The Challenges for Catastrophe Loss Risk Modelling in Meeting the Future Needs of Asia

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Typical Individual Property Insurance Risks

- $\mu$ = mean = AAL
- $\sigma$ = standard deviation
- CV = coefficient of variation

Average Annual Loss (AAL)

- $\mu$ Small (Relative to Owner’s Assets)
- $\sigma$ Large (Relative to $\mu$)
- CV Large

Maximum Credible Loss
Role of Insurance

True Insurance Cost (TIC) = \( C \)

Premium (P) = AAL + TIC

\[
\begin{align*}
\mu & \quad \text{Small} \\
\sigma & \quad \text{Small} \\
CV & \quad \text{Small}
\end{align*}
\]

\( C = \frac{TIC}{AAL} \) = Mark Up Factor

Annual Loss

Probability Density

AAL

\( \mu \)
Basic Principle of Insurance

Reduce the Coefficient of Variation of Risk to a Manageable Level

by Combining Many Small Independent Risks of Similar Size

Using the Central Limit Theorem

Generally Satisfied for Home and Contents Fire and Theft Insurance
Catastrophe Risks

A Few Large Independent Risk Events of Differing Size

Unmanageable by most insurance companies

Main Solution: Catastrophe Reinsurance

Increases number of independent risks

BUT

Very large risks still a problem

Mark up factor (C) increases with decrease in number of similar sized risks
Independent Catastrophe Insurance Risks

Number of Independent Catastrophe Insurance Events

Size of Catastrophe Insurance Events ($)

2B

100B

HENCE

Mark Up Factor (C) Increases with Increase in Event Risk Size
History of Catastrophe Loss Risk Assessment

Initially:

Problems of catastrophe insurance risk not recognised.
Major Lesson: 1906 San Francisco Earthquake

Premium Based Heuristics:

Multiply total catastrophe insurance premium income by a factor. Factors will differ from country to country and for different hazards. Gives size only

CRESTA Zone Method

Determine aggregate sum insured in assumed independent catastrophe zones and multiply by Zone PML factors. Gives size only

GIS Based Catastrophe Loss Modelling

Detailed probabilistic modelling of event loss risk based on computer based event simulation. Gives size and statistical characteristics required to analytically determine C
Simulation on a computer of the

• magnitude and

• frequency

of insured losses arising from
the impact of a major hazard event
on an insurance portfolio
GIS Earthquake Loss Modelling

Simulate ground motion levels geographically for specified earthquakes

Simulate damage loss to individual buildings from simulated ground motion

Aggregate losses across portfolio

Repeat for large sample of range of possible earthquakes
Restraints on Cat Loss Model Use

Expensive
Restricts high level of commercial development to areas of large catastrophe insurance risk – ie hazard prone areas with high concentrations of insured values

Demanding on Data
Restricts level of development in areas for which there is poor scientific data on hazards, and poor data on the relationship between hazard intensity and insurance loss for different types of buildings
and
Restricts quality of use where level of detail of portfolio data on insured property characteristics relevant to vulnerability to modelled hazards is poor
Asian Dilemma (Excluding Japan)

- Penetration of property insurance low – mainly medium to large commercial and industrial property
- Penetration of catastrophe insurance even lower
- Scientific data on hazards limited – earthquake better than typhoons better than flood
- Data on vulnerability of property to hazards poor
- Quality of portfolio data generally poor
- Flooding is a major catastrophe insurance hazard but is poorly developed area of catastrophe modelling internationally - mainly due to US situation
Asian Dilemma (Excluding Japan) (Cont)

- Because of low penetration, the size of catastrophe insurance event risks is currently small in general so reinsurance rates relatively low and reinsurers can afford to take some of the risks due to poor quality of modelling.

BUT

- Penetrations of commercial and industrial property insurance are increasing relatively rapidly.

AND IN COMBINATION WITH

- Increasing pressure for establishment of large scale disaster insurance schemes at domestic and small business level.

WILL REQUIRE

- High quality catastrophe insurance loss risk models to maintain reinsurance support at reasonable cost.
Currently general hazard vulnerability of much of the building stock in Asia is relatively high, but not a big problem for insurance at this stage because of the low penetration and selective nature of it – ie primarily high income demographic.

BUT

If major increase in penetration, especially in low income demographic, vulnerability will become a major issue as high vulnerability means higher AAL’s which means larger aggregated insured risks and thus larger mark ups (C) than with low vulnerability leading to higher reinsurance premiums – and consequent insurability issues due to affordability restraints

THEREFORE

Need to start reducing vulnerability of new construction now to ensure satisfactory situation in future
Catastrophe loss risk models can be a powerful tool for undertaking cost-benefit studies of mitigation measures.

- Enable estimation of changing pattern of risks into the future assuming:
  - No change in vulnerability
  - Projected changes in vulnerability

- Enable assignment of true costs and benefits to relevant parties—e.g., owner, insurer, government, etc.—which is necessary if costs of mitigation are to be assigned in an equitable manner.

- Enable the effect of increasing penetrations of insurance on insurance costs due to the increase in size of insured event risks to be taken into account in modelling the impact of insurance on cost-benefit analysis.
Climate Change

Can be modelled if know expected change and uncertainty of prediction

IPCC4 Report provides this type of information

Extreme events have inherent large uncertainties on an annual basis. From one year to the next changes not likely to be very significant – hence not highly significant in terms of annual insurance and reinsurance analysis.

Much more important for long term planning – eg cost benefit analysis of mitigation, or sustainability of projected national disaster insurance schemes
Who Pays? Who Benefits?

Many Stakeholders - insurers, reinsurers, commercial modelling companies, governments, general public

Current level of insurance activity insufficient to make development of the level of models required to meet challenges of rapidly changing demographics commercially viable

A high penetration of insurance combined with a moderate to high level of physical mitigation appears to be important for long term sustainability of national economies

High quality catastrophe loss risk models needed to achieve this in most cost efficient manner

Suggests governments need to play major role in funding R&D for model development in cooperation with insurance and reinsurance industry, and commercial model developers
The Singapore Solution

NTU Institute for Catastrophe Risk Management

Big Challenges

But

Big Rewards if can focus on Big Issues
Thank You