Securitisation of Non-Life Insurance Working Party

GIRO 2008

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1. INTRODUCTION

One of the assertions often levelled at catastrophe bonds is that the sponsor is left with greater basis risk compared with reinsurance protection strategies. However there is no universal approach to identifying or quantifying this risk.

This paper aims to:

- define basis risk,
- describe different trigger types,
- identify the various components within basis risk, and assess each trigger type against each component,
- describe an approach to modelling and quantifying basis risk, allowing objective comparison between a range of catastrophe protection strategies,
- show a comparison of the modelled results for a number of trigger types.

We will also provide a simplified model using Excel / @Risk to illustrate the modelling approach with the GIRO paper on the Institute of Actuaries website.

This paper is one of a series of stand-alone but complementary papers produced by the GIRO 2008 Securitisation of Non-Life Insurance Working Party.

The other papers cover:

- a **History of Securitisation** to date including a review of predictions made in prior GIRO papers,
- a quantitative and qualitative review of the **Zero-Beta** quality often claimed for catastrophe bonds,
- a review of the **Lessons from Sub-Prime** and wider credit crunch for non-life insurance linked securitisation and more widely for non-life insurers,
- a review of **Regulatory Regimes** (particularly capital regime) treatment of non-life insurance linked securitisation,
- a review of the securitisation possibilities for **Other Non-Life Risks and Assets** other than purely catastrophe bonds.

2. DEFINITION OF BASIS RISK

There are a number of different definitions of basis risk, examples of which include the following.

- **Institute of Actuaries, GIRO 1997:** "Basis risk is the risk to the issuing insurance company which arises from any mismatch between the performance of the index and the performance of the insurance company's own portfolio of risks."
- **American Risk and Insurance Association:** "Basis risk occurs when cash flows from the hedging instrument do not exactly offset cash flows from the instrument being hedged. Basis risk thus arises when the counterparty's payments are based not on the insurer's claim payments but on an industry average."
- **A.M. Best:** "Basis risk… generally reflects the possibility that a catastrophe bond may not be partially or fully triggered (for covered perils) even when the sponsor of the catastrophe bond has suffered a loss"

These contrast with a much broader definition for basis risk in reinsurance:

- **International Association of Insurance Supervisors**: "The reinsurance cover might prove insufficient to adequately handle the risk in question because reinsurance needs have not been precisely identified.

Clearly each of these definitions encompasses different elements of risk.

We believe that it is vital to quantify the sponsor's residual risk, so have adopted a very broad definition for the purposes of this section:

> **The residual risk that remains with (re)insurer in respect of perils & territories covered by the selected protection strategy**

We recognise that this definition might include elements that some do not consider pure basis risk. However we feel it is more important to measure what is most important to the bond sponsor rather than to focus too much on the label that is applied to this risk.

3. TRIGGER TYPES

In the initial development of catastrophe bonds there were a number of issuances with indemnity triggers; but in 2006, the year in which catastrophe bonds really developed as an established asset class, issuance was dominated by market loss triggers, with most other bonds being parametric. In 2007 and so far in 2008, there appears much greater willingness again to invest in indemnity trigger bonds, particularly for insurers who demonstrated superior data accuracy and completeness.

One explanation for this is that it is linked to the softness of the conventional reinsurance cycle; as that market softens catastrophe bonds need to offer indemnity triggers to compete with the availability of conventional reinsurance whereas in a hard market insurers require protection in any form and are willing to accept the perceived greater basis risk of indemnity and parametric triggers themselves.

Another explanation is that in the initial development of catastrophe bonds many if not most investors were reinsurers. Indexed bonds were required to give the market critical mass and attract investors from outside the (re)insurance industry, but these investors are becoming more familiar with catastrophe exposures and so more comfortable absorbing the basis/operational risk inherent for investors in indemnity triggers. It is possible that this situation would change radically following a major event, with investor support for indemnity triggers rapidly evaporating if a number of these bonds are triggered with unexpected losses for the sponsor compared to market losses.

Trigger type also depends on the type of business assumed by the sponsor (insurance, reinsurance or retrocession), and on the investors' view on the sponsor's ability to accurately model their potential losses.

Each type of catastrophe bond contains basis risk; clearly some more than others. Illustrations of the source of that risk are given below using examples of the typical triggers used in each type on bond.

Please note the specific bonds referenced below are done so for the purposes of illustrating the type of trigger; it is not intended to imply any one contains greater basis risk than any other.

3.1. Indemnity

These bonds are generally considered to have minimal basis risk, however, some still exists. The bonds trigger a loss to investors if the losses to the sponsor's underlying portfolio exceed a predefined value, behaving much like non-proportional catastrophe reinsurance.

At the point when a catastrophe bond is likely to cause a default event, i.e. a loss to the investors, the sponsor will file an extension event notice and the bond then goes into a period of 'deferment'. This extension period is usually designed to be sufficient to allow for the loss on the notes to be established with certainty. There may also be provision for the loss to the investors to be established by using predefined methods to estimate ultimate losses, comparable to commuting a reinsurance contract. This latter approach allows for earlier triggering and greater cashflow certainty for both sponsor and investor.

There are potential disadvantages to either approach to triggering an indemnity bond. If there is no estimation of ultimate losses cashflow strain can be a very significant issue. For example, Kamp Re has only recently triggered, more than two years after the triggering event. The sponsor (Zurich Financial Services, arranged via Swiss Re) would have funded the US trust funds for their losses immediately following Katrina, generating a two-year cashflow strain. Conversely, if there is a shorter extension period combined with ultimate loss estimation, there is a risk that, at the final extension date, any unpaid reported losses (Outstanding or IBNR) ultimately turn out to be underestimated.

Investors have, in the past, been reluctant to support indemnity based catastrophe bonds. During 2006, only two of the bonds issued had indemnity triggers, being Vasco Re 2006; Residential Re 2006.

However 2007 saw six bonds with indemnity triggers, being East Lane Re; Merna Re; Mystic Re II; Nelson Re; Puma Capital; Residential Re 2007, and there appear to be a greater number of investors now willing to support these bonds.

3.2. Modelled loss

These bonds estimate any losses to investors by applying the actual catastrophic event to a 'notional' portfolio of policies. The portfolio is set at the start of the deal (and often reset each year) to best reflect the expected portfolio of the sponsor, i.e. to minimise basis risk. However, basis risk does still exist in two forms:

- actual vs. notional portfolio at the date of the event,
- actual losses to the portfolio compared to modelled portfolio losses.

Typically the trigger and exhaustion points will be in the form of monetary amounts, as it would be in an indemnity bond, e.g. Nelson Re Ltd. Nelson covers 3 perils – US Hurricane, US Earthquake and European Windstorm – although only the European Windstorm section of the issue is based upon a modelled loss.

There is a very real risk arising from potential modelling error; this could arise from the completeness and quality of the portfolio data used or from the model itself. It is typical that after a major event the catastrophe modelling firms use the additional damage and insured loss information to update and revise their models. In some cases these revisions can cause radical changes in the estimated losses from a specific event, or significant changes in modelled loss frequency; both were seen following the European Anatol / Lothar / Martin run of windstorms in 1999 and the 2005 US hurricane season.

3.3. Parametric index

These bonds estimate any losses to investors by applying the actual catastrophic event/hazard magnitude (based on some form of Parametric Index) at a series of locations to a set of weights. The weights are set at the start of the deal (and often reset each year) to best reflect the expected exposure of the portfolio of the sponsor, i.e. to reduce basis risk. However a parametric trigger adds one more block of basis risk, as compared with a modelled loss issue, as now the sponsor is also reliant on the parametric index being a reliable measure of their loss.

For a parametric trigger the basis risk can be thought of as existing in a two main areas:

- parametric index value vs. modelled loss,
- modelled loss vs. actual portfolio loss

Typically the trigger will be in the form of an index value calculated by applying a predefined formula to the actual event values and combining with the selected weights over all locations. One example is Green Valley Limited and Atlas Reinsurance IV Ltd for European windstorm.

Typically increasing the number of the points at which the selected parameter is measured as well as using more complex parameters will decrease the basis risk; however there is a trade off with the risk that the index calculation will become so complex that it becomes difficult for the sponsor and investors to understand whether a particular event will trigger the bond.

The comments on the catastrophe models described in the “Modelled Loss” section apply equally to bonds with parametric triggers.

3.4. Industry loss

Typically this form of trigger is only used for the US, where the PCS (Property Claims Services) reported loss values are regarded as a reliable and independent basis for bond triggers. However there have been recent attempts to produce a market loss index for European losses so as to facilitate industry loss catastrophe bonds for European windstorm.

Bonds using this approach are sometimes perceived as having the largest potential basis risk, as the bonds respond to a trigger that is based upon industry-wide impact, which may be considerably different from the sponsor’s individual loss experience. However this bond is simple for both sponsor and investor to understand and requires less disclosure than other types of index.

An example of a recent issue is Mystic Re, issued by Liberty Mutual to protect against US hurricane for a specified region in the USA. The bond responds to events with a PCS reported value (excluding workers compensation) of $30bn for the subject area.

3.5 Modified industry loss

A more recent development is to use losses reported by PCS, but rather than taking aggregate losses to instead take the values reported by PCS for each state in the US and weight them to reflect the sponsor’s portfolio. A recent example was Newton Re, issued on behalf of Catlin in December 2007 and protecting US earthquake and hurricane. Potentially these bonds have significantly less basis risk than a “nationwide” industry loss trigger whilst retaining the benefits of simplicity and minimum disclosure.

3.6. Hybrid trigger

2006 saw the ACE Calabash bond issue, where the trigger was a hybrid of modelled and market losses. This bond uses the portfolio modelled loss as percentage of industry modelled loss and then applies this percentage to the PCS loss value. By rescaling the portfolio modelled loss in line with the ratio of PCS loss value / industry modelled loss, the risk of the catastrophe modelling software undervaluing the overall event is removed.

4. OTHER PERSPECTIVES

4.1. Catastrophe modelling agencies

We asked the three main catastrophe modelling companies to comment on basis risk in catastrophe bonds:

AIR

Definition from "Evaluating the Effectiveness of Index-Based Insurance Derivatives in Hedging Property/Casualty Insurance Transactions", by American Academy of Actuaries Index Securitization Task Force, 1999:

"Basis Risk is the risk that there may be a difference between the performance of the hedge and the losses sustained from the hedged exposure. It is the risk that the value of the underlying or index used and/or structure of the settlement of the derivative may not provide the desired offset to insurer's loss. For most reinsurance contracts, basis risk is eliminated since the reinsurance contract's terms and conditions specify the subject losses that are to be covered by the contract. Basis risk may exist in reinsurance contracts containing industry loss warranties - a class of reinsurance contracts that use industry or parametric indices to trigger coverage. With this type of contract no payment is made, for a given occurrence, unless the industry index or the parametric value exceeds a specific value."

Eqecat

Reply from Dennis Kuzak:

"You are correct that there are various definitions of basis risk but we at EQECAT define it as the difference in actual (UNL) losses incurred by an insurer and the recovery that will be received by the insurer via the purchase of an insurance contract, catastrophe bond, industry loss warranty (ILW) or risk swap. The definition is simple, but the devil is in the details.

It is generally presumed that an insurer has no basis risk if it purchases indemnity cover, but the timing of the cash outlays and recoveries will not be the same. So there may be a time value of money issue. Also, some claims may be denied or reduced by the reinsurer, delaying the final cash payments. If the hedge is a catastrophe bond or ILW, there will be different cash flows (in many cases, cash will be received from the hedge before the final losses are paid out), but the total cash received may be more or less than the realized losses. Thus the basis risk here is a net of the cash flow pattern plus the variability between the realized losses and losses recovered under the hedge. This will vary depending the on the type of loss trigger (e.g. parametric index, ILW, or modelled loss) and the variability in the "footprint" of the loss event.

We do make estimates of the basis risk arising from the difference between a modelled loss and the loss trigger used, but estimating basis risk on an ex-ante basis is very difficult since each catastrophe event will have unique properties that may not necessarily match each stochastic event in the model. Our catastrophe models do have significant uncertainty built into the loss estimating procedure, and using the standard deviation in the model outputs could provide for a measure of the probability that a loss could exceed (or be below) the targeted risk protection level."

RMS

The following will be included in a white paper to be published by RMS summer 2008:

“The term basis risk is used to describe a variety of phenomena in the insurance linked securities realm, and is used even more broadly in the reinsurance universe. Hence, it is central to this discussion that basis risk be defined in its various guises: armed with such definitions, we are in a stronger position to understand and quantify the impacts it has on a company’s risk management practices and, ultimately, its financial strength.

Basis Risk: The degree to which the indemnity loss experienced as a consequence of an event or set of events does not match the payment received under a related contract designed to cover these losses.

Importantly, from a risk analysis standpoint, there are distinct components to this: modelled and non-modelled. The non-modelled basis risk has 2 elements:

Non-modelled Basis Risk: The net consequence of:

- The degree to which the peril model’s estimate of the indemnity loss is not consistent with that of the actual coverage required; and
- The degree to which the peril model’s estimate of the trigger payment is not consistent with that of the actual payment

There are many factors at play contributing to the difference between the cost of doing business, and the ‘technical rate’ one should charge for a specific insurance product.

In essence, this definition of Non-modelled basis risk is really a reformation of the question “Does stochastic modelling, as applied to indemnity contracts or ILS triggers, give an accurate account of the risk inherent therein?

This is a broad question somewhat beyond the scope of this discussion; suffice to say that the role of the modelling agencies is to ensure the constant scientific advancement to minimize the potential deviation between the modelled and ‘true’ technical rates. One can establish a point view of non-modelled basis risk through the examination of historical events and comparison to actual loss experience to the extent available. However, to generate a complete distribution thereof implies the use of (or even development of) a model; which then takes us into a modelled basis risk realm.”

4.2. Rating agencies

We also reviewed the published criteria from rating agencies relating to basis risk. There are varying degrees of detail in the public information from the major rating agencies but each makes an allowance for basis risk in the credit given to ILS transaction within the capital adequacy tests, as part of their Financial Strength Ratings (FSR) process. For example the following rating agencies either implicitly or explicitly allow for basis risk as follows:

- Standard & Poor's allows insurers and reinsurers to take an appropriate level of credit for their ILS protections within their net 1-in-250 year catastrophic charge,
- AM Best has a four-step process for estimating the effectiveness and thus the credit given to ILS transactions as a form of 'reinsurance' protection,
- Fitch incorporates ILS transactions within their PRISM capital model.

5. COMPONENTS OF BASIS RISK

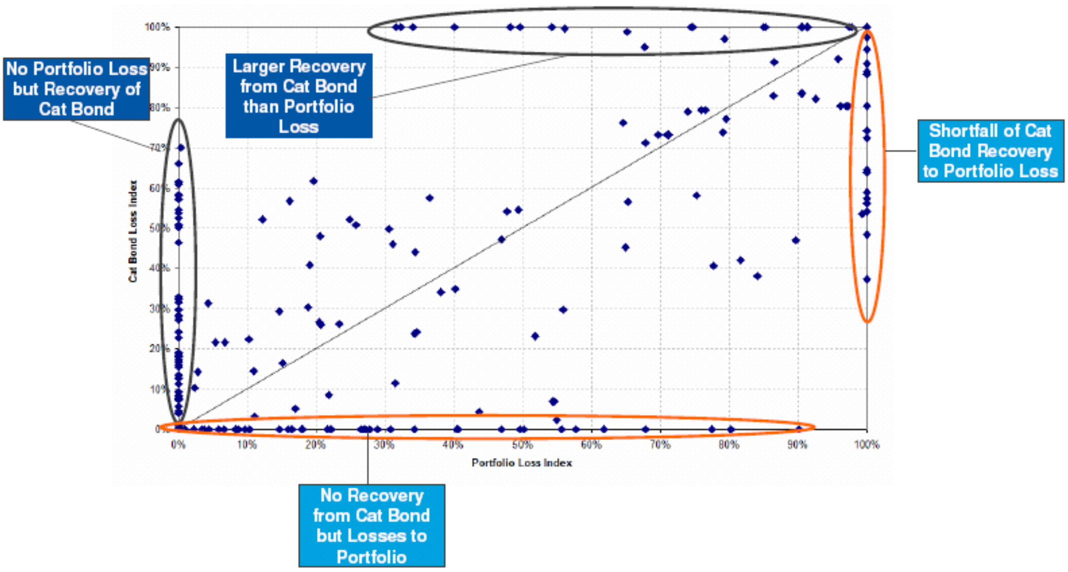
Basis risk can broadly be split into modelled and non-modelled basis risk.

5.1. Modelled basis risk

This component is the result of the modelling exercise undertaken to gauge the level of basis risk. The sponsor would normally model its expected losses for a range of scenarios, and:

- calculate the recoveries expected from a pure indemnity trigger
- contrast them with the recoveries expected from a non-indemnity trigger
- contrast net aggregate claims based on the different triggers, to put the quantum of the difference into perspective

The graph below illustrates the results of such an analysis.



Source: Guy Carpenter

This element of basis risk is therefore transparent to the sponsor, who can then decide whether to bear that level of basis risk.

5.2. Non-modelled basis risk

In addition to the modelled basis risk described above, the sponsor is also assuming additional basis risk that is not captured by the modelling exercise. We can break down this non-modelled basis risk into a number of components:

Contractual definition

This first component reflects the potential for the contractual definition for the trigger to be different from the one used in the model. For instance:

- a US catastrophe bond with an industry loss trigger may be defined by reference to a PCS index, which is different from the industry loss produced by the catastrophe model,
- the definition of an industry loss trigger may include perils not modelled by the catastrophe model,
- the definition of the measurement procedure for a parametric trigger may give a different result from that provided by the catastrophe model.

Model risk

This second component arises from the fact that models are only a simplification of reality, and using models therefore adds additional uncertainty to the outcome. For example, events like Hurricane Katrina have reminded us that catastrophe models have uncertainty built-in, relating to their methodology and assumptions. It is clear that actual losses are more complex than assumed by catastrophe models. Model risk itself breaks down into a number of areas.

- Event frequency – in some catastrophe models the event frequency increased by approximately 30% following the 2004/5 hurricane seasons.
- Event location – there is a finite number of stochastic events within the catastrophe models; relatively small changes to a storm path or earthquake epicentre can cause significant changes in the damages caused
- Event severity – for a given event in a given location, the actual cost of damage caused may differ quite significantly from that modelled

Data quality

This third component captures the bias associated with the quality of the information, which results in the model being used sub-optimally. Examples of this risk would be:

- exposure leakage, as parts of the portfolio are not modelled because the exposures have not been captured or modelled;
- poor or erroneous exposure information on the risks in the portfolio;
- extrapolation from the historical portfolio to the portfolio subject to the transaction.

Liquidity risk

This is the risk that there is a significant delay between the triggering event and the actual date on which the bond is triggered. This is most significant for indemnity triggers, but may also be an issue for market loss triggers as PCS may continue to update its loss estimates for many months following the event.

Summary and elements of basis risk by recovery trigger

Contrary to the modelled part, the non-modelled basis risk is much harder to quantify in order to make information decisions. Unfortunately, as insurance-linked securities are becoming increasingly designed to minimize modelled basis risk, the non-modelled part represents a growing proportion of the basis risk in transactions. However, where it is not possible to measure these elements of basis risk, we can assess the relative significance of each for a particular catastrophe bond trigger. This subjective assessment can be used alongside the quantification of modelled basis risk in evaluating the potential bond triggers.

The table below summarises the different sources of sponsor basis risk by family of triggers:

	Modelled	**Contractual Definition**	**Model Risk**	**Data Quality**	**Liquidity Risk**
Indemnity	L	L	L	L	H
Modelled Loss	L	L	H	M	L
Industry Loss	H	M	M	n/a	L/M
Modified Industry Loss	M	M	M	M	L/M
Parametric	M/H	H	H	H	L

It is not possible to generalise about hybrid triggers, as these are designed to take the better elements of two or more of the above.

6. MODELLING BASIS RISK

6.1. Methodology

It is possible to model some elements of basis risk. There are difficulties in assessing appropriate values for some of the parameters, particularly error functions and correlations. However it seems more appropriate to include these aspects and use sensitivity testing on the selected parameter values rather than ignore these important elements of basis risk.

We describe below an approach to modelling market loss triggers; a similar approach can be adopted for other trigger types. We assume for this that the sponsor has selected a trigger value with the hope of protecting the portfolio when its own losses exceed $170m. This equates to approximately a 1 in 30 year event.

- Simulate the number of events for the period of the catastrophe bond
- For each event count, randomly select an event ID; this selection should incorporate the relative frequency of each event from the event set
- For each selected event ID, simulate the event modelled market loss value based on the distribution parameters (RMS / EQE both identify these parameters explicitly, AIR embed this within the software, making it harder to replicate)
- For each selected event ID, extract the distribution parameters for the modelled portfolio loss value of that specific event. Select a correlation factor to describe the relationship between the percentile of the severity distribution simulated for the modelled market loss for that specific event, and the percentile of the severity distribution for the modelled portfolio loss for that specific event. Note that assuming a high correlation is not the same as assuming that in general small modelled market loss = small modelled portfolio loss; rather it is assuming that if for a specific event in a specific location the market loss is greater or smaller than would normally be expected for that event, then the portfolio loss will follow suit
- Simulate the modelled portfolio loss using the distribution parameters and correlation factor described above
- Simulate error function for actual PCS market loss value vs. modelled market loss value, and for actual portfolio loss value vs modelled portfolio loss value. Again it seems reasonable to correlate the error functions for market and portfolio loss for each specific event; if a PCS loss value is significantly higher than the modelled loss, it seems reasonable to assume that the actual portfolio loss will also tend to be higher than the modelled portfolio loss value. We have used unbiased error functions, but clearly the user can adopt biased functions if they so wish.

  This error function provides a broad allowance for elements of the "non-modelled" basis risk. However we would recommend separate sensitivity testing on event frequency in addition to the use of the error function.
- Set trigger to "yes" or "no" based on the simulated PCS value and also collect values for both PCS and portfolio simulated "actual" loss values.

- Based on simulated output identify the likelihood of having a portfolio loss exceeding $170m without having a PCS loss sufficiently high to trigger the catastrophe bond

Clearly careful sensitivity testing is required in selecting the error functions and the correlation factors. Thought must be given as to whether these factors should vary based on the size of the event. Arguably for the very largest events where many properties in the affected area are effective total losses there may be closer agreement between modelled and actual losses, however this point of convergence is likely to be far beyond the trigger point for most catastrophe bonds.

We also recommend sensitivity testing on the event frequency. The simplest and most transparent approach would be to load the frequency of each of the synthetic modelled events, for example a flat 25% increase on the likelihood of each event.

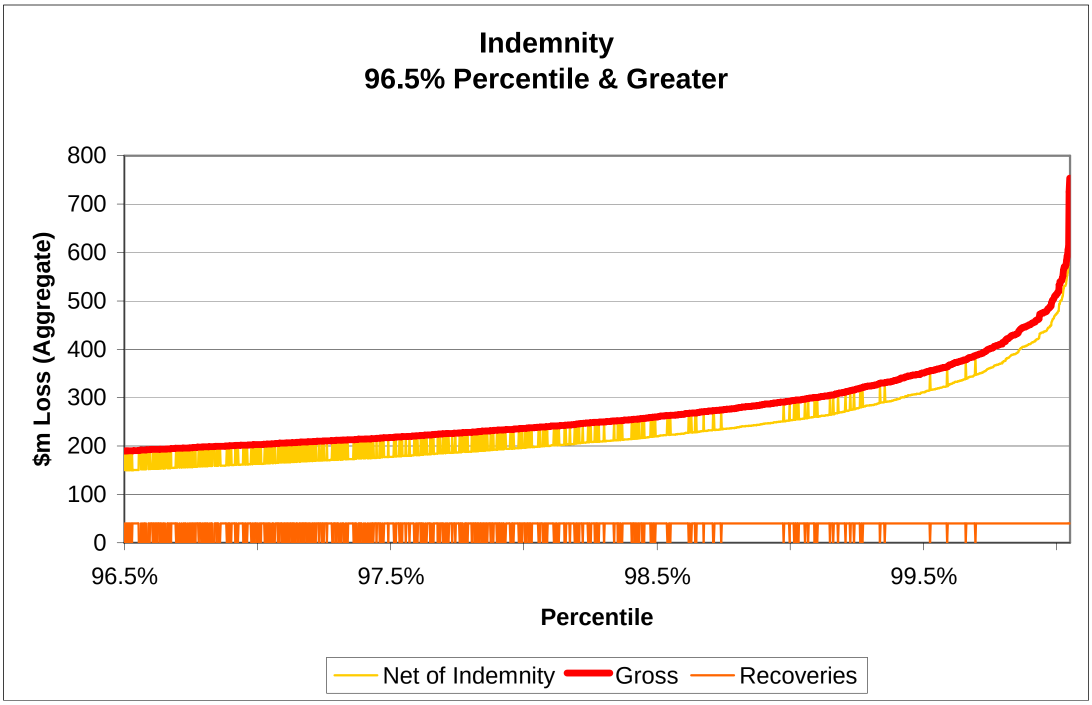
It can be helpful to have one or more specific values quantifying the basis risk, allowing the sponsor to easily compare this for different types of catastrophe bond triggers, and indeed between catastrophe bonds and other protection strategies. Simply looking at the standard deviation of the “net of bond” losses can be misleading, as it includes those events where the bond has been triggered although the gross losses were not high. An alternative is to consider instead the adverse semi-deviation, which is calculated in a similar way to a standard deviation but only taking into account those results which are worse than the mean. A refinement on this, and the measure that we have adopted for the examples in this paper, is a limited adverse semi deviation. This is calculated only for the 96.5 – 100th percentile range of gross losses, so ignores the “noise” arising from smaller events. The range was selected to tie in with setting the trigger at roughly 1 in 30 years.

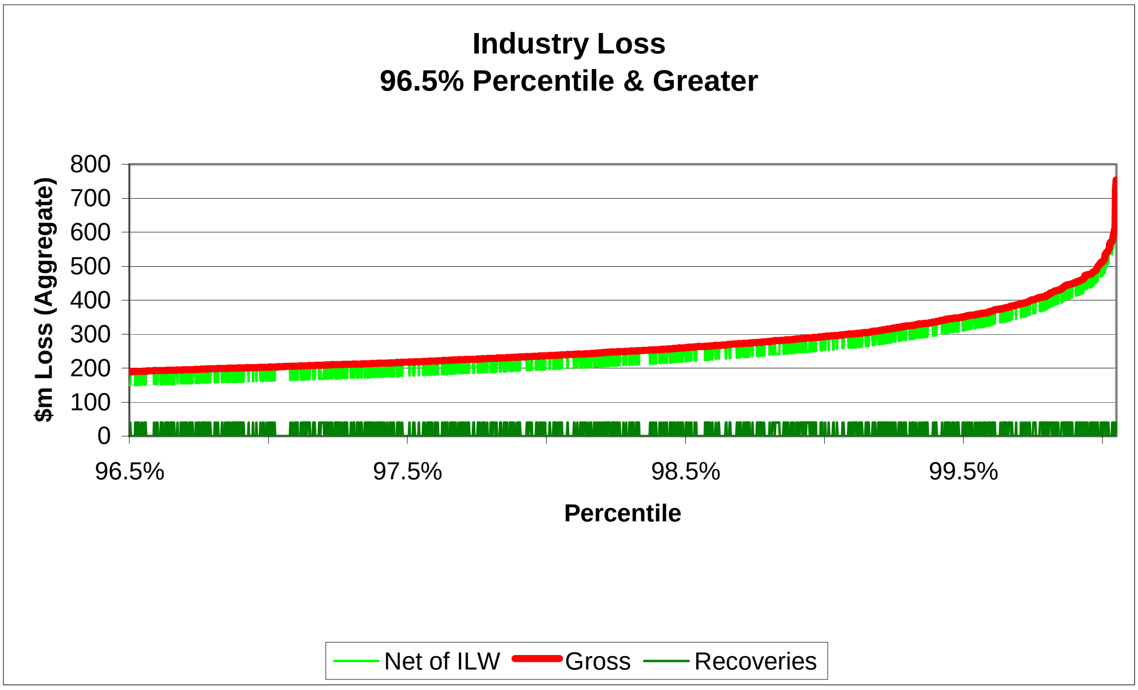
6.2. Example

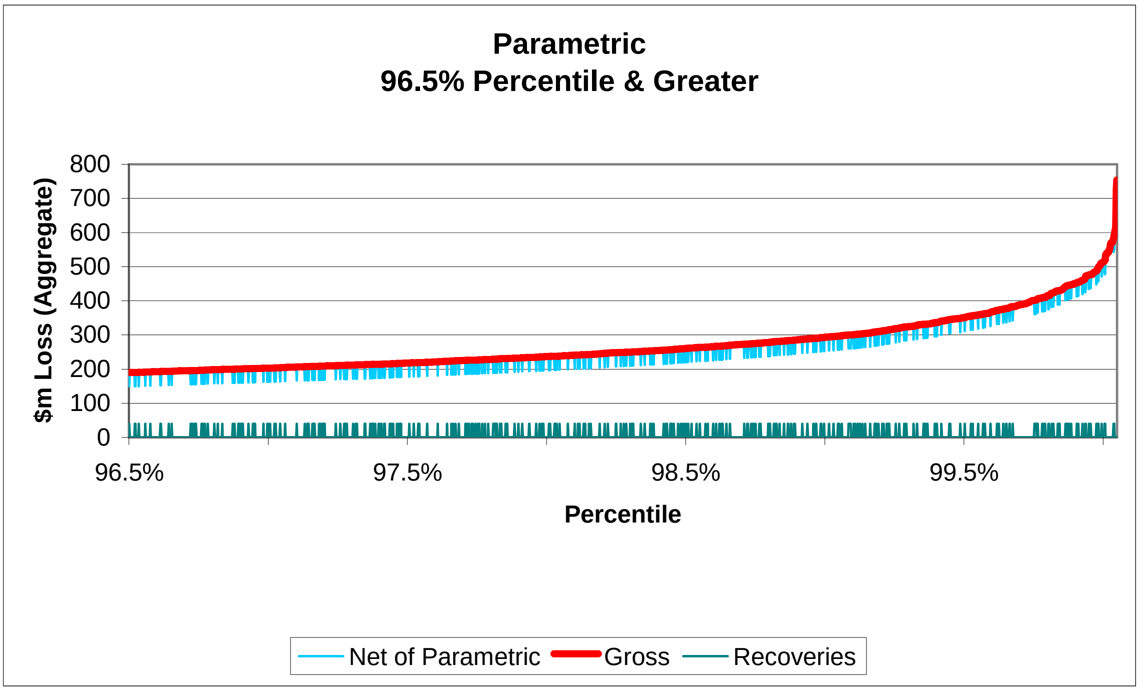
We have developed a basis risk model along the lines compared above to compare indemnity, market loss and parametric triggers for US hurricane. A simplified version of this model will be made available on the GIRO website prior to the September 2008 conference.

The parametric trigger in our somewhat synthetic example is very simple, being a category 5 on the Safir-Simpson scale based on the highest category recorded on land. The market loss trigger value has been set at $57bn as reported by PCS. The indemnity trigger is set as a franchise at $170m, at which point the entire $40m bond value is triggered – this being chosen to give the closest comparison to the market loss and indemnity triggers in this example.

The graphs below show the gross and net aggregate catastrophe claims and the recoveries from the bond based on the three triggers described above. Ideally one would see the recoveries remaining steady at $40m with minimal 'fringing', indicating the response of the catastrophe bond to all events in our select percentile range.







Of these, the indemnity graph appears to show the most consistency in net result and least "fringing" of recoveries, and the parametric the worst. However it is difficult to get any quantum from the graphs. Instead, we have selected some key values to both illustrate the quantification of basis risk. We believe there are a number of alternative approaches to quantifying basis risk, and that each approach will be more or less suited to a particular portfolio and risk mitigation aim. In particular we are not suggesting that the measures set out below are appropriate in every case, or that they are superior to other measures that have been developed.

In this example the Coefficient of Adverse Deviation (CoAV), based on the adverse semi-deviation for the selected percentile range, appears to be a more sensitive measure of basis risk than simply taking the more usual Coefficient of Variation for this range. The ordering of the CoAV follows that which we would expect given the graphs shown on the preceding pages, showing the indemnity bond creating least **adverse** variation in net results and the parametric trigger the most.

	Gross	**Net of Indemnity**	**Net of Market Loss**	**Net of Parametric**
Full Range:				
Average	186,069,966	173,021,966	175,605,966	179,765,966
St Dev	82,833,302	70,467,915	81,945,380	83,633,824
CoV	44.5%	40.7%	46.7%	46.5%
96.5 - 100% range:				
Average	273,683,692	241,593,551	259,779,467	266,765,382
St Dev	79,514,141	76,240,455	80,694,700	80,680,511
CoV	29.1%	31.6%	31.1%	30.2%
Adverse semi deviation		64,112,293	75,846,643	79,798,141
CoAV		26.5%	29.2%	29.9%

Clearly this is a very simplified example. In reality, the choice is unlikely to be between indemnity, market loss and parametric triggers. A writer of non-US reinsurance may only be offered a parametric index, as investors may not support an indemnity trigger for this business and there is no universally accepted, independent market loss reporting. However, measuring the basis risk might allow the potential sponsor to assess a range of different parametric triggers, tailoring the trigger so as to minimise the level of basis risk. Similarly, the approach can be used as a means of comparing reinsurance with catastrophe bonds.

7. Conclusion

There is risk within every protection strategy, whether reinsurance or non-life insurance linked securities. For catastrophe bonds the selection of the bond trigger is key to determining the level of risk remaining with the sponsor. However the investor appetite for the various types of triggers appears to be cyclical, which will sometimes limit the trigger types available. At the time of writing, the market is relatively soft, with more appetite for indemnity bonds than has been seen previously and reducing margins.

When considering the suitability of various triggers, sponsors should take into account the level of their reliance on the catastrophe models in selecting a trigger, and assess the potential impact on their portfolio of having a miss on the trigger. For complex parametric indices, the sponsor should also take into account its reliance on the catastrophe models to calculate whether the bond has actually been triggered.

We recognise that basis risk is only one of many factors to be considered when assessing a catastrophe bond. For example, if a catastrophe bond is being compared against traditional reinsurance, the fully collateralised nature of the bond must be measured against the bad debt potential on the reinsurance. Time and resources are also an important consideration; a market loss catastrophe bond can be executed faster and with much less resource than an indemnity bond, although all bonds are likely to take more time and resource than a typical catastrophe reinsurance programme. Additionally, the basis risk must be assessed in context; where a catastrophe bond forms only a small part of the sponsor's overall catastrophe protection the impact of the basis risk on the overall net may be relatively minor. It is vital that one always measures the net claims, not just the recoveries, to ensure this perspective is not lost.

Finally, and most importantly, given the cyclical nature of insurance, reinsurance and catastrophe bond investor appetite, the assessment of "best available" protection strategies is necessarily an ongoing exercise. Potential bond sponsors should regularly assess the basis risk in the range of protection options available to them, as this year's results may differ significantly from last year's. In particular, one should not assume that a particular trigger type must, by definition, have less basis risk than another simply because this is "market wisdom". We believe that measuring basis risk to the widest extent possible, sensitivity testing key assumptions, and examining the potential areas of basis risk that cannot easily be modelled to assess their relative significance are all essential parts of catastrophe bond assessment.

REFERENCES

In preparing this paper we have made use of the following sources of information.

Guy Carpenter

http://www.guycarp.com/portal/extranet/insights/reports.html?vid=24

Guy Carpenter produce amongst their "Insight Reports" annual reports on the catastrophe bond market. Their annual reports on the Reinsurance market also give useful commentary on areas such as rate movements, sidecar and ILW activity.

Past GIRO papers

www.actuaries.org.uk

(follow links for General Insurance and then Past GIRO papers)

1997 GIRO: "The Securitisation of Insurance Risk" - Richard Bulmer et al

Casualty Actuarial Society papers

http://www.casact.org/pubs/forum/03spforum/03spf245.pdf

http://www.casact.org/sections/care/0202/petlick1.ppt

Hedging Catastrophe Risk Using Index-Based Reinsurance Instruments - Lixin Zeng

Catastrophe modelling agencies

We would like to thank the three main catastrophe modelling companies for their contributions:

AIR	www.air-worldwide.com
EQE	www.eqecat.com
RMS®	www.rms.com