



GEORGE CAUGHEY
Associate
Insurance-Linked Strategies

CALLUM O'ROURKE
Vice President
Insurance-Linked Strategies

A Validation Study of Catastrophe Bond Losses Over Time

We explore the relative historical performance of catastrophe bonds in relation to various trigger types.

Our publication "[Context Is Key: Deconstructing Expected Loss](#)" explored the nuances inherent to catastrophe (cat) bond-modeled risk metrics and detailed the significant influence that trigger type can have in shaping them. Building on that foundation, this insight examines the relative historical performance of the various trigger types. We divide the analysis into two sections:

- **Realized losses** of the cat bond market across 2002 – 2025 versus the long-term modeled expected loss (EL), with a secondary focus on peril region exposure type
- **Mark-to-market** performance following significant cat events

Realized Losses

It is important to first note that caution should be exercised when drawing conclusions on observed catastrophes, which are inherently low-probability and high-severity. EL represents a probabilistic, modeled long-term annual average loss calculated by simulating thousands of years of catastrophe activity, whereas well-documented realized loss records for the cat bond market are restricted to a 24-year period. In other words, assuming models are perfect, only with a sufficiently long history of realized losses would one expect to see convergence with the EL, with the majority of no-loss years punctuated by single years that deviate substantially from the EL. Additionally, varying sample sizes across trigger and peril region type, as well as the non-stationarity of market size over time, add further complexity; despite these shortcomings, meaningful observations can still be drawn.

Intrayear issuances and multiyear risk periods make it challenging to capture a representative point-in-time estimate for the cat bond limit deployed in a given year. Therefore, for this analysis, realized losses are evaluated against the summation of “annual” cat bond deployed limit values¹ to derive a realized loss ratio for a given time period, defined in the formulas below. This methodology smooths timing-related effects and facilitates direct comparison to EL, expressed as an annual metric for various cat bond market segments by using a notional weighted average of all relevant cat bond ELs issued over the entire history of the market, as specified in the deal documentation.

Cat Bond Deployed Limit¹ for Year Y

$$\text{Cat Bond Deployed Limit} = \frac{\sum_{w=1}^{N_y} \text{Total Cat Bond Notional Outstanding}_{y,w}}{N_y}$$

Where:

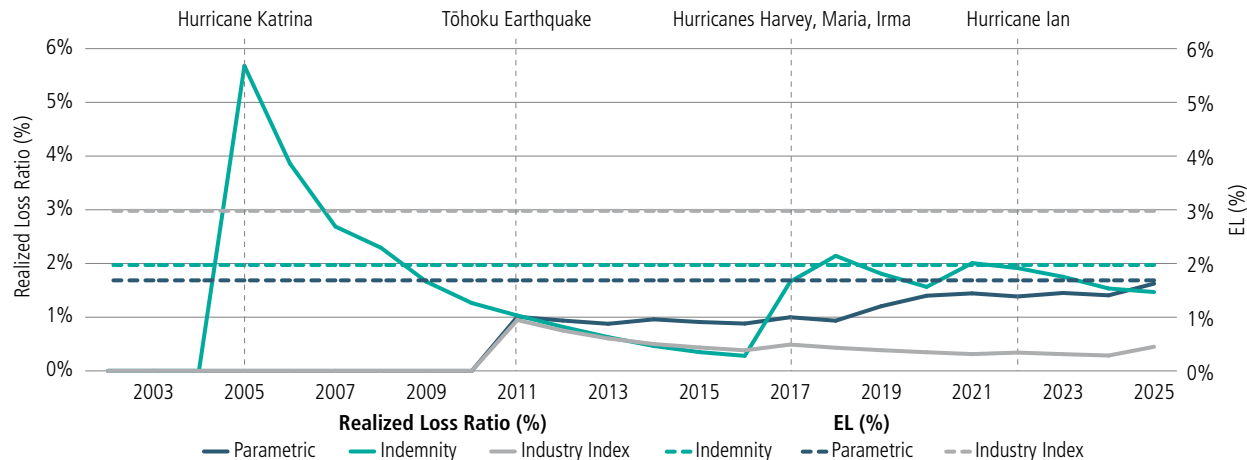
Total Cat Bond Notional Outstanding_{y,w} = Total Cat Bond Notional Outstanding in week w of year Y

N_y = number of weeks observed in year Y

Realized Loss Ratio over Period X

$$\text{Realized Loss Ratio}_x = \frac{\sum_{Y \in X} \text{Realized Loss}_Y}{\sum_{Y \in X} \text{Cat Bond Deployed Limit}_Y}$$

FIGURE 1: REALIZED LOSS RATIO VERSUS EL BY TRIGGER TYPE



Source: Artemis.bm, Lane Financial. NB ILS analysis as of December 31, 2025. Includes coupon-paying, non-life 144a catastrophe bonds.

¹ Includes coupon-paying, non-life 144a catastrophe bonds.

TABLE A: PERIL REGION BREAKDOWN, 2002 – 2025 (%)

Trigger Type	Realized Loss Ratio (%)			EL (%)			Difference		
	Peak	Other	Combined	Peak	Other	Combined	Peak	Other	Combined
Indemnity	1.1%	1.6%	1.5%	2.0%	2.0%	2.0%	-0.9%	-0.4%	-0.5%
Industry Index	0.1%	1.0%	0.5%	2.9%	3.1%	3.0%	-2.8%	-2.1%	-2.5%
Parametric	0.3%	2.3%	1.6%	1.5%	1.8%	1.7%	-1.2%	0.5%	-0.1%

Source: Artemis.bm, Lane Financial. NB ILS analysis as of December 31, 2025. Includes coupon-paying, non-life 144a catastrophe bonds.

Over the full period examined, Figure 1 shows that industry index bonds have experienced significantly lower realized losses than what their respective modeled EL would imply. Several features of industry index transactions, like those discussed in the prior insight [“Context Is Key: Deconstructing Expected Loss”](#), including cedant agnosticism, independent third-party loss reporting and larger relative exposure to better-understood “peak”² peril regions, could explain why industry index transactions have outperformed indemnity deals when comparing realized losses to EL thus far. Moreover, Table A highlights the robust performance of peak peril exposure versus “other” peril regions, and in the case of industry index transactions with peak peril region exposure, the realized loss ratio is only 0.1%, 2.8% lower than the respective EL.

Conversely, intrinsic indemnity transaction risks such as idiosyncratic factors could be what is driving a generally higher realized loss ratio, with hurricanes Harvey, Irma, Maria and Michael driving losses in 2017 and 2018. Nevertheless, when viewed across the full period, the loss ratio has remained below the EL, but substantial annual volatility persists across shorter periods.

Although not covered in [“Context Is Key: Deconstructing Expected Loss”](#), transactions with parametric³ triggers make up approximately 3% of the cat bond market, and they differ from other trigger mechanisms because payout is not based on an insured loss amount, but on a predefined threshold of a specific chosen physical or natural parameter, such as the wind speed of a hurricane in a defined place. Parametric transactions can add value to portfolios through their fast and transparent payout mechanism, along with exposure to diversifying structures and peril regions, but often come with their own modeling complexities, which need rigorous assessment. Figure 1 shows that parametric transactions have experienced the largest realized loss ratio over the full period, and Table A shows that, like industry index triggers, this is largely driven by bonds with “other” peril region exposure. This underlines the importance of evaluating parametric transactions individually, with particular focus on whether anomalous “other” peril region exposure risk is being adequately captured by catastrophe models.

Although catastrophe models suggest that future events could ultimately bring the industry index realized loss ratio closer to the EL, the buffer observed over the past 24 years relative to indemnity is noteworthy and supports our general preference for industry index risk.

Mark-to-Market Performance

While industry index transactions have outperformed other trigger types with respect to realized losses, how does their mark-to-market performance compare after significant cat events?

Figure 2 presents the weighted⁴ average Swiss Re bid price for industry index and indemnity transactions for the two-year periods following Hurricanes Irma (2017) and Ian (2022). Industry index prices returned to par⁵ at a notably faster rate than indemnity following Hurricane Ian. Also, despite a more significant one-week downturn immediately following Irma, industry index prices recovered to par within 217 days post-event, whereas indemnity prices remained below par even two years later.

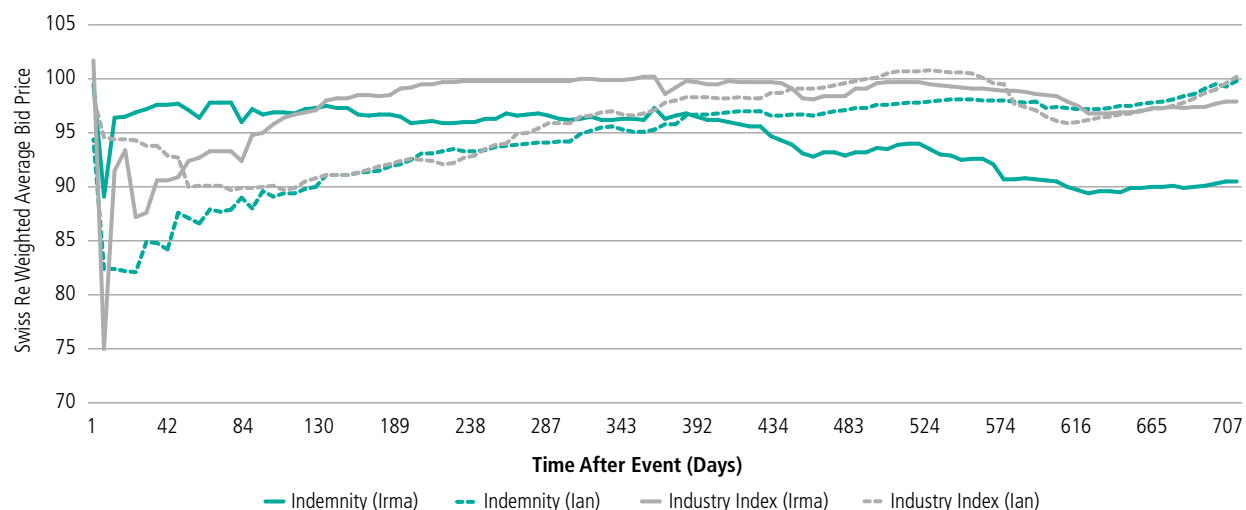
² “Peak” peril regions comprise the U.S. and U.S. territories and possessions, and Canada hurricane and earthquake.

³ “Parametric” includes issuances with single Parametric triggers, single Modeled Loss triggers or combined Parametric and Modeled Loss triggers.

⁴ Weighted by Notional Outstanding as per Swiss Re ILS Weekly Pricing Sheets.

⁵ “Par” classified as Swiss Re Bid Price being equal to or larger than 99.5.

FIGURE 2: POST-EVENT SWISS RE WEIGHTED-AVERAGE BID PRICE



Source: Swiss Re ILS Weekly Pricing Sheets. Includes coupon-paying, non-life 144a catastrophe bonds.

TABLE B: SUMMARY OF POST-EVENT PRICING DYNAMICS

Event	Trigger	Time From Event to Price X (Days)		Post-Event 1-Week Price Change
		95	99.5	
Ian	Indemnity	336	714	-12.0
	Industry Index	287	490	-3.6
Irma	Indemnity	14	>730	-10.4
	Industry Index	98	217	-26.7

Swiss Re ILS Weekly Pricing Sheets. Includes coupon-paying, non-life 144a catastrophe bonds.

Distinct risks associated with indemnity bonds, such as potentially poor cedant cat claims management, often contribute to extended periods of distressed pricing. Furthermore, these issues are less pronounced in industry index transactions, where payouts are based on estimated losses across the entire insurance industry, as determined and reported on a scheduled basis by an independent claim reporting service, such as Property Claims Services (PCS). This approach diversifies away from dependence on the performance of any individual cedant.

Collectively, these findings demonstrate that industry index cat bonds have outperformed the broader market with respect to realized losses and mark-to-market performance after Ian and Irma, reinforcing the assertions made in "[Context Is Key: Deconstructing Expected Loss](#)" on the advantages of industry index triggers.

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Neuberger Berman

1290 Avenue of the Americas
New York, NY 10104-0001

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