

INSURANCE SPECIAL

RMS

Innovative modelling from RMS' perspective

Answered by: Robert Muir Wood, Chief Research Officer at RMS



How do you model the risk of a meteorite hitting the earth's surface? Have you?

The risk, from space impacts of all kinds, is actually one of the easier catastrophes to quantify. In terms of defining the hazard we can approach the problem in three ways:

- by observing the spectrum of what arrives at Earth each year
- by identifying the full range of orbiting near-Earth objects; and
- by exploring the rate of impacts large enough to leave craters from the geological record.

We have not yet built such a model because the risk is actually fairly low – below the typical level considered by insurers. However, we have thought about how we would build it, and of course there is the potential for very extreme 'global' events. The hazard is higher at low latitudes than at high latitudes (because most asteroids orbit in the same plane as the planets), but living close to sea-level on an oceanic coastline presents the highest hazard, as it could be susceptible to an asteroid-generated tsunami.

Is there a model for "the" earthquake in Tokyo?

The purpose of a probabilistic catastrophe model is to explore the full range of possible events. While the most likely significant earthquake beneath Tokyo is c. Magnitude 7, it would not be totally catastrophic. However, the model also allows for far less likely events - such as the M7.9 1703 earthquake, which would be a genuine 'Big One'.

Or a pandemic?

RMS has already developed a probabilistic pandemic influenza model that considers a wide range of possible viral outbreaks in terms of their infectiousness – as well as where the outbreak begins and how effective counter-measures prove to be - in all the different countries.

Is it possible to "quantify" and achieve "precision" or define parameters for catastrophes that are unknown (eg. lurking, undiscovered

deadly virus strains, etc.)

Where a source of catastrophe is completely unknown – such as a hypothetical new virus – the model can be used for exploring the implications and potential losses, but one cannot achieve 'precision' for a situation that is completely uncertain.

What are RMS' current model offerings and what does it takes to maintain those models at the cutting edge?

We continue to research all aspects of how we build models, accumulating new knowledge that can be employed when we rebuild a model. For example, we have been researching how to build physical models of all those processes that lead to increases in repair costs after the largest catastrophes. We have a strong culture that emphasizes the need for on-going research and innovation at RMS.

How do you fine tune your model for globally, unstable, weather patterns?

The model already includes a full range of climatological conditions driving extreme events. However, we are actively researching the way that climate change is expected to affect catastrophe occurrence and will be adding a 'future climate' perspective to the services we offer to clients.

...to accommodate varying intensities and frequencies for both naturally occurring and unknown man made catastrophes?

We encourage clients to understand model sensitivity by making it possible to explore how to test assumptions around the severity and frequency of events. In future we will make the ability to perform stress tests on assumptions a core part of the model.

...unexpected associated damage (fire is included - but how about water, the air, floods, epidemics. etc.)?

Models are becoming more comprehensive in modelling all sources of loss – for example shaking, tsunami and fire for an earthquake. We would like to ensure the 'unexpected' is being sampled in generating loss outcomes.

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Is the transferring of catastrophe risk to capital markets, different from transferring credit risk, spliced and diced... in what ways and why?

Answered by Peter Nakada, Managing Director of RMS Consulting



Transferring catastrophe risk to the capital markets is conceptually similar to transferring credit risk through credit-linked securities. Yet, the alternatives available for transferring catastrophe-linked securities have not developed as quickly as those for credit-linked securities.

For example, the cat-linked securities market has:

- A small number of unique deals with issuer-specific characteristics
- A specialised investor base with heavy reliance on rating agencies
- No “synthetic” underlyings
- A limited secondary market
- Pricing that reflects concentration and illiquidity premiums.

By contrast the collateralised debt obligation market has:

- Risk depends on structure more than issuer
- A broad investor base, research-driven rather than expert-driven
- Trading and hedging isolating secondary parameters (e.g., volatility, correlation)
- Synthetic structures that allow volume to outstrip primary issuance
- Pricing based on market-derived parameters (price = cost to hedge)

We believe that the path to a more mature catastrophe-linked securities market is:

- Through intermediaries helping to reduce the all-in cost of issuance through more standardisation of structures
- Issuers would then issue more, because it would be incrementally more attractive vs. traditional reinsurance
- Larger issuance would attract more main stream investors, who would not have the concentration issues that the specialists have
- Risk premiums in the market would be bid down, further reducing the all-in cost of issuance

Notice that there is a chicken-and-egg problem here – the market won’t get bigger until it gets cheaper – but the way to make it cheaper is to make it bigger. Once the market gets larger and more liquid, it won’t be long before the same types of “particle finance” that exist in the credit markets work their way into the catastrophe-linked markets as well.

Simplification of natural catastrophe risk (eg. a hurricane): total cat risk = hazard risk + vulnerability risk + other basis risk.

To better understand the different components of risk, let’s consider an example of hurricane risk for a homeowner’s portfolio:

- **Hazard risk** = the risk that the wind blows 120 mph on that house
- **Vulnerability risk** = the risk that there is insured loss given that the wind blows 120 mph on a given house
- **Other basis risk** = the risk that political pressure causes the insurer to pay for flood even though the policy only covers wind

If we were to think about where each component of risk belongs, you would guess that the **vulnerability risk** belongs with the insurer who is underwriting the property – that is, deciding which houses will fall over and which ones will stand up in 120 mph winds. Because this is their “value added”, they should keep this risk along with its associated return.

The other **basis risk** should probably stay with the insurer as well, since this is something that is at least

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partly under the insurer's control (it's the insurer's decision to give in to the political pressure).

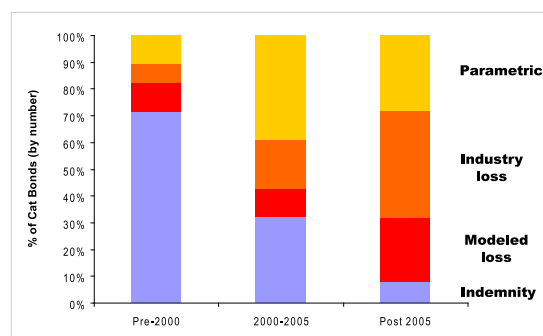
However, the **hazard risk** (which is transferred through "parametric" risk transfer) is one that should logically find its way into the grand casino of the capital markets. It's not likely that insurers believe that they have a competitive advantage in meteorology or seismology (although there are some Bermuda-based reinsurers that do invest in this capability). Furthermore, this is the risk that it most difficult to diversify because it is so lumpy (75% of all of the hurricane risk in the US is in the state of Florida).

There has been an increasing trend toward parametric transfer of risk to the capital markets (see chart below).

However, there are a couple of things holding back the development of this market:

- The industry has not become fully comfortable with basis risk
 - Insurers and reinsurers are not comfortable with the risk that they could sustain actual losses that are not covered by the parametric instrument
 - Insurers and reinsurers have not historically thought about separating hazard and vulnerability/basis risk – it will take some time for them to change their business models
 - Rating agencies are still conservative about how much credit they give for risk transfer that leaves basis risk
- There are not standardised parametric indices for all perils
 - In the past, there wasn't a reliable parametric index for US hurricane because existing stations (mostly operated by NOAA) were not designed to withstand hurricane force winds
 - However, RMS in partnership with WeatherFlow is developing a new network of weather stations called WindX – scheduled to be ready for the 2008 hurricane season

The hope is that parametric securities will allow a less specialised investor to enter this market. Specialist investors and hedge funds understand the mechanics of how insurance losses are incurred – many are as sophisticated as reinsurers. However, investors in parametric securities would only need to understand the odds of, say, the wind blowing 120mph in South Miami. This simpler trigger should attract more main stream investors, and will likely jump-start the virtuous cycle of growth in the catastrophe-linked securities market.



Cat bonds are moving away from indemnity triggers

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How do models for natural catastrophes differ from those for terrorism catastrophes? What are the challenges posed by both? In what way are the models alike and how do they differ? How much of terrorism catastrophe risk is currently being transferred to the capital markets? Prospects and potential for investors?

Answered by Peter Ulrich, Senior Vice President of Model Management at RMS



The framework used to model terrorism risk is similar to that of natural catastrophes. Three separate modules are developed to assess the risk:

1. **Hazard module:** what is the likely frequency and severity of the natural catastrophe or terrorist attack
2. **Vulnerability module:** given the occurrence of a natural catastrophe or terrorist attack, what are the likely damages to the exposed buildings given proximity to the event, and construction characteristics of the buildings, and what are the expected human casualties from the event.
3. **Financial module:** given the property damage and human casualties computed in the vulnerability module, the financial module translates these into dollar losses to the policyholder, insurer(s) and reinsurer(s)

By definition, catastrophic events occur relatively infrequently and thus data with which to build models can be scarce in some instances. Approximately two US hurricanes make landfall each year and RMS was able to collect over USD20 bn in loss data for use in calibrating our model. However, in the case of New Madrid earthquake risk, it has been almost 200 years since a major event.

A common misconception is that there is very little data with which to build a US terrorism model due to the fact there have only two major successful *jihadi* attacks on US soil (1993 World Trade Center bombing and the 9/11 attacks). However, RMS has collected a significant body of data for use in building a terrorism model for the US.

- **Compilation of a database of 20,000 *jihadi* terrorist attacks around the world:** mining this data reveals distinct tendencies in terrorist attacks.
 - **Type of cities attacked:** capital city vs. major city vs. other
 - **Type of terrorist targets:** office building, infrastructure, consulate, airport, tourist attraction, etc.
 - **Type of weapons:** likelihood of different weapons (bombs, airplane hijacking, sabotage, CBRN) along with magnitude of weapon (1-ton bomb vs. 5-ton bomb)
- **Interdicted attacks in the US:** close to 30 known attacks have been interdicted in the US since 9/11. Analysis of these provides insights into terrorist capabilities in the US (frequency of attempted attack) along with targeting and weapons tendencies

To date there has only been one capital markets terrorism deal – the 2006 FIFA Golden Goal transaction. RMS performed the analysis supporting the deal which was put in place to cover the potential for the World Cup being cancelled due to a terrorist attack. While there haven't been subsequent capital market transactions, there certainly are a number of insurers exploring the possibility, and the decision on TRIA - could make a major impact here. If TRIA is not extended, there will be an extreme and immediate shortage of terrorism reinsurance, and insurers will be looking to the capital markets for capacity.

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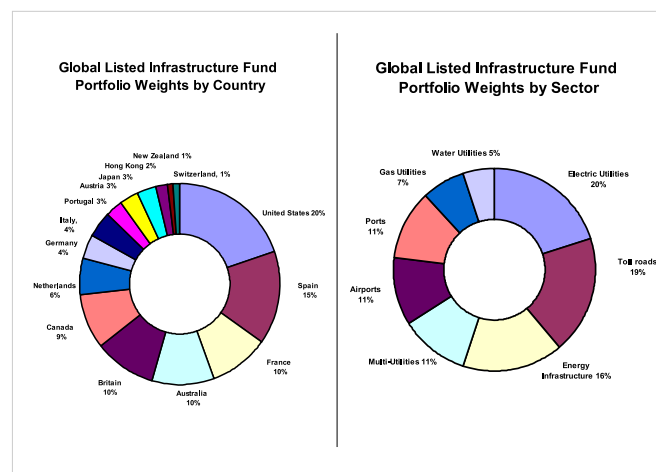
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LISTED INFRASTRUCTURE



Fund's diversification: by geography and sector

Source: Colonial First State Global Asset Management

FIRST STATE GLOBAL LISTED INFRASTRUCTURE FUND

Focus: • A long only fund that will invest in listed infrastructure securities from around the globe:

- Primarily toll roads, airports, utilities and pipelines in developed countries
- Focuses on assets with barriers to entry, pricing power and predictable cash flow

• Managed against a benchmark: the S&P Global Infrastructure Index

Strengths: • Liquid, diversified and transparent exposure to infrastructure assets (listed securities offer a more liquid and diversified exposure to infrastructure than a portfolio of physical assets)

• Experienced team specialised in infrastructure-led investing and positioned to benefit from the emergence of this global sector.

Weakness: • Short-term market volatility can distract investors from the long-term benefits of infrastructure

Opportunities: • Infrastructure offers steady capital growth and inflation-protected income.

• Dedicated asset allocations could drive infrastructure valuations higher, similar to property.

Threats: • Regulatory environment, legal framework, excessive financial leverage, company reputation

Risk Management

Low Low / Moderate Moderate Moderate to High High

- Ability to identify investment opportunities:

Low Low / Moderate Moderate Moderate to High High

Eliminates securities with:

- A market capitalisation < USD500mn
- With low earnings growth or distribution yields
- That are not free float
- That exhibit high price volatility

- Ability to assess:

Low Low / Moderate Moderate Moderate to High High

- asset quality:
- competitive advantages:
- pricing power:
- operational leverage:
- industry specific dynamics:

Low Low / Moderate Moderate Moderate to High High

- Tracking error: 3 - 5%

- Volatility of returns at fund level: Annual avg. 9 -12%

- Avg. liquidity of underlying:

Time required to unwind all positions under normal market conditions: 1-3 days

- Leverage applied at fund level: none

- Currency risk: hedged

- Regulatory risk: (at stock level)

Low Low / Moderate Moderate Moderate to High High

- Keyman risk:

Low Low / Moderate Moderate Moderate to High High

Performance Parameters

Low Low / Moderate Moderate Moderate to High High

- No. of positions in the portfolio: Average of 40 holdings

- Efficiency in putting investor capital to work:

Low Low / Moderate Moderate Moderate to High High

- Diversification:

- Geographic: US 20%, Spain 15%, Australia 10%, Britain 10%, Canada 9%, Netherlands 6%, Germany 4%, Italy 4%, Others:22%
- Sector: break up: Toll roads:19%, Airports 11%, Ports 11%, Water utilities 5%, Multi-utilities 11%, Electric utilities 20%, Gas utilities: 7%, Energy infrastructure 16%

- Investment horizon avg: 3months to 3 years

Outlook

- Barriers to entry: Sector specific expertise
- Outlook for the infrastructure sector: Upside
- Outlook for FSG Listed infrastructure fund: Upside
- Threat posed by competition: Exist, but is not expected to have a bearing on the fund's ability to perform

- Ability to deliver net annual targeted returns over:

- Next 12 months: Realistic
- Next 3-5 years: Sustainable

- Fund would outperform when: Securities are being priced on fundamentals

Investment

- Fund to be officially launched: Late September 2007
- Fund is targeted at: Retail and institutional investors
- In order to optimise returns recommended holding period: min: 3years
- Geographic restriction: the Fund will initially be available to UK investors

- Fund's base currency: GBP, could cater for: EUR
- Fund's complexity for an investor: Simple
- Transparency provided: High

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VOLATILITY

VOLATILITY CAN MAKE YOUR P&L SMILE



Peter van Kleef

Which managers, that trade volatility, would do well in a situation like this...?

Based on the low equity volatility (with a floor of around 10-12%) we have recently witnessed anyone with a long volatility position that stays and/or is even more long volatility as the market drops.

A position that is generally long volatility is usually quite expensive to carry if nothing happens. As volatility can also drop back quite quickly once markets cool down, someone with a long vega-gamma or long volatility of volatility position would do quite well.

Would you say it is underlying specific ... i.e. FX vs. equities-indexes vs. fixed income?

If the market correction is driven by a general increase in uncertainty then it doesn't matter. If the event is more specific, as is the case with credit, then you have to see which asset class is the one most affected. On this occasion currency volatility was less affected than fixed Income and equity volatility. Also financials and builders were clearly more affected than others as the trigger was quite specific - i.e. the credit problems of the sub-prime US segment. However, as credit worries spread, other sectors and asset classes get hurt as well. Credit tends to be capable of starting a domino effect - as in today's global markets the credit web is very complex and far reaching...

Since the inter-connection between markets increase, the correlation of volatility increases and falls (rapid increases of volatility are usually followed by sharp drops. Volatility of volatility can be as high as 200% when actual volatility is only 25-30%).

Would you say it is determined by the time interval and the pre-set levels at which they trade ...?

The fastest one will always be able to exploit erratic moves much better than someone with an intermediate time horizon and trading frequency. If a portfolio is set up in a way that it automatically provides excess payoffs in a substantial market dislocation it is much easier to be the fastest then if you have to start changing your book once the market starts to move. Most prudent traders will always be long "the wings" and long "teenies" which means having long positions in far out of the money options that are nearly worthless but can become very valuable once markets start to become erratic.

Volatility is mean reverting. That means it has to be traded to get maximum effect. That means pre-set levels are more important than time intervals.

To set levels, it is helpful to look at the theta/gamma (cost/benefit) ratios in combination with historic moves. It is easier to make the right decisions when measuring the dislocation on an objective scale. Discretionary decisions tend to be coloured by the hype and excitement in the market.

Since a lot of funds are model driven... i.e. the challenges they are braced with...

The challenge is always that volatility trading is not Physics. All models, however good they are, are only models. To come as close as possible to reality is the essence. To correctly model the connection between short and long term volatilities is key. This is especially crucial when the market approaches from extreme levels as volatility behaves quite differently at very high and very low levels from what it does when trading at intermediate levels. The winners usually understand what their models do and what they don't, and act accordingly.

How they can/do they optimise performance in times like these...

The only certainty in an environment like this is change. So one needs to position oneself in a way that allows for swift changes in exposure from long to short and vice versa. People

that bulk up with their positions one way do extremely well for a week and blow out the next. Volatility based products allow you to construct dynamic portfolios. The optimal strategy is to set up your portfolio in a way that your portfolio's dynamics are in line with what the market does e.g. focussing on gamma in short but swift moves and focusing on vega in extended significant moves. Ideally your portfolio would move from one exposure to the other once certain thresholds of market moves are breached. In a quick moving market there are also much more arbitrage opportunities than in quite markets. However the margins need to be locked in rather quickly as they can disappear as quickly as they appear.

When would they stand to lose?

Model driven traders generally lose when the way the market moves changes. Nowadays this happens in a significant way about every two to three years. It used to be seven to 10 years but the time intervals in which market behaviour changes are getting smaller. So there is more turnover among purely model driven traders. Last years winners are this years losers. The good news is, that volatility arbitrage works best and is most reliable when the dependency on the underlying model is reduced to a minimum. In this aspect, volatility is unique.

The role of leverage ...

Leverage per se is not necessarily as evil and dangerous as many think. It becomes dangerous if it is used on strategies that try to trade very diverse assets against each other. The more similar the assets and products traded, the less severe the impact of liquidity and credit squeezes. This is another feature of volatility. There is no product I know with so many similar contracts. This however doesn't deter many to sell highly leveraged positions in unrelated assets as arbitrage.

And how are they best prepared to surf a tide like this...

Discipline is key here. Sometimes trading very diverse assets or products may seem to offer exceptional margin. But margin needs to be scaled by risk. If one loses the discipline to do so - it's usually the first step over the cliff.

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