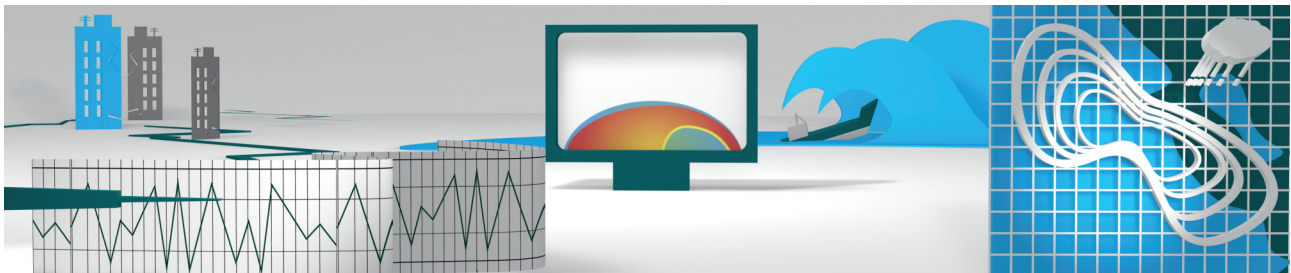


Reinsurability of Natural Catastrophes as Extreme Risks

This article considers whether natural catastrophes are universally reinsurable by reference to the characteristics of insurable risks, with particular emphasis on the need for risks to be calculable, given the inherent nature and limits of scientific knowledge. Notwithstanding some historic market failures to cope with natural catastrophes, these are primarily related to dislocations of the direct insurance markets and often pre-date the existence of robust catastrophe models. These models are in a phase of rapid development, supported by the latest technology and an increase in the number of specialist suppliers. Sufficient reinsurance capacity exists today to protect the level of insured catastrophe risk, but will need to scale-up to match the growing needs of developing economies.



Introduction

With the year 2011 producing the largest natural catastrophe economic losses in history, reaching US\$386 billion, the positive role that (re)insurance can play in helping societies to recover from the disastrous effects of natural catastrophes

is beyond doubt. A research paper by the Bank for International Settlements (von Peter *et al*, Dec 2012) strongly makes the case that risk transfer mechanisms help mitigate the macroeconomic costs and facilitate post-disaster recovery.

In this article, we address the question of whether Natural Catastrophes are reinsurable in all cases, and in doing so look back at some historic market failures as well as forwards to future challenges and opportunities.

Characteristics of Reinsurability

By extension, reinsurable risks have most of the characteristics typically associated with insurable ones, and this provides a useful framework within which to discuss the theme of this article.

Globally, one could argue that the diverse nature of Natural Catastrophes means that these risks do not represent a large number of similar exposures that can easily be pooled. However a global reinsurer can construct a portfolio of (largely) **independent risks**, thereby benefitting from diversification effects. Indeed, earthquakes, tropical cyclones (also called hurricanes and typhoons) and floods occur in many different countries. While there are, of course, differences in the nature of the hazard and built environment in different countries, these perils respond to the application

of similar techniques in terms of risk quantification and management.

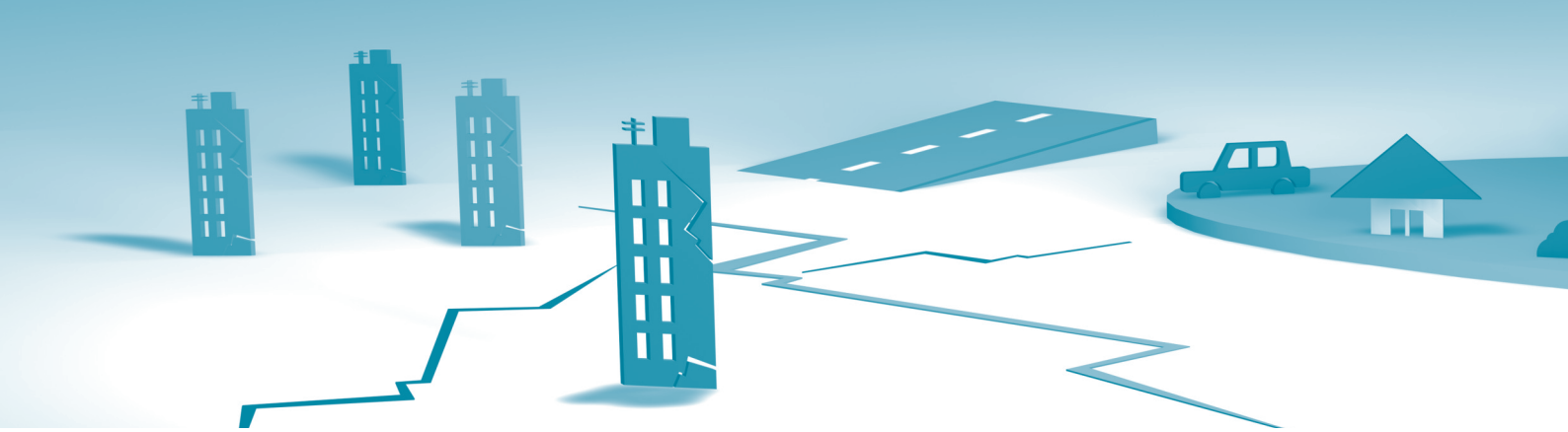
It is also clear that, natural catastrophes represent losses that are:

- **definite** (take place at a known time and place and with a known cause),
- **meaningful** (in terms of size of financial impact) and,
- **fortuitous**, although there are certain circumstances in which this last point can be brought into question. It is too often the case that homes and businesses are built, and sometimes re-built, on known flood plains without the appropriate investment in defences or resilient design to then withstand regular and inevitable flooding. Similarly, properties in high earthquake hazard zones are, to a degree, subject to inevitable earthquake

damage (irrespective of how well they are engineered) although the lower frequency nature of earthquakes means that loss in any given 12-month policy term is essentially fortuitous.

“The economics of supply and demand play a key role here.”

Affordability is a characteristic that varies over time from a reinsurance perspective. The economics of supply and demand play a key role here. On the supply side, we are currently experiencing a period of excess capacity after a couple of low/moderate cat years and an influx of new appetite for catastrophe risk from



hedge funds and pensions funds seeking higher returns than those available in the financial markets. The demand side is more mixed, with the low underlying economic growth in the mature, established markets resulting in stable demand in the US, Europe and Japan, while we see year-on-year

increasing demand for insurance, and downstream risk transfer as reinsurance, in developing economies (BRICs, MINTs) where investment in infrastructure and an emerging middle class fuel take-up of insurance coverage. This surfeit of capacity in 2014 is manifesting itself in the over-placement

of reinsurance contracts and increasing signing-down of reinsurers' participation shares. This clearly shows that the global reinsurance industry has sufficient capital and risk transfer capacity to match the needs of insurers, even in the global peak region of Florida Hurricane, at affordable pricing levels.

► The changing world of cat models

In the context of natural catastrophes, the criterion that insurable risks should be **calculable** is an interesting one. The reality is that reinsurance of natural catastrophe perils pre-dates the relatively recent arrival of catastrophe risk models. This demonstrates that, notwithstanding the tremendous uncertainties characterizing the assessment of frequency and severity of natural catastrophes, in the past reinsurance underwriters were able to apply simple approaches to pricing and accumulation modelling where necessary. That said, today it is typically the case that reinsurers will use some form of catastrophe risk modelling, whether internally developed or externally sourced. This activity has grown into a significant segment of the industry, with 3rd party vendor model licensing generating an estimated US\$500 million in annual revenues, and directly employing approximately 2,000 people to develop and maintain region-peril-based model solutions for licensing to the (re)insurance industry.

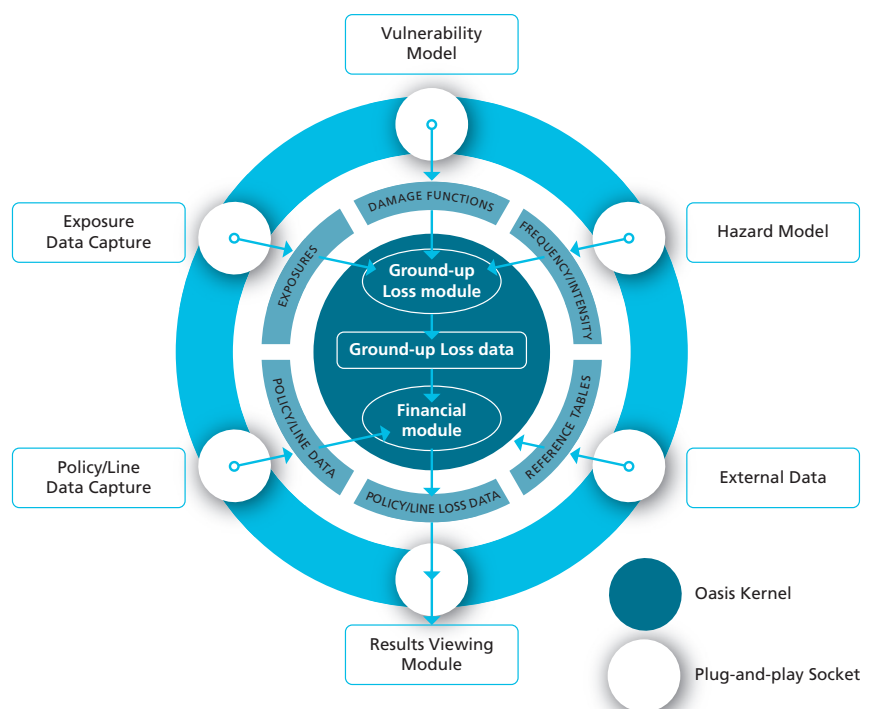
“The catastrophe risk modelling industry is undergoing a period of transformation.”

Following 25 years of broad stability in terms of software, data, hardware and architecture, the catastrophe risk modelling industry is undergoing a period of transformation. The *status quo* in which three dominant vendors (RMS, AIR Worldwide, EQECAT) supply cat

modelling intellectual property via client / server software is changing - and fast. New, “open”, alternatives are arriving and looking to compete through differentiation of product offering, leveraging new technologies and innovating new modelling methodologies that do not fit the standard cat model architecture. Oasis Loss Modelling Framework is a non-profit, open-architecture, industry-backed, “new kid on the block” which could be a potentially disruptive threat/ competitive force for the major three.

Launched in January 2014, with 3-tier architecture and modular design, Oasis is hardware “agnostic”, i.e. can be deployed on laptop, distributed grid, cloud, supercomputer, and will benefit from the falling costs of hosted IT computing resources. There is a long list of organisations building models, interfaces and connectors to the Oasis framework (Figure 1). The cat events of 2011 highlighted gaps in geographic scope (flooding in Thailand) and unmodelled components¹ (Tohoku tsunami) and stimulated demand

Figure 1: Oasis Loss Modelling Framework



¹ For a more comprehensive treatment of non-modelled catastrophe risks see “Non-Modelled Risks – A guide to more complete catastrophe risk assessment for (re)insurers”, published by the Association of British Insurers (May 2014)



for further choice of models. Recently, new probabilistic catastrophe models have been made available from respected organizations such as Karen Clark and Co. (Karen is a cat modelling pioneer and founder of AIR Worldwide), and Impact Forecasting (a specialist catastrophe modelling unit of AonBenfield). Another development, responding to needs of the many (re)insurers to adopt a multi-model approach, is the re-architecting of cat modelling tools to allow other suppliers' cat models to run natively alongside vendors own models. Specialist suppliers that are currently in the process of re-packaging their models to run in Oasis and/or RMS and/or AIR 'platforms' include: Ambiental, ARA, Cat Risk Solutions, Catalytics, ERN, JBA, KatRisk and Risk Frontiers. The capability to routinely present location and contract

exposure data to multiple models and produce output results from a common IT environment will be a game-changer in terms of revealing the inherent uncertainties in the cat modelling process. This is expected in the next 12 months. One of the sources of uncertainty in modelling is the characterization of the input exposure information and new datasets are being developed to augment existing sources. Exposure inventories are either in development, or already available, for assets such as Warehouses (Lloyd's Agents), Industrial Parks (RMS, RMSI, NIIT and others), Ports (Cargo accumulation modelling), and there are outline proposals to create inventories of public infrastructure assets in support of modelling economic resilience. Validating input data quality used in models has always been

challenging, but new heuristic testing methods are emerging, in part stimulated by the need to meet expectations around data quality under the Solvency II internal model standards. Remote sensing data such as satellite and aerial imagery technology are in the early stages of establishing insurance industry applications, for example, supporting post-disaster damage assessment and loss adjusting, while investment in weather station data collection is enabling new index-based product developments in emerging markets. In summary, while quantification of cat risk is difficult, ongoing catastrophe model development continues to support this area of activity.

➤ Risks Pooling and Prevention

The need to pool risks and develop prevention has often led to the creation of public sector-financed pooling arrangements, schemes or special insurance vehicles to ensure widespread access to protection for the public. Some initiatives have also emerged over the years from private insurers and reinsurers, for example in Norway with both a mandatory surcharge of insurance and a mutualised private pool "*Norsk Naturskadepool*". Does that mean that affordability should

become the absolute objective? In my view the answer is no. A significant body of research on the societal benefit and *affordability* of catastrophe insurance has been undertaken at the Wharton Risk Center by Howard Kunreuther and Michel Erwan-Kerjan, who counsel that fully risk-adjusted premiums, including mitigation credits where appropriate, play an important signaling role in building disaster resilience. This works by enabling undistorted cost-benefit decisions to be

made around investment in mitigation such as flood defences and hurricane shutters, appropriate land-use zoning and management as well as building code design and enforcement. Where risk-based premiums are unaffordable to low income or vulnerable groups in society, they advocate a means-tested federal subsidy program to support universal access to coverage, rather than distorting the risk signal through the regulation of primary rates.

➤ Is the Reinsurance market big enough?

We now turn to the question of whether there is enough reinsurance capacity in the industry to accommodate the risk transfer of all the catastrophe hazards worldwide. The current global peak catastrophe risk is North Atlantic Hurricane, with the reinsurance requirements predominantly driven by insured assets in Florida, particularly the Tri-county area around Miami, and the Northeast US around

the greater New York metropolitan area. Based on current reinsurance contract placements, at least US\$150 billion of limit is available to protect Florida by the traditional reinsurance market plus a further US\$10 billion US Wind capacity via Cat Bonds and other Insurance Linked Securities. While this level of available risk transfer² is sufficient to support a large natural catastrophe event anywhere in

the world, it will clearly have to grow over time as economic development and insurance penetration increases the reinsurance needs of insurers in the populous countries of China and India. While we often focus on preparing for the severity of catastrophes, 2011 highlighted that the frequency of moderate events in many countries can accumulate within a single financial year for a global reinsurer,

² For context Hurricane Katrina (2005) is the largest ever natural catastrophe insurance loss at \$75-80bn (nominal basis)

“2011 stands as the worst ever year in terms of total direct economic losses due to natural catastrophes.”

(see Table 1)

reaching a total of US\$110 billion in insured natural catastrophe losses, only just behind the US\$116 billion insured total for 2005. However, due to approximately US\$180 billion in uninsured damage from earthquakes, 2011 stands as the worst ever year in terms of total direct economic losses due to natural catastrophes. There is some evidence that natural calamities are occurring with greater frequency under climate change conditions, with more droughts, wild fires and extreme precipitation events leading to flash flooding such as experienced by Copenhagen in 2011.

Table 1: 2011 catastrophe events and related losses

Country	Japan	Thailand	New-Zealand	United States	United States	Australia
Event	Tsunami	Flood	Christchurch earthquake	Convective storm	Hurricane Irene	Flood
Insured losses in millions US\$						
Amount	36,000	14,000	13,000	6,900	5,300	2,200
Ratio insured losses / economic losses	17.1%	32.6%	86.7%	49.3%	66.3%	73.3%
Economic losses in millions US\$						
Amount	210,000	43,000	15,000	14,000	8,000	3,000
In % of GDP	3.5%	11.8%	10.7%	0.1%	0.1%	0.2%

Conclusion

Discussion of the aspects of *reinsurability* shows that natural catastrophes are indeed reinsurable. However, challenges remain, including the lack of primary insurance penetration in many risk zones, particularly in emerging markets. Reinsurers have a

strongly positive societal role to play in providing risk transfer and specialist knowledge that fosters mitigation and resilience. As an industry, we must do more to understand the shifting patterns of natural catastrophes in a changing climate, adapt our “risk lens”

and incorporate the latest scientific knowledge into catastrophe models.

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