

BEST'S REVIEW

Catastrophe Bundles Can Deal With Unknown Risk

by Graciela Chichilnisky



The property/casualty insurance industry has experienced record catastrophe claims over the last several years. In the United States alone, there were the 1988 Midwest drought, the 1993 Midwest floods, the 1995 flooding along the California coast, Hurricanes Andrew (1992) and Opal (1995), and the Northridge, Calif., earthquake (1994), to name a few. Since 1989, the 10 most costly catastrophes in the world amounted to more than \$43 billion.

Today's catastrophic risks are highly unpredictable. The global climate appears to be in a state of flux. We cannot anticipate statistically how many hurricanes, floods or droughts may occur within a region or their severity. The traditional way for an insurer to manage these risks is to purchase reinsurance. However, to be effective, reinsurance must be based on actuarial tables that predict exposure and allow reasonable and effective coverage. A mistake on the part of the reinsurer can lead to losses that compound the weather catastrophe with financial catastrophe.

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The recent spate of catastrophes has strained the financial base of the reinsurance industry over the last several years. These risks cannot always be diversified and cannot be quantified with standard tables. Catastrophe Bundles® (see "Global Environmental Risks," *Journal of Economic Perspectives*, 1993), a new financial instrument consisting of a standard reinsurance package and a mutual fund in catastrophic futures, may be the answer. In response to the increase in unpredictable catastrophes, reinsurers have increased dramatically their deductible rates and may refuse to sell reinsurance in specific instances. The industry, like the climate, is in a state of flux. Just when reinsurance is most needed to mitigate exposure to catastrophic risk, reinsurers fear the risks they face and shy away from business (see *BestWeek*, Property/Casualty edition, July 25, 1994). The issue is how to price the reinsurance without facing impossible risks. In other words, reinsurance, the traditional way to manage catastrophic risk, has become a source of financial risk itself.

Reinsurance is about diversification. It depends on the "law of large numbers": The larger the group affected, the safer the reinsurer is. Of course, no one knows who will be damaged, but it is possible to predict the overall damage statistically. Historically, the basis for the theory of insurance is that, on average, the extent of loss can be anticipated. Reinsurance can theoretically price accordingly and take a calculated and reasonable statistical risk.

Today, this basis for reinsurance is comprised of two factors. (1) Risks are unknown, even statistically, because the weather is in a state of flux and actuarial tables cannot be developed. (2) Catastrophes recently have been more violent and widespread and the property being insured is more valuable than in the past. The exposure is much larger and the risks are more difficult to diversify.

How can insurers deal with this problem of more volatile and violent risks with ignorance about their frequency and severity? It helps to separate the problem into two related portions: how to deal with diversifiable but unknown risks and how to protect against risks that cannot be diversified.

These two elements led a group of economic consultants (including Geoffrey Heal, Garrett Professor of

Public Policy and Corporate Responsibility, Columbia Business School, New York, and myself) to design the Catastrophe Bundle to manage the financial risk of reinsurance in a volatile and unknown environment. The concept is a modified reinsurance package, which diversifies the risk and protects the insurer against unknown financial risks, and a security, which captures correlated risks that cannot be diversified in any way. The reinsurer can customize it to each insurer's specific exposure.

The Catastrophe Bundle has an historical precedent in the financial wisdom of several hundred years ago, as well as taking advantage of some of the newest securities in the market. Four hundred years ago the Monti di Paschi di Siena, Italy's oldest agricultural bank, ran a cooperative insurance program that shared all the main features of a Catastrophe Bundle. To protect against weather-related losses, landowners in Tuscany had a mutual insurance program with the added feature that it carried forward funds from years of good weather to disburse in years of bad weather. This was essentially a reinsurance scheme for deviations from the average loss. The carry-over played the role of a security that spread the gains from years of good weather to the years with bad weather. Catastrophe Bundles function similarly.

In 15th century Italy, risks were moved across time from those who could afford it to those who could not. Today's analog to the carry-over aspect is the catastrophe future (CAT), which moves risks to those who want them and away from those who don't. Catastrophe futures are new securities and derivatives introduced in December 1993 by the Chicago Board of Trade.

Futures Decrease Exposure

Catastrophe futures allow property/casualty firms to manage the risk of increasing claims arising from losses across all lines of business. The more losses an insurer has, the more the contract pays. No commodities are exchanged: only money. A CAT contract entitles the insurer to a dollar payment that depends on the frequency with which catastrophes occurred in a certain

region of the United States within a quarter—for example, the number of floods that occurred in the Midwest in the first quarter of 1995—as measured by the Insurance Services Office. The index goes up when the number or value of claims related to floods in the Midwest goes up, and down when the claims go down. The contract pays the insurer an agreed dollar amount that is higher when flood claims rise.

How does this help the reinsurer? A reinsurer faces more flood-related risks than average. If the reinsurer buys CAT contracts, they will pay the reinsurer more money than average: The value of the CATs goes up when losses increase. With the CAT, the reinsurer decreases its overall exposure.

In addition to reinsurers, investors can trade CATs to make a profit. The price of a CAT depends on the market's expectations about future losses from floods. If floods occur at a rate higher than predicted, the CAT price goes up. Otherwise it goes down. Trading CATs is a simple financial proposition: In its simpler form, it is a new form of betting on the weather. While people readily understand why a reinsurer would want to buy a CAT, they wonder who would sell a CAT. Simple: Anyone who stands to gain from the catastrophe, such as construction businesses in the case of hurricanes. They could sell their CATs when the weather was good. At the end of the day, it does not matter who is affected by the catastrophe but, rather, who gains and who loses from it.

As more investors enter the CAT market, the market achieves more liquidity. It is easier to buy and to sell, to take a position and to exit. Does more active trading improve the market or does it make it more speculative? This is an age old question. All markets face the same dilemma, and there is nothing new or peculiar to CATs. I favor liquidity.

Catastrophe Bundles

Why should reinsurers consider Catastrophe Bundles? Say a group of property/casualty insurance companies face a one-third chance of 10 hurricanes in a given year with damages

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in excess of premiums amounting to \$600 million per hurricane, amounting to an exposure of \$6 billion, and a two-thirds chance of five hurricanes occurring, amounting to only \$3 billion exposure. No one knows if the true frequency will be five or 10 hurricanes. The risk is truly unknown. Science can only tell us that there will be either 10 or five catastrophes that year, the former case with probability one-third and the latter two-thirds. Traditionally, the reinsurer offers the insurance companies a package covering the expected loss, which is \$4 billion, and charges so as to face an acceptable risk of default. Yet it remains concerned about overexposure when there are 10 hurricanes. This concern is real: in many cases the remaining exposure leads to default.

Today the reinsurer goes to the CAT market to cover the difference in its own exposure. The reinsurer buys CATs which pay it \$4 billion in the first case. When there are 10 hurricanes rather than five, the cost is

shared with its clients. This is certainly an improvement over the previous situation. The reinsurer will not default. All seems well. But what about the insurers themselves?

Covered up to the average exposure of \$4 billion, if there are only five hurricanes, the insurers have bought too much insurance. If there are 10 hurricanes, they have bought too little. Conventional reinsurance with the addition of CATs certainly improves matters. Now there is no default in addition to their exposure. But they are left with having bought too much or too little coverage.

Obviously insurance companies would prefer to get a two-part reinsurance package that covers them for \$6 billion when there are 10 hurricanes, and for \$3 billion otherwise. Then they never will be overinsured or underinsured in the face of unknown risks. Catastrophe Bundles allow reinsurers to structure and customize such deals for individual insurers and price them effectively. The mathematics are

somewhat complex, but the concept is simple common sense.

While catastrophe futures provide additional cash just when it is needed—when the frequency of the catastrophes increases—they can't do the whole job. More risk spreading is needed and is possible with a Catastrophe Bundle. A two-part contract, it provides a mutual reinsurance scheme and a security that represents participation in a mutual fund. The mutual reinsurance is designed to cover deviations from the average exposure. The mutual fund package provides shares in a CAT pool provided by the reinsurer. The Catastrophe Bundle allows the reinsurer to provide full and customized coverage to the property/casualty insurer without facing undue risk itself.

As the global climate evolves, financial innovation must match the challenges and capture potential gains. Society's welfare depends on the industry's ability to manage risks. So do the industry's profits. ■