Vantage Risk

On Losses

Introduction

The insurance industry, and society at large, is concerned with the frequency and severity of catastrophic events. Severity is often measured in terms of financial loss but what do we mean when we talk about losses and how are the different types of losses related? This paper seeks to serve as a primer on this topic. It should be noted from the outset that this paper will just concentrate on natural catastrophe losses.

Definitions

- *Economic* loss – this can be defined in many ways and is generally taken to mean the total value of monetary loss to society from a given catastrophic event. For this paper, we will use the definition from Smith & Katz (2013)[1]: (t)hese loss estimates reflect direct effects of weather and climate events (i.e., not including indirect effects) and constitute total losses (i.e., both insured and uninsured). The insured and uninsured direct losses include: physical damage to residential, commercial and government/municipal buildings, material assets within a building, time element losses (i.e., time-cost for businesses and hotel-costs for loss of living quarters), vehicles, public and private infrastructure, and agricultural assets (e.g., buildings, machinery, livestock). Our disaster loss assessments do not take into account losses to natural capital/assets, healthcare related losses, or values associated with loss of life.
- *Insured* loss – this is easier to define since it is simply the total insurance claims paid by the industry for a given catastrophic event. Generally, this is taken to include losses just paid by insurers but can, in some very rare cases, include losses paid by reinsurers (for example, reinsurance on captives) and ILS structures (if they are taking original risk).
- *Insurable* loss – we are not going to use this in our analysis (below) but the insurable loss is the maximum possible insured loss. That is, if the take up rate for insurance was 100% then the insurable loss would be the insured loss. However, not everyone can or does purchase insurance which leads to a protection gap.
- *Modeled* loss – this is the insured loss estimated from a catastrophe model (either pre- or post-event). We note that catastrophe models are not designed to provide a loss estimate for a given real event. Some models do provide these estimates but that is not their primary purpose. However, it is a common industry activity to use modeled estimates of insured loss.

We have some simple a priori expectations for these different types of loss:

- Economic loss should be bigger than insured loss;
- Insured losses should be correlated with economic loss (i.e. bigger economic losses lead to bigger insured losses)
- Modeled insured losses should be relatively close to realized insured loss; and,
- Modeled insured losses should be highly correlated with realized insured loss.

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[1] Smith, A.B., Katz, R.W. US billion-dollar weather and climate disasters: data sources, trends, accuracy and biases. Nat Hazards 67, 387–410 (2013). https://doi.org/10.1007/s11069-013-0566-5

Economic and Insured Losses

Two questions we might like to know the answers to:
1. How much of an economic loss is insured?
2. How does that proportion change by peril?

Our analysis uses data from two sources:
- NOAA's Billion Dollar Disaster Event data[2]. This tallies economic loss from atmospheric related perils from 1980 to present. By definition this analysis will only look at atmospheric-related perils – flooding, freeze, severe storm (i.e. tornado, hail, and straight line winds), tropical cyclone, wildfire, and winter storm – with larger losses (i.e. over $1b in total) for the US only. The data also contains drought losses, which are significant, but as these are generally a non-insured peril[3] they have been excluded.
- Verisk's PCS data[4]. PCS provides industrywide insured loss estimates and estimated claim counts for the United States (including the U.S. Virgin Islands and Puerto Rico), Canada, Turkey, and Mexico[5]. Reporting is based on information provided by the insurers affected by an event. PCS includes flood losses in its catastrophe estimates when those losses fall under traditional insurance programs, such as auto comprehensive or commercial. However, it does not include flood losses in its core estimates that the National Flood Insurance Program (NFIP) covers or losses that fall under the NFIP's Write Your Own (WYO) Program. PCS estimates include covered losses from personal property, vehicle, and commercial property policies. Those policies cover real property, contents, time-element losses (e.g., business interruption and additional living expenses), vehicles, boats, and property under certain inland marine and specialty policies. PCS also typically include losses insured by state wind pools, joint underwriting associations, and certain other residual market mechanisms.

In our analysis, we matched the NOAA data to PCS events. In most cases, a direct match was possible but, for a few cases, a NOAA event (such as a wildfire season) required aggregating over multiple PCS events. Further, for both NOAA and PCS we used unadjusted/uninflated estimates so as to better assure an apples-to-apples comparison.

The first thing to ensure is that economic and insured losses are well correlated, and indeed they are. The linear correlation between the two is **91%.**

[2] NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2022). https://www.ncdc.noaa.gov/billions/, DOI: 10.25921/stkw-7w73
[3] MPCI does cover drought losses to some extent but these difficult to unpack from other MPCI losses.
[4] https://www.verisk.com/insurance/products/property-claim-services/overview/
[5] Of note, PCS also provide reporting on Japan/Asia-Pacific and Latin America (ex-Mexico) using a streamlined methodology which differs from that used for the regions mentioned in the main text.

Looking at the proportion of insured to economic loss over all perils, we see that, on average, insured losses make up **57%** of economic losses. This is line with other work. AIR, in their 2021 Global Modeled Losses Report[6] , estimated that the insured losses account for 51% of economic losses in North America. Globally, the proportion of economic loss covered by insurance is less than this – several studies from Swiss Re, Munich Re, and Aon, have shown a global proportion in the range 30-40%.

When we break the insured proportion numbers down by peril, we see wide variation, however. Table 1 shows the average proportion of insured to economic loss for a variety of US perils. We see that a relatively large proportion of economic loss from severe storms (72%) is insured where as tropical cyclone, wildfire, and winter storm all languish in the 30-50% range.

Peril	Insured Proportion of Economic Loss
Flooding	28%
Freeze (*very few events)	19%
Severe Convective Storm	72%
Tropical Cyclone	38%
Wildfire	45%
Winter Storm	53%
All Perils	57%

Table 1: Average Insured Proportion of Economic Loss

Figure 1 shows the individual event level proportion of insured to economic loss. Several points are noted:

- The density of events increases over time. This is a function of the, now well known, fact that billion dollar events in the US are increasing in frequency.
- The majority of events are Severe Convective Storm and, for an individual event, the proportion can reach almost 90% insured. This probably represents the upper bound of possible insurance proportion, insured losses are approaching insurable losses. Quite why Severe Storm should be so well insured is up for debate. We postulate that part of the reason is Severe Storm events are generally geographically small so larger systemic effects, such as damage to infrastructure, are minimized.
- Not shown but all of the perils (apart from the data-sparse Freeze) show an increasing trend, so losses are becoming more insured over time, implying a modest narrowing of the insurance gap, at least in the US.
- Tropical Cyclone losses hover in the 30-50% range. Why this is relatively low is probably the inverse case of Severe Storm; Tropical Cyclones cover a very large area introducing the probability of systemic effects, such as widespread and long-lived infrastructure damage. Further, much of the infrastructure damaged is government-owned (Federal, state, or local), which is seldom, if ever, insured. Finally, storm surge (which can form a significant component of tropical cyclone losses) is significantly under-insured.
- Flood events are generally poorly insured. Further, in their main reporting, PCS do not include NFIP or NFIP WYO policies. PCS does report NFIP incurreds in a separate product.

[6] https://www.air-worldwide.com/siteassets/Publications/White-Papers/documents/2021_air_global_modeled_losses.pdf

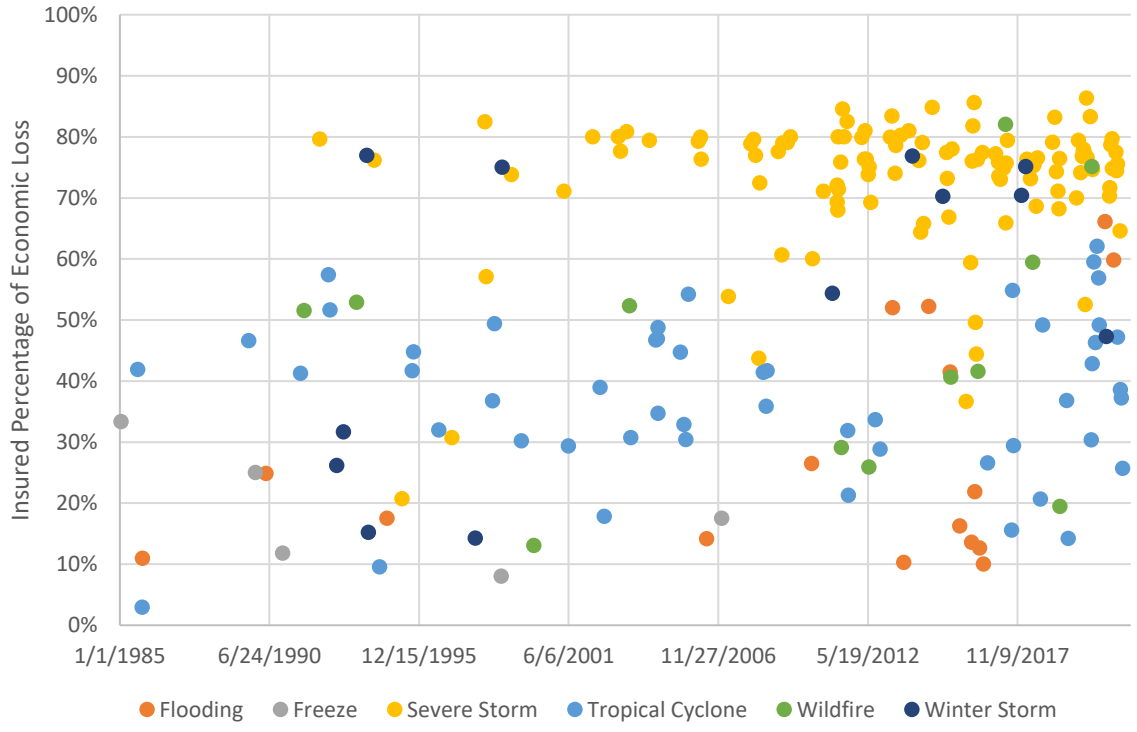

Figure 1: Insurance Proportion of Economic Loss per Event

Insured and Modeled Losses

The essential question when looking at modeled loss estimates is how well they compare with the actual observed insured loss from an event. To examine this, we used the PCS data (per above) as the industry loss and for modeled estimates used the modeled losses announced by the various modeling companies just after an event occurred, based on press releases and/or industry press reports. Then, for each event we created a consensus modeled estimate – generally an average of the different model estimates for an event, taking the approximate midpoint of a range if a company produced range of estimates. This left us with 20-30 events for comparison, given that initial model estimates prior to 2008 are hard to find and don't represent the current state of modeling well.

We are not trying to evaluate which, if any, model company's estimates are 'better', merely trying to answer whether the models *in general* compare well to insured loss. Also, we could have used the modeled losses that the companies have in their software platforms as of writing this report – it would certainly have massively increased the number of events we could compare with – but these events when incorporated in the models several years post-event are optimized to represent the event better with the benefit of hindsight and knowing what industry loss occurred. We felt a fairer comparison was to look at the modeled estimate concurrent with the loss happening.

It should be noted that the vast majority of losses used here are tropical cyclone events; only 2 non-tropical cyclone events made it into the study (both wildfire events). There are, of course, large winter storm and severe convective event losses but modelers generally do not report estimates on these (or reported estimates are hard to find).

Looking over all events in the study, we found that modeled losses are indeed well correlated with insured loss, with a linear correlation of 96%. We found that there are two distinct populations in the data – small events (where the insured loss was less than $1B) and large events (where the insured loss was greater than $1B – which have different characteristics. Figure 2 shows the individual consensus model estimates against insured loss. We see that:

- Small events are generally very much overestimated by the models. The average ratio is 143%, i.e. the models on average over-estimate the insured loss by 143%.
- Large events, as a whole, are quite well estimated by the models. There is obviously some variation, ranging from 60% to 200%, but the average ratio is 105%.

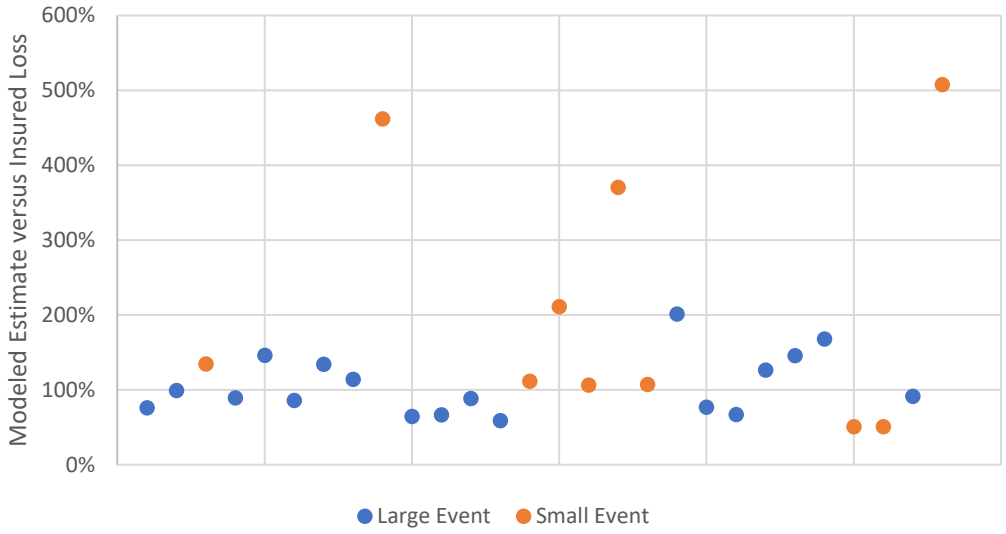

Figure 2: Consensus modeled loss estimates versus insured loss

The results shown above are surprisingly good, at least for large losses. A conclusion we can draw from this is that, when using modeled loss estimates, a useful practice is to use the consensus loss from multiple sources, rather than focus on any one company estimate.

Summary

This paper serves as a primer on economic, insured, and modeled insured losses. We found that our a priori expectations were met:

- Insured losses are well correlated with, and smaller than, economic losses;
- Modeled insured losses are well correlated with, generally on par with, insured losses.

Further we found that, for the US perils examined, the insured loss is roughly half of the economic loss (in line with other work), with significant variations by peril. We note that the US is likely the best developed and most penetrated insurance market so the proportion of insured to economic loss ex-US is lower than for the US.

Modeled losses, at least on a consensus basis for larger events (greater than $1B), appear to match realized insured losses surprisingly well.

About the Author

Dr. Steve Smith is the Head of Research & Development at Vantage Risk.

Steve has spent over 20 years in re/insurance in analytic roles. He is a Fellow of the Royal Meteorological Society, a Certified Catastrophe Risk Management Professional, a Chartered Physicist, and holds a doctorate in atmospheric physics and a first class honours degree in physics, both from the University of Oxford. He was the 2007 recipient of The Review Worldwide Reinsurance Future Industry Leader award and a 2008 recipient of a Risk & Insurance Risk Innovator award