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FINANCIAL INNOVATION IN PROPERTY CATASTROPHE REINSURANCE: THE CONVERGENCE OF INSURANCE AND CAPITAL MARKETS

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The property catastrophe reinsurance industry faces a major challenge. Since 1989, climatic volatility has produced unprecedented insured losses of $43 billion, $18 billion of which were from Hurricane Andrew alone. A surge of insurer defaults and dramatic changes in capacity and pricing have followed in their wake.

Catastrophic risks must be addressed with innovative financial approaches that bring the insurance industry closer to the securities industry. This article discusses the new financial instruments that can be successfully used to hedge unknown catastrophe risks.

[1]The author acknowledges information provided by Peter Vloedman, Columbia Business School.

Hurricane Andrew Changed It All

In August 1992, Hurricane Andrew caused an unprecedented level of destruction. With insured losses of more than $18 billion and total losses greater than $25 billion, Andrew was the most devastating *natural* catastrophe ever recorded. It has also led to a wave of *financial* catastrophe: the hurricane affected almost every major insurance company in the United States. No matter how hard reinsurers tried to diversify their portfolios among different insurance companies, they sustained losses on virtually every account that they had underwritten.

Reinsurers Depart

The magnitude of these losses contributed to the demise of numerous reinsurers. In the year following Andrew, 38 non-U.S. and 8

continued on page 2

INSIDE ...

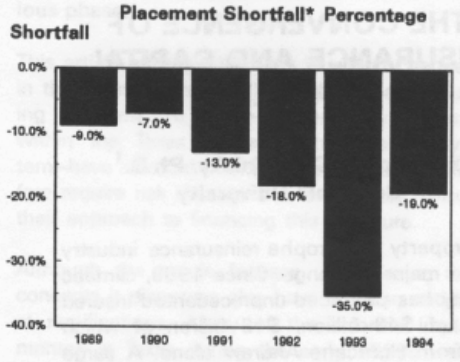
... *Catastrophe Reinsurance cont. from p. 1*

U.S. reinsurers, with familiar names such as Continental Re and New England Re, either withdrew from the reinsurance business completely or ceased underwriting catastrophe reinsurance. Moreover, in the late 1980s to mid-1993, more than 200 reinsurers left the marketplace, citing intense competition, reserve strengthening due to asbestos and environmental losses, and prior natural catastrophes (such as the 1990 European windstorms and Hurricane Hugo) as reasons for their departure.

Capacity Constraints

The departure of reinsurers caused catastrophe reinsurance capacity to drop by more than 30 percent between 1989 and 1993—over 20 percent of which occurred between 1992 and 1993 and was due to Hurricane Andrew. In 1989, the average U.S. catastrophe reinsurance program was approximately $144.3 million. But by January 1993, immediately after Andrew, the average program capacity had plummeted to $93.7 million. Insurance companies could not buy enough catastrophe reinsurance—no matter how much they were willing to pay. The worldwide catastrophe reinsurance demand exceeded the supply. This is illustrated by Figure 1.

FIGURE 1
PROPERTY CATASTROPHE REINSURANCE CAPACITY: A HISTORICAL COMPARISON OF PLACEMENT SHORTFALL PERCENTAGE



Composite of 14 programs placed by Guy Carpenter & Co., Inc.

*Shortfall is the difference between the amount of coverage desired and the amount of coverage available in the market.

Prices Rise

Between 1989 and 1994, the contraction of capacity caused reinsurance prices to rise al-

continued on page 3

Risk Financing NEWSLETTER

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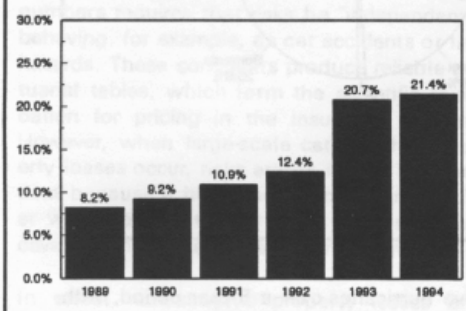
... *Catastrophe Reinsurance cont. from p. 2*

most 70 percent: from 12.4 percent rate on line to 20.7 percent rate on line, much of it as a result of Andrew. (Rate on line is the price charged per dollar of coverage purchased.) This is illustrated in Figure 2.

FIGURE 2
PROPERTY CATASTROPHE REINSURANCE CAPACITY: A HISTORICAL COMPARISON OF PROGRAM RATE ON LINE



Composite of 14 programs placed by Guy Carpenter & Co., Inc.

*Rate on line is the price charged per dollar of coverage purchased.

Bermuda Emerges

The decrease in catastrophe reinsurance supply following Andrew led to changes in the marketplace. With the continuing doubts over the future existence of Lloyd's of London and the need for capacity, Bermuda has become a major force in the property catastrophe reinsurance market. In a period of 1 1/2 years, $4 billion of capital was infused into Bermuda companies formed for the purpose of writing property catastrophe business. These new entities included Centre Cat, Global Capital Re, International Property Catastrophe Re, La Salle Re, Mid Ocean Re, Renaissance Re, Partner Re, and Tempest Re. Interestingly, investors in those companies comprised major players in the securities industry, such as Morgan Stanley, Goldman Sachs, J.P. Morgan, and Warburg Pincus. This combination indicates the interest of the securities industry in the high margin reinsurance business. It anticipates the combined use of insurance and security instruments as a means of hedging property catastrophe risks.

The Effect upon Worldwide Capacity

The emergence of the Bermuda market is responsible for more than 80 percent of the 35 percent increase in worldwide reinsurance capacity from 1993 to 1994. Bermuda has gone from comprising less than 1 percent of the catastrophe reinsurance market to 25 percent in 5 years. In contrast, U.K. capacity dropped about 60 percent during the same period. In 1994, the Bermuda companies averaged a combined operating profit ratio of 40 percent, which translated into an average 15 percent return on equity; an excellent return in a year that witnessed almost $19 billion in worldwide catastrophe losses. These changes in reinsurance market share are depicted in Figure 3.

Problems in Predicting Catastrophic Risks

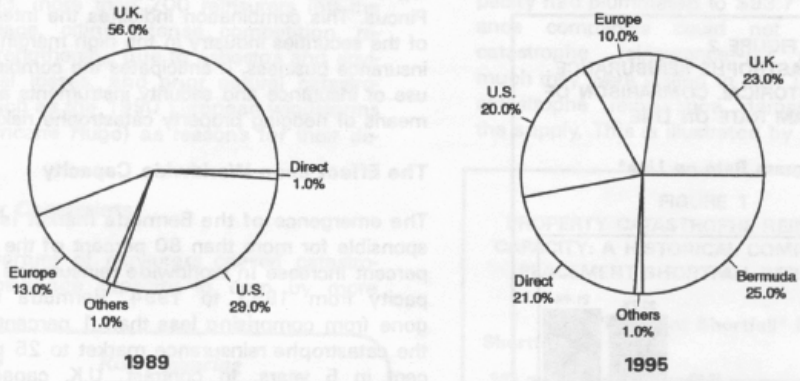
The practical problem for the reinsurance industry is that catastrophic risks have reached record values. Currently, reinsurers face two difficulties in underwriting such coverage: volatile climatic conditions and the inapplicability of the law of large numbers in predicting catastrophe losses.

continued on page 4

... *Catastrophe Reinsurance cont. from p. 3*

FIGURE 3
PROPERTY CATASTROPHE REINSURANCE CAPACITY:
A HISTORICAL COMPARISON OF MARKET SHARE BY REGION

Market Share by Region



Composite of 14 programs placed by Guy Carpenter & Co., Inc.

Charts provided by Guy Carpenter & Co.

Climatic Conditions

In recent years, the increase in weather volatility has heightened the difficulty in predicting catastrophic property losses, rendering standard actuarial tables unreliable. Such climate volatility is often associated with global climate change. This is blamed by some on the emission of greenhouse gases into the planet's atmosphere by Organization for Economic Cooperation and Development (OECD) countries, the group of the world's most industrialized nations. If so, volatility is only going to increase. The problem is not likely to go away.

As climate becomes more volatile, actuarial tables have become unreliable, creating the risk of using the wrong table for predictive purposes. For example, one table could predict five hurricanes over a 5-year period, with average strength and associated loss of $3 billion each. Another, equally reliable, table could predict 10 hurricanes during the same period, having losses of about $2 billion each.

Although one can take an average of the two source's opinions in creating a new actuarial table, this does not work in actual practice. If both scenarios are equally plausible, for example, then taking the average guarantees that, most of the time, the exposure to risks will either be overinsured or underinsured. Both lead to costly risks. The former leads to financial losses since insurance is expensive. Underinsurance is even more costly; underinsurance leads to financial risks of default. In

continued on page 5

... *Catastrophe Reinsurance cont. from p. 4*

either case, to the physical catastrophe one may add financial catastrophe. This happened to many reinsurers on the eve of Andrew. It also happened with Lloyd's of London, where underestimation of climate losses has led to continuing doubts about its future existence.

Inapplicability of the Law of Large Numbers

The second problem associated with predicting the incidence of catastrophic property loss is that insurance does not work very well under these circumstances. The law of large numbers requires that risks be "independent," behaving, for example, as car accidents or fire hazards. These conditions produce reliable actuarial tables, which form the scientific foundation for pricing in the insurance industry. However, when large-scale catastrophic property losses occur, risks are no longer independent because a hurricane affecting one insurer will also affect every other insurer writing coverage in the same geographical area.

In effect, catastrophic property losses are highly correlated risks—as opposed to being independent risks. And since large-scale property catastrophes impact a significant part of the insurer population both in physical and in financial terms, the law of large numbers does not operate under these circumstances, making it impossible for reinsurers to diversify risks. What can be done?

Catastrophe Bundles: A Tool for Hedging Risks

In response to this problem, the insurance industry has begun to adopt innovative solutions. Reinsurers can deal with the correlated risks posed by property catastrophes using a "catastrophe bundle,"[2] introduced at the program on Information and Resources at Columbia University (copyright 1995). A catastrophe bundle is a two-part contract which combines a catastrophe future with a mutual reinsurance portfolio. Catastrophe bundles permit reinsurers to provide full, customized coverage to an insurer without having it assume unreasonable risk.

Catastrophe Futures

The first component of a catastrophe bundle treats the actuarial table as the risk,[3] i.e., the risk of using the wrong actual table for predicting the frequency of property catastrophes. Securities similar to those suggested in 1992 are now traded on both the Chicago Board of Trade (CBOT) under the name "CAT" (catastrophe) futures as well as in private sales. A CAT future entitles the reinsurer to an agreed dollar amount that increases as the *frequency* of catastrophe claims in a given region increases. Since the value of CAT contracts rises as losses increase, reinsurers decrease their exposures by buying such instruments. On the other side of the equation, speculators can trade CAT contracts to make a profit, in effect providing them with a means of betting on the weather.

The Mutual Reinsurance Portfolio

In addition to the protection provided by catastrophe futures if catastrophe *frequency* rises, reinsurers also require additional protection if the *severity* of catastrophes exceeds their predictions. This, in turn, is afforded by the second part of a catastrophe bundle: a mutual reinsurance portfolio. The mutual reinsurance portfolio provides shares in a CAT pool and is designed to cover deviations from the average *severity* exposure posed by catastrophes.

[2]See *A.M. Bests's Review,* March 1996, p. 45.

[3]See, for example, G. Chichilnisky and G. Heal, "Global Environmental Risks," *Economic Perspectives,* October 1993, and G. Chichilnisky, "How To Hedge Unknown Risks," *A.M. Best's Review,* March 1996.

continued on page 6

... *Catastrophe Reinsurance cont. from p. 5*

This combination of catastrophe futures and a mutual reinsurance portfolio can be meshed to provide reinsurers with a very effective means of hedging property catastrophe risks, ultimately producing an optimal allocation of risk bearing between reinsurers seeking to *hedge* their risks, and *speculators* who seek a profit from the transaction. The mathematical formulas required to implement a catastrophe bundle can be provided by consultants at the Program on Information and Resources at Columbia University and are customized according to each reinsurer's individual situation. Although other hedging instruments are possible, catastrophe bundles are straightforward and relatively easy to execute and trade.

Negative Correlations

In contrast to insurance, catastrophe bundles are not based solely on either the law of large numbers or on the pooling of risk. Rather, they involve the use of negative correlations (in the case of catastrophe futures), together with risk pooling (as respects the mutual reinsurance portfolio). The principle of negative correlations is one with which the securities industry is familiar but the insurance industry is not. For example, when there is an earthquake, those who are affected are affected differently. The homeowner loses from the earthquake but the construction industry gains. Thus, by buying enough shares in the construction industry, one can hedge the risk of losing one's home. The point is that it does not matter who suffers the risk. Everyone does. There is no risk pooling when using negative correlations. Rather, negative correlations allow reinsurers to hedge risks by buying catastrophe futures.

Catastrophe-Linked Bonds

Banfield Ellinger, a London-based reinsurance broker, has recently pioneered a product similar to catastrophe bundles. It joined with AIG Combined Risks (AIGCR), the investment banking arm of American International Group, to place a portfolio of catastrophe-linked bonds with a U.K. manager. The fund manager is investing about $10 million with an offshore special vehicle which will sell a loss warranty reinsurance contract to reinsurance companies. The policy is triggered if catastrophic insurance losses in one of five geographical areas—the United States, Japan, Australia, the Caribbean, and Western Europe—exceed a level stipulated in the contract. Losses are measured against the industry loss indexes of Property Claims Services. M. Matthew Harding, the chairman of Banfield, calls this a "groundbreaking product which accesses a new source of capital for the reinsurance industry."[4]

The Future of the Industry

Solving the problem of hedging unknown catastrophic risks requires a blend of skills from the securities and insurance industries. By tapping capital markets, reinsurers will be better able to deal with correlated, catastrophic risks. The size of the derivative securities markets is a great plus: with about $3 billion traded per day, this market avoids the major difficulty of "thin" markets in which prices turn against the reinsurer after a catastrophe, precisely when capital is needed most. Because the derivatives market is both large and liquid, when a number of reinsurers go to the market to borrow after a catastrophe, it will not turn against them, thus affording reinsurers a source of funds even when demand is high. The Fields Institute of Mathematical Sciences conducted a workshop in June in Toronto, during which industry players and scientific researchers

[4]See R. Lapper, "Catastrophe insurance loss bonds pioneered," *Financial Times*, Thursday, May 2, 1996, p. 26.

continued on page 7

... *Catastrophe Reinsurance cont. from p. 6*

would flesh out solutions to these problems using the new instruments proposed here.

In practical terms, what is required to successfully hedge property catastrophe risks is the skill to produce and sell a simple product which is transparent, credible, and can be priced fairly and traded easily. Experience has shown that this can be achieved.

From the insurance industry's point of view, management must ensure that the culture of its firm encourages the innovation needed to hedge these risks. The future of the industry lies with those firms which implement such innovation. The companies that adapt successfully will be the ones that survive. In 10 years, these organizations will draw the map of a completely restructured reinsurance industry.

***Graciela Chichilnisky** is UNESCO Professor of Economics and Mathematics at Columbia University. She has taught at Harvard, Essex, and Stanford universities and from 1985–1989 was chairman and chief executive officer of FITEL, an international financial telecommunications corporation. She has been adviser to the Organization of Economic Cooperation and Development, the United Nations, and the Organization of Petroleum Exporting Countries in international economics and environmental policy. She was a member of the Presidential Cabinet of the Central Bank of Argentina, and she holds doctorates in mathematics and economics from the University of California at Berkeley. The author of five books and numerous articles, Professor Chichilnisky is an active consultant to the global financial industry. She can be reached at (212) 854-7275; or E-mail: GC9@Columbia.EDU*

CIRCLES AND CYCLES, PHASES AND STAGES: THEIR EFFECT UPON WORKERS COMPENSATION FINANCING DECISIONS

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Self-Insurance Resource, Inc.

Willie Nelson, in his famous ballad, describes "circles and cycles, phases and stages." This wonderful analogy can apply to the workers compensation risk financing decision process. Specifically, different approaches become alternatively more or less viable as the market for workers compensation moves through various phases.

This article analyzes the way in which changes in the Texas workers compensation market during the past 10 years—triggered by reforms within the Texas workers compensation system—have affected market conditions and therefore require risk managers to continually review their approach to financing this exposure.

Although the article focuses upon Texas, the concepts it discusses also have broader, national ramifications. Many of the reforms implemented in Texas during the early 1990s were adopted in other jurisdictions, as well. Such reforms are likely to be adopted in virtually all states by the end of the decade.

Reforming the Texas Workers Compensation System

At a seminar more than a decade ago in 1985, Self-Insurance Resource, Inc., forecasted the inevitable implosion of the Texas workers compensation system by 1990. The chart in Figure 1 at that time graphically demon-

continued on page 8