Special Report

New Thinking on Catastrophic Risk and Capital Requirements

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■ Summary

The purpose of this report is to present Fitch Ratings' updated and evolving views on catastrophe risk in the property/casualty insurance and reinsurance sectors, and the migration in Fitch's approach to developing capital requirements for this risk. Fitch believes a fresh look at capital requirements is needed given the unparalleled level of losses suffered by the industry in the 2004–2005 timeframe, and the wide variances between modeled losses and actual losses reported by a number of firms.

That said, given the complexity surrounding the assessment of catastrophe risk, and the evolutionary nature of the third-party catastrophe simulation models, we present today our framework for enhanced risk and capital assessments. Movement to a final methodology, including a complete set of new and updated assumptions, will be completed by Fitch over the next 3–6 months, following additional research and analysis.

Historically, rating agencies and third-party industry observers, including Fitch, assessed catastrophe risk by focusing on losses produced by third-party simulation models (or an insurer's proprietary simulation model). Typically, capital requirements were linked to losses produced at the level of the so-called "100-year loss," which equates to the 99th percentile loss taken from the simulated probabilistic loss curve.

However, based on recent experience, Fitch notes two core potential short comings with this approach:

- Recently, and especially for losses related to Hurricane Katrina, there have been wide variances between simulated losses and actual losses. Hurricane Katrina is generally considered to be a less than 100-year storm, yet losses suffered by many insurers greatly exceeded their simulated 100-year Gulf Coast loss levels. Fitch believes such variances are a function of both the accuracy of the models themselves, but also, and possibly more importantly, the varied manner and skill with which various companies use the models. For example, quality and granularity of exposure data fed into the models can have a material impact on the simulated losses.
- By looking at only a single point on the simulated loss distribution, such as the 100-year event loss, no capital is required for more extreme events. Further, Fitch notes that exposures to extreme events can vary greatly among insurers with similar 100-year simulated loss levels. For example, assume two insurers, both with simulated 100-year losses of $100 million. It would be possible for one company to have a simulated 500-year event loss

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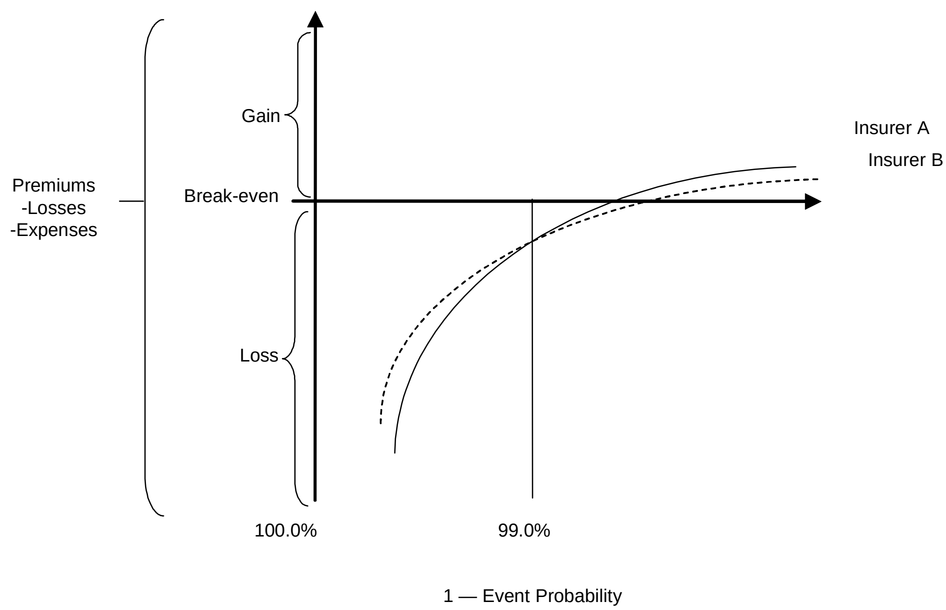
How Fitch's New Methodology Differentiates Insurers — Annual Aggregate Loss Curve



of $200 million, and another to have an event loss of $1 billion or five times greater, given differences in business mix and reinsurance programs. Fitch believes the latter company requires more capital than the first.

Fitch is nearing the final stages of completing a new global economic capital model to support its ratings analysis of insurance and reinsurance companies. The model will employ stochastic modeling techniques to produce an overall probabilistic loss distribution for all risks facing an insurer, including catastrophe risk. Fitch is designing the catastrophe risk component of the model to address the concerns noted above, as follows:

- Capital requirements will no longer be based on single points along the simulated loss distribution. Thus, Fitch will no longer simply focus on the "100-year" simulated catastrophe loss. Instead, capital requirements will be based on so-called Tail Value-at-Risk (T-VaR) measurements. T-VaR is a robust statistical measurement that considers all extreme events. For example, a T-VaR of 99 would include an average of all simulated losses from the 99th percentile through the full "tail" of the loss distribution. Thus, in the example above, T-VaR would average each of the two insurers 100-year losses of $100 million, with their respective 500-year losses of $200 million and $1 billion, respectively, as well as all points in between and beyond the 500-year event. This would create a much higher capital requirement for the second insurer. By incorporating the full "tail" of the distribution, capital requirements will better incorporate extreme events and provide better differentiation among insurers.
- In designing our capital model, we will give Rating Committees flexibility to make adjustments to the catastrophe loss distributions of given insurers produced by third-party models. These adjustments will address issues such as data granularity and data quality (i.e., if analysts have concerns about below-average data quality used in the model by the insurer, they will be able to increase simulated losses to compensate), as well as the perceived reliability of the modeled simulations themselves (i.e., if Fitch believes that generally there are regions or perils the models simulate less accurately, we will be able to increase or decrease simulated losses for that circumstance).

The chart above illustrates how two insurers with identical 100-year losses actually have different risk profiles. Insurer A has a lower frequency and higher

Major Insurance Losses of the 2004–2005 Hurricane Season

Event	Year	($ Bil.)
Hurricane Charley	2004	6.8
Hurricane Ivan	2004	6.0
Hurricane Frances	2004	4.4
Hurricane Jeanne	2004	3.2
Hurricane Katrina	2005	34.4
Hurricane Rita	2005	3.9
Hurricane Wilma	2005	8.7
Total		67.4

Source: Insurance Services Office Inc., Fitch Ratings Estimates.

severity profile than Insurer B. Fitch's new methodology will capture this variance.

The T-VaR levels incorporated into our capital requirements at various ratings categories, as well as the methodology for making the noted adjustment to the simulated loss distributions, will be finalized in the coming months. Fitch's expectation is that our updated methodology may result in moderately higher capital requirements for catastrophe risk, for the industry overall, compared to our current approach. However, some insurers could see a reduction in required capital, and, most importantly, our enhanced methodology will allow for the development of more robust and better differentiated capital requirements among insurers.

In discussing the development of our enhanced capital framework throughout this report, we also discuss related issues, including our view on a possible over-reliance on modeling by insurers in lieu of underwriting, and poor disclosures by many public firms on the nature of their catastrophe exposures.

Fitch believes there is very little public commentary on holding the necessary capital to offset such catastrophe losses. Too often, catastrophes are viewed as an "earnings" issue — meaning that the losses are not too large and capital can be replenished with operating earnings in future years given higher premium levels. However, Fitch believes that catastrophe risk is also a balance sheet issue, particularly when it comes to very large events such as Hurricane Katrina. Fitch believes greater commentary and disclosure by all insurers related to risk management techniques would be a significant step forward in the understanding for catastrophe risks.

Fitch notes that the frequency and severity of insured losses from the 2004 and 2005 hurricane seasons are unparalleled in recent history. The sum of total U.S. insured losses for the four hurricanes of 2004 and the three large hurricanes in 2005 is projected to be approximately $67.4 billion.

Given the size of these losses, there is value in stepping back and reviewing the history of how the industry and others have attempted to assess the likelihood that such losses could occur.

Traditional Methods

"Probable Maximum Loss" Approach: Until the early 1990s, most firms assessed catastrophic risk mainly using so-called "probable maximum losses" or PMLs. In most instances, early PMLs were derived by deterministic scenarios identified internally by the insurer to reflect their likely losses under a highly adverse scenario. However, these deterministic PML scenarios had no "probability" attached to them, which made it impossible to compare PMLs across the industry. Rules of thumb existed in which factors could be applied against exposures to calculate these early PMLs.

Positively, these early PML estimates did provide some guidance as to management's views on catastrophic loss potential, and they were employed heavily in reinsurance purchase decisions. They also allowed Fitch and other industry observers to retrospectively judge how actual catastrophes measured up against the insurer's internal PML estimates. But since this PML approach also had numerous shortcomings due to its simplicity, a more sophisticated approach was needed.

Catastrophe Risk Simulation Models: In the 1980s, several firms were formed to build models that scientifically measure catastrophe risks on a probabilistic basis using sophisticated Monte Carlo simulation techniques. Some of the leading catastrophe modeling firms include: AIR Worldwide Corporation; EQE International, Inc; and Risk Management Solutions, Inc. Fitch believes that the modeling firms became firmly entrenched as the industry experts in measuring catastrophe risk sometime after Hurricane Andrew in 1992. Thus, for more than a decade, the modeling firms' opinions have held strong clout and have been a major information source.

The ability to model the financial losses resulting from catastrophic events on a probabilistic basis reflected the advent of increasingly sophisticated computer simulation models, enhanced computing power, advances in capturing and applying relevant catastrophe data, application of traditional risk management techniques to the insurance markets, and better policy level data reporting by insurers.

These simulation models have evolved over the years and are highly flexible. They can use very detailed information from each insurer to help assess catastrophe risks. Factors considered in the models include:

- loss exposures by street address, zip code or CRESTA zone;
- complex reinsurance structures;
- deductibles and limits.

The catastrophe models reinvented the concept of the PML, which is a phrase that continued to be used despite movement from a deterministic approach to a probabilistic simulation approach. PMLs were now described in terms of "return periods", such as "100-year events" and "500-year events." The simple translation was that a 100-year PML represented a 1% probability event (i.e. the 99th percentile event along the loss distribution) and the 500-year PML represented a 0.2% probability event (i.e. the 99.8th percentile). Importantly, simulation models improved Fitch's ability to compare one insurer's catastrophe exposures to its peers' exposures, provided they both used the same simulation model.

Challenges with Traditional Methods

Public Disclosure is Poor: Fitch generally considers insurers' public disclosures about their catastrophe loss exposures to be poor. This is unfortunate since catastrophe-related losses are typically the largest shock loss faced by large primary property insurers and property/catastrophe reinsurers. Fitch believes that this poor disclosure is related to accounting rules that prohibit insurers from reporting catastrophe reserves.

Fitch believes enhanced disclosure in the notes to the financial statements would be extremely beneficial to external parties. Ideally, insurers would disclose their entire catastrophe loss distribution curve, in the contingent liabilities footnote or significant risk factor footnotes reported with their financial statements. At a minimum, providing several points along the loss distribution curves, such as loss amounts at the 50, 100, 250, 500, 1,000 and 10,000 year return periods would allow observers to estimate the full curve through extrapolation. In addition, Fitch supports disclosing this information consistently with respect to taxes and reinsurance — as some disclosures are gross or net of reinsurance and some disclosures are pre or post-tax.

NAIC Risk-Based Capital Formula Falls Short: The current version of the National Association of Insurance Commissioners (NAIC) risk-based capital (RBC) formula does not directly address the effect of natural catastrophe exposure. Certain business lines that are exposed to catastrophes are given higher charges to account for some potential volatility. However, Fitch believes this approach does not fully capture an insurer's risk profile given that insurer A may write its homeowners insurance in Florida and insurer B may write its homeowners insurance in South Dakota. Both write homeowners insurance and both get the same RBC treatment, but the risk profile of each insurer is very different.

Terminology is Used Inconsistently: Fitch believes that terminology used to measure and assess catastrophe risk often varies depending on the participants involved. This was very evident following Hurricane Katrina, as most industry observers described Katrina as an event with characteristics that were consistent with a less than 100-year event, yet a few prominent insurers described their Katrina losses in terms of being a several-hundred-year PML.

Fitch notes that the term PML is often used interchangeably to describe one of the following:

- A frequency-severity measure derived from modeled parameters that is based on the *insurer's* risk exposures.
- A frequency-severity measure derived from modeled parameters that is based on the *industry's* risk exposures.

Fitch notes that an event with a 1% probability of occurring does not translate directly into a 100-year PML. For example, a hurricane of a given magnitude and landfall could have a 1% probability of occurring. However, if an insurer has comparatively little insured exposure in the landfall area its losses are unlikely to approach those of a 100-year PML. Conversely, if an insurer has large concentrated exposures in the landfall area its losses could exceed those of a 100-year PML.

Disconnects in understanding exposures on a probabilistic basis exist when inconsistent terminology is used. Additionally, many questions arise if an insurer's catastrophe losses differ materially from those suggested by the industry's catastrophe losses or by the event's probability of occurring. The source and magnitude of this variance will need to be understood in order for Fitch to place confidence in the insurer's overall catastrophe risk management and disclosure policy.

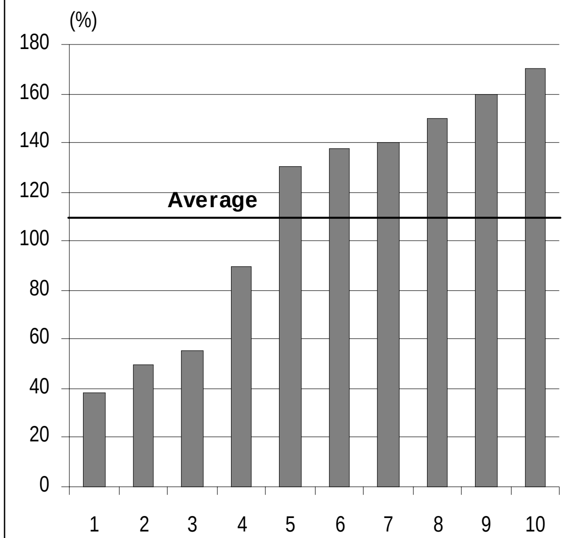
Users Rely Too Heavily on Modeled Results: If there has been a downside to the modeling firms and their role in the (re)insurance industry, it is that many industry participants — both internal and external — have become too dependent on the model's output, taking those estimated numbers as fact. A model is just a model and not a precise predictor of future results, particularly for complex events such as natural catastrophes, and risk must still be judgmentally underwritten, with extra focus on the nature of the risk that the model may not adequately capture.

Fitch has studied the models produced by the major catastrophe modelers extensively over the past several years as part of both our catastrophe bond and property/casualty insurance ratings. Fitch notes that modeled output *for the same risk* varies, often significantly, between modeling firms. Additionally, the models are continuously updated and modeled results often vary significantly from one version of the model to the next *for the same modeling firm.*

Simply considering that the modeling firms continually update and improve their products should provide sufficient evidence that models alone are not the end-all solution. Core underwriting skills are equally important. Fitch believes that catastrophe models are truly beneficial when they are used to supplement, rather than replace, traditional risk management and underwriting approaches, and we believe for some companies there has been a break-down in achieving this mix.

Results are Mixed: Given our previous comments regarding a potential over-dependence on the catastrophe models, Fitch thought it would be insightful to compare several insurers' expected 100-year PML to actual experience encountered with Hurricane Katrina. Various comments have been made that Hurricane Katrina may be somewhere between a 60–80 year storm. The results of 10 randomly selected insurers in Fitch's rating universe are shown in the chart above. Fitch notes that the average ratio of Hurricane Katrina losses to model loss estimates in this sample is 114%.

Actual Versus Modeled Losses*
(Net of Reinsurance)



*Hurrican Katrina Pre-tax Loss/1-in-100 Year Model loss Estimates.

Updates to Fitch's Catastrophe Risk Capital Charge Methodology

Fitch will continue to analyze business mix, geographic concentration, premium growth rate and past results as the starting point of its catastrophe-risk analysis. We will also continue to review results generated by insurers' internal models and software.

As noted in this report, Fitch believes the optimal approach is to review the entire catastrophe loss risk distribution and move away from the 100-year PML approach. To re-iterate, possible catastrophe losses are generated through a stochastic process creating a large distribution of potential catastrophe losses. Thus, insurers communicating the 100-year loss are simply picking one point — the 99th percentile — along that distribution. When testing thousands of scenarios, looking at one point along the distribution is simply inadequate.

Fitch is currently developing a stochastic capital model that includes a catastrophe risk component. Within this capital model, catastrophe risk will be modeled and aggregated along a full loss distribution. The end-product of this process will be a unique loss

What is a Tail-VAR?

Tail-VAR (value at risk) - is the average of all scenarios above a certain threshold — for example, T-VaR (95) is the average of all output variables above the 95th percentile. It provides enhanced information about the tail of a loss distribution when low probability but high severity events are modeled. Fitch estimates that a T-VaR (95) measure would typically correspond to a 97.5–98.5 percentile ranking. We also plan to do more research on how to best communicate the linkage between T-VaR and percentile results. Obviously, in order to calculate T-VaR, Fitch requires the entire loss distribution curve which is available in our licensed software tool.

distribution curve for each insurer that fits their overall risk exposure. Appendix A provides a detailed schematic of Fitch's updated catastrophe risk modeling process, and the following summarizes this process:

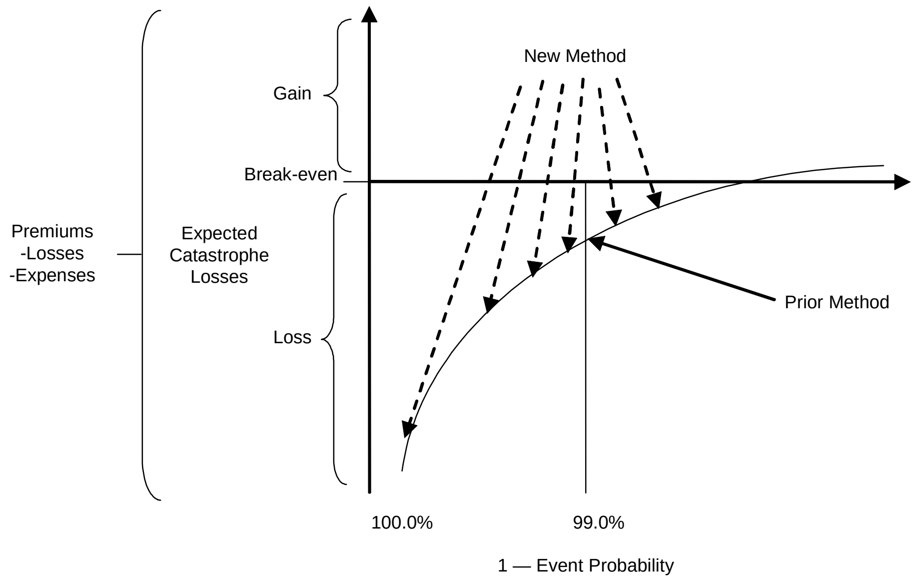
- To generate catastrophe loss curves required by its stochastic capital model, Fitch has licensed AIR's CATRADER natural catastrophe modeling tool. Fitch notes that CATRADER can replicate the results generated by CLASIC/2, AIR's more sophisticated tool used by insurers to manage catastrophe exposure. Results from CATRADER can be adjusted based on information provided by other software modeling firms such as RMS or EQE.
- The data for this model will be based on publicly available data, such as premiums written or sums insured, but companies will be encouraged to submit more granular data. Fitch has the option to adjust this data based on reputable data information.
- Fitch will adjust this "ground-up" analysis to reflect three general, yet reasonable categories of reinsurance coverage (high, medium, low) to derive a net exposure curve. Again, insurers will be encouraged to supply detailed company information to develop a more representative net distribution.
- The CATRADER software will be used to generate a 10,000 scenario event set meaning each insurer will be treated consistently. To avoid over-reliance on this curve, Fitch will also analyze specific scenarios — such as Lloyd's Realistic Disaster Scenarios.
- Fitch has the flexibility to shift or bend the net distribution curve based on analyst subjectivity or if the insurer furnishes selected PML points from its own model.
- Finally, Fitch will use a Tail Value-at-Risk (T-VaR) statistical to capture the extreme tail events as we believe PMLs must evolve from a "year return" approach. Thresholds will be tied to a ratings quality and will be linked to general bond default studies. This approach is similar to what the U.S. life insurance industry is doing relative to measuring risks related to variable annuities.

Thus, at the 'AAA' rating level the related catastrophe risk will be stressed at a very high scenario and will create a greater need to hold capital, all other factors being equal. On the other hand, at the 'BBB' rating level catastrophe risk will be stressed at a lower scenario and will create less need to hold capital, all other factors being equal. Catastrophe risk will generate various capital needs in conjunction with other items — such as asset risk or reserving risk — and overall capital needs will be considered in

What are the advantages to using CATRADER software in Fitch's rating analysis?

- Allows Fitch to review the entire simulated cat loss distribution curve rather than selected PML points such as 1 in a 100 year (i.e. 99th percentile) or 1 in 250 year (99.6th percentile) events.
- Provides a stress-test capability to compare historical events, such as Hurricane Wilma (2005) v. Hurricane Andrew (1992).
- Accepts a variety of exposure inputs including market share information and company loss files generated by CLASIC/2.
- Uses a consistent path event such that a company's exposure or losses can be tracked as a hurricane cuts a path through several regions. This has implications in Europe where a windstorm may, for example, affect two countries.
- Models multiple events such as several hurricane occurrences in one season or the probability of an earthquake and hurricane event sets.
- Provides a consistent platform from which to evaluate companies' catastrophe exposure.

Comparing Fitch's Old and New Methodologies — Annual Aggregate Loss Curve



aggregate. Thus, the degree that Fitch's enhanced methodology impacts insurers will vary from company to company. Some insurers will incur higher capital requirements while others may see lower capital requirements, for their given rating levels.

Another core aspect of our updated economic capital model will enable analysts to use alternate version of base risk curves to reflect the unique attributes of a given insurance or reinsurance company. Fitch believes this functionality will prove especially useful in the area of catastrophe risk analysis.

Fitch recognizes that modeling techniques work better for some perils, and some regions, than others. We will have the flexibility to adjust for such difference in the model by altering the loss distributions, accordingly. For example, if we believe that extreme tail risk may be understated for a certain peril, we would have the ability to "fatten" the tail portion of the distribution while leaving the rest of the distribution unchanged. Similarly, if Fitch believes the modeled loss distribution may be less reliable for one insurer versus another due to weaknesses in the quality or granularity of the data fed into the model by the insurers, we will also be able to make adjustments.

The methodology to make these adjustments is still being developed, and Fitch recognizes it will be subjective. However, we believe such adjustments are necessary given weaknesses, at times, noted in the reliability of model outputs. Importantly, our framework is designed to allow analysts to make adjustments at a company-specific level to reflect differences in risk or uncertainty, as opposed to a making a "blanket" adjustment for all companies.

Conclusion

Fitch views the assessment of catastrophic risk as a challenging task for both the (re)insurance industry and third-party observers, such as rating agencies. Our methodology of developing capital requirements is evolving to reflect those challenges, and to specifically address general shortcomings in the prior methodology. We believe our focus on the full distribution tail, as opposed to single points along the distribution, such as 100 or 250 year return periods, is a significant step forward. We also believe our framework, which will allow for adjustments to the modeled outputs to reflect modeling error and data issues, should allow for a more accurate answer that is better differentiated by insurer.

Additionally, we believe that in addition to better understanding its capital requirements, the industry needs to take steps to better mitigate catastrophic risk. Key is enhanced underwriting for risks not wellcaptured by the simulation models. Fitch also believes significantly enhanced public disclosure of catastrophe exposures and loss distributions will not only help third parties understand this risk, but will also make companies more accountable for their accumulated exposures. Thus, better disclosure will lead to better management decisions.

Appendix A: Fitch's Catastrophe Risk Modeling Procedure

Procedure	Level I — Minimum Level of Detail	Level II	Level III — Maximum Level Of Detail
Data collection and Exposures	Download individual state premiums by personal and commercial lines (OneSource).	Insurer Provides Reputable evidence that certain high-risk area are avoided.	Insurer Provides detailed CRESTA files.
Catastrophe Reinsurance Evaluation	Analyst selects one of three general, yet realistic, reinsurance programs (High/Medium /Low) based on industry knowledge.	Insurers provides "layered" cake reinsurance program structure indication "surplus at risk" targets, first-dollar coverage, quota-share and excess limits.	Insurer provides Company Loss Files (CLF's) captured in AIR models.
Simulation Engine	AIR CATRADER Software using 10,000 annual event sets		
Stress Scenarios	Probable Maximum Loss • 1-in-50 year • 1-in-100 year • 1-in-250 year • 1-in-500 year • 1-in-1000 Historic Events •Hurricane Andrew •San Francisco earthquake •Galveston hurricane		Realistic Disaster Scenarios (Lloyds market) • Two hurricanes making landfall in the Miami and Tampa area • Hurricanes making landfall in the gulf of Mexico • Two California earthquake with epicenters in the Los Angeles and San Francisco regions • Two New Madrid region earthquakes • Europe windstorm • Japan Typhoon • Japan Earthquake
Analyst Adjustments	• Analyst can selectively adjust the curve upward /downwards (or twists) based on quality of data, premium. growth and management capability. • Estimates from other modeling firms will be reviewed.	If insurer does not utilize AIR model, they can supply selected PML'S and stress scenario results so that the AIR loss curve can be modified.	Insurer provides loss distribution curve from internal models.
Calibration Points	Historical Bond default studies T-Var measurements (recognizing diversification benefits)		

AIR – Applied Insurance Research. CRESTA – Catastrophe Risk Evaluating and Standardizing Target Accumulations. PML – probable maximum loss. T-Var – Tail Value at Risk.