AIRCURRENTS

THE AIR INDUSTRY EXPOSURE DATABASES

10.2008

EDITOR'S NOTE: Development and maintenance of industry exposure databases for all modeled countries is a critically important activity at AIR. In this article, Cheryl Hayes, who manages the exposures team at AIR, and Senior Research Manager John Rowe explain how they're developed, how they're used and why the reliability of catastrophe modeling results depends so heavily upon them.

By Cheryl Hayes and John Rowe

INTRODUCTION

The industry exposure database (IED) provides a foundation for all catastrophe model loss estimates. The IED contains counts of all insurable properties and their respective replacement values, along with information about occupancy and the physical characteristics of the structures, such as construction type, year built and height classifications. Even information pertaining to standard industry policy conditions, such as limits and deductibles, is incorporated into the database.

The benefits and uses of the IED in catastrophe modeling are numerous. Estimates of potential insurance losses for specific geographic locations from catastrophic events like hurricanes, earthquakes or terrorist attacks are generated based on the IED. This information can be used by insurance companies, reinsurance companies and others to gauge whether they have the appropriate level of coverage for the potentially impacted areas.

Probabilistic loss distributions are derived from the IED for all models, covering all regions and perils. IED values are fundamental in calculating industry loss estimates for all event types, whether simulated events from a stochastic catalog, the "recreation" of historical events, or for actual events unfolding in real time. As an example of the importance of the accuracy and completeness of the IED, loss mitigation mechanisms such as industry loss warranties (ILWs) pay out reinsurance contracts based on the amount of loss to the industry by region and peril, or across multiple regions and perils—and these estimates of industry loss are based on the IED.

WHY USE THE IED?

IThrough AIR's CATRADER system, individual companies can use the IED to evaluate their own loss potential. The total insured value on an individual company's books is compared to total industry-wide exposure in the IED to calculate a company's market share; this market share can then be used to prorate an industry loss to calculate the company's share of that loss.

AIR

This approach, when used in conjunction with detailed analysis at the location and policy level, can provide insight into the accuracy of results from such analyses. Performing catastrophe risk analyses at the location level enables insurers to take full advantage of site-specific information, such as structural details and high-resolution geological information.

However, the catastrophe loss estimates generated by detailed catastrophe modeling are only as good as the quality of the exposure data entered. If your market share is 1%, for example, you should expect something on the order of 1% of industry losses. If the results of your detailed analysis indicate significantly lower (or, more unusually, higher) losses, this would suggest the need for further scrutiny of your company's catastrophe exposure data. After Katrina, the market share analyses based on the IED proved more dependable than analyses run at the detailed level. The reasons included poor geocoding of risks, inaccurate replacement costs, and lack of information about occupancy and building characteristics, such as construction type and height.

The IED can also be used by companies as a means of benchmarking their exposure to catastrophe risk. That is, even when a company's exposures legitimately diverges from industry average exposures, the comparison can still provide a meaningful starting point from which to assess the risk to their portfolio relative to the industry and the quality of their data. For example, the client may only write high-value locations, which can be determined by comparing with the IED averages. In the opposite case, the client may be undervaluing their risks and exposing themselves to greater losses than their exposure assumptions would reveal.

The IED can also be used to validate the building characteristics in a company's portfolio—characteristics such as construction type and height, both of which play an important role in determining the vulnerability of an individual portfolio.

COMPILING AND UPDATING THE INDUSTRY EXPOSURE DATABASE

In light of the critical role that the IED plays in catastrophe modeling, its development is the focus of considerable resources at AIR. For the team charged with compiling and updating the IEDs for all modeled countries, it is both a challenging and exacting job.

A bottom-up approach is used. To begin the process, detailed data on risk counts, building characteristics and construction costs are obtained from a host of data sources. Depending on the country of interest, the information contained in these sources may be provided in a variety of languages, so additional steps may need to be taken to translate the data before it can even be used. The resolution and vintage of the data can also vary by source. As a result, the task of compiling and analyzing these diverse data sets can be extremely time-consuming. The preparation of an IED requires skill and experience working with demographic data, along with a basic understanding of cost engineering and economics.

Each country presents its own challenges and it can be particularly difficult to create IEDs for developing countries. Limited access to data or poor data quality have been problems in such regions as South America and parts of the Caribbean. Lack of current data can also be an issue. The commercial census data in some countries in Central America, for example, is more than 10 years old. In such cases, index factors are created and used to project the data forward. Information pertaining to current estimates of population, housing counts or other demographic variables obtained from other sources is used in the development of these factors.

Work on the IED does not stop after its initial compilation. Once the IED is developed, it must be continually updated to accurately reflect current values. For example, minor growth in replacement values in the U.S. can result in an increase of a few trillion dollars in total value. Updates are also particularly important in developing countries with rapidly expanding economies, where the annual change can be quite significant.

The replacement values contained in the IED are developed using a rebuild cost approach in which risk counts (number of properties), building characteristics and costs act as the main drivers. Due to the dynamic nature of these elements, new information on each must be gathered for each update. An increase in total industry insured value of residential properties, for example, is unlikely to reflect an increase in risk counts alone; rather, adjustments in housing sizes and updated costs would likely also be contributing factors.

Validation of the replacement values contained in the IED is quite important. In contrast to the bottom-up approach that is used to develop the IED, a top-down approach is utilized for validation. Once the replacement values in the IED are derived, they are validated against client data and information on fixed assets and other economic variables.

AIR'S U.S. INDUSTRY EXPOSURE DATABASE

AIR first began compiling data for the IED in the U.S. in 1987 and has been updating it annually since. Residential and commercial risk counts are obtained each year from a private data provider. The current estimates of residential risk counts are based on census data, which is the primary source of residential risk information. For commercial risks, actual counts of commercial establishments are provided each year. Cost indices are used to update replacement costs.

The IED for the U.S. is developed at a very high geographic resolution—down to individual building locations for commercial exposures and census block for residential exposures. A high level of detail and spatial accuracy in the data is particularly critical in modeling perils such as wildfire, tornado, hail, terrorism and flood, which tend to have smaller footprints and cause more localized damage.

The image below shows the perimeter of the 2003 Cedar wildfire in California in red. The green points within the boundary represent exposure locations. As the image illustrates, the exposure locations within the fire perimeter are not uniformly distributed. Instead, they appear in clusters. Based on this image, it is clear that high resolution exposure data is necessary to accurately model losses from this type of event.

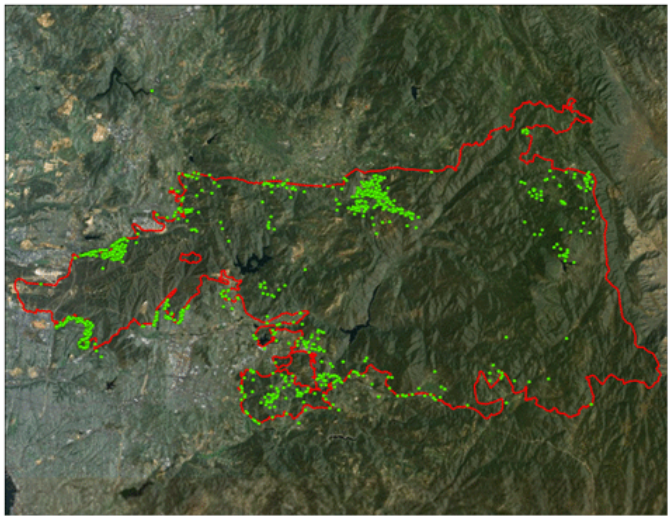

Figure 1. Locations of individual properties within the foot print of the 2003 Cedar (CA) wildfire

For perils such as earthquake and wind, where the event footprints are much larger, the data contained in the U.S. IED is aggregated to ZIP Code level resolution for use in modeling. This lower resolution is acceptable because the change in intensity with distance is more gradual. Also a major factor to bear in mind is that while all models can be run with geocoded exposures data, the cost in terms of model run time is probably not worth what will ultimately be only minor differences in calculated loss amounts.

RECENT CHANGES IN U.S. REPLACEMENT VALUES

In the U.S., the change in residential risk counts in the last 5 to 10 years has been in the range of a few percent a year. A review of replacement values for residential risks during the same period shows a greater increase—recently in the range of 8% to 10% per year—suggesting that the change in risk counts accounts for only a small portion of the total change in residential replacement values. The additional increase in value can be partially attributed to increases in construction costs, which have continued to show signs of growth in recent years.

Another source of the increase in residential replacement value is the expanding size of new houses in the U.S., which cost more to build. According to the U.S. Census

Bureau, the average size of a new single-family house has increased from 1,500 sq. ft. in 1970 to 2,434 sq. ft. in 2005. Replacement costs for new homes have increased over time as a result of both the sheer change in size of the houses and for updated features, fixtures and fittings not found in older homes. As a result, communities that have experienced large housing booms in recent years have also shown quite large annual increases in total residential replacement values. In Southeastern Florida, for example, the increase in replacement values has been in the range of 10% to more than 20% per year.

Another example is the state of Nevada. In the last ten years alone, the total replacement value of all single-family homes in the state has increased by more than 100% (see figure below)—and has consistently outpaced the national growth rate. The increase is attributed to the rise in single-family home counts needed to accommodate the large influx of people into Nevada, which has become a popular choice for retirees and those seeking better economic opportunities or changes in climate.

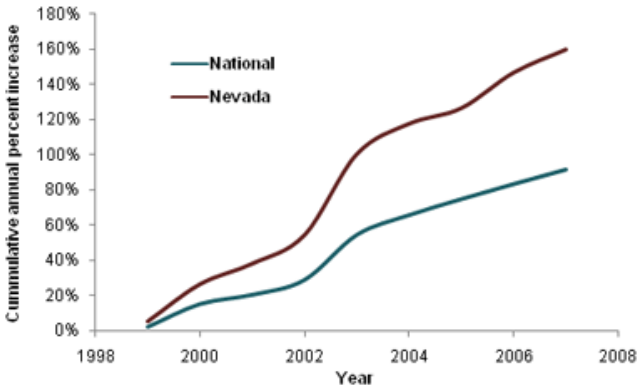

Figure 2. IED Single-Family Home Yearly Increase

For commercial properties, the growth in both commercial risk counts and replacement values nationwide has been much lower, at basically 5% or less per year over the last 5 to 10 years. There has, however, been more variability in the levels of change at finer geographic resolutions during that period. Yearly fluctuations that occur in risk counts due to business closures and new company startups have large impacts on total value. Areas that exhibit a sharp decline in risks and values one year may rebound and show increases over the next few years. This type of pattern of change has been observed in places like Silicon Valley, California, where values can decrease by more than 10% in an area one year and increase by 20% the next.

LEVERAGING THE ISO CONNECTION

The information contained in AIR's U.S. industry exposure database is quite robust. The values in the IED are generated from high resolution input data, obtained from data vendors, tax assessor data, census data and a host of other reliable sources. Cost estimating tools such as ISO's 360Value™ are used in the derivation of building replacement values. Data obtained from ISO databases is also used in the development of content and time-element splits, as well as policy conditions. The annual updates to the IED ensure that the values contained in the database accurately reflect current replacement values.

The ability to leverage ISO data to augment the information in the IED is unique to AIR and adds significant value. The ISO data for commercial lines covers a very large proportion of the insured U.S. market and allows for accurate estimation of coverage percentages and other related variables that other modeling companies cannot match. The inclusion of ISO data is a major reason why the AIR IED estimates are more accurate than other modeling companies purporting to offer estimates of insured values.

CONCLUSION

The value of industry exposure databases to the modeling process cannot be overemphasized—from evaluating the accuracy of industry loss estimates to a multitude of additional applications. Thus, investment in data sets and the experts skilled at constructing IEDs for all regions is a critically important attribute of any catastrophe modeling company and of primary importance at AIR.

ABOUT AIR WORLDWIDE CORPORATION

AIR Worldwide Corporation (AIR) is the scientific leader and most respected provider of risk modeling software and consulting services. AIR founded the catastrophe modeling industry in 1987 and today models the risk from natural catastrophes and terrorism in more than 50 countries. More than 400 insurance, reinsurance, financial, corporate and government clients rely on AIR software and services for catastrophe risk management, insurance-linked securities, site-specific seismic engineering analysis, and property replacement cost valuation. AIR is a member of the ISO family of companies and is headquartered in Boston with additional offices in North America, Europe and Asia. For more information, please visit www. air-worldwide.com.