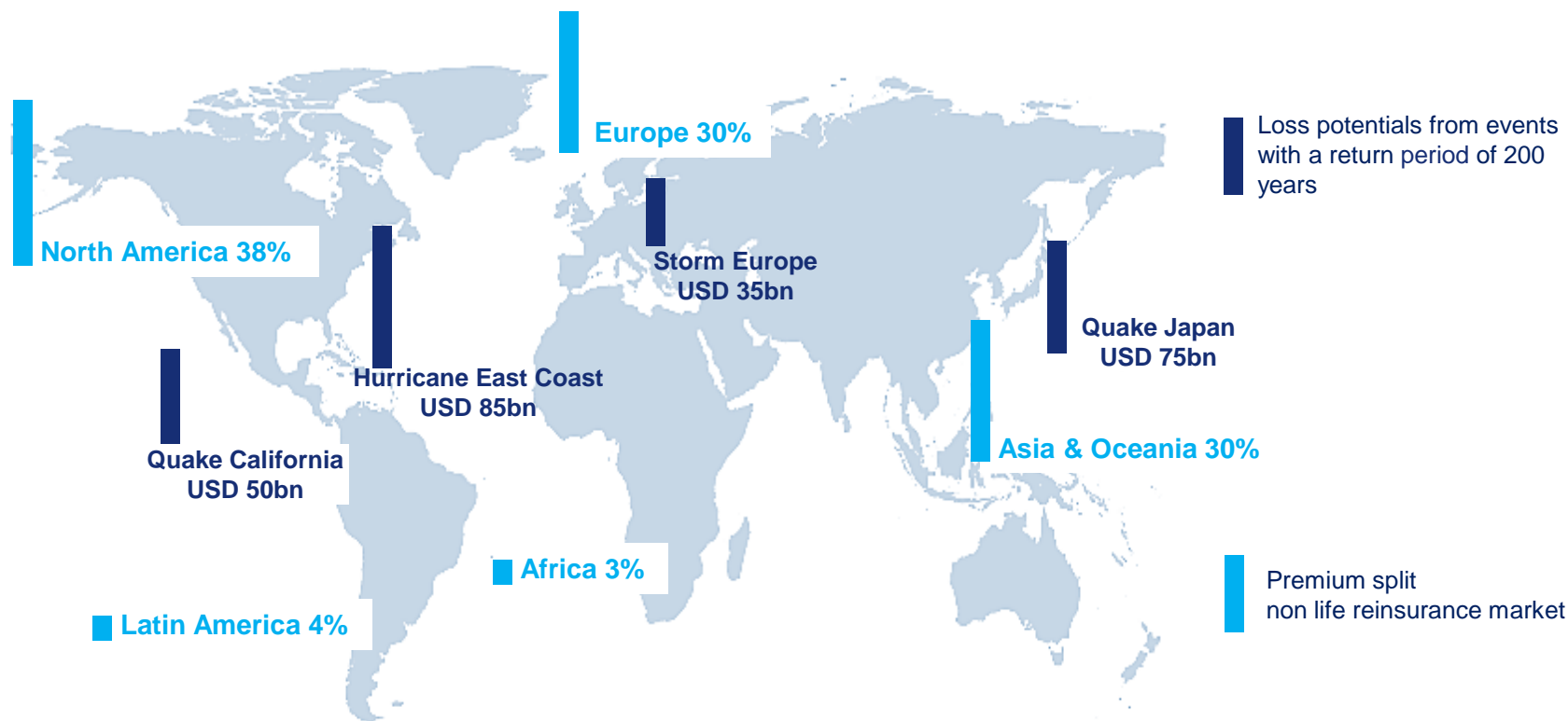
Increased diversity

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Investment universe: geographical split

Insurance loss potentials

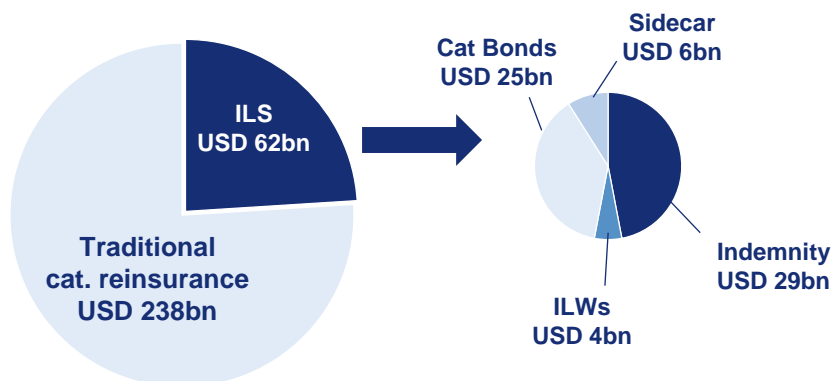
- Loss potentials from natural perils are rising, predominantly because of higher concentration of insured values in catastrophe prone areas
- The chart below suggests the areas with highest need for (re)insurance capacity
- The sheer size of numbers imply the need for a sharing of capacity in a larger group



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Market growth

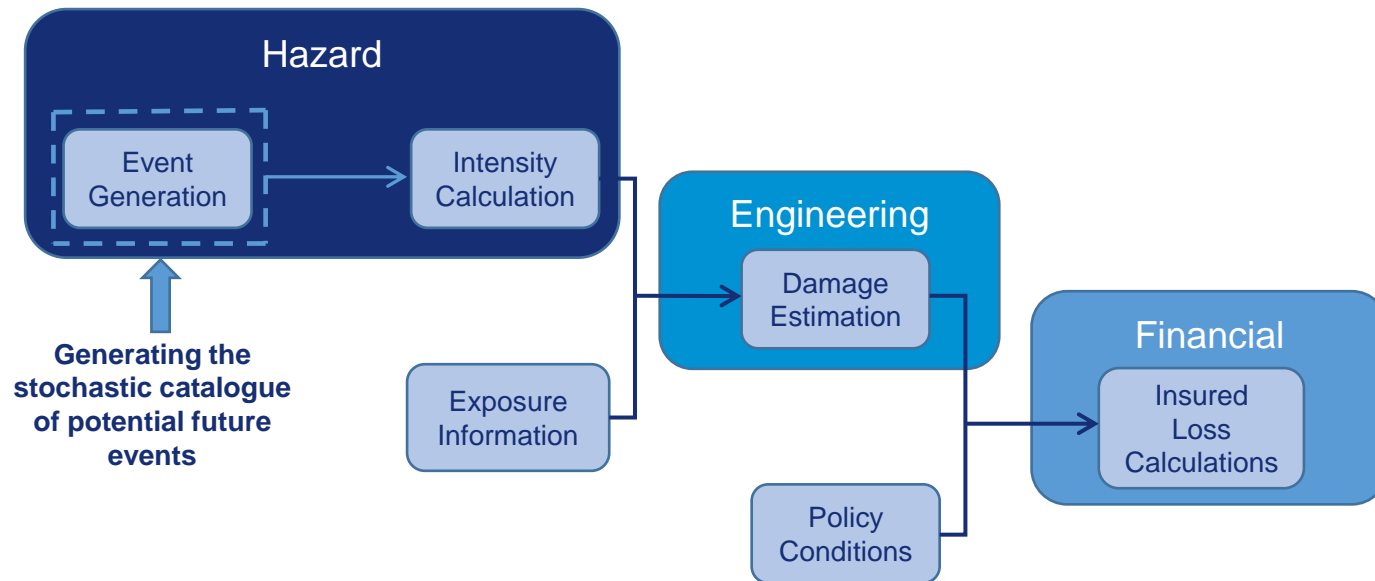
Market segment		Market size	Growth drivers
Traditional catastrophe reinsurance		USD 238bn	New sponsors, emerging markets, developing markets
ILS	Cat Bonds	USD 25bn	New sponsors, emerging markets, developing markets, market acceptance
	PILS- Indemnity based	USD 29bn	Solvency II, institutional investor demand
	PILS - Industry loss warranties (ILW)	USD 4bn	Solvency II, institutional investor demand
	PILS - Sidecars	USD 6bn	Solvency II, institutional investor demand



Growth is expected:

- Major events will highlight a gap between economic and insured losses in emerging markets and drive demand for market access to reinsurance
- Activity of the World Bank
- Collateralised reinsurance securities will become important tools for disaster relief and attract even greater interest from institutional investors

Insurance-Linked Securities Excursion to Nat Cat Modelling



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Excursion to Nat Cat Modelling: Typical Output

Event Type	Scenario	Severity		Frequency	
		Modeled Loss (USD bn)	SD Loss (USD bn)	Full Exposure (USD bn)	Yearly Event Rate
HUR FL	535	13.5	0.6	3'300	0.0000455
EQ CAL	2'354	87.1	3.2	2'500	0.000000321
...					
HUR TX	21'788	43.5	1.7	1'000	0.00000548

The (normalised) loss random variable of a transaction is defined as:

$$L = \sum_{i=1}^n \sum_{j=1}^{N_i} C_{ij}$$

n : number of rows

N_1, \dots, N_n : random variables representing the frequencies

$C_{ij}, 1 \leq i \leq n, j \in \mathbb{N}$: random variables representing normalized claims

The distribution of the above quantities is derived by the above Event Loss Table.

Key Risk Metrics

$$P(L > 0)$$

$$Exp[L]$$

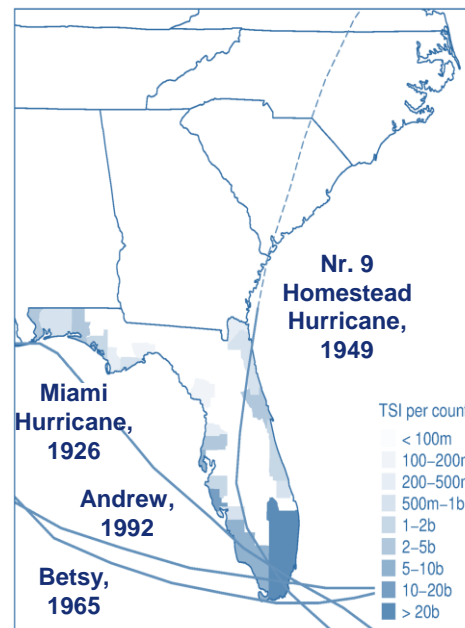
$$P(L = 1)$$

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Examples: Everglades 2014-1 Class A

Ceding Company:	Citizens Property Insurance
Original Principal Amount:	USD 1.5bn
Trigger Type:	Aggregate
Loss Reporting:	Indemnity
Peril Covered:	Hurricanes
Territorial Scope:	Florida
Attachment Level:	USD 5.202bn
Exhaustion Level:	USD 7.702bn
Attachment Probability:	2.89%
Expected Loss:	2.30%
Exhaustion Probability:	1.72%
Spread	7.50%

Exposure of the bond and modeled impact of historical event on bond

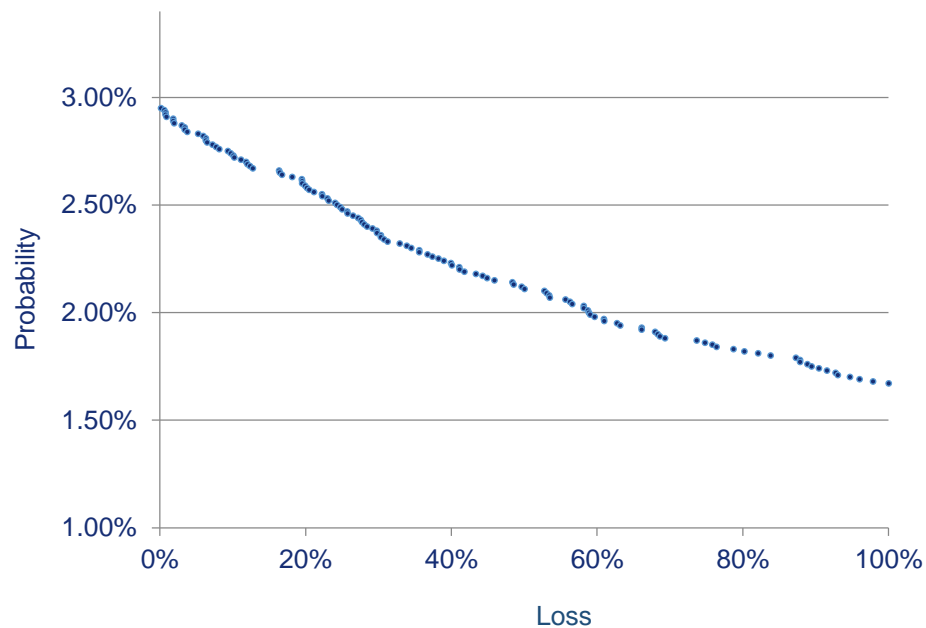


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Examples: Insurance Loss Warranty

Ceding Company:	XYZ re
Original Principal Amount:	USD 10m
Trigger Type:	Per Occurrence
Loss Reporting:	PCS
Peril Covered:	Earthquakes
Territorial Scope:	California
Attachment Level:	EUR 15bn
Exhaustion Level:	EUR 30bn
Attachment Probability:	2.95%
Expected Loss:	2.17%
Exhaustion Probability:	1.67%

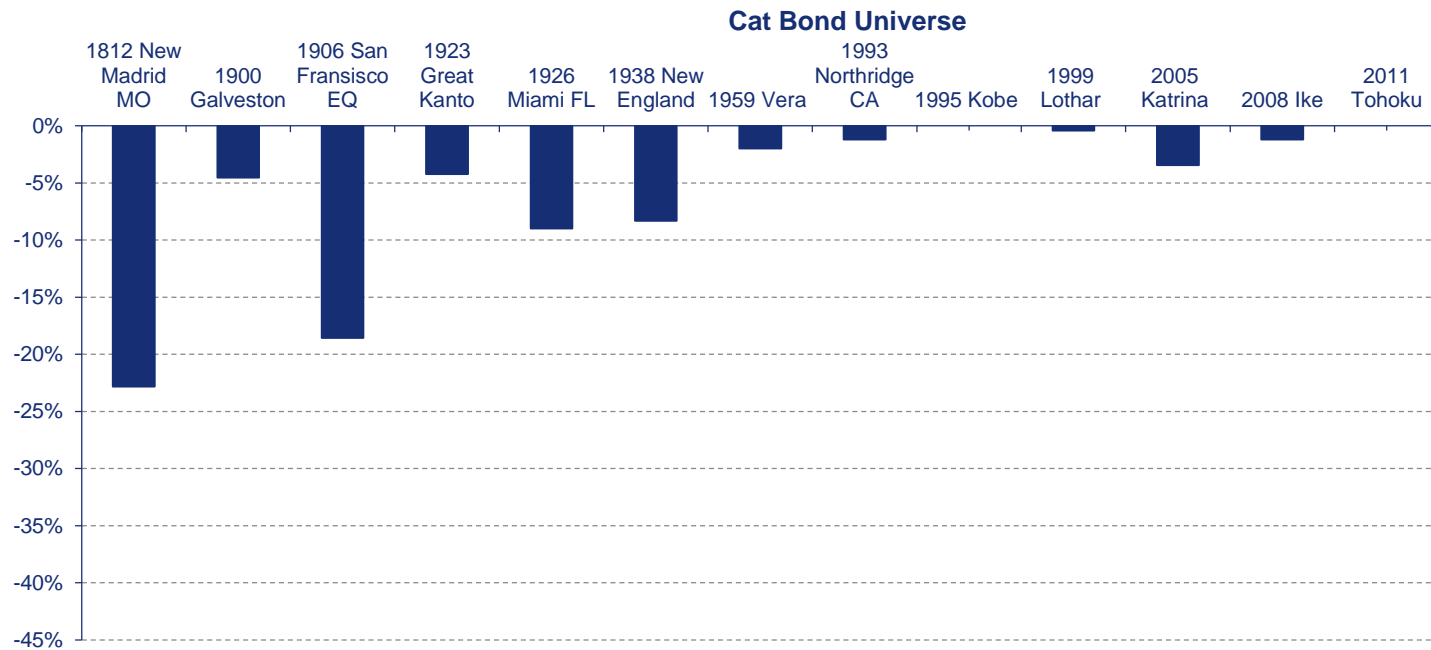
Loss Exceedance Probability Curve



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Drawdown analysis for Cat Bonds

Modelled drawdown as % of universe size



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Modelling accuracy: Basic Case Study

“...we use it [WYSIWYG] in the context of trying to assess how good ‘expected loss’ estimates are for investors in ILS. The short answer is, [SO FAR SO] pretty good...”

The Loss File WYSIWYG, March 1, 2013, Morton Lane

Issue	Loss Triggering Event	Nat Cat Loss	Financial Loss	Non-Nat Cat Loss
Ajax Re	Investment Loss- Lehman Bros. Swap Default		\$88	
Avalon Re C	NY Sewer Explosion			\$12
Carillon Re A-1	Investment Loss- Lehman Bros. Swap Default		\$36	
Crystal Credit B	Trade Credit Losses			\$63
Crystal Credit C	Trade Credit Losses			\$93
Kamp Re	Hurricanes Katrina, Wilma	\$144		
Mariah Re 2010-I	US Windstorms - Tornado Loss	\$100		
Mariah Re 2010-II	US Windstorms - Tornado Loss	\$100		
Muteki Ltd.	Tohoku Earthquake	\$300		
Nelson Re Class G 2008-I	Hurricane Ike	\$38		
Newton Re 2008 A-1	Investment Loss- Lehman Bros. Swap Default		\$21	
Willow 2007-1 B	Investment Loss- Lehman Bros. Swap Default		\$45	
		\$682	\$190	\$168

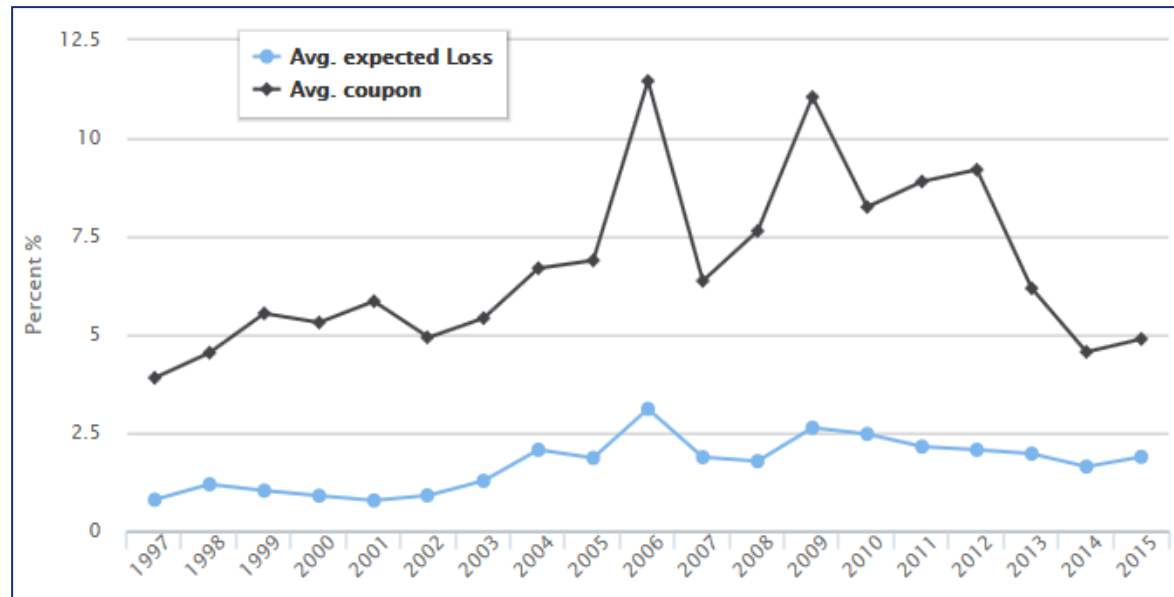
- Historical weighted Nat Cat average (monetary; estimated) expected loss according to models is varying from **USD 622mm to USD669** (USD 39.6bn times 1.57% or 1.69%)
- The realized Nat Cat loss for Cat bonds is **USD 682m**

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Pricing and placement in primary market

“There is no right price of insurance; there is simply the transacted market price which is high enough to bring forth sellers and low enough to induce buyers.” - Finn and Lane (1997)

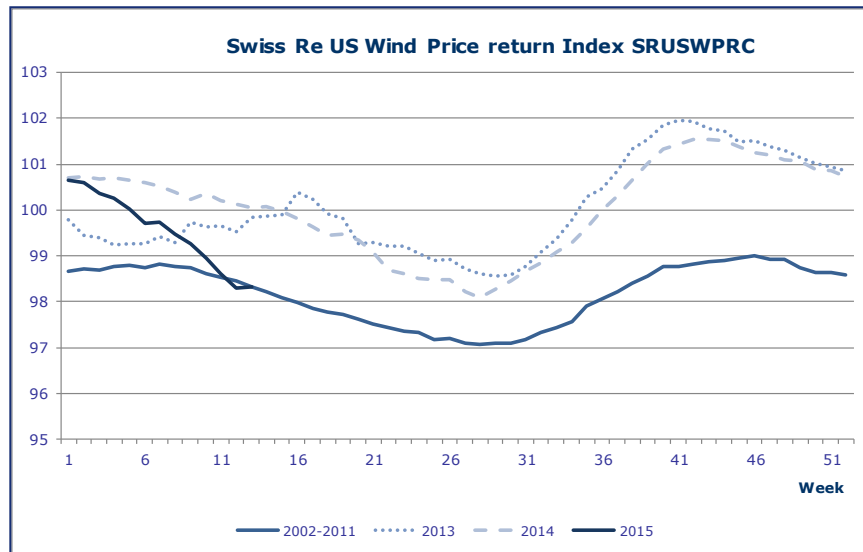
Pricing: Coupon = Expected Loss + Margin



Insurance-Linked Securities Pricing in the secondary market

Cat Bond risk changes dynamically:

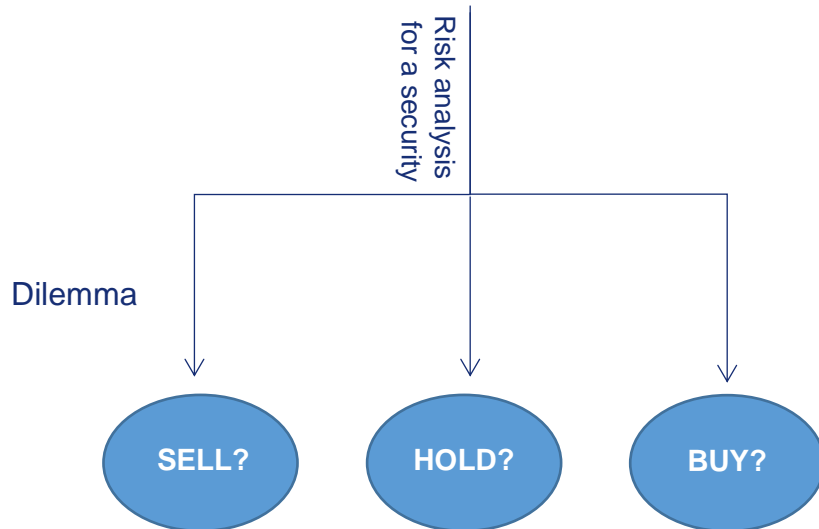
- Seasonality
- Number of events required for triggering
- Aggregate / per occurrence
- Impairment (existing claims)



Example: Armor Re 2014-1 (maturity: 15.12.2016)

	At issuance	As at 01.10.2014
Attachment probability	0.56%	0.41%
Expected loss	0.44%	0.33%
Exhaustion probability	0.38%	0.28%

Insurance-Linked Securities Live Cat Trading



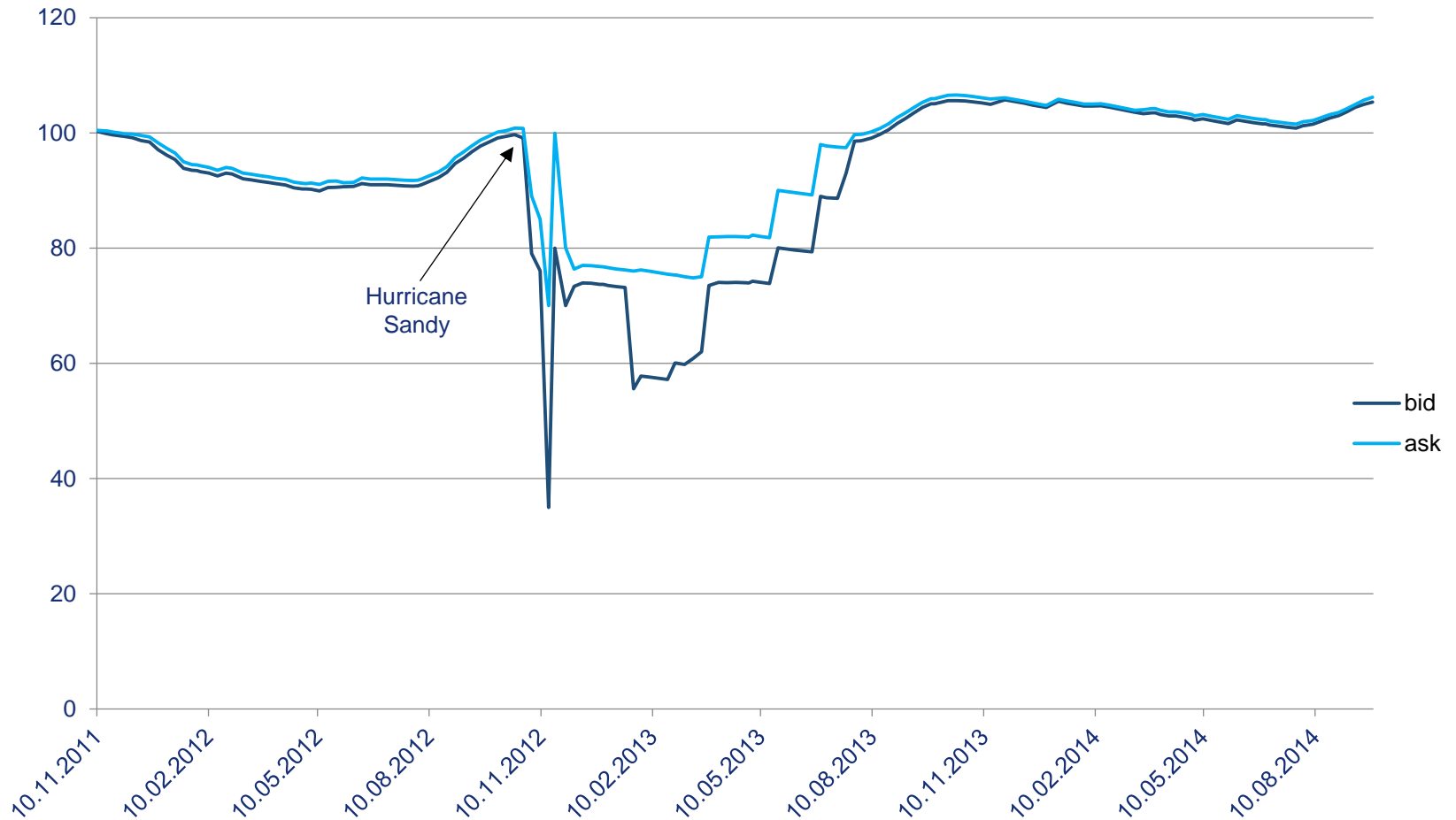
And if yes, then at **what price...?**

“...the *ground* is shifting *below* our feet, and there appears to be no other way out.”

Sam Rogers briefs the Trading Floor on liquidation of the firm's assets on the eve of the financial crisis.

From the film Margin Call, 2011.

Insurance-Linked Securities Live Cat Trading: Hurricane Sandy



Insurance-Linked Securities

Future: Innovation

- New cedants
- New territories
- Perils
- Trigger structures

New (-old) securitized risk placements:

- Operational?
- Cyber?
- Casualty?
- Contingency?
- Mortgage Insurance?!?!

Caveats: Modeling/Researching/Challenging/Discipline !!!

“Always be scientifically critical, as well as socially honest, adhere to the highest ethical principles, especially in the face of temptation ... which will come!”

Prof. Paul Embrechts

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