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Navigating the challenges of aggregate pricing

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Introduction

Aggregate reinsurance structures have always posed a pricing challenge. Burn costs are too backward-looking in a rapidly changing environment, while in our view, catastrophe (cat) modelling output can paint an unrealistically optimistic picture - particularly for tail frequency coverage in regions driven by secondary perils. An aggregate treaty that looks moderately priced in one view, can quickly deteriorate in another.

In this article, we explore some methods we have used to address the challenges of aggregate pricing, leading us to four guiding pillars:

1. **Model augmentation:** supplement cat models with stochastic, peril-aware frequency and severity analysis. Use distributions that reflect the true volatility and test alternative severity shapes to capture tail behaviour under aggregate terms.
2. **Forward-looking burn:** treat historical burn cost as an anchor, not a destination. Trend for exposure and inflation, but also allow for additional shifts in hazard and vulnerability. Recent Property Claims Services (PCS) experience (GDP-trended) shows the case for an additional trend beyond exposure and inflation.
3. **Parameter uncertainty:** quantify parameter risk explicitly. Small shifts in frequency or severity can produce disproportionate changes in burn due to the non-linear nature of aggregates.
4. **Treaty structure:** avoid structures that exacerbate uncertainty (e.g., franchise deductibles); set occurrence deductibles to avoid cession of normal attrition; set aggregate deductibles against realistic experience levels; and ensure net recovery requires multiple events to avoid occurrence exposure.

When applied together, these practices could help support a sustainable aggregate market.

Understanding the limitations of cat models

Catastrophe models are well-suited to single-event occurrence covers. However, the results of aggregate treaties are typically driven by the accumulation of multiple mid-sized events across a range of perils; conditions under which we find models can struggle.

Event sets may not include a sufficiently rich spectrum of realistic scenarios for every cedant, particularly for regionally focused carriers. In practice, we have seen modelled burn for aggregate treaties come in far below historical burn. In one instance, the treaty wasn't simulated to pay out in any of 10,000 modelled years, yet it had incurred a loss within the last decade.

Burn cost – a starting point, not the destination

Standard burn cost analyses provide a familiar anchor, but relying on them alone can underestimate the true ceded risk.

A typical burn analysis trends historical losses for exposure and inflation, but today's climate environment is evolving rapidly, so pure exposure and inflation trending is insufficient.

Analysing PCS losses from 2008-2024, we see a significant upward trend in both frequency and severity, even after trending the losses by state GDP to proxy inflation and exposure growth.
If we take trended industry losses greater than $500m, capped at $5bn, to be a good sample for losses that Aggregate Excess of Loss (XoL) structures pick up: the 10-year rolling average of total losses has increased nearly 50% from the 2008-2017 period to 2015-2024 (see figure 1).

Implication: we must apply additional trend beyond inflation to reflect today's climate environment.

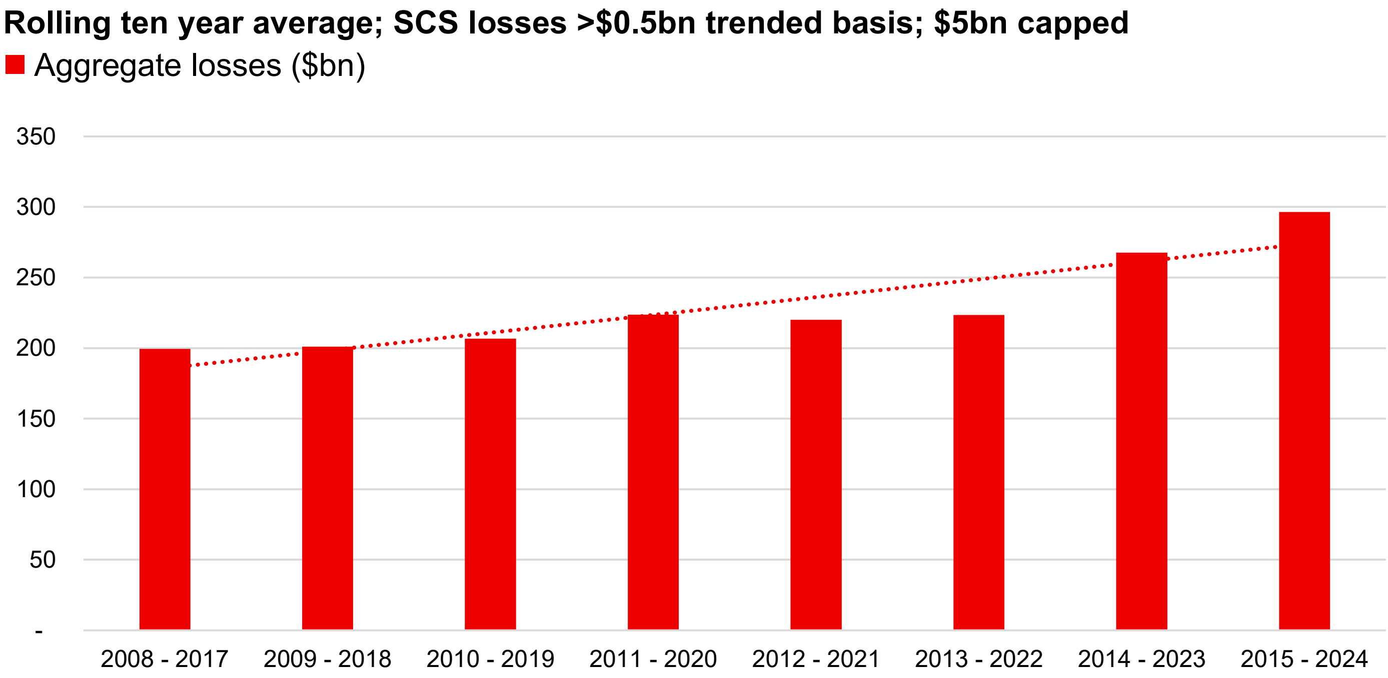

Figure 1: PCS loss trends (2008-2024, GDP-trended)

Incorporating stochastic approaches

Separating frequency and severity in a stochastic framework helps (i) reflect observed trends, and (ii) include tail events, not seen in the burn analysis, at appropriate return periods. When supplementing burn analyses with a stochastic view, the distribution choice matters:

— **Frequency**: negative binomial often better captures volatility than Poisson, particularly important for remote frequency covers.

— **Severity**: pareto tends to be a good default, particularly if the occurrence limit is high, but interplay between occurrence and aggregate terms can complicate outcomes. If the contributing occurrence layer sits below a Cat XoL tower, we typically see Weibull or Lognormal more effectively representing the loss distribution.

To better understand the difference a selection could make, consider two frequency models, Poisson and Negative Binomial, calibrated to the same mean. At the mean, both models produce similar expected losses. However, aggregates are most sensitive to tail outcomes, not the mean.

Let's take a hypothetical 10-year trended history, with an average of just over three losses per year, and fit both distributions to it. For this sample, with the Poisson distribution, the probability of five or more claims is around 11%; but under Negative Binomial, it is 30% higher at 14%. Looking slightly further into the tail for six or more claims (about a 1-in-15 event), the Negative Binomial has a 60% higher probability of this occurring than the Poisson. These differences matter because aggregate treaties are designed to respond to clusters of events. If the frequency distribution underestimates tail clustering, the pricing view will materially understate risk.

Drivers of Cat returns

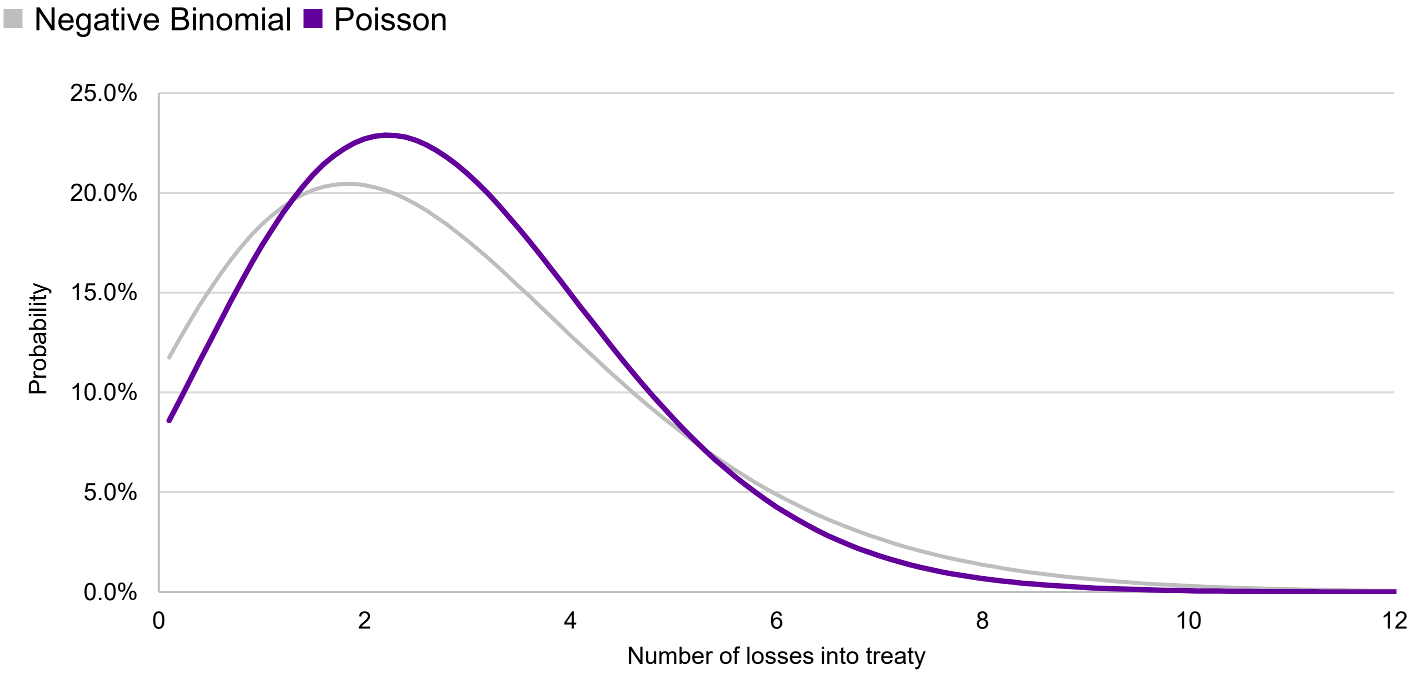

Figure 2: example probability distribution functions for both Poisson and Negative Binomial distributions with the same mean parameter

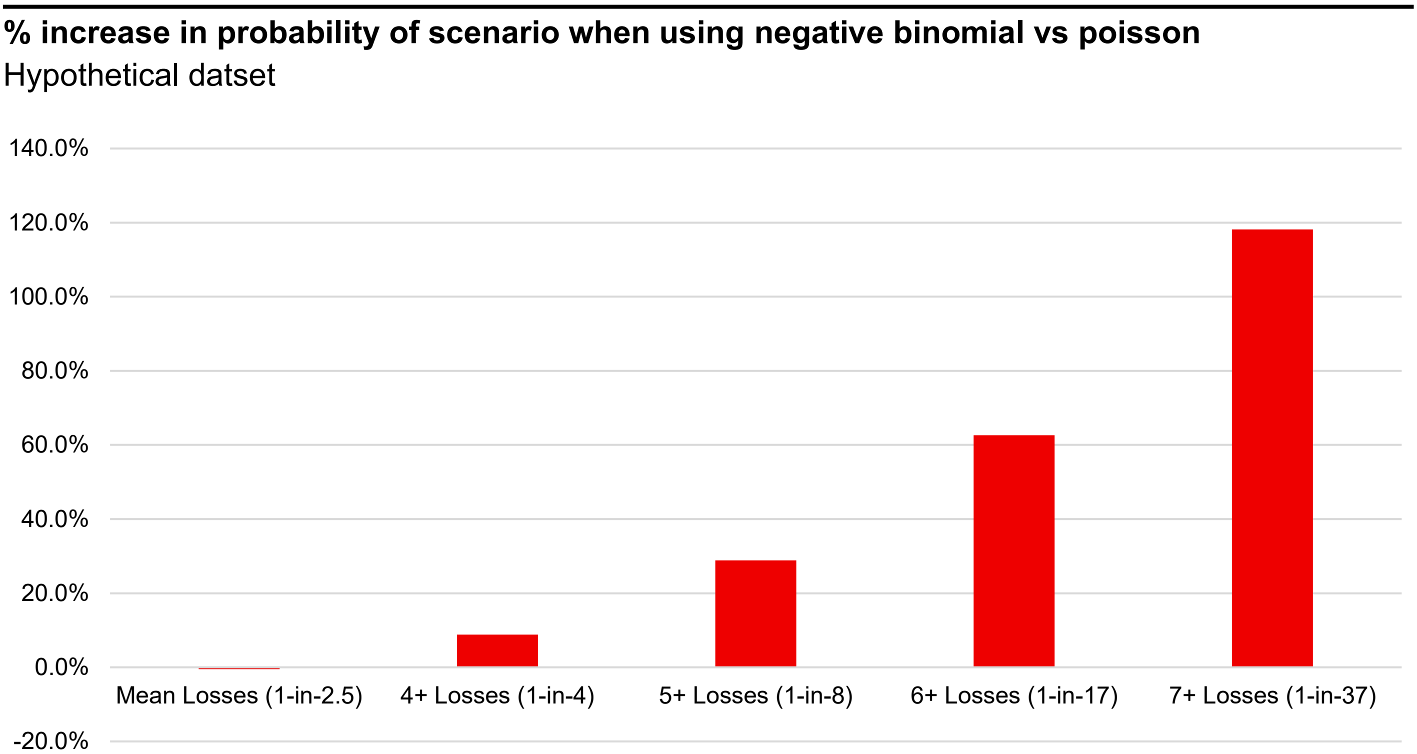

Figure 3: a scenario likelihood comparison, when assuming negative binomial vs poisson

Understanding parameter uncertainty

Aggregate structures can appear profitable under standard assumptions, yet small deviations can cause rapid deterioration because the aggregate recovery is non-linear. Historical data in submissions are finite and may be unrepresentative (unusually heavy or light periods), which can bias fit parameters.

Consider a hypothetical treaty of ***$200m xs $200m occurrence*** with **a *$200m xs $400m aggregate*** structure. The result of a standard Poisson–Pareto calibration might yield a burn-on-line of 8%. As a proxy for parameter uncertainty, we can vary the frequency and severity parameters by +10% and +20% (roughly equivalent to the 75th and 90th percentile of possible parameters). For this example treaty, a ***+10% frequency*** *results in* ***+35% burn*** - a disproportionate impact relative to the parameter change.

Sensitivity of frequency and severity assumptions on burn cost

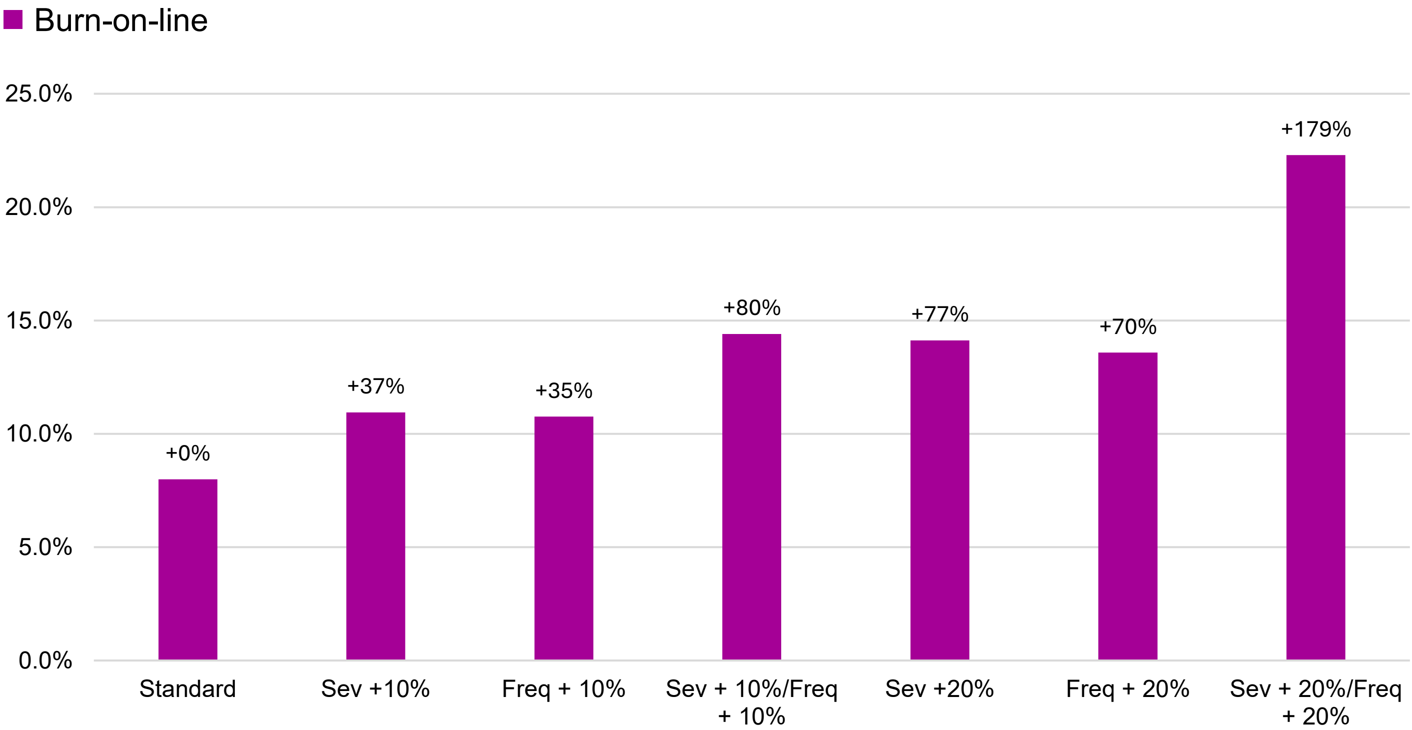

Figure 4: sensitivity of frequency and severity assumptions on burn cost

Allowing for parameter uncertainty

A common counterargument is that downside and upside parameter shifts balance out. For aggregate treaties, they generally do not. Because of the non-linear recovery structure, pessimistic parameter shifts typically worsen burn more than optimistic shifts improve it.

The table below shows the asymmetrical impact of parameter shifts, for the same hypothetical treaty pricing example as above. Rows vary frequency parameters (standard, ±10%, ±20%); columns vary severity parameters. Each cell reports the average burn uplift from pairing optimistic and pessimistic shifts. For instance, with ±10% changes in both parameters, the +10% case lifts burn by 80% (see figure 4) while the -10% case cuts it by 50%, the average of the two results in a 15% increase compared to the original burn (central cell in figure 5 table).

Total increase in AAL to the layer averaging symmetrical parameter shifts

		Severity parameter		
		Standard	±10%	±20%
Frequency parameter	Standard	**0%**	**5%**	**15%**
	±10%	**3%**	**15%**	**30%**
	±20%	**10%**	**30%**	**50%**

Figure 5: showing the total increase in AAL to the layer averaging symmetrical parameter shifts

Pricing takeaway: include an explicit ***parameter risk load*** (or simulate from a distribution of parameters) rather than relying on a single point fit.

Structure takeaway: the factors you see above will vary significantly by treaty structure (as well as underlying loss data and distribution selection). Not only should we appropriately factor this into our pricing, but we need to be designing treaty structures that don't exacerbate this effect by creating cliff-edge scenarios and solely place the burden of this risk on the reinsurer.

Designing sustainable aggregate structures

Not all aggregates are created equal. Sustainable structures tend to share these traits.

— **Use hard deductibles, avoid franchise.** This mitigates cliff-edge behaviour and tempers sensitivity to a frequency miss.

— **Set deductibles at robust levels.** Calibrate to ~2-3 years of attritional losses or 3-5 mid-sized events, aligned to the cedant's risk mix.

— **Isolate from critical-catastrophe occurrence**. Avoid tail occurrence exposure via limits that can be pierced by a single major event.

— **Require multiple events for recovery.** Ensure the cover addresses volatility rather than routine attrition.

Checklist for pricing aggregates

✓ **Challenge baseline catastrophe models:** supplement with tailored frequency/severity analysis by peril and region.

✓ **Don't rely on burn cost:** adjust with forward-looking scenarios and explicit trend beyond inflation.

✓ **Load for unused capacity and tail risk** via stochastic simulation and stress to relevant return periods.

✓ **Quantify parameter uncertainty:** (±10-20% or more sophisticated Bayesian/posterior sampling) and reflect asymmetry in loadings.

✓ **Adjust for deductible and limit structure:** price embedded options and non-linearities explicitly.

✓ **Document** assumptions, parameter choices, and rationale to support consistency and challenge.

Closing thoughts

Aggregate pricing is complex but not insurmountable. By recognising the limitations of traditional tools and utilising the pillars explored within this article, we can build structures that are robust, fair, and sustainable.

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