

THE DISASTER GAP

HOW INSURERS AND THE
CAPITAL MARKETS CAN
HARNESS BIG DATA TO
CLOSE THE GAP.



BNY MELLON

THE DISASTER GAP: HOW INSURERS AND THE CAPITAL MARKETS CAN HARNESS BIG DATA TO CLOSE THE GAP

TABLE OF CONTENTS

Foreword: A Leap of Faith

2

Executive Summary

4

About BNY Mellon

5

Chapter 1: Spot the gap

- US Natural Catastrophe Focus
- Opportunity and Challenge

6

Chapter 2: Mind the Gap

10

Chapter 3: Bridging the Gap

- Working with Governments
- Barriers to growth

12

Chapter 4: Closing the Gap

- A bright future

17

Dedications

22

FOREWORD: A LEAP OF FAITH

The time has come for the insurance industry to acknowledge “alternative capital” (capital from outside the insurance industry which is now backing insurance risk; for example from endowments, pension funds or hedge funds) is here to stay, and as a consequence, the debate must move to one which explores how the industry and society can benefit from this capital.

BNY Mellon acts as trustee, paying and collateral agent on both public and private insurance-linked securities (ILS) structures. For example, in the public catastrophe (cat) bond market we act as the trustee on more than 65%¹ of issues. Issuers and structurers like our credit rating, our deep experience and expertise, and our independence.

We believe that within five years public cat bond debt outstanding will have reached the \$50bn mark. Total ILS will be a multiple of that.

ILS is an efficient mechanism for the capital markets to gain exposure to the insurance industry. The low interest rate environment has encouraged investors to look more closely at ILS. We believe that even when interest rates normalise, allocations of institutional investors such as pension funds in ILS will continue to increase because of returns over the London Interbank Offered Rate (Libor) and for reasons of diversification.

Insurers must shift their mindset that returns are only generated by deploying their own capital. We think the tipping point will come when big data (loosely defined as the exploitation of voluminous, fast changing and unstructured data) allows insurers to deploy their own capital and third party capital against new risks. Anticipating the location and size of future earthquakes is still an inexact science, however big data can capture the fragility of buildings and identify areas at risk from future earthquakes and shaking damage.

¹68% market share of CAT bonds issued in 2012, BNY Mellon data matched against market data from Artemis.bm

At the 2013 annual Asia Pacific Risk and Insurance Association (APRIA) Conference, held in New York, BNY Mellon moderated a panel on the role of cat bonds. The conference was attended by more than 200 delegates from 23 countries. Eighty percent of the audience said they believed that ILS, through partnership between nation states, insurers and the capital markets, offers the financial services industry an opportunity to demonstrate its positive contribution to society.

Never has the experience of the insurer been needed more. Deploying capital against much needed cover over non-modelled exposures requires deep underwriting and technical expertise. It is unlikely that the capital markets would provide this cover in the absence of insurers' expertise and the comfort that comes from seeing the insurer also deploying its capital against these previously uncovered risks.

Invariably, there will also be further innovation in the various structures or special purpose vehicles. Here, we urge caution. It would be unfortunate if both issuer and investor understood the risks and returns on offer, only to fall foul of a shortcoming in vehicle design. For example, you may remember at the time of the financial crisis a handful of bonds were impacted by having Lehman Brothers as a total return swap counterparty. Consequently, the investment of the collateral tends to be more straightforward these days.

I am very grateful for the knowledge and insight that has been provided by our diverse range of contributors. I hope you enjoy this paper and that it informs your thinking as you prepare for the changes this new capital heralds.

Paul Traynor, Head of Insurance Segment, International, BNY Mellon



EXECUTIVE SUMMARY

- Convergence between the traditional reinsurance market and the market for ILS has now occurred. An estimated \$50bn of ILS will be in force by the end of this year and the cat bond industry is on track to break the previous 2007 issuance record of \$7.2bn.
- There is huge potential for the ILS sector and cat bond industry to become much bigger. BNY Mellon predicts ILS in force could grow to \$150bn by 2018, with the cat bond share of that total volume worth up to \$50bn.
- The “disaster gap” between economic losses and insured losses is getting wider, leaving governments and society on the hook for the cost of rebuilding. Climate change and urbanisation are expected to exacerbate future losses from catastrophes.
- At present, 75% of this alternative capacity is focused on US peak perils – mainly windstorm and earthquake.
- There is a real opportunity for insurers to properly embrace the cat bond sector, to innovate and become more global. At the same time it will fulfil an important social role in covering the cost of future catastrophes.
- There are numerous challenges to overcome, including the lack of historical data and sophisticated catastrophe modelling in some regions. Big data could be the answer, providing underwriters with tools to price and structure future deals; and investors the tools to assess the risks.
- Insurers must acknowledge alternative capital is here to stay. Insurers and the capital markets working together with big data should be able to deploy this new capital to cover new perils.

THE DISASTER GAP

The gap between the cost of a disaster and the level of insurance was the subject of Lloyd’s Global Underinsurance Report, which came out in 2012. It estimates the annual gap at just over \$168bn. The research, carried out by the Centre for Economic and Business Research defines this gap as the minimum levels of cover necessary and the actual levels that businesses and governments have set aside to rebuild and recover following major catastrophes.

The largest single gap in monetary terms is in China. With rapid economic growth and urbanisation the country’s exposure to earthquake, windstorm and flood losses is growing substantially. Yet only 1.4% of the losses between 2004 and 2011 were insured. One barrier to increasing insurance penetration in countries such as China is the role the government takes as insurer and reinsurer of last resort. “In China there is this attitude of government paternalism to the public when it comes to disasters,” says the World Bank’s Eugene Gurenko.

ABOUT BNY MELLON

BNY Mellon is a global investments company dedicated to helping its clients manage and service their financial assets throughout the investment lifecycle. Whether providing financial services for institutions, corporations or individual investors, BNY Mellon delivers informed investment management and investment services in 35 countries and more than 100 markets. As of September 30, 2013, BNY Mellon had \$27.4 trillion in assets under custody and/or administration, and \$1.5 trillion in assets under management. BNY Mellon can act as a single point of contact for clients looking to create, trade, hold, manage, service, distribute or restructure investments. BNY Mellon is the corporate brand of The Bank of New York Mellon Corporation (NYSE: BK). Additional information is available on www.bnymellon.com, or follow us on Twitter @BNYMellon.

The insurance industry is a key focus for BNY Mellon:

- Globally, clients include 78 of top 100 Life Insurers² and 68% of top 50 Non-life insurers²;
- We help Insurers manage and service their financial assets throughout the investment lifecycle. We maintain insurance assets under custody of more than \$2 trillion³;
- We are a top-5 manager by AUM globally, managing more than \$70 billion¹ in insurer assets;
- We help Insurers manage their liabilities:
 - by helping them issue ILS – we are the world’s largest catastrophe bond (cat) trustee; or
 - by using insurance trusts to marry-up assets and liabilities in a jurisdiction. We administer some 1,950² trusts with \$176 billion in assets.
- We were the first investment services firm in Europe to launch
 - a data management solution to meet the asset data reporting requirements arising out of Solvency II;
 - a Solvency II compliant Insurance Trust vehicle in Europe.

² BNY Mellon client data as matched against A.M. Best industry rankings publication as of December 2012

³ As of 31 December 2012

1. SPOT THE GAP

Third party capital is slowly but surely transforming the property catastrophe reinsurance market. Since the height of the financial crisis in 2008 investors have steadily increased their inflows into the industry. “Investor demand continues, especially for new risk types,” says Emma Wilkes, Managing Director of Corporate Trust Insurance Services at BNY Mellon. “Look at Turkey’s 2013 Bosphorus Re issuance, which was being marketed with a coupon of 3.25% over Libor on an issue size of \$125m. When it was issued the size had grown to \$400m and the coupon came in to a price of just 2.50% over Libor. The issue size is growing and the coupon is shrinking.”

An estimated \$50bn of catastrophe bonds, collateralised reinsurance, industry loss warranties (ILWs) and sidecars will be in force by the end of the year, predicts Willis Re. Cat bonds currently account for \$19bn of the total year-to-date and collateralised reinsurance for \$20bn. Year-to-date cat bond issuance has reached \$5bn and this market is on track to surpass the previous record issuance in 2007 of \$7.2bn.

“In the last few years the growth has been substantial, but most of the investors and the sponsors driving the issuance are familiar with each other and so it doesn’t have the feel of a bubble to me, it’s just more that the deal sizes are a little larger and the pension commitments are continuing to increase,” says Bill Dubinsky, head of Willis Capital Markets & Advisory (WCMA).

Repeat and increasingly new sponsors are accessing the ILS market to leverage the favourable market conditions. The initial investor base was dominated by opportunistic investors such as hedge funds and private equity. This has given way to investors with longer-term horizons, including pension funds and other institutional investors.

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Fungible capital has now overtaken bricks-and-mortar start-up insurance companies as a preferred route to market, particularly in the aftermath of catastrophe driven industry dislocations. Capital can flow quickly and easily into sidecars, cat bonds and other insurance instruments to take advantage of heightened demand post-catastrophe. But what began as an opportunistic play has evolved into a new market with expanding opportunities.

“Historically insurers, reinsurers and hedge funds were the main investors, but pension funds are much newer to the party and probably have a longer-term view than some of the other investors in that space,” says Chris Waterman, managing director and Head of EMEA Insurance at Fitch Ratings. “The key play for pension funds here is diversification and the lack of correlation between the risks they’re assuming and those in the broader financial markets. A further attraction for pension funds is the additional yield they can generate.”

In insurance, investors have found an alternative investment that provides an attractive risk and return. There is the additional advantage that insurance risk is largely uncorrelated to the traditional capital markets. A Florida hurricane is unlikely to occur at the same time as a stock market adjustment for instance and therefore insurance investments offer all-important diversification.

“The low interest rate environment encouraged investors to look more closely at ILS, and cat bonds in particular” says BNY Mellon’s Wilkes. “A return to the normal interest rate environment is probably some time away,” she continues. “Even when this occurs, we believe allocations of institutional investors such as pension funds to ILS will continue to increase as they seek sources of diversification.”

US NATURAL CATASTROPHE FOCUS

The bulk of alternative capital is currently focused on US natural catastrophe perils and insurance products that seek to transfer this risk to the capital markets. To date, these perils have offered the best returns and are also arguably the best understood thanks to sophisticated probabilistic catastrophe models to help underwriters assess the risk and their exposure.

“The quality of data is a key issue here and that’s why we’re seeing new capital investment in property cat,” says Fitch’s Chris Waterman. “New capital has been heavily targeted towards the US, which is where good quality, granular data is available over a longer period.”

US hurricane risk continued to be the main peril ceded to the ILS market in 2013. However, a number of cat bond issuances stood out by taking on a new range of perils, demonstrating investor appetite for risks in new areas. Non-peak US perils such as thunderstorms and wildfires featured in some transactions, as did secondary perils arising from earthquakes, such as liquefaction and tsunami.

In 2013 issuances also included MetroCat Re, the first cat bond for storm surge risk, and AIG’s Tradewynd Re, which has a broad geographical footprint for named storms, including the Gulf of Mexico, providing cover for exposures there such as offshore energy and marine. Bosphorus 1 Re was structured to cover earthquakes in the Istanbul region of Turkey on behalf of the Turkish Catastrophe Insurance Pool (TCIP).

“When we went to the market the investors welcomed us extremely well as we offered them diversification,” says Ismet Güngör, coordinator of the TCIP at Eureko Sigorta. “From the investors’ point of view the cat bond market needs to have some other risks in the market to diversify their portfolio – so the capacity is there – they want to diversify their portfolio not only in terms of geography but also in terms of the risk.”

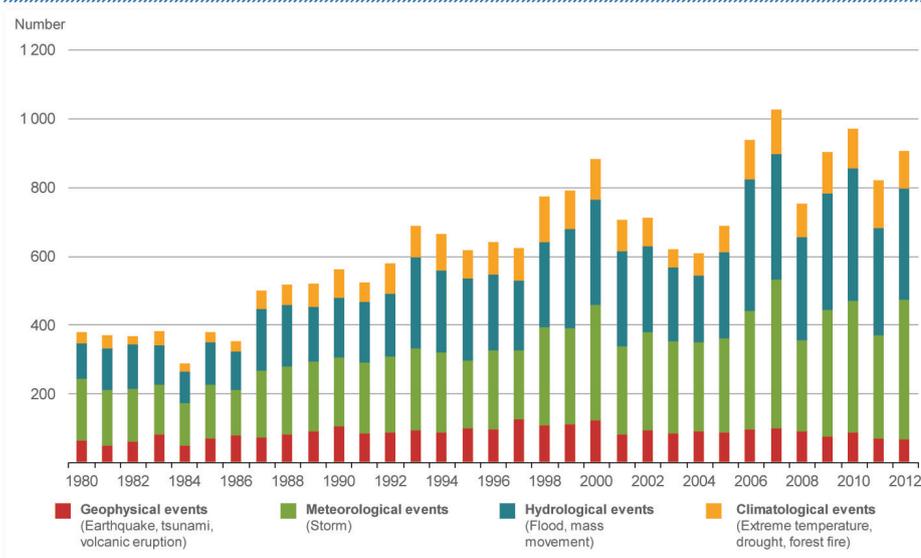
“When we went to the market the investors welcomed us extremely well as we offered them diversification.”

Ismet Güngör, coordinator of the Turkish Catastrophe Insurance Pool at Eureko Sigorta.

NatCatSERVICE

Natural catastrophes worldwide 1980 – 2012 Number of events

Munich RE 



TAIWAN'S FIRST CAT BOND

By Mark Wei, chairman of KGI Securities

When I was insurance commissioner of the Ministry of Finance in Taiwan in 2003, we structured a three-year \$100m principal at-risk variable rate note to diversify the catastrophe risk derived from our Taiwan Residential Earthquake Insurance Pool (TREIP) through the global capital markets. This was the first cat bond sponsored by the Taiwanese government.

As Taiwan's earthquake frequency and severity is among the highest in the world, cat bonds can help reduce earthquake risk and increase capacity in Taiwan, in addition to the traditional insurance and reinsurance scheme under the TREIP. After the issuance of the cat bond, we started to set up our own earthquake risk assessment model and periodically practise TREIP's early warning and claim management system, aimed at improving our technology and skills to cope with various natural disaster risks in Taiwan.

The total value of outstanding cat bonds increased significantly after 2005. As cat bonds offer attractive and stable returns with minimal exposure to the credit cycle, equity market, foreign exchange or interest rate risk, they became an important alternative asset class for institutional or professional investors, such as hedge funds, insurance and pension funds to invest in diversifying their portfolio.

There is a situation of rising catastrophe risks and limited insurance coverage in Asia, especially in Greater China. Going forward, we should consider promoting cat bonds to those capital market investors who have the capacity and interest in taking on some of these unexpected man-made or natural disaster risks in Asia.

OPPORTUNITY AND CHALLENGE

To date, there has been much discussion in the industry as to how "convergence" will impact the traditional reinsurance market. Willis Re predicts third-party capital could comprise 30% of the global catastrophe market within three to four years with a "significant and material" effect on the market, particularly for peak zones such as US wind. As a result, between \$30bn and \$40bn of traditional reinsurance capital could be displaced by the new money coming in.

Fitch Ratings director Martyn Street thinks the impact of alternative sources of capital will lead to an evolution of the market, rather than sweeping reforms. "If you look across our universe of rated reinsurers clearly some of those are likely to be more heavily impacted by the developments we're seeing," he says. "Some of the Bermudian players are larger writers of cat business in the first place so they are going to be more exposed to the current market trends versus the larger Europeans which are more diversified in their businesses."

"My gut feel is that we are in the beginnings of a fairly major structural change for the reinsurance market and we're just seeing some of the very early stages of it now."

Steve Evans, founder of Artemis.

It is clear that new money coming into the market is affecting reinsurer strategies to varying degrees. Some have dipped their toes into the alternative market, launching sidecars or setting up ILS funds. The larger institutions, including Munich Re and Swiss Re, are actively involved in arranging and placing cat bonds.

"If you go back to some of the Bermudian players most affected by this development it will be interesting to see if they try and shift into other markets where they write a smaller proportion of their business at the moment or if they hold back and return some of that capital to investors to see how the market develops," says Street. "The reinsurance industry is very good at returning capital or moving it around in a fluid way as required."

Many experts feel it will take time for the industry to adjust to the impact of the new capital. Artemis founder Steve Evans thinks the industry is on the cusp of significant change. “My gut feel is that we are in the beginnings of a fairly major structural change for the reinsurance market and we’re just seeing some of the very early stages of it now. Traditional reinsurers are feeling the pressure from it now, which is why we’re seeing much more coverage of it and seeing much more noise around it.”

It is also apparent that the line between the traditional reinsurance industry and the ILS sector is increasingly blurred.

“Convergence capital is here to stay,” says BNY Mellon’s Emma Wilkes. “Insurers and reinsurers must accept this and move on, only then will they truly challenge their operating models. Properly embraced, convergence capital has the potential to drive up insurance penetration globally.”

CAT Bonds and Other Asset Classes Returns

ILS VS TRADITIONAL ASSET CLASSES



| Benchmarks | Returns from To | 01/01/2009 01/07/2013 | 01/01/2007 01/07/2013 | 01/01/2005 01/07/2013 |
|---|-----------------|--------------------------|--------------------------|--------------------------|
| SRe BB Rated Cat Bond Total Return | | 43.77% | 65.57% | 79.20% |
| Bloomberg ticker: | SRBBTRR Index | | | |
| US Corporate Bond Investment Grade | | 34.25% | 41.03% | 48.50% |
| Bloomberg ticker: | NBBTR Index | | | |
| US Corporate Bond High Yield Return | | 92.33% | 47.77% | 71.18% |
| Bloomberg ticker: | NBBHTR Index | | | |
| S&P US 500 Total Return Index | | 150.88% | 49.10% | 93.02% |
| Bloomberg ticker: | SPTR Index | | | |

ILS VS NON-TRADITIONAL ASSET CLASSES



| Benchmarks | Returns from To | 01/01/2009 01/07/2013 | 01/01/2007 01/07/2013 | 01/01/2005 01/07/2013 |
|---|-----------------|--------------------------|--------------------------|--------------------------|
| SRe BB Rated Cat Bond Total Return | | 43.77% | 65.57% | 79.20% |
| Bloomberg ticker: | SRBBTRR Index | | | |
| S&P GSCI Commodity Total Return Index | | 16.84% | -11.00% | -12.79% |
| Bloomberg ticker: | SPGCCITR Index | | | |
| S&P GSCI Energy Total Return Index | | 16.66% | -15.34% | -26.76% |
| Bloomberg ticker: | SPGCENTR Index | | | |
| S&P GSCI Agriculture Total Return Index | | 11.09% | 7.91% | 19.30% |
| Bloomberg ticker: | SPGCAGTR Index | | | |

Source: Bloomberg, 1st July 2013

2. MIND THE GAP

There is often a startling gap between the economic losses and insured losses when catastrophes occur. Looking at statistics for catastrophes in 2012 the total economic loss from disasters reached \$160bn, according to Munich Re. But just \$65bn of that total was covered by insurance. Widespread floods in Central Europe, Alberta and more recently in Colorado have threatened to rival 2011 in insured flood losses, but this is still only a small margin of total losses.

“There is a considerable gap between insured and economic losses everywhere in the world.”

Eugene Gurenko, lead insurance specialist at the World Bank.

Even in the US, flood is an underinsured peril. Cat modelling company Eqecat estimates economic losses from the Colorado floods in September 2013 will amount to \$2bn, but very little of this is insured. And homeowners are unlikely to get relief from the US National Flood Insurance Program as most areas impacted by the Colorado floods are not within the defined flood zones.

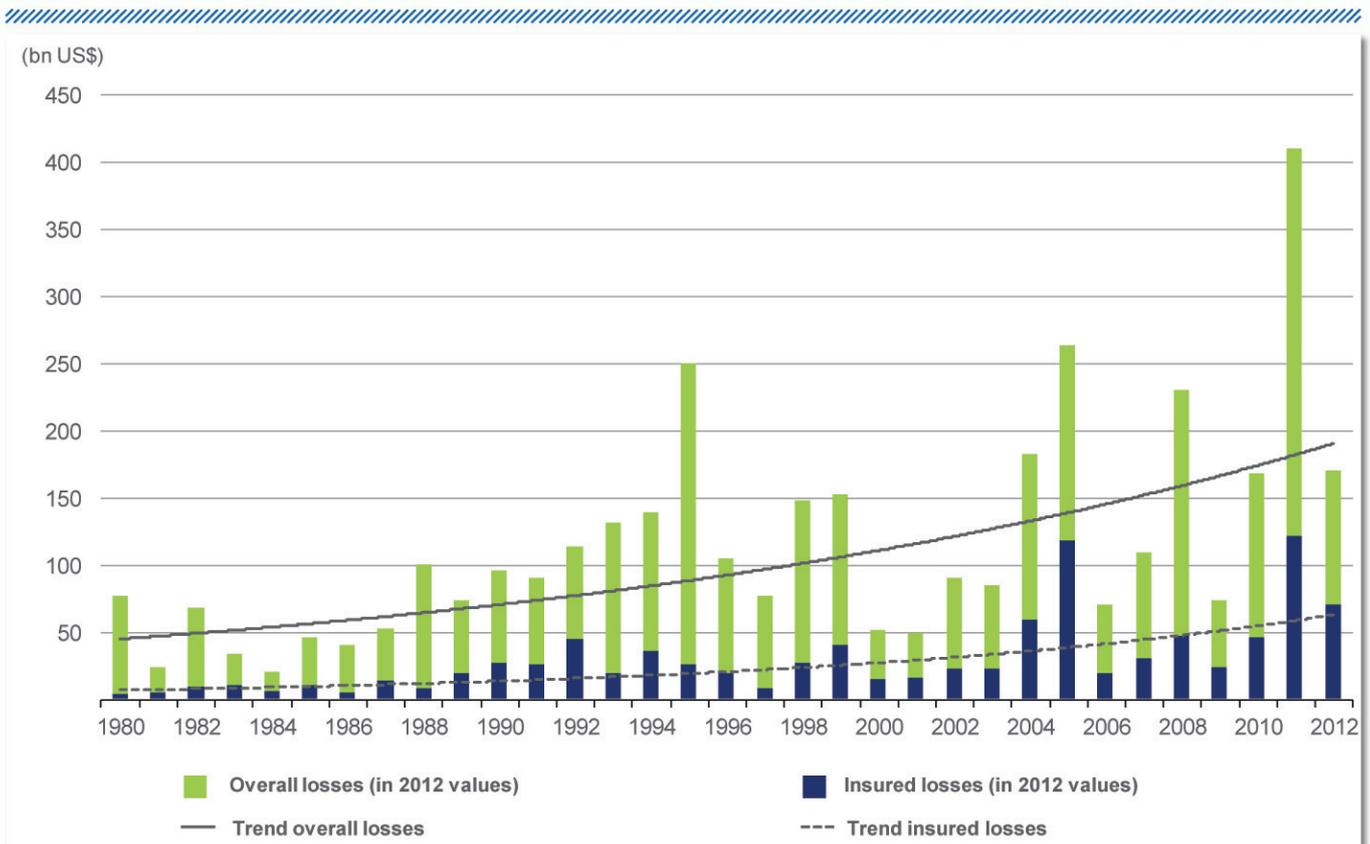
If you look beyond the mature insurance markets to the emerging markets it is clear the disaster insurance gap is widest there. 2011 was a record year for natural catastrophes, with Asia Pacific accounting for two thirds of total losses, including events such as the Tohoku Earthquake and Tsunami, the second Christchurch Earthquake and the Thai floods.

Globally, these disasters cost the industry over \$105bn (according to Munich Re). However, with overall economic losses estimated at around \$380bn, insurance covered less than a third of the total and there was an insurance shortfall of \$275bn globally.

NatCatSERVICE

Natural catastrophes worldwide 1980 – 2012

Overall and insured losses with trend



The Tohoku Earthquake – the most costly natural catastrophe in history – revealed that even in a developed economy such as Japan, earthquake insurance penetration is surprisingly low. “There is a considerable gap between insured and economic losses everywhere in the world, except perhaps for a few countries which have mandatory catastrophe insurance schemes and a well developed insurance industry,” says Eugene Gurenko, lead insurance specialist at the World Bank.

“The level of coverage for cat risk perils varies quite a bit from the level of coverage for basic homeowners’ fire perils, and the numbers are not that encouraging,” he continues. “If you look at California about 15% of homeowners have cover [for earthquake], in Florida it is around 20-25% and Japan is about 15-20%. New Zealand has a cat pool and there the cover was much better because of the compulsory nature of it.”

“In markets where you don’t have the compulsion, penetration for catastrophic perils is very low,” he concludes. “In emerging markets the situation is notoriously bad. According to our research only one to two percent of insurable housing stock is covered in middle-income emerging market countries. Catastrophe coverage is virtually nonexistent in these countries and the question is: why?”

Statistics from Munich Re indicate both the frequency and cost of natural catastrophes have increased over the last three decades. The reinsurer advises caution when drawing conclusions from these trends however, pointing out that many factors can contribute to the trends, including economic development in exposed regions.

“This can have an impact on the number of events as those are always loss events – and a hailstorm that would have hit trees in the past nowadays may damage houses,” points out Munich Re spokesman Michael Able. “And increasing values (at risk) normally go hand in hand with increasing insurance premiums. But we do think climate change also plays a certain role, which has to be a topic for societies and insurers as well.”

CLIMATE CHANGE AND FUTURE CATASTROPHES

Losses from natural and manmade catastrophes are trending upwards. In its fifth assessment, the Intergovernmental Panel on Climate Change (IPCC) says the human influence on the climate system is clear and that human influence has been the dominant cause of observed warming since the mid-20th century. This warming of the climate is likely to influence the frequency and severity of natural disasters and cause more weather extremes in the future.

“Heat waves are very likely to occur more frequently and last longer,” noted the co-chair of the IPCC Work Group. “As the Earth warms, we expect to see currently wet regions receiving more rainfall, and dry regions receiving less, although there will be exceptions.”

Seventy-seven percent of people around the world fear being hit by a natural disaster in the next two decades, and many believe the state would leave them with the bill for damages. This is according to a Gallup survey commissioned by Swiss Re of nearly 22,000 citizens across 19 markets on five continents. Fifty-eight percent think that climate change will contribute to future natural catastrophes.

3. BRIDGING THE GAP

The future growth potential of the ILS market is dependent on two key supply and demand drivers. The first, whether the reinsurance sector – both traditional and non-traditional – can grow its overall premium base and second, whether the investors in insurance products have a long-term commitment and are willing to deploy their capital to new areas of risk.

We expect reinsurance demand covering natural catastrophes to double in high-growth markets. But much of this depends on how quickly emerging insurance markets can grow and mature. “It’s about how can the capital markets come together with the traditional insurers and reinsurers to solve these problems, because I don’t think for the most part the capital markets can do it alone,” says WCMA’s Dubinsky.

“How can we increase the amount of insured interest in the world so that shareholders, government and taxpayers do not have to keep on paying for catastrophes?”

Luca Albertini, chief executive officer of Leadenhall Capital Partners.

“There is clearly a significant opportunity to grow,” adds Fitch’s Chris Waterman. “Many traditional players are looking to expand in Asia on the back of that growth potential. The growth in premium volumes for the major reinsurers is faster in Asia than in more developed markets – so they are beginning to take advantage of that. Although it’s relatively early days, the potential is significant.”

Increasing insurance penetration in underserved catastrophe-exposed markets is a major challenge for the future. “When you sell a cat policy you charge \$1 per \$1,000 of risk exposure – that’s typical risk pricing,” explains the World Bank’s Eugene Gurenko. “Imagine the sophistication you need to enable you to manage that risk. For many insurers this is a scary proposition. Many don’t have the expertise and resources to develop this line of business from scratch because it’s highly knowledge- and capital-intensive, so as a result cat risk insurance in most emerging markets is a second thought.”

But without better penetration in many markets, there is little opportunity for traditional reinsurers or the ILS market to deploy their capacity and knowledge. “For reinsurance to grow globally – particularly property catastrophe risk insurance beyond the boundaries of the developed economies – local primary insurers will need to achieve better penetration,” thinks Waterman. “It will be difficult to increase demand for reinsurance capacity and related cessions from emerging markets without that.”

“Better penetration is unlikely to be achieved unless there is a combined effort between local governments and local primary insurers to educate the local population on the economic benefits that insurance provides,” he continues. “This effort could be supported by traditional insurers and reinsurers providing their knowhow and expertise, which they’ve been very good at exporting for years.”

There is also an opportunity to improve catastrophe protection in mature insurance markets, as the recent floods in Colorado and Central Europe have shown. “We’ve seen people structure cat bonds linked to flood and now storm surge so there’s no reason why investors wouldn’t accept it,” thinks Artemis’ Steve Evans. “If you could get full earthquake insurance penetration across the US and flood coverage in Europe, Canada and other regions that have that same risk, then cat bonds do seem very well suited to it.”

The lack of earthquake cover for homeowners in California needs to be addressed, thinks Leadenhall’s Albertini. “There is a gap between insured and economic losses, but that’s not only in Bangalore, in Bangladesh and in Thailand. That is in California... that is in Florida. The question is: How can we increase the amount of insured interest in the world so that shareholders, government and taxpayers do not have to keep on paying for catastrophes?”

WORKING WITH GOVERNMENTS

Assuming insurance penetration continues to grow in catastrophe-exposed regions of the world, there is a bright future for the traditional and non-traditional property catastrophe reinsurance market. Cat bonds are particularly well suited to governments and cat pools looking to transfer peak risk to the capital markets. As in Turkey, there are earthquake pools in Japan, California (US), New Zealand and Taiwan, each of which has tapped capital market capacity to some extent.

“For California quake (and we’re not talking about developing economies, we’re talking about California) the percentage of homeowners who have earthquake insurance is something like 10% to 12%, so there the capital markets have supported the California Earthquake Authority (CEA),” says Dubinsky. “And as the capital markets capacity becomes more available and attractively priced it really has the potential to reduce the cost for that pool and expand the coverage and penetration of insurance, and that is a good thing.”

The UK is in the process of launching Flood Re as a public/private backstop for properties that cannot find flood insurance in the private market. It also has a terrorism pool – Pool Re, the ARPC in Australia, GAREAT in France and TRIPRA in the US are all government-backed terrorism backstops.

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is the first region-wide catastrophe pool, backed by the World Bank and several reinsurers and brokers. Other countries with cat pools include Iceland, Norway, Spain and Switzerland. In the US there are 30 fair access to insurance requirements (FAIR) plans and several beach and windstorm plans (such as the Texas Windstorm Insurance Association) in addition to two state insurers in Florida and Louisiana and a state reinsurer in Florida.

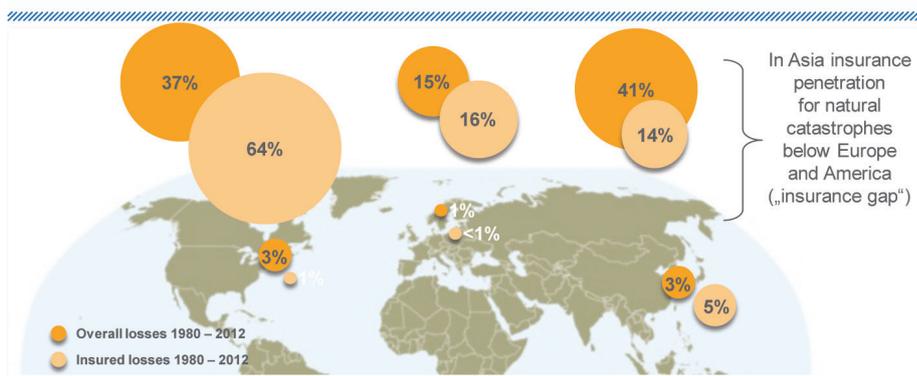


For big reinsurance buyers like government-backed catastrophe pools, securitising risk via catastrophe bonds also helps diversify the number of counterparties. A mixture of rated capacity and collateralised capacity is ideal, thinks the Turkish cat pool's Ismet Gungor. "Risk carriers need diversification in their claims payment capacity – so for both sides there is demand."

As cat bond pricing has come down – by nearly 40% since the end of last year – these structures have also become a more viable option. "In the past the cat bond market wasn't attractive for us because there was huge capacity in the insurance market and the cat bond market was limited," says Gungor. "There was a big difference in pricing the risk between cat bonds and reinsurance. Now there is only a little gap in the pricing."

NatCatSERVICE

Natural catastrophes worldwide 1980 – 2012 Overall losses, insured losses and fatalities



| Continent/ Subcontinent | Overall losses US\$bn (US\$ 3,800bn)* | Insured losses US\$bn (US\$ 970bn)* | Fatalities (2,300,000) |
|-------------------------|--|--|---------------------------|
| America | 1,500 | 630 | 340,000 |
| Europe | 500 | 160 | 150,000 |
| Africa | 45 | 2.1 | 610,000 |
| Asia | 1,600 | 130 | 1,180,000 |
| Australia/Oceania | 105 | 42 | 5,900 |

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* 2012 values

BARRIERS TO GROWTH

Investors have demonstrated they have appetite and capacity for new perils and new regions given the level of interest in issuances such as Bosphorus Re and the Mexican cat bonds issued via the World Bank's MultiCat Program. "As investors get more comfortable with the emerging markets it will have a knock-on effect and people will be looking at more interesting markets," says BNY Mellon's Emma Wilkes.

To date, most investors in ILS restrict their mandate to modelled perils. This explains why the majority of transactions have been for US peak perils. "The alternative capacity is predominantly invested in a contained niche: non-proportional natural catastrophe business relating to specific peak risks like US wind and US earthquake, due to the very short-tail nature of this business and the availability of external models," says Dr Andreas Müller who heads up the ILS Investments Department in Munich Re's Risk Trading Unit. "Most funds outsource risk modelling to modelling agencies such as AIR Worldwide and RMS and as a result cannot sufficiently assess risks for commercially available models which do not exist."

Dickie Whitaker, director of the Lighthill Risk Network and Oasis Loss Modelling Framework sounds a note of caution in relying too much on the output of catastrophe models. “The insurance and reinsurance industry has an emerging understanding that these models are very uncertain. But I’m not convinced some of the investors in the ILS marketplace have that same appreciation.”

“For the investor base supporting the cat bonds and the ‘quants’ that do all the work, how can they get a real understanding of the uncertainty in the models when it isn’t available from the cat modelling companies today in a format we want to use?” he continues. “They see returns that don’t incorporate the full uncertainty that we’re all aware are in these products.”

One of the biggest difficulties as the cat bond market looks to grow and diversify is the lack of data and catastrophe models in other geographical regions. Many regions lack both historical hazard data and claims information upon which catastrophe underwriters would traditionally turn to. In these situations the industry must look to other sources of data to help assess and underwrite the risk.

While cat modellers, brokers and reinsurers continue to invest in modelling and analytics, it is clear a different approach is needed if cat bond capacity is to be successfully deployed to cover a broader range of territories and risk. The exploitation of big data which is loosely defined as voluminous, fast changing and includes unstructured data could be one of the keys to achieving this.

“Only by joining together multiple different structures of different datasets and using some fairly sophisticated algorithms can you really understand the risk,” says Alex Plenty, associate partner, business analytics and optimisation, Global Business Services at IBM.

“If investors are serious about taking an opportunity to differentiate or to compete they will be looking at these things in more detail,” he continues. “You can use a default model or a parametric index or you could use some other method to give yourself the confidence. But the days are gone when going by the output of a third party is enough. If you’re a sophisticated investor with serious intent in this market you need to be taking some time to understand the risks more fully.”

Forward-thinking market participants are looking to “non-traditional” data sources and processing techniques. For example, collating data from numerous models (external and internal) to facilitate sensitivity analysis and comparison.

Catastrophe models typically use a stochastic model for estimating probability distributions of potential outcomes by allowing for random variation in one or more inputs over time. The random variation is usually based on fluctuations observed in historical data for a selected period using standard time-series techniques. Distributions of potential outcomes are derived from a large number of simulations (stochastic projections) which reflect the random variation in the input(s).

Big data facilitates the analysis of actual weather readings allowing the construction of predictive models. The combination of legacy model results with predictive models produces more robust frequency and severity attributes for a set of events relating to particular perils. Other developments include:

- Looking at open and transparent frameworks to understand uncertainty (eg Oasis Loss Modelling Framework);
- Augmenting data with highly unstructured and volatile information;
- Improving speed of analysis by the use of Massively Parallel Processing, complex in-database algorithmic analysis; and
- Intuitive visualisation such as Geospatial and dashboarding.

The emergence of big data technologies and methods has supported the development of new models by providing two fundamental capabilities: data management platforms and advanced data analytics.

- Big data management platforms (for example, those based on open source concepts like Hadoop and MapReduce) allow firms to ingest and store large quantities of data at a lower cost than traditional platforms. At the same time, they support the loading of near-real time data and the integration of traditional structured quantitative data with unstructured data such as news feeds, documents, web and social media feeds, and more.
- Advances in data analytics have allowed firms to leverage the information on their big data platforms in new ways. The growing adoption of big data has driven advancements in fields such as machine learning, data visualisation, and natural language processing. These analytic techniques allow us to explore structured and unstructured data and to derive meaning and recognise patterns in ways that were previously very difficult.

Rather than relying on outside agencies for model development, firms that effectively leverage big data to create a decision science ecosystem will be able to quickly and iteratively test and refine models. This will foster innovation, because concepts for new models can be developed, tested, and revised (or abandoned) more rapidly and at a lower cost. Big data and Decision Science will be key weapons in the race to develop alternative models that let market participants access non-traditional risks.

CASE STUDY: BIG DATA IN HEALTHCARE

Some of the biggest strides in big data have occurred in the healthcare sector. In hospitals there is a clear need to better detect subtle warning signs of complications and doctors need to gain greater insight into the moment-by-moment condition of patients.

Today, patients are routinely connected to equipment that continuously monitors vital signs such as blood pressure, heart rate and temperature. The equipment issues an alert when any vital sign goes out of the normal range, prompting hospital staff to take action immediately. But many life-threatening conditions do not reach critical level right away.

Often, signs that something is wrong begin to appear long before the situation becomes serious. But even a skilled and experienced nurse or physician might not be able to spot and interpret these trends.

In an effort to better spot early warning signs a three-way collaboration was set up between the University of Ontario Institute of Technology, the Hospital for Sick Children in Toronto and IBM. The result was Project Artemis, a highly flexible platform aiming to help physicians make better, faster decisions regarding patient care for a variety of conditions.

The system's outputs are based on algorithms developed as a collaboration between the clinicians and programmers. It alerts hospital staff to potential health problems before patients manifest clinical signs of infection or other issues. These early warnings give caregivers the ability to proactively deal with potential complications – such as detecting infections in premature infants up to 24 hours before they exhibit symptoms.

CASE STUDY: MEXICO'S MULTICAT BOND

Mexico is vulnerable to numerous natural hazards including hurricanes, earthquakes, floods and volcanic eruptions. It has a history of deadly earthquakes. In 1985 the magnitude 8.1 Mexico City caused serious damage to the nation's capital and is thought to have killed 10,000 people.

A number of transactions in recent years have transferred windstorm and earthquake risk to the capital markets. In 2009, the World Bank's MultiCat was used to issue a cat bond on behalf of FONDEN, the Mexican Fund for Natural Disasters. The deal saw FONDEN enter into an insurance contract with state-owned insurer Agroasamex SA to provide protection against earthquakes and both Pacific and Atlantic hurricane events on a parametric basis. In 2012, Mexico issued MultiCat 2012 as a successor, with a larger coverage area and much more detailed structure than the 2009 transaction.

4. CLOSING THE GAP

Despite the barriers presented by a lack of historical data and models for certain perils, many experts think the next generation of cat bonds will broaden their scope to cover classes of business outside property catastrophe. After all, traditional reinsurers and retrocessionaires have deployed a sophisticated approach to underwriting risk management for a wide range of classes and specialist risks. Such an approach, combined with better exploitation of big data, should aid cat bond innovation in the future.

To date, some cat bond transactions have occurred for mortality and longevity risk, while this year's Tradewynd deal and much earlier Avalon Re cat bond have securitised energy liability risks. Other cat bonds have been used for motor insurance, terrorism and workers' compensation risk transfer. Aviation cat bonds have also been mooted.

However, it is unclear how future bonds will be structured for some of these new classes and whether investors would have the appetite for longer-tail risks. "Before you can move into these areas you need a robust modelling structure that can look back over historical data as well so that when putting some of these structures together you know how to price them," says Wilkes.

Assuming current barriers can be overcome there is great potential for cat bonds to expand. The difficulty is coming up with accurate predictive data to reflect the potential size of the market in the next few years. Willis Re is bullish about the market's potential, predicting \$100bn in alternative capital will enter the reinsurance business over the next three to four years, transforming the industry in the process.

Other experts take a more cautious view. They question how "sticky" the new money entering the sector really is and what will happen if interest rates go up or if there is a major catastrophe event. Munich Re's Dr Müller predicts that for the foreseeable future alternative capacity will remain within the commoditised space like natural catastrophe excess-of-loss.

For Artemis' Evans, ILS investors are here to stay. "I talk to the pension funds and ILS managers on a weekly basis and they are adamant that the money is going to stick around," he says. "They have no interest in coming into this space just speculatively – they're not just seeing an opportunity for short-term yield – and in fact if they had done they would have pulled their money back out because yields have dropped so much."

The big brokers are each predicting that convergence capital is here to stay and that it is likely to grow substantially over the next five years or so. Predicting the potential for ILS growth requires that you consider the growth in investors, growth in issuers and impediments to the asset class and writing of risk in emerging economies.

As it relates to the growth in investors we see four key drivers behind the convergence of the reinsurance and capital markets:

- direct investment into insurance;
- returns over libor;
- uncorrelated asset class; and
- risk diversification.

The growth in issuers or the evolution of insurance-linked securitisations is being driven by:

- sources of capital;
- counterparty diversification;
- management of uninsurable risks;
- cost and capacity limitations; and
- solutions for seasonal or cyclical issues.

Some of the impediments to the asset class (and specifically the writing of risk in emerging economies) that we see being addressed include:

- improved risk insights;
- simplification of the technical data;
- an historical lack of preventative measures;
- standardisation of the asset class; and
- an historical lack of consistent ratings.

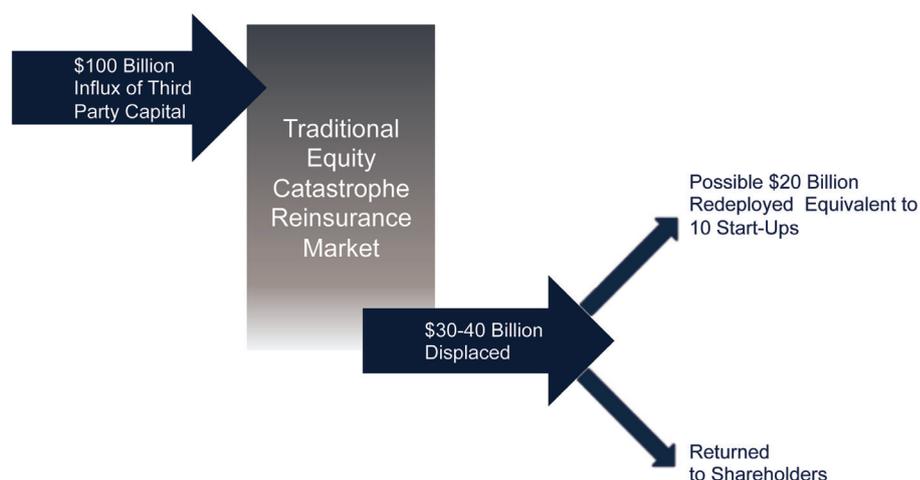
When BNY Mellon considers these, the growth in issuance we have witnessed in 2013 and the fact that the asset class has now tipped into the mainstream, we believe that total ILS could reach \$150bn by the end of 2018.

We also believe \$50bn of the \$150bn will be publicly traded cat bonds, up from today's \$19bn (likely to be \$20bn at the end of 2013).

We are therefore predicting a compound annual growth rate (CAGR) of 25% for ILS as an asset class and 20% for cat bonds as a subset of this. These compare to CAGR of 24% for the asset class as a whole over the past 13 years and 30% for cat bonds as a subset over the past nine years.

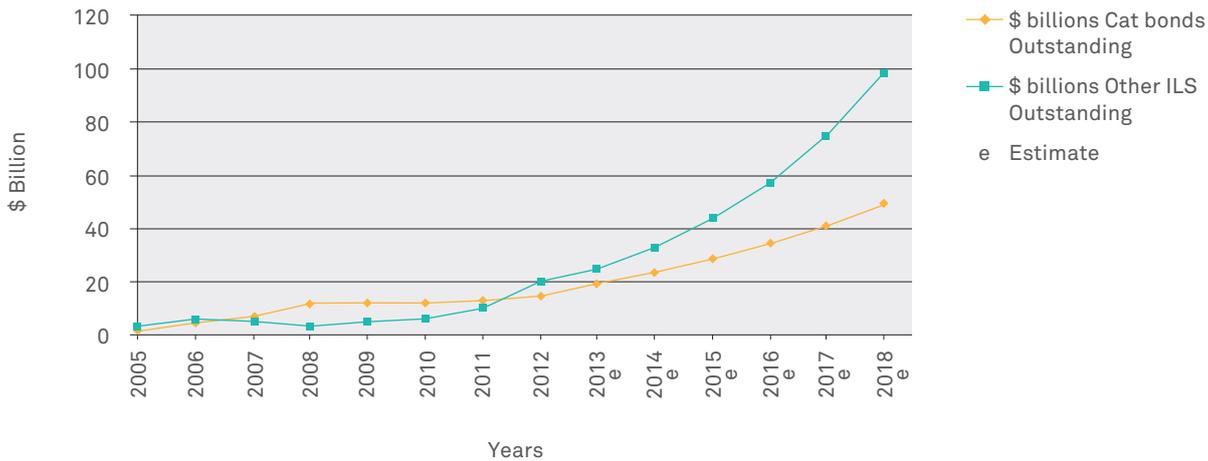
Impact of New Capital

Willis Re recently outlined the potential effect of a further \$100 billion of new capital flowing into the reinsurance industry over the next few years. The firm said it believed that such an influx had the potential to cause the displacement of as much as \$30-40 billion of traditional equity reinsurance capital. They said that while it would be likely that as much as \$20 billion of this would be given back to shareholders, up to a further \$20 billion would be left as excess capital.



Willis Re

ILS Outstanding



Source: BNY Mellon, various trade sources

“Where I really struggle is to pin down exactly how the capital will flow in between the different opportunities that are there,” says WCMA’s Dubinsky. “As we look between cat bonds, collateralised reinsurance, sidecars, derivatives and contingent capital – and that’s just in the natural catastrophe space – there are lots of opportunities to grow. And a lot of things are up in the air in terms of what will drive that, such as Solvency II in Europe and Dodd-Frank in the US.”

The overall slowing down of CAGR is explained by the fact that ILS came from a small base. The larger slowdown of growth in cat bonds is explained away by the variety of ILS options now available, for example collateralised reinsurance and sidecars to name but two. That said, BNY Mellon does believe cat bonds will continue to remain attractive both to investors and issuers.

“Governments are the first people who will look for coverage and cat bonds are very suitable for governments – they work really well for them because of the way their capital works and they can use them as contingent capital,” says Artemis’ Evans. “It makes sense for governments and sovereign cat pools to be the people who open up new markets.”

ASIA’S 2011 WAKE-UP CALL

One of the lessons from the 2011 Asia Pacific catastrophes was an underestimation of the potential hazard in this region of the world. The sheer magnitude of the Tohoku earthquake at 9.0 was not something the cat models had predicted. And the secondary characteristics from this quake and the second earthquake in Christchurch in terms of damage caused by tsunami and liquefaction were also unmodelled. At the time, Thai flood risk was a largely ignored catastrophe exposure but ended up costing insurers and reinsurers between \$15bn and \$20bn.

These events also showed how losses can be magnified in an interconnected world. Supply chain disruption was a big feature of both the Tohoku earthquake and tsunami and the Thai floods, which inundated seven major industrial estates in central Thailand. Producers of PCs and servers were unable to access component parts during the Thai floods and, as a result, the cost of hard drives more than doubled.

“Flooding in Thailand wasn’t given the focus and attention it should have been until the floods took out a significant chunk of the supply chain for the Apple iPhone handset,” says IBM’s Alex Plenty. “It was only through looking at the combination of supply chain contracts (often tied up in legal documents) and combining that with some kind of catastrophe modelling analysis that people actually understand that the risk to business continuity was bigger than they would otherwise have understood.”

A BRIGHT FUTURE

Reinsurance convergence is one of the big topics of 2013 as pricing and coverage in the non-traditional ILS market comes into line with what is offered by traditional property catastrophe reinsurers. Institutional investors are showing an increased interest in and dedication to insurance products. As the market grows and develops it is clear the ILS sector is at a crossroad, with an as-yet unrealised opportunity to expand into new areas.

Whether the cat bond market is worth \$50bn in five years or 10 years' time, growth is clearly going in just one direction. Much of that future growth depends on the sector's willingness to innovate to allow new risks to be transferred to the capital markets. This will require new underwriting approaches in partnership with the reinsurance industry and something akin to a leap of faith on the part of investors as they move outside of their comfort zone.

“Whilst I understand the modelled perils give you an extra layer of comfort, the differences between models show that modelling output cannot be taken at face value.”

Luca Albertini, chief executive officer of Leadenhall Capital Partners.

While ILS investors have a clear preference for modelled perils, cat modelling is an inexact science. “There is still a chunk of investors who want to restrict their mandate only to modelled perils, which is one I personally challenge,” says Leadenhall's Luca Albertini. “Whilst I understand the modelled perils give you an extra layer of comfort, the differences between models show that modelling output cannot be taken at face value.”

Steve Evans agrees. “We all know models are there to give you a view of risk over the last 100 years and it's very hard to predict the future in any meaningful way when you look at the frequency of an event happening,” he says. “You might say it's a one-in-50 year event and then you might get three in the same year, as was the case in Florida in 2004.”

For investors to move outside their comfort zone of highly modelled risks like US hurricane an education process needs to take place. It is clear that while ILS investors have become increasingly comfortable with insurance risk over the past five years, this has been largely because the analytics applied to the peak risks are similar in nature to the models applied to other capital instruments.

There is less understanding and less comfort in applying the underwriting process to unmodelled perils. “Some investors who have a small allocation into this sector are using mathematical means for most of their portfolio, so they want to see it here as well,” explains Albertini. “The reason some of them are uncomfortable with non-modelled perils is that they haven't been explained properly how these risk can be underwritten and that's our fault as managers.”

IBM's Alex Plenty noted: “The most forward-thinking operators in the catastrophe risk market are making use of an increasingly wide variety of data sets in order to understand the underlying risks and uncertainties more clearly. This includes unstructured data, fast changing data and data generated from an increasing number of sensors, mobile devices and social media applications. This trend will only continue and those which leverage this opportunity will be able to uncover hitherto unseen insight in the risks to which they are exposed.”

One aspect of big data that is poised to make a dramatic impact on analytics and data insight is the concept of the “internet of things.” This refers to the increasing use of sensors to capture detailed (and sometimes real time) information about processes and systems, both virtual and physical. A sensor can be a physical device that reports back information about its environment, such as a GPS tag that reports the movement of a package through a distribution system. Or a sensor can be software based, reporting on the performance of a computer system. In either case, the volume of data generated by these sensors can quickly overwhelm traditional data processing systems. But by applying big data solutions, firms can capture, analyze, and derive insights from this sensor-generated data.

Based on its development to date it is likely that a few pioneering transactions is all it will take to build momentum for a more broad and diverse cat bond market in the future. From earthquake risk in China and California to energy, aviation, workers’ compensation and longevity risk, tomorrow’s range of catastrophe securitisations will be fascinating to watch as they are put together.

With a little innovation and willingness to embrace big data and new underwriting approaches, the cat bond sector has untold ability to transfer underinsured global catastrophe risk to the capital markets. This untapped opportunity is a vital social imperative in a world where catastrophes are becoming more extreme and societies increasingly vulnerable.

GEM (Global Earthquake Model) is creating a database (OpenQuake) of the fragility of every building on Earth, a global earthquake catalogue for the past 1,000 years, and a map of every known active fault. Could the capital markets, governments and supranationals come together to harness the power of GEM’s OpenQuake? No. Could those same participants, in partnership with the insurance industry offer much needed cover to developing nations? Yes.

This new alternative capital has increased competition and lowered the cost of insurance. This lower cost of insurance should encourage previously underinsured emerging markets to look again at the value of catastrophe insurance.

Growth in the penetration of emerging markets will require the harnessing of two forces. Firstly, the marrying of catastrophe models to big data to allow insurance companies to much more accurately predict the economic consequences of a catastrophe and in a more timely manner. Secondly, insurers and reinsurers to challenge their current operating models, finding ways to embrace ILS to open up new markets whilst allowing them to deploy their own capital alongside new capital in these emerging markets in a prudent fashion.

A real partnership between nation states, insurers and the capital markets offers the financial services industry an opportunity to demonstrate its positive contribution to society.



DEDICATIONS

BNY Mellon would like to thank the following experts for their insight and contributions to this report:

Luca Albertini, chief executive officer of Leadenhall Capital Partners. London-based investment manager Leadenhall Capital Partners LLP is wholly focused on investing in insurance-linked investment portfolios for institutional investors. It was set up as a joint venture between international Lloyd's insurer Amlin Group and Leadenhall's highly experienced management team.

Bill Dubinsky, head of Willis Capital Markets & Advisory. WCMA is a specialised investment banking boutique exclusively focused on the insurance industry with ILS underwriting as one of its solutions.

Steve Evans, founder of Artemis. www.artemis.bm is the leading website for news and analysis on catastrophe bonds, insurance-linked securities, reinsurance and weather risk transfer.

Ismet Güngör, coordinator of the Turkish Catastrophe Insurance Pool at Eureko Sigorta. Established in 2000, the TCIP is responsible for provision, implementation and management of compulsory earthquake insurance in Turkey.

Eugene Gurenko, lead insurance specialist at the World Bank. The World Bank's Disaster Risk Financial and Insurance (DRFI) Program helps developing countries increase their financial and fiscal financial resilience against natural disasters within the broader disaster risk management and climate change adaptation agenda.

Dr Andreas Müller, head of the ILS Investments Department in Munich Re's Risk Trading Unit. Munich Re is the world's biggest reinsurance company, combining primary insurance and reinsurance under one roof, and offers expert solutions across all lines of insurance business including ILS.

Alex Plenty, associate partner, business analytics and optimisation, Global Business Services at IBM. IBM has carried out in-depth research and published several papers investigating how solutions designed for big data can help insurers accelerate the speed and increase the precision of catastrophe risk modelling.

Martyn Street and **Chris Waterman** are directors of Fitch Ratings. Fitch is a global rating agency which covers all areas of the insurance market including life, property & casualty and reinsurance.

Mark Wei, chairman of KGI Securities. With total assets of about TWD150 billion and over 4,500 employees in all main markets in the Asia-Pacific region, including: Taiwan, Hong Kong, China, Thailand and Singapore. KGI Securities provides a fully functional platform of investment products, including securities, asset management, derivatives, fixed income, and corporate and personal investment services.

Dickie Whitaker, director of the Lighthill Risk Network and Oasis Loss Modelling Framework. Oasis provides a new, more transparent way of modelling catastrophes, allowing users to fully test uncertainty in model results.

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