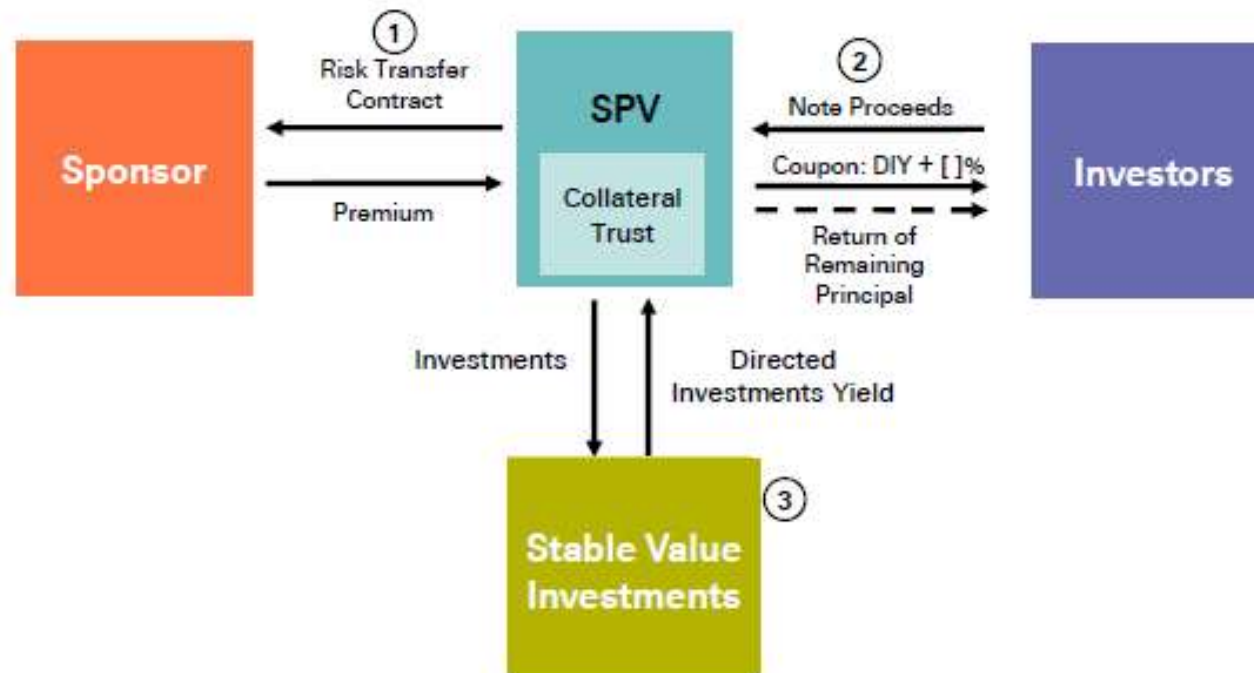


Insurance-linked Security (ILS)

Yas Suttakulpiboon

What are Insurance Linked Securities?

- Natural catastrophe bonds (cat bonds for short) and other types of ILS are usually issued in order to provide re-/insurance protection to insurers, reinsurers, governments, and corporations
- Cat bonds allow companies to obtain reinsurance protection from a new pool of capital separate from traditional reinsurers
 - Money managers, hedge funds, and pension funds represent a new pool of capital for insurers and reinsurers to gain protection from
- Investor capital provides collateralized cover
 - Investor capital sits in a segregated collateral account, meaning that if an event occurs, dedicated funds are available to make a payment
 - This virtually eliminates the credit risk inherent in traditional re-/insurance



1. The sponsor (the insurer or reinsurer looking to get protection) enters into a risk transfer contract (reinsurance or derivative) with a special purpose company established specifically for the transaction (SPV)
 2. The SPV capitalizes itself by issuing Notes (the "Cat Bonds") to Investors in the capital markets in an amount equal to the limit of the risk transfer contract
 3. Proceeds from the securities offering are transferred into a collateral trust account and invested to provide a stable return
 4. If no covered event occurs during the risk period the bonds will be redeemed at 100% of face value. In case of a covered event meeting the thresholds set forth in the risk transfer contract, funds will be withdrawn from the collateral account to make an event payment to the sponsor. The redemption price of the bonds is reduced accordingly
-

How ILS emerged

- In 1992, Hurricane Andrew made landfall in Florida causing \$15.5b in insured losses
- The resulting shortage of reinsurance capacity prompted reinsurers, banks, and academics to investigate new ways of transferring catastrophe risk outside the traditional reinsurance capital pool
- In 1997, Residential Re, the first catastrophe bond was sold to capital markets investors, protecting USAA against the risk of a major hurricane
- Since then, approximately \$45 billion of cat bonds have been issued, providing protection to over 70 insurers, reinsurers, governments, and corporations for a multitude of risks

Non-Life

- Catastrophe Bonds
- Catastrophe Derivatives/
Industry Loss Warranties
- Collateralized
reinsurance/retro
- Quota Shares/Sidecars

Currently \$15.5 billion in cat bonds
are outstanding, with an estimated
\$10-15 billion in other private non-life
risk transfer to capital markets
investors

Life

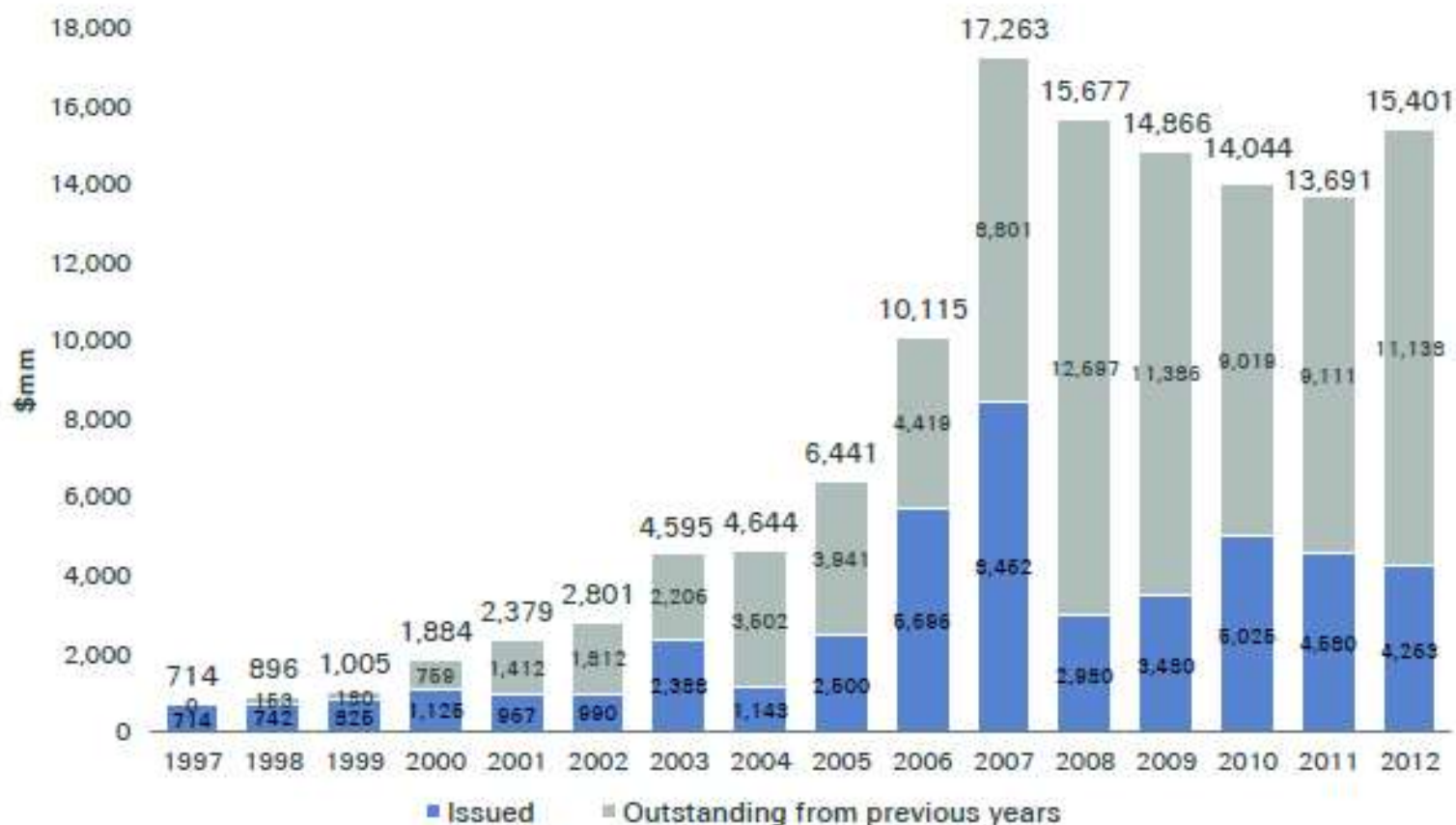
- Extreme Mortality Bonds
- Longevity swaps/bonds
- Embedded Value
Securitizations
- Life Settlement Securitizations
- Reserve Financing (e.g Reg
XXX)

Swiss Re has issued approximately
\$2.2 billion in Vita extreme mortality
bonds since 2003.
Post financial crisis, the embedded
value and life settlement markets
have slowed considerably

Entry of new sponsors
and investors continue
to expand the market

2012 has seen 4.26bn
YTD, including the
largest first half since
2007

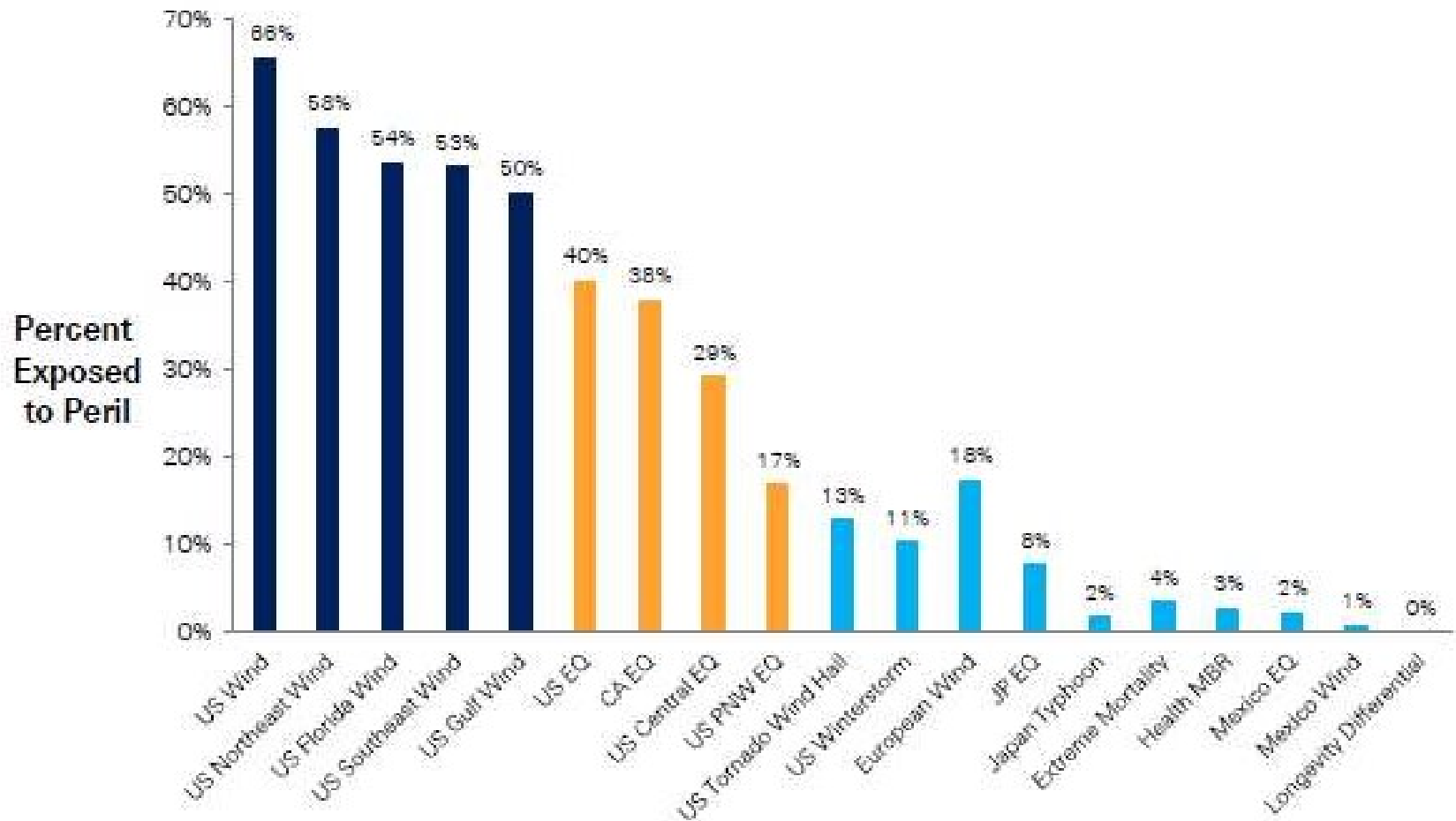
Swiss Re Capital
Markets expects 5.0-
7.0 billion of issuance in
2012



Outstanding Cat Bonds by Peril

US Wind represents the largest peril in the ILS space, consistent with its position as the most capital intensive peril in the global re-/insurance markets

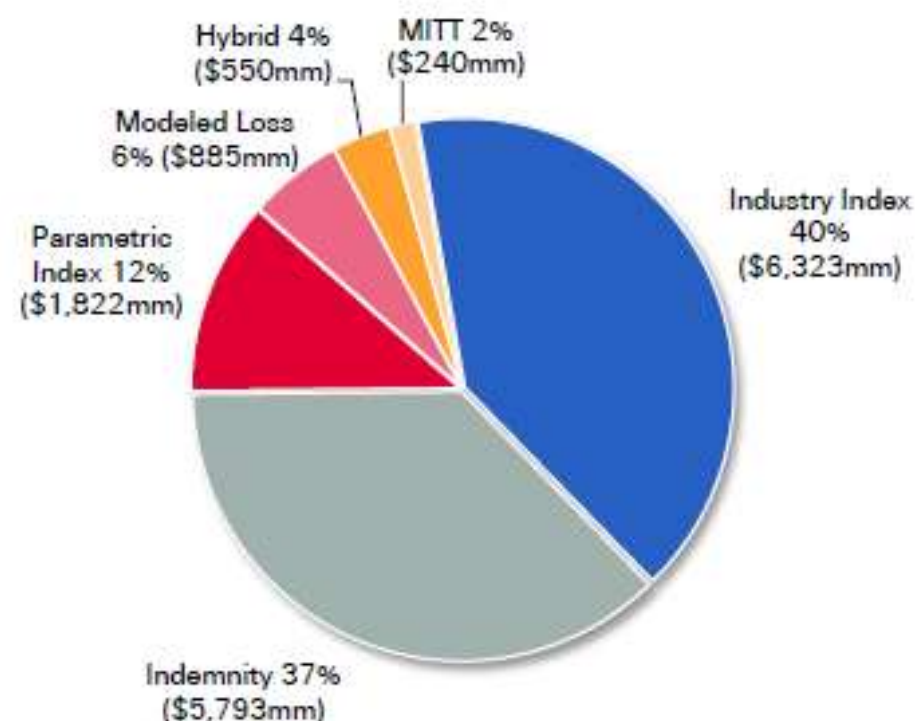
Diversifying perils achieve tighter spreads and appeal to investors whose investment guidelines require them to be diversified within their ILS portfolio



Sponsors have increasingly looked at indemnity triggers in the past year, as they look to minimize their basis risk.

- Industry index is still the largest trigger outstanding
- Index-based transactions will typically price tighter than indemnity transactions
- However, an indemnity trigger will offer a sponsor the lowest basis risk in a cat bond

Catastrophe Bond Trigger Breakdown (Natural Catastrophe Bonds Only)



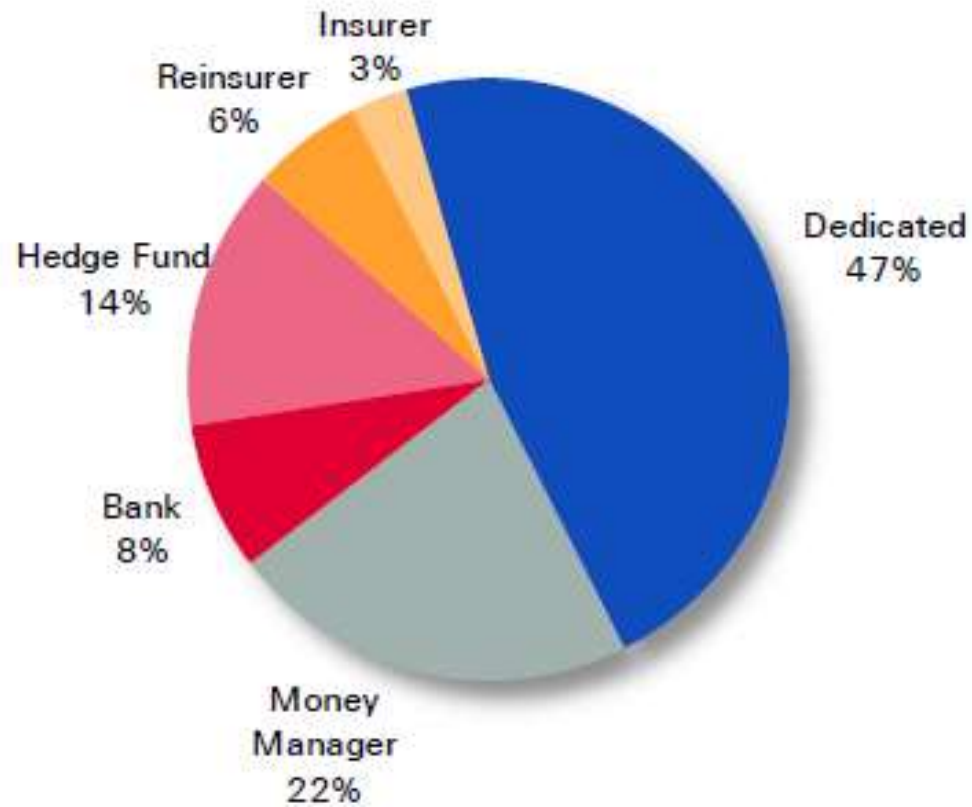
Why Consider Cat Bonds? The Sponsor's Perspective

- Concern about counterparty credit in case of a large event
- Shortage/pricing of available traditional capacity
 - e.g. companies with large reinsurance programs, peak perils
- Diversifying sources of capacity
 - Reducing dependency on one just one market
- Structural features that the traditional markets have difficulty providing in size at the right price
 - Aggregate, second event, Drop down, etc
- Multi-year pricing stability (3 – 5 year term is typical for cat bonds)

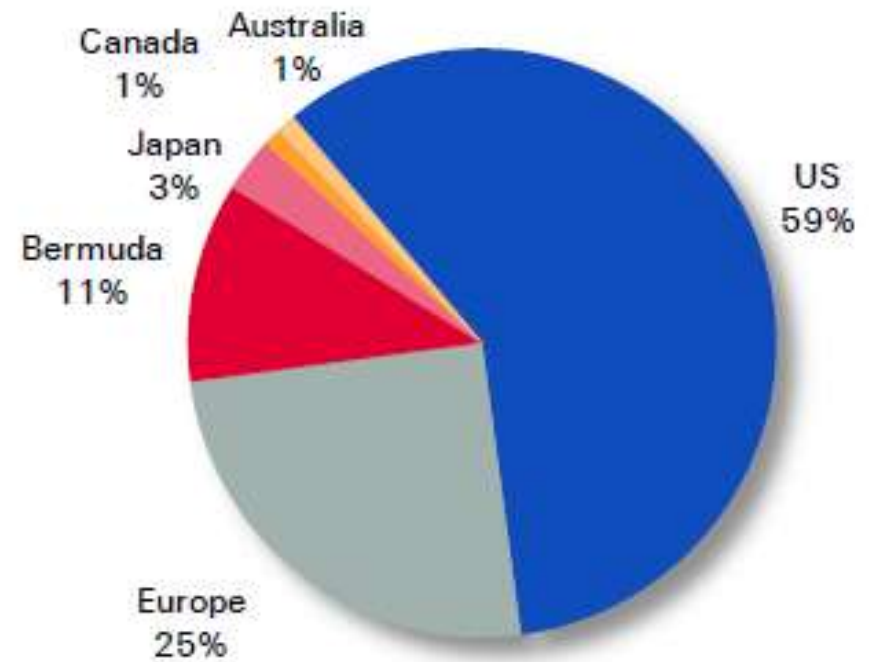
Why Consider Cat Bonds? The Investor's Perspective

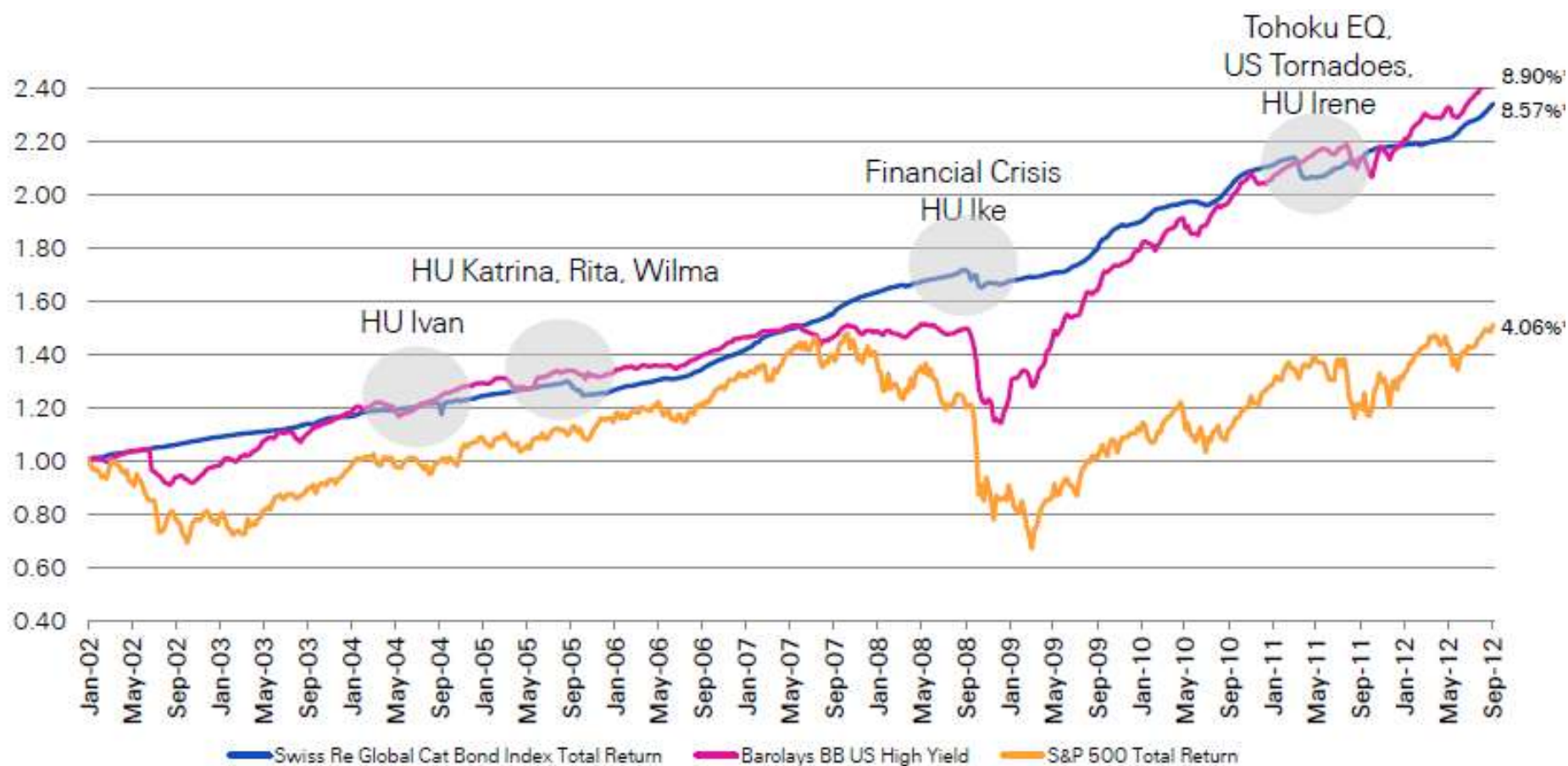
- Different types of investors participate in catastrophe bonds for a number of reasons, such as:
 - Uncorrelated to traditional asset classes (equities, bonds, etc.)
 - High risk adjusted returns
 - Low volatility when compared to other asset classes
 - Strong collateral structures, including treasury money market funds and AAA rated customized notes issued by supranationals such as e.g. the World Bank
- Cat bonds represent an asset whose value is largely driven by the occurrence of events that are not correlated to the financial markets, allowing for a high degree of diversification
- Transaction size varies from a minimum of around \$100mn with the largest transactions reaching \$750mn to \$1bn
- Individual investors' bite sizes vary depending on the size of an investor's portfolio as well as the nature of the transaction and can range from a few million up to several hundred million.

Investors by Type



Investors by Region





* Compound Annual Growth Rate since 1/1/2002

"Swiss Re Global Cat Bond Index: Total Return", calculated by Swiss Re Capital Markets, is a market value-weighted basket of natural catastrophe bonds tracked by Swiss Re Capital Markets, calculated on a weekly basis; past performance is no guarantee of future results

Underlying data for Barclays Capital High Yield Index provided by Barclays Capital

Underlying data for "Swiss Re Global Cat Bond Index: Total Return" is based on indicative prices only

Long Point Re III Ltd.

- In May 2012, Travelers successfully sponsored Long Point Re III Ltd. Series 2012-1, its first indemnity cat bond
 - Travelers had previously sponsored two PCS-based transactions
- Long Point Re III covers certain Travelers business units for Hurricanes in certain Northeast states
- The subject business for the transaction includes the personal insurance segment as well as the select accounts and commercial accounts business units of the business insurance segment
 - Business units which cover large and unique exposures, complex financial structures, and mobile property are excluded from the Subject Business
 - Investors appreciated the "main street" nature of subject business
- The Long Point Re III issuance was well-timed by Travelers:
 - Significant US wind risk issuance exposed to Florida (the \$750mm Everglades transaction), as well as other regions, gave investors an incentive to view Northeast Wind as a diversifying peril
- The decision to approach the market with a straightforward transaction, both with respect to structure and collateral solution proved economical for Travelers

Ceding Company:	The Travelers Indemnity Company (and several of its affiliates)
Original Principal Amount:	\$250,000,000
Initial Modeled Trigger Probability^(a):	0.97%
Initial Modeled Exhaustion Probability^(a):	0.77%
Initial Modeled Expected Loss^(a):	0.88%
Modeling Firm:	AIR
Risk Period:	June 7, 2012 to June 7, 2015
Trigger:	Indemnity, per occurrence
Covered Event:	Hurricane
Covered Area:	Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia
Rating (S&P):	BB+ sf
Collateral:	Treasury Money Market Funds
Investor Spread:	6.00%

Risk Factors (As Noted in the Prospectus)

- Investors may lose all or a portion of their investment in Insurance Linked Securities if a natural catastrophe or other event triggers a payment by the issuer of the Insurance Linked Securities under the underlying risk-transfer agreement that the Insurance Linked Securities relate to.
- The maturity of Insurance Linked Securities may be extended without the prior consent of the investor.
- The Insurance Linked Securities may be redeemed before their maturity date (including before any extension of such maturity date by the issuer).
- If the Insurance Linked Securities are redeemed before maturity, the interest rate payable under the Insurance Linked Securities will be reduced.
- Investors have limited recourse to assets of the issuer of the Insurance Linked Securities and no recourse to assets of the counterparties to the underlying risk-transfer agreements to which the Insurance Linked Securities relate.
- If the issuer of the Insurance Linked Securities becomes insolvent, investors may lose some or all of their investment.
- Investors may be required to consolidate the issuer for accounting purposes under certain circumstances.

Risk Factors (As Noted in the Prospectus)

- An investment in the Insurance Linked Securities may have adverse tax consequences for investors.
- Any claim you have against the issuer in the event of the issuer's insolvency will rank below any claim a counterparty to the underlying risk-transfer agreements, to which the Insurance Linked Securities relate, has against the issuer.
- Enforcement of the security interest granted to a Trustee for the benefit of the investors may be limited.
- The Insurance Linked Securities may not have a secondary market or the secondary market for the Insurance Linked Securities may have limited liquidity; the market price of the Insurance Linked Securities in the secondary market may be highly volatile.
- The Rating Agenc(y)(ies) (if any) may change any rating assigned to the Insurance Linked Securities. Any credit rating given in respect of the Insurance Linked Securities may not reflect the potential impact of all risks related to the Insurance Linked Securities. A credit rating is not a recommendation to buy, sell or hold the Insurance Linked Securities and may be revised or withdrawn by the rating agency at any time.

Cat Bond Pricing Model

CATEGORY	2014S Variable	2014S Coefficient	Braun Variable	Braun Coefficient
Independent Variable	Spread at Issue		Spread at Issue	
Data Range	3/2004-3/2014		6/1997-12/2012	
Data Points	372		466	
R^2	0.94		0.89	
SE	251		156	
Categories of Influence				
Constant (Intercepts set=0)	0		0	
FIXED INCOME MARKETS	HY-IG	0.98	IG	-159.76
			BB	26.57
Note: 2014S uses TRACE Data and the HY-IG spread; Braun has separate coefficients for IG (a binary indicator) and BB using Merrill Lynch Indices. Both seek to frame the financial context in competitive markets at time of issue				
DEAL STRUCTURE	Single Peril (0); Multi (1)	100	Peak (1); Non Peak (0)	175
Both models try to take account of the fact that the Structure (for example whether it can be exhausted by more than one peril or territory) of a model affects price. 2014 divides between Multi-peril bonds and Single Peril Bonds; Braun between "Peak" and "Non-Peak". Since the definition of Peak is essentially any deal including US Wind, the principal difference between these divisions is the set of Single Peril bonds covering US Wind.				
			Swiss Re (1);	

ISSURER	-	-	Swiss Re (1); Non Swiss Re (0)	-103.58
REINSURANCE CYCLE				
Both Models try to take account of the Reinsurance Cycle. Braun uses a "Rate-on-Line" Index. 2014S seeks to capture the cycle by dividing the periods of issue into "Hard", "Neutral" and "Soft" periods in the market. Thus there is a coefficient for each market circumstance. 2014S uses a somewhat rigorous definition of Hard/Neutral/Soft explained elsewhere. Both characterizations emanate from the same source.	-	-	RoLX	161.85
EXPECTED LOSS				
The 2014S model separates out the variable showing the difference between the EL for the WSST case and the EL for the SSST case.	WSST Premium	4.7	-	-
The Braun Model gives a single EL coefficient; The 2014S model gives several, by peril and by state of the market.	EITHER "HARD"		Expected Loss	221.04
Both Models agree on the primacy of Expected Loss as a determinant of Spread, but they handle it in different ways. Braun uses a single figure for EL, although in the latter half of the training period most PPM's investor guidance section offers two estimates of EL - one Long Term (SSST) and one Short Term (WSST). It is not clear which is used although the higher WSST figure is likely and presumed to be the case. The two cases emanate from the sea surface temperature in the North Atlantic. SSST means Standard Sea Surface Temperature' WSST means Warm sea surface temperature.	H US Wind	2.05		
	H US Quake	2.05	-	-
	H Euro Wind	1.64	-	-
	H Japan Quake	1.59	-	-
	OR "NEUTRAL"		-	-
In a further distinction, The 2014S model splits the total EL into its component perils - another practice that is revealed in PPM's investor guidance section that is not utilized in the single figure approach. Accordingly 2014S has 16 separate parts of expected loss compared to one for Braun. They are listed alongside. To give an example, if a deal covers US Wind and US Quake, the investor guidance will show the EL from wind and a separate EL for quake. The sum of those components is the EL for the deal.	N US Wind	1.85	-	-
	N US Quake	1.25	-	-
	N Euro Wind	0.83	-	-
	N Japan Quake	2.03	-	-
	OR "SOFT"		-	-
Two Comments on the 2014S model are in order. The periods of Hard/soft markets are not always continuous. Under the definition, aberrant or seasonal prices may interrupt the market for short periods. Ideally they should be removed in future analysis. A second comment concerns the coefficient estimates for the "soft" market period. They are only marginally statistically significant and have relatively high p-values. They are kept in the reported analysis for purposes of symmetry.	S US Wind	1.74	-	-
	S US Quake	1.04	-	-
	S Euro Wind	0.67	-	-
	S Japan Quake	1.75	-	-

Testing the Fit and the Forecasts of Various Machine Learning models

	Training Period 3/2004 - 3/2014		ONE YEAR TEST 3/2014 -3/2015		THREE YEAR TEST 3/2014 - 12/2017	
	Accuracy	RMSE	Accuracy	RMSE	Accuracy	RMSE
Braun (actual 1/97 - 12/12)	0.89	1.56	0.95 [#]	2.41 [#]	0.96 [#]	3.44 [#]
2014S (original,i.e. w.Outliers)	0.94	2.51	0.95	0.99	0.94	1.82
Machine Learned	In-Sample CV Model Train on Primary Only		Out of Sample Test Testing on Post 2014 Primary Issuance ONLY		Out of Sample Test	
	Accuracy	RMSE	Accuracy	RMSE	Accuracy	RMSE
Linear Model (KS)*	0.90	2.09	0.96	2.01	0.96	4.54
Linear Model (AS)**	0.86	2.47	0.96	2.44	0.96	4.45
Randon Forest	0.92	2.10	0.98	1.30	0.92	2.74
Randon Forest (AS)	0.89	2.22	0.97	1.80	0.94	3.86
	Train on Primary and Secondary Mkt Qrtly Data		Testing on Post 2014 Primary Issuance ONLY			
Linear Model (KS)	0.91	1.89	0.96	2.02	0.97	3.53
Linear Model (AS)	0.89	2.04	0.95	3.03	0.96	4.76
Randon Forest	0.99	0.57	0.97	1.98	0.91	3.09
Randon Forest (AS)	0.99	0.48	0.98	2.19	0.94	4.23

indicated that these numbers were construct using synthetic data. It NOT the work of the original author and therefore may be in error.

* KS =Kitchen Sink, **AS= Attribute Selected

Read for Final Exam:

- https://forms2.rms.com/rs/729-DJX-565/images/cm_cat_bonds_demystified.pdf
- <http://www.lanefinancialllc.com/images/stories/Publications/Pricing%20Cat%20Bonds%20-F.pdf>
- <https://www.swerma.se/assets/Catstrophe-bonds-Viktor-Karlsson-Emelie-Karneba%CC%88ck.pdf>