

# **HOMOGENIZING CATASTROPHE RISK: An Overview of Catastrophe Indices**

By Bruce Thomas

Touted as a means of securitizing insurance risk caused by natural calamities such as earthquakes and hurricanes, catastrophe bonds are theoretically quite attractive. They offer investors inviting returns that are uncorrelated with other asset classes and provide insurers' a layer of protection against the impact of major catastrophes. In practice, however, there have been a number of complications.

A year ago, many reinsurance and investment experts viewed the absence of any large, successful catastrophe bond offerings as proof that these securities were not economically viable. These securities were deemed to be too complicated and many people worried that unfavorable accounting and regulatory treatment would make these offerings too costly to be useful in managing risk. Some insurance industry leaders wondered if the spadework done in this area would ever amount to anything.

A number of private placements in spring and summer 1997 gave even the skeptics reason to be hopeful. The most important of these issues was a catastrophe bond offering from USAA, a large homeowner insurance company. This debt issue, which raised some \$477 million, demonstrated that catastrophe risk could be packaged and priced to meet the needs of both insurers and investors.

Although we cannot point to a bumper crop yet, a number of leading reinsurance and investment companies have been putting the people and technology in place to ensure future success. Most importantly, they have been cross-pollinating the insurance and investment communities with professionals who understand catastrophe risk and have the in-depth knowledge and experience necessary to make the capital markets a regular feature of the catastrophe risk management landscape.

The experts are no longer asking whether or when, but how. How can these instruments be tailored to better fit the needs of insurers and investors? How can these transactions be standardized so as to reduce costs and achieve widespread acceptance with regulators and rating agencies? How can these individual securities offerings grow into a market for catastrophe risk?

## **More and Better Information**

Plentiful information is at the core of any successful market and catastrophe risk is no exception. However, it is very difficult to get high quality information about catastrophic risk. Catastrophes, by definition, are events that do not occur every day, are impossible to predict with any degree of certainty, and cause huge losses. While a sound historical record of catastrophe damage would be a good starting point for analyzing potential losses, much of this information was never recorded in sufficient detail to be very useful today.

Measuring catastrophe losses in a reliable way is very difficult. The claim reporting and settlement process takes a great deal of time, and many months may pass before the insurance companies know the ultimate amount of their individual net losses. Detailed information concerning insured

properties and losses is confidential in nature, and there is no single entity that collects this information for all companies and all geographic areas of the United States.

Catastrophe indices can help fill this information void. Whether they provide a quick estimate of damage, just days after an event, or detail actual paid losses, catastrophe indices are a valuable resource for those who want a better understanding these perils. Indices can also serve as a reference basis for financial contracts where settlement values are based on indexed losses rather than an individual company's loss experience.

### **A Reference Basis**

To move beyond individual transactions and develop a market for catastrophe risk, buyers and sellers need to quickly exchange information about their preferences. They must be able to describe their wares and wants in a few key terms such as: price, risk period, type of property, geography, and peril(s) covered. By homogenizing catastrophe risk, an index makes rapid exchange of information possible and creates a platform on which to base standardized financial products. This standardization is critical to creating the market breadth and depth that will generate the capacity that insurers need and the liquidity that investors desire.

Using an index as the reference basis for financial contracts eliminates the need for investors to understand all of the unique characteristics of a particular insurer's book of exposures and loss potential. Gaining this understanding demands a high level of expertise and involves a process that is time-consuming and costly.

Likewise, index-based contracts eliminate the insurer's disclosure burden. If the index determines settlement values, it is no longer necessary for the insurer to reveal confidential information about its growth plans, distribution systems, and underwriting and claim payment practices. Negotiations can be expedited by focusing on price, credit, and settlement terms rather than on all of the unique characteristics of that particular insurance company.

From an investor's perspective, index-linked contracts can mitigate the impact of any particular company's abnormal loss experience and reduce transaction costs by eliminating the need for processing, transmitting, and auditing claims information. Also, using a measure of loss that is produced by an independent party helps eliminate the informational advantage that the insurer would otherwise have over the investor and protects the investor from potential moral hazard that might affect settlement values.

### **Competing Objectives**

While the benefits of catastrophe indices are clear, developing such an index is not easy because the objectives are often contradictory in nature. To be useful, an index must produce information that is both timely and accurate. Given the long claim development periods that typically accompany catastrophes, these goals are seemingly irreconcilable.

For an index to be widely accepted, both the data supporting the index and the index calculations must be understood. However, catastrophe index calculations either require lengthy description or are so complicated or subjective that no detailed description is possible. Moreover, catastrophe

indices are based on confidential information, which makes it difficult or impossible for third parties to recalculate or verify index values.

Basing financial contracts on an index can help homogenize risk, but at what cost to the hedger? Traditional reinsurance is based on individual insurer loss experience and is therefore perfectly correlated with it. In contrast, a hedge based on an index-linked contract becomes ineffective and inefficient if there is a significant possibility that insurer' losses will not track the index as expected, i.e too much basis risk. This uncertainty either causes the insurer to pay for more protection than is desirable or to retain too much risk. Without the information necessary to measure and minimize basis risk, the cost and uncertainty of using index-linked contracts make them unpalatable.

While it is not possible for any one index to satisfy *all* of these disparate objectives, many of these goals can be reconciled. An index can be highly correlated with insurer loss experience, and there is no reason why index calculations have to remain a mystery or why supporting index data cannot be provided in aggregate, without disclosing any confidential information. Nevertheless, it is impossible to reconcile the need for immediate information with the need for accuracy. For this reason, each of the existing catastrophe indices relies on a different estimation method. (See Figure 1.)

Figure 1. Catastrophe Index Comparison

<b>Features</b>	<b>PCS</b>	<b>SIGMA</b>	<b>RMS</b>	<b>GCCI</b>
<b>Geographic Detail</b>	State	Country	ZIP code	ZIP code
<b>Insured Property</b>	All major lines	All lines	All major lines	Homeowners
<b>Perils</b>	All significant Perils	All Perils	Earthquakes and Hurricanes	Hurricanes, hailstorms, Tornadoes, thunderstorm Winter storms, and Freezing conditions
<b>Index Value</b>	Dollars of loss	Dollars of loss	Dollars of loss	Paid loss-to-insured Value ratio
<b>Source of Estimate</b>	Insurer survey, computer model, and ground survey	News and other sources	Computer model	39 companies' insurance and paid loss records
<b>Other Information Provided</b>	None	Number of casualties	None	Premiums, deductibles, amounts of insurance, claim counts, paid losses construction types
<b>Published</b>	3 to 5 days after event, Updates as necessary	Annually	7 days after event, Final value after 28 days	Quarterly

## **PCS Loss Estimates**

Tracing its origins back to 1949, Property Claim Services (PCS) publishes the oldest index of insured catastrophe loss and is currently the reference basis for the Chicago Board of Trade's catastrophe options contracts. These loss estimates represent PCS' best judgment of the insurance industry's total personal and commercial property catastrophe losses for states and regions. Based on a telephone survey of insurers, on a proprietary model, and on opinions of PCS' staff members who may have inspected damaged areas, the PCS Index has the advantage of being able to report loss estimates only days after an event.

Insurers use these early forecasts to designate losses as catastrophic when coding claim information. This helps identify potential reinsurance recoveries, but it also facilitates actuarial analysis. Since catastrophes introduce so much volatility, it is useful to isolate these losses when setting reserves and making pricing decisions. A reliable early estimate is also important for mobilizing insurance company personnel and helping market participants understand the likely magnitude of an event.

While PCS' estimates provide valuable information, they have not been totally successful as a basis for financial contracts. This Index is based on multiple layers of judgment, and many potential users do not feel they understand the calculations behind these estimates. An additional problem is that the PCS Index does not report on geographic areas within states and does not produce separate estimates by line of insured property or by peril. Since most insurers do not write all lines of property insurance and their property exposures are not uniformly distributed within states, their correlation with PCS loss estimates is not as high as they would like.

## **SIGMA**

Swiss Re/North American Reinsurance Corporation has been publishing an index of catastrophe loss, known as SIGMA, since 1970. SIGMA reports the total insured losses from both natural and man-made disasters and is worldwide in scope. Like the PCS Index, SIGMA relies on a variety of data sources including original documents, press reports, technical journals, and reports by insurance and reinsurance companies.

SIGMA and PCS loss estimates share a common heritage in that both were designed as a means of gathering and disseminating information that would be helpful to insurers. A key difference between these indices is the frequency with which they are reported. Since it is published on an annual basis, SIGMA's information is not nearly as timely as PCS.

Given that their intent was to be informative, it is not surprising that the objectivity and transparency of their respective methodologies was not of particular concern at the time they were developed. Only in recent years have insured loss indices been considered a potential reference basis for financial contracts such as options, futures, and catastrophe bonds.

## **RMS CAT Index**

The RMS catastrophe (RMS CAT) Index is the creation of Risk Management Solutions, one of the major providers of catastrophe modeling software. First published last July, this Index is calculated by entering event parameters into RMS' proprietary software, which then estimates the insured damage from hurricanes and earthquakes. RMS' hurricane model, for example, projects losses

based on landfall location, direction, forward velocity, central pressure, and the radius to the maximum wind speed. There are some obvious advantages to this approach.

Like the PCS Index, the RMS CAT Index is developed within days following a catastrophe. Because it is based on a model of loss experience, users can quickly and flexibly aggregate and disaggregate the model's estimated losses by peril, line of insured business, and geographic area. Although RMS' catastrophe model is modified and updated over time, the model is essentially frozen in advance of a particular Index series. This helps eliminate potential manipulation that might affect settlement values.

While risk management professionals agree that models can be useful in assessing potential catastrophic damage, most people do not believe that a model can predict losses with any precision. A half-dozen parameters may be useful for developing a good ballpark estimate of total event damage, but are not nearly as helpful in calculating damage for specific geographic areas or by type of insured property. Thus, the RMS CAT Index may be more useful to an investor who desires a quick estimate of potential damage than to a hedger who wants a precise measurement of actual loss.

### **The Guy Carpenter Catastrophe Index**

The Guy Carpenter Catastrophe Index (GCCCI) was first published in August 1997 by IndexCo, LLC, an affiliate of Guy Carpenter & Company, Inc., and is the reference basis for option contracts traded on the Bermuda Commodities Exchange. Based on over 40 million insurance and paid loss records annually, the GCCCI measures the insured damage to homeowner properties caused by atmospheric perils for over 9,600 individual ZIP codes in the United States.

Because the GCCCI is based on actual insurance and paid loss data supplied by 39 of the largest writers of homeowners insurance in the United States, it sacrifices the benefits of immediate information in favor of objectivity and transparency. There is virtually no informational advantage to any one insurer over potential investors since the GCCCI is an unweighted average of each of its reporting companies' paid losses divided by their insured values in each ZIP code.

Actuaries, meteorologists, and engineers will view the unprecedented level of supporting insurance and loss information as the GCCCI's most significant feature. In advance of each Index series, IndexCo publishes a database of insured properties for each of the ZIP codes covers by the GCCCI. This database includes such information as written premiums, deductibles, and housing stock with splits by age and construction class. After catastrophes have occurred, IndexCo provides a detailed analysis of paid losses by date, peril, construction class, age, and cause of loss. This information will be important for fine-tuning catastrophe models and for investors and hedgers who want to reduce basis risk.

The GCCI's biggest drawback is its reliance on massive amounts of accurate and consistent exposure and loss information. Although the perils and property covered by the GCCI make up over two-thirds of historical catastrophe losses affecting the United States, critics point out that the Index does not cover all types of insured property or perils. Unfortunately, there is not yet enough consistently high quality data to publish an earthquake index using this methodology or to extend the GCCI to other types of insured property.

The GCCI will be most helpful to hedgers. The detailed geography covered by the GCCI combined with the fact that it is peril and line specific make the GCCI highly correlated to the loss experience of insurers writing homeowners policies. By providing a database of properties and related losses for each ZIP code it covers, the GCCI will enable insurers to obtain a detailed understanding of how their particular loss experience relates to the Index. Intimate knowledge of the premium, deductible, and building stock information supporting the GCCI will allow insurers to measure potential basis risk and tailor hedges to meet their unique risk management needs.

Also important is the predefined system of weights that the GCCI uses to combine ZIP level Indices to form loss estimates for larger geographic areas. This system provides a handy road map showing the connections between the ZIP level Indices that insurers need to hedge their risks effectively and the broad geographic areas, such as states and regions, that most investors will find attractive.

### **Final Estimate**

Providing copious amounts of detailed, objective, and reliable information is an essential first step in developing standardized catastrophe risk financial instruments, and the GCCI covers this ground admirably. However, this information by itself is not enough; the market for catastrophe risk also has a huge appetite for immediate information.

Fortunately there are other indices that can help satisfy this need. PCS and RMS are helpful if you want to quickly assess the magnitude of a given event, and these indices will be important to hedgers and investors who desire early damage estimates so they can adjust their financial positions.

Like all tools, these indices have strengths and weaknesses, and their significance will depend on how useful people find them. If there is a lesson to be learned from the capital markets, it is that no one index is going to accomplish every objective. Ultimately, the success of these indices will be determined not by how old they are or how innovative, but by how reliable they are and by whether the information they convey helps people understand and manage catastrophe risk.

### ***Author's Note:***

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