Managing Economic Exposures of Catastrophe and Terrorism Risk:
International Financing Solutions

Torben Juul Andersen
Copenhagen Business School
Denmark

OECD

CONFERENCE ON CATASTROPHIC RISKS AND INSURANCE
November 22-23, 2004
Direct Economic Losses from Natural Catastrophes

Direct Economic Losses from Man-Made Disasters

Source: Sigma No. 1/2004, Natural Catastrophes and Man-Made Disasters in 2003, Swiss Re.
# The Ten Largest Insured Catastrophe Losses

<table>
<thead>
<tr>
<th>US$ Million</th>
<th>Victims</th>
<th>Year</th>
<th>Event</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>20,511</td>
<td>38</td>
<td>1992</td>
<td>Hurricane Andrew</td>
<td>USA, Bahamas</td>
</tr>
<tr>
<td>19,301</td>
<td>3,000</td>
<td>2001</td>
<td>Attacks on WTC</td>
<td>USA, Bahamas</td>
</tr>
<tr>
<td>16,989</td>
<td>60</td>
<td>1994</td>
<td>Northridge earthquake</td>
<td>USA, Bahamas</td>
</tr>
<tr>
<td>7,456</td>
<td>51</td>
<td>1991</td>
<td>Typhoon Mireille</td>
<td>Japan</td>
</tr>
<tr>
<td>6,321</td>
<td>95</td>
<td>1990</td>
<td>Winterstorm Daria</td>
<td>France, UK</td>
</tr>
<tr>
<td>6,263</td>
<td>80</td>
<td>1999</td>
<td>Winterstorm Lothar</td>
<td>France, Switzerland</td>
</tr>
<tr>
<td>6,087</td>
<td>61</td>
<td>1989</td>
<td>Hurricane Hugo</td>
<td>Puerto Rico, USA</td>
</tr>
<tr>
<td>4,749</td>
<td>22</td>
<td>1987</td>
<td>Storms and floods</td>
<td>France, UK</td>
</tr>
<tr>
<td>4,393</td>
<td>64</td>
<td>1990</td>
<td>Winterstorm Vivian</td>
<td>Western Europe</td>
</tr>
<tr>
<td>4,362</td>
<td>26</td>
<td>1999</td>
<td>Typhoon Bart</td>
<td>Japan</td>
</tr>
</tbody>
</table>

Policyholders

Direct insurers

Reinsurers

Retrocessionaires

Reinsurers retrocede part of the reinsurance premiums to limit risk exposure

Primary insurers cede actuarial and catastrophe risks to limit undiversifiable risk exposure

Preferably similar risks with independent loss events to obtain a balanced insurance portfolio

Customers’ individual risk exposures

The Insurance and Reinsurance Markets
Development in Reinsurance Prices

World Rate-on-Line

(1990 = 100)

Catastrophe Loss Probability Curves

Model Estimates - Probabilities of Catastrophe Losses

\[ \text{LEP} = \int P(x) \, dx \]

the loss exceedance curve

the probability density function
Catastrophe Loss Probability Curves

Model Estimates - Probabilities of Catastrophe Losses
(Layered Reinsurance Program – Example)

AEP (Aggregate exceedance probability)

Total losses – USD million (log scale)

loss exceedance curve
Structure of Risk-Linked Securities

Securitization of insurance exposure – catastrophe risk

CEDING PARTY
  e.g. reinsurance company

SWAP
  Counterpart

COLLATERAL
  Trust account

SPV
  Special Purpose Vehicle

INVESTORS
  Institutional note holders

Principal
  at maturity

Libor

Return

Principal
  less catastrophe losses

Insurance contract

5%
  premium
  claims

Principal
  Libor+5%
Issuance of Risk-Linked Securities

Transactions (#)

Risk Capital ($ million)


Incorporating Cat-bonds in the Invested Portfolio

Risk Diversification
## Comparing Risk-Management Instruments

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance treaties</td>
<td><em>a well established market</em></td>
<td><em>reinsurance prices are highly cyclical</em></td>
</tr>
<tr>
<td></td>
<td><em>risk is transferred — no repayment</em></td>
<td><em>capacity sensitive to recent loss experiences</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>premium paid up front</em></td>
</tr>
<tr>
<td>Risk-linked securities</td>
<td><em>large capital market reservoir</em></td>
<td><em>finite market size</em></td>
</tr>
<tr>
<td></td>
<td><em>institutionalized practice</em></td>
<td><em>it is extremely hard to model terrorist risk</em></td>
</tr>
<tr>
<td></td>
<td><em>risk is transferred — no repayment</em></td>
<td><em>premium paid up front</em></td>
</tr>
<tr>
<td>Contingent capital</td>
<td><em>additional market segment</em></td>
<td><em>premium paid for right to borrow money</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>provides possibility to borrow money</em></td>
</tr>
<tr>
<td>Financial derivatives</td>
<td><em>large market</em></td>
<td><em>limited interest and market liquidity</em></td>
</tr>
<tr>
<td></td>
<td><em>diverse catastrophe indexes</em></td>
<td><em>exchanges close due to lack of business</em></td>
</tr>
<tr>
<td>Catastrophe swaps</td>
<td><em>may provide flexible documentation</em></td>
<td><em>constitutes another type of insurance contract</em></td>
</tr>
<tr>
<td></td>
<td><em>can reduce handling time</em></td>
<td><em>needs insurance companies as counterparts</em></td>
</tr>
</tbody>
</table>
The Formal Risk Management Process

- Identify major catastrophe risks
- Outline the contours of direct economic exposures
- Analyze cost/benefits of risk mitigation efforts
- Determine the government commitments
- Assess opportunities for risk-transfer and finance
- Establish risk-financing solutions for residual risk exposures

*Risk mitigation investment reduced risk exposures*

*Risk financing arrangements reduced economic exposures*
Insurance Layer - Example

Layer

Exhaustion point

Attachment point

Loss limits [USD million]

800

400
Layered Reinsurance Program - Example

Loss limits [USD million]

1,000
800
400
200
100
0

100%
50%
75%
90%

Ceded to reinsurance
Retained insurance
Loss limits [USD million]

- Government backing
- Committed credit
  - Cat-Bonds
- Reinsurance treaties
- Retention
- Mutual reinsurance
- Earned fund surplus

- Government guarantee
- Committed credit facilities
  - Contingent surplus notes
  - Risk-linked securities
- Ceded in the global reinsurance market
- Retained risk
- Ceded for reinsurance
- Retained risk covered by escrowed fund