12WCEE 2000

0471

METHODS AND DIFFICULTIES OF NATURAL HAZARD ASSESSMENT - A REINSURANCE PERSPECTIVE

Paul HERTELENDY[1], Dörte ALLER[2] And Rick THOMAS[3]

SUMMARY

As a world leading Catastrophe reinsurer, PartnerRe's role is to protect the insurance industry against the financial impact of catastrophic events such as earthquake, windstorm and flood. Fair pricing is an important aspect and has been achieved by deploying proprietary underwriting tools in a sophisticated business environment. PartnerRe's research team forms an integral part of the concept and adds value to tailor-made solutions designed to fit actual client needs.

INTRODUCTION

Most of the economic losses from natural catastrophes larger than US$ 10 billion have occurred in the last 10 years. The insurance and reinsurance industry is in the business of pre-financing, and sometimes post-financing, such losses and to compensate those who are affected when nature strikes. Hence, insurers and reinsurers should have an idea of what size future losses may be and how often such catastrophes can happen. Natural science, actuarial science and other sciences are methodologies to provide the tools to successfully tackle the issues.

Insurance and reinsurance functions on the principle of risk sharing. In the chain of risk takers, the reinsurer is the one who sells insurance to an insurance company that wants to reduce the impact of a major catastrophe on its business. In other words, the reinsurer is the insurer of the insurance company. This paper gives some insight into how this business works, which procedures are normally applied and what contributions are expected from a research team.

INSURANCE AND REINSURANCE

Insurers are usually able to cope with losses when they result from a moderate event (high-frequency-low severity). This is because the damaged structures are likely to represent only a relatively small number of insured values within a large portfolio of risks. However, the portfolio can be hit by a severe event (low-frequency-high-severity) simultaneously affecting a considerable number of risks. This is when the insurance companies may have to rely on reinsurance to carry the main part of the loss amount.

Insurance companies play an important role in reducing the impact of natural catastrophes, even before they occur. They can provide important information on hazards, vulnerability and loss prevention to their clients, the policyholders. In order to manage their book of business, insurance companies should know exactly which specific risks (e.g. single objects) they insure, what premium must be charged to cover such risks, how the risks may be best protected and what kind of reinsurance needs to be purchased. The problem is that insurance premiums in catastrophe prone areas need to be substantial, although technically justified. In fact, if looked at in isolation, exposed regions may find it difficult to buy insurance where it is most needed.

Reinsurers know which risks they cover and they use risk assessment methods and pricing models to assess the reinsurance premium to be charged to the insurance company. Scientists provide such tools.

In most countries, natural catastrophes are considered insurable. Whether extended coverage is available - i.e. a fire policy providing coverage against natural perils as well - largely depends on the amount of capacity the

[1] *PartnerRe Services*
[2] *PartnerRe Services*
[3] *PartnerRe Services*

insurance and reinsurance markets are willing to offer. Another aspect is that capacity may be inadequate for some risk situations or prices are too high from the buyers' point of view. For example, PartnerRe doubts whether more than US$ 8 billion of flood capacity is available at a fair price for any specific region likely to be inundated (PartnerRe, 1997). In order to cope with the potential lack of traditional reinsurance capacity, other markets with different products may step in and be added to the catastrophe reinsurance program. The current industry buzzword is "ART" which stands for Alternative Risk Transfer; ART includes risk transfer by means of securitization, but also catastrophe index futures and options based on catastrophe indexes.

REINSURANCE TASKS

There are three core technical functions which reinsurers must perform. Reinsurers must assess the probable maximum loss, determine the price for capacity, a function of the loss potential and the loss frequency relation, and evaluate whether the up front insurance pricing is accurate.

PROBABLE MAXIMUM LOSS (PML) EVALUATION

The reinsurer wants to know the worst case scenario for the risks he shares, be it a number of risks or a whole book of risks. PML in traditional fire insurance is the maximum probable loss amount assuming that loss control systems operate. Reinsurers may suggest that the largest probable event occurring in a given period is what they refer to as their PML. Typically a reinsurer would talk about an event that occurs with a return period between 100 and 250 years.

ESTABLISHING NEEDS

An alternative means of measuring worst probable loss scenarios is to make a judgement on whether a company, either insurance or reinsurance is adequately capitalized. The challenge is to optimize capital allocation. Reinsurers are experts in doing this. An insurance company may work with its own capital or prefer to depend largely on the capital of its reinsurers. There is a choice, and one solution may be more economical than the other, depending on the situation. Many reinsurance products and solution are based on real time multi-variate modeling of the grand total of business risks assumed. The method is called "Dynamic Financial Analysis". DFA techniques to combine management, underwriting and asset risk evaluation.

INSURANCE AND REINSURANCE PRICE CALCULATIONS

Experience pricing for natural hazards is highly dependent on having an understanding of the history in a given hazard region. Confidence in "what we know" is not always high because the retrospective records, combined with the details of the hazard environment and the insurance conditions prevailing are often inadequate. However, underwriters are held responsible for their professional assessment of coverage and pricing. The challenge researchers must meet is to make a forward-looking evaluation of risk by analysing the exposure. By using computer modeling techniques, much improved underwriting tools have been created in recent years and consequently, the margin of error has narrowed. Additionally, the credibility gap continues to close rapidly. Today, it is fair to say that insurers and reinsurers alike have a much better understanding of the risks kept on their books.

When calculating a price, the reinsurer considers the loss experience of the past, referred to as experience pricing. Typically, this information is available for the low severity / high frequency losses. For low severity / high frequency losses the price is primarily determined by the losses to be expected based on scientific knowledge. The latter is referred to as exposure pricing.

Experience pricing, where an insurer can make use of historical information available, provides an instant insight into the relative success (or failure) of an insurer's underwriting capabilities.

On the other hand, pure exposure based pricing is the most difficult, yet the most rewarding. At best, it allows the reinsurance underwriter to fully evaluate the potential impact of all possible loss events.

PARTNER RE'S RISK ASSESSMENT METHOD FOR EXPOSURE PRICING

Catastrophe reinsurance provides protection against the impact of financial losses caused by natural catastrophes at a fair price for an insurer's property book of business. One standard reinsurance product is called "Excess of Loss Treaty". This contract allows an insurance company to recover, if and when a certain retention, the

deductible, is exceeded. Pricing should be fair, but in today's market, competitive as well. Four main pillars form the general framework of PartnerRe's risk assessment methodology.

These are:

Hazard

Geographical distribution of values

Vulnerability and

Insurance conditions.

It is a demanding job to assess all four parameters correctly. The findings are then merged and condensed into a "loss frequency distribution". The loss frequency distribution is the backbone of what is used by the underwriters to measure price and it shows the annual frequency of a catastrophe exceeding a certain loss level.

HAZARD, GEOGRAPHICAL SPREAD, VULNERABILITY AND INSURANCE CONDITIONS

Hazard deals with the intensity, frequency, and location of the natural phenomenon causing damage.

The insurer submits the geographical spread of insured values and the information is broken down into various business types such as automobile, dwelling risks, household, commercial and industrial.

The vulnerability section quantifies how insured properties are likely to respond to a given hazard intensity.

Policy conditions, such as deductibles, must be considered since they have a large influence on the overall loss amount per event and premium rates. It is also crucial to know the extent of coverage provided by the original policy. For example, some policies cover buildings only; others include contents too or even consequential losses. The loss to the reinsurer greatly depends on the scope of the underlying covers.

PARTNERRE MODELS

PartnerRe has analysed many hazards including tropical and extratropical storms, floods, hailstorms and earthquakes in a number of countries. The main advantages of developing in-house experience are flexibility and responsiveness. Requirements of management and needs of underwriters can be both fully addressed. Moreover, new scientific knowledge can be built into a model update easily. The uncertainties of a model have to be taken into account too, and in-house modelling makes sure, users know the models hands-on, understand what the model can deliver, but also what its limitations are.

EARTHQUAKE MODEL

Fortunately damaging earthquakes are rare events, and as a result it is not possible to set a price for earthquakes using loss experience alone. In fact for this peril the only viable pricing solution is an earthquake model. Such a model must credibly reproduce the hazard, and deal with data in the form that underwriters receive it. PartnerRe has developed models using Arc View GIS (Geographic Information System), because the customizable user interface has allowed a standard model template to be created. This template deals with all the basic data manipulation, and data formats in a common way for all models. The hazard and vulnerability are then built in as peril and location specific components.

For earthquake, the hazard can be modelled based on a combination of historical seismicity, fault and palaeoseismic data. This data is used to produce a worldwide seismic zonation, as the basis for event simulation. Any such model must implement, as far as possible, the best practice for each location worldwide; this requires a thorough literature search. Earthquake events can then be created using Monte Carlo simulation based on the parameters defined in the seismic zonation. For each potentially damaging earthquake a ground motion map must be produced using standard attenuation functions and local soil conditions. Vulnerability is modelled based on ATC13, or modifications ATC13 based on more recent published damage studies and actual claims experience. These data can then be combined with client portfolio information within the standard model interface, and used to produce prices.

An event set must be used rather than a seismic hazard map because it is essential to build in the effects of simultaneous losses correctly. The following key advantages of using GIS for model development have been repeatedly demonstrated within the PartnerRe research team:

Rapidly developed models

Researchers develop the models, not programmers

Pricing models that underwriters find easy to use

Future modification is easy to build in.

HURRICANE MODEL

Many of the existing model methodologies currently used by reinsurers, are based solely on historical land-falling data. In addition, this more traditional approach can not adequately weigh the impact of storms that make multiple landfalls. In response, PartnerRe established a new modelling methodology in 1997. Our improved methodology allows for analysis of multiple land-falling cyclones. The new approach simulates the entire life cycle of a tropical cyclone, including its development and subsequent movements. This enables PartnerRe to use much more data, i.e. data of all tropical cyclones, and not only of those that hit land. The more data used the better the prediction. In addition, The method allows inclusion of more sophisticated features, such as climate change scenarios and El Niño effects.

Moreover, the models generate windfields for both historical and synthetic storms, which are then translated into insured loss amounts. PartnerRe's model takes into account the roughness of the terrain profile, the duration of the storm as well as different vulnerability functions of the insured objects. For major historic storms, wind and damage maps are available and based on those, "synthetic model storms" are validated against reality. It may be added that based on PartnerRe's hurricane model, an insured market loss for the US East Coast runs at US$ 42 billion with a return period of 100 years.

CONCLUSIONS

Wherever there are risks – there is (or should be) insurance and reinsurance. Today much improved risk assessment enables insurance and reinsurance companies to help countries and people to better cope with natural catastrophes. The basic questions insurers and reinsurers have to answer are: Where can it happen? What is the impact? And how often should we expect it? In order to answer these questions, a significant concerted effort is required. The scientific community, governments, and the insurance and reinsurance industry must all join forces with a common goal. Only when these institutions are willing to communicate and to collaborate, natural catastrophes can be managed more efficiently and more effectively.