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Catastrophe Bonds: Natural Diversification

Catastrophe bonds (or “CAT” bonds) were first introduced to help strengthen reinsurance companies’ balance sheets in the aftermath of Hurricane Andrew in 1992. Hurricane Andrew caused over \$15.5 billion in insured property loss (close to \$29 billion in today’s dollars) and ultimately led to the insolvency of at least 16 insurance companies. This brought to light significant shortfalls in the industry’s resilience to infrequent, but severe, natural catastrophe events.¹

Since then, catastrophe bonds have played an integral role in a maturing and increasingly dynamic insurance-linked securities (“ILS”) market, which has attracted the attention of institutional investors given its potential to deliver returns that are fundamentally uncorrelated to traditional financial markets. In this white paper we explain what catastrophe bonds are and how they work, and discuss the long-term outlook for this asset class.

¹ Source: <https://www.insurancejournal.com/news/southeast/2017/08/24/462204.htm>.

Executive Summary

- Catastrophe bonds are an alternative risk-transfer instrument used, primarily, by insurance and reinsurance companies to transfer specific natural catastrophe risk to the broader capital markets.
- Catastrophe bonds offer access to a fundamentally uncorrelated asset class (natural catastrophe risk) in a form that is typically more liquid than most reinsurance contracts and vehicles.

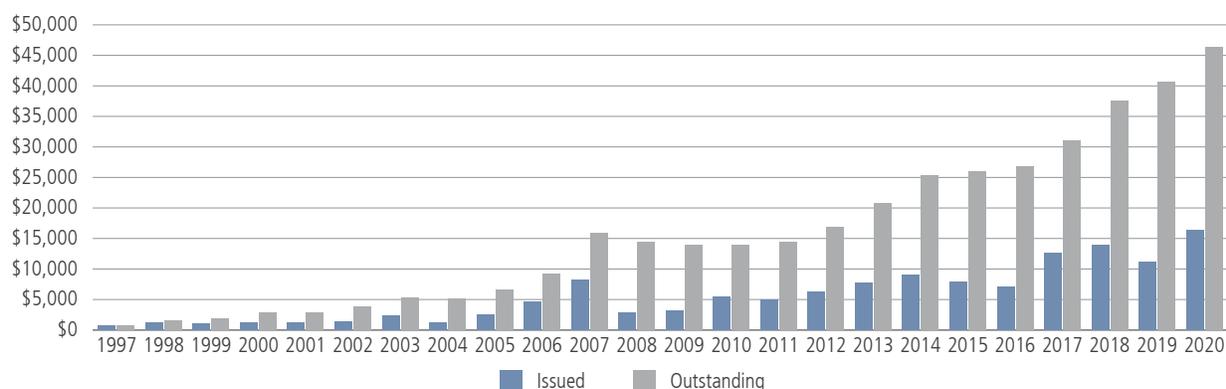
The insurance-linked securities market has its origins in the 1990s, following a number of unprecedented insured loss events, including Hurricane Hugo, Hurricane Andrew and the Northridge earthquake in California, which caused extreme capital stress amongst insurers and reinsurers. In response, rating agencies and regulators forced insurance companies to significantly increase their capital levels based on new, forward-looking probabilistic models to provision for future infrequent but large catastrophes.² Standard approaches to raising this additional solvency capital, such as frequently issuing equity to address tail-event exposures, proved prohibitively costly—hence in our view the attractiveness of transferring this risk to the broader capital markets via insurance-linked securities.

Hannover Re undertook what is believed to be the first securitization with its KOVER transaction in 1994.³ This was followed by several smaller risk transfer transactions, including Georgetown Re in 1996. In 1997, USAA's first Residential Re catastrophe bond was issued, securing \$480 million of protection and cementing the arrival of the modern CAT bond. USAA remains a prominent market issuer to this day.⁴

Over the years, the market has grown as insurers and reinsurers continued to use CAT bonds and other ILS products to free up capital resources, allowing them to write additional policies, meet solvency objectives and optimize balance sheets under ever-evolving regulatory requirements. Growth and diversification have been accelerated by events such as Hurricane Katrina in 2005 and the multiple global catastrophes in 2011, when significant industry losses encouraged issuance from new entrants.⁵

The ILS market size has almost quadrupled since 2010, reaching \$91 billion at mid-year 2020.⁶ The catastrophe bond segment has in our view remained an important part of the market over this time with total outstanding at-risk capital today standing at \$46.4 billion and total new issuance in 2020 reaching \$16.4 billion, surpassing all previous records (figure 1).

FIGURE 1. THE STRONG GROWTH OF THE CATASTROPHE BOND MARKET



Source: Artemis Deal Directory. Data as of December 31, 2020. **Past performance is not indicative of future results** and there can be no assurance or guarantee that the catastrophe bond market will achieve similar characteristics in the future.

² One example of the new models deployed is the National Association of Insurance Commissioners' Risk Based Capital model. Source: https://content.naic.org/cipr_topics/topic_riskbased_capital.htm.

³ Source: <https://www.hannover-rueck.de/956399/50-years-of-hannover-re-1966-2016.pdf>.

⁴ Source: Swiss Re Sigma Report No. 3/2001. These transactions are also listed in Swiss Re's extensive database of CAT bond deals, at <https://www.artemis.bm/deal-directory/>.

⁵ Until 2005, CAT bond issuance was concentrated in the hands of several re/insurers with Swiss Re and USAA particularly dominating the issuance calendar. Hurricane Katrina resulted in \$62 billion in insured losses, which significantly depleted reinsurance capital and caused reinsurance prices to increase. This saw reinsurance capacity enter the market to take advantage of pricing. This helped support the CAT bond issuance market, with 2006 and 2007 seeing consecutive years of (at that time) record issuance of \$4.7 billion in 2006 and \$7.1 billion in 2007. Source: Michael Lewis, "In Nature's Casino", at <https://www.nytimes.com/2007/08/26/magazine/26neworleans-t.html>.

⁶ Source: Aon Reinsurance Market Outlook Report September 2020.

Who Issues and Who Buys Catastrophe Bonds?

Insurance companies (both regional and national) still account for the largest volume of catastrophe bond issuance, according to the NB ILS team's analysis of the market. Capital adequacy requirements have overall become more stringent, particularly under Solvency II in Europe, at a time when insurers have faced several years of high claims and economic contraction could lead to declining insurance premiums. We believe it is likely that a future large natural catastrophe could result in losses that exceed the current capital capacity of the reinsurance industry as a whole, meaning there is significant scope for further growth. Insurers may also be attracted to issue catastrophe bonds because of their relatively long-term duration versus other ILS risk transfer methods, which are typically one year in duration: reinsurance pricing is highly volatile in response to fluctuating losses, and this allows buyers to lock in pricing for a known period.

Catastrophe bonds have also traditionally been issued by reinsurers seeking retrocessional protection (a key trend in late 2020). The complexity and limited transparency of a reinsurance portfolio generally leads issuers to utilize industry-loss type structures.

In addition to insurers and reinsurers, publicly operated catastrophe insurance vehicles or funds such as the California Earthquake Authority, Texas Windstorm Insurance Association and National Flood Insurance Program have also utilized the CAT bond market for protection.

In recent years, new participants have accessed the market. One prolific new issuer since 2017 has been the World Bank, which has used catastrophe bonds (structured as IBRD notes) to provide the financial capacity to directly respond to damages caused by certain extreme events in developing economies. Coverage to date has included earthquake and windstorm events in Mexico and the Philippines, earthquakes in Peru, Mexico, Colombia and Chile, and even a global pandemic bond (this bond paid out in the second quarter of 2020).⁷ We believe this has interesting implications for the use of catastrophe bonds by other government agencies and as a potential component of socially responsible investing.

Growth is also coming from more idiosyncratic participants seeking to cover explicitly defined risks to which they are exposed, including New York's Metropolitan Transportation Authority, Bayview Asset Management, which was hedging its residential mortgage book, and Alphabet, which sought cover for its corporate real estate assets.⁸ Given that the catastrophe bond market can be used to structure protection for a range of risks, we believe that this demand for idiosyncratic coverage could grow significantly.

Investment in the ILS market primarily comes from institutional investors allocating through dedicated ILS funds since there is no investable ILS or CAT bond index. Some ILS funds will invest exclusively in catastrophe bonds while others will use them in combination with other ILS instruments. The appeal of the "solvency risk premium" and the fundamentally uncorrelated return stream at times attracts other entrants such as multi-strategy hedge funds or retail-focused intermediaries, although we believe the relationship-driven nature of this unique market presents significant barriers of entry to novice investors.

What Exactly Is a CAT Bond?

Catastrophe bonds are fixed income instruments typically structured as 144A floating-rate, principal-at-risk notes. Common sizes range from \$50 million to \$500 million, although the market has at times supported deals as large as \$1 billion to \$2 billion. Duration tends to be in the one- to five-year range, with three to four years being the norm.⁹

Investors pay cash on issue for the bonds and the proceeds are commonly held in a dedicated collateral account within a Special Purpose Reinsurance Vehicle (SPRV). This protects counterparties from one another's credit risk so that the only risk is the insurance risk from pre-defined catastrophes. Typically, the terms of the bond will allow the collateral to be invested in government-backed debt or other highly rated and highly liquid debt instruments. The investors receive quarterly or monthly coupons for the term of the bond, made up from the return on the collateral (hence the floating rate) plus the spread (the risk premium) paid by the insurance-company counterparty (the "sponsor" or "cedant") to transfer the risk.¹⁰

⁷ Source: Bloomberg and <https://www.wsj.com/articles/pandemic-insurance-for-poor-countries-pays-out-195-8-million-11589544010>.

⁸ Source: <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/new-york-mta-sponsored-cat-bond-settles-at-top-end-of-price-guidance-8211-artemis-58543485>; <https://www.swissre.com/media/news-releases/nr-20200113-swiss-re-capital-markets-structures-places-the-first-parametric-earthquake-catastrophe-bond.html>; and <https://www.artemis.bm/news/alphabets-googles-first-catastrophe-bond-priced-on-target-at-237-5m/>.

⁹ Source: NB ILS analysis of the market.

¹⁰ Occasionally shorter duration CAT bonds are issued as zero coupon notes, issued at a percentage discount to par or principal value to be redeemed at par (or par net of any principal losses) at maturity.

FIGURE 2. THE ANATOMY OF A CAT BOND



Source: Neuberger Berman. For illustrative and discussion purposes only.

Catastrophe bonds may cover specific or multiple perils in one or more locations. Coverage can be based on several different event definitions, such as “per-occurrence” losses (exposure to a single event), “annual aggregate” losses (exposure to multiple events over the course of a year) or “frequency” losses (exposure once a specific second or third event has occurred within a defined risk period).

Should any of the pre-defined events occur, assets are liquidated from the collateral account and paid to the sponsor to cover the insured loss claims, and coupon payments are reduced or ceased. Not all CAT bonds have a binary trigger for the loss of principal so a bond may be only partially impaired if an event occurs. Each bond has an attachment point (the loss amount which, when exceeded, triggers a payout from the bondholder) and an exhaustion point (the maximum loss amount for which the bondholder is liable).

Most CAT bonds come with an “Extension Period”, which the sponsor can use to extend the maturity of the bond when a qualifying event has occurred, but the ultimate loss is not yet known. This allows time to receive third-party loss estimates or collect claims and calculate the final balance sheet impact. How quickly this process can be undertaken depends on the type and structure of the bond: it can be as long as three or four years, but is typically quicker. An extension spread is paid over this period.

Finally, at maturity, or following the Extension Period, the investor receives the principal remaining in the collateral account net of any payouts to the sponsor.

How Are CAT Bond Payments Triggered?

The CAT bond market covers a wide range of defined perils. While this includes (but is not limited to) several non-natural perils such as mortgage insurance risk, aviation, marine, extreme mortality, life, health care and terrorist attacks, the majority covers damage from natural catastrophes. This includes (but is not limited to) windstorms, earthquakes, flooding and wildfires. U.S. wind-related risk represents a large proportion of the risk transferred into the CAT bond market simply because U.S. hurricane and earthquake exposure is believed to be the biggest risk on the insurance industry’s balance sheet.¹¹ Regionally, Japan and Europe have the most coverage after North America, according to the NB ILS team’s analysis.

A CAT bond includes a pre-defined parameter outlining when an insurance payout should be made and how large that payout should be. This is called the trigger for the bond, and there are four main types: indemnity, parametric, industry-loss and modelled-loss. Indemnity bonds, representing nearly two thirds of the market, are typically most favored by cedants because they have the least basis risk (that is, the risk that the recovery amount following a qualifying event is different from the actual loss incurred by the sponsor). Some cedants will favor different triggers, however, largely depending on the nature of their underlying portfolio of risk and settlement needs, as well as the market pricing. Figure 3 shows the characteristics of the different trigger mechanisms.

¹¹ Source: <https://www.munichre.com/en/risks/natural-disasters-losses-are-trending-upwards/hurricanes-typhoons-cyclones.html#-1979426458>.

FIGURE 3. CAT BOND TRIGGER MECHANISMS

Trigger Type	Share of Market	Description	Transparency	Settlement Time	Notes
Indemnity	62%	Payout is dependent on cedant's actual loss	LOW Investor is relying on the loss that the cedant faces	MODERATE Requires verification of actual losses incurred	<ul style="list-style-type: none"> Favored by insurance companies given lowered basis risk for the sponsor Investors may be additionally compensated for lack of transparency
Parametric	10%	Payout is dependent on pre-agreed and measurable parameters	HIGH Investors and cedants are relying on a pre-agreed, measurable trigger (i.e. wind speed at a certain location)	RAPID Pre-agreed parameters are easily measurable, leading to minimal risk of trapped collateral	<ul style="list-style-type: none"> Favored by institutions protecting against very specific risks, which require quick payout times (e.g. World Bank) Basis risk can be high unless properly structured
Industry Loss	28%	Payout is dependent on third party industry-wide loss reporting, e.g., by Property Claims Services	HIGH Both parties are relying on a third-party loss estimate	MODERATE Third party provides periodic reports about an incident before releasing a "final" report	<ul style="list-style-type: none"> Favored by reinsurers given their risk exposure typically mirrors broader insurance industry loss exposure
Modelled Loss	<1%	Payout is dependent on catastrophe model output using given parameters	HIGH Both parties are relying on a third party's loss model	RAPID Results from catastrophe model are available quickly	<ul style="list-style-type: none"> Rare, but is increasingly favored for risks in developing countries, where there may not be a well-established or well-understood claims process

Source: Neuberger Berman. As of October 2020. For illustrative and discussion purposes only.

CAT bonds can be issued with maturities as long as five years. Over the risk period, the nature of the risks they cover can change substantially. For example, property count and value may increase in a covered location, the size of coverage underwritten by an insurer or reinsurer may grow or shrink, or a specific risk might be covered by more or fewer insurers, changing the risk profile of an indemnity or industry-loss trigger. As well as an impact to investors, material changes in exposure increase the sponsor's basis risk, which is particularly relevant for indemnity issues.

For that reason, the bonds typically feature an annual "reset" mechanism that adjusts the bond's trigger parameters, based on current risk modelling, to maintain its risk and return profile within an agreed range. In indemnity bonds, where the premiums written by the insurer may be growing at a high rate, the maximum exposure will typically be capped to a predetermined amount through the application of a Growth Limitation Factor in the calculation of Ultimate Net Loss for qualifying events.

How Are Catastrophe Bonds Priced?

While some CAT bonds have been issued with a credit rating, ranging from BBB+ to B-, NB ILS analysis indicates that they represent less than 10% of the universe, as issuers instead typically include a risk analysis from an expert third-party modeling firm.¹² This analysis includes an "expected loss" metric: the average annual loss of principal modeled across the set of all simulated event years.

¹² Source: <https://www.artemis.bm/news/decline-in-ils-ratings-shows-the-asset-class-isnt-so-alternative-kbra/> for a discussion of the decline in CAT bond transactions with credit ratings.

Given the skewed nature of loss distributions, these losses would not be likely to occur each and every year, but this metric captures the central moment of risk, such that the higher the expected loss, the higher the risk is considered to be. Other risk metrics can be considered, including the “probability of attachment” (the likelihood the bond will see some loss of principal over a set period of time) and the “exhaustion probability” (the likelihood of a full loss of bond principal over a set period of time).

CAT bonds can be considered to price at a risk premium above the modeled expected loss. Market spreads are strongly influenced by recent insurance losses: a year of high losses tends to mean higher demand for coverage and higher risk aversion from investors in the following year, leading to spreads being set wider. This is referred to as a “hard market” (while the reverse would be a “soft market” and lower CAT bond pricing). CAT bonds are typically issued with spreads of 5 – 15% and the average spread for 2020-issued natural catastrophe bonds stood at 7.7%, according to NB ILS market analysis as of the end of November 2020. Spreads are usually wider for CAT bonds covering “peak perils” such as U.S. wind and for indemnity-trigger bonds (to compensate for the lower transparency), while less common triggers and non-peak perils such as Philippines typhoons are generally priced tighter, given the lower issuance and diversifying nature of the risk in investors’ portfolios.

Once issued at par, pricing is determined by the secondary market. The new issuance calendar, maturity schedules, the insurance renewal season, investor flows and the relative pricing of CAT bonds versus other ILS will all likely affect pricing. Seasonality is another factor, with prices typically falling in anticipation of an active hurricane season and rising when bonds come off-risk at the end of the season. This is also why the Swiss Re CAT Bond Index typically has its most volatile months in August and September each year, when the risk of a bond being triggered is at its highest. Individual bond prices may also fluctuate during live events, for example in the case of a large hurricane threat with the potential to trigger the bond.

How Liquid Is the CAT Bond Market?

Unlike other ILS instruments such as industry loss warranties (ILW) and collateralized reinsurance, there is an active secondary market in CAT bonds, with trading over-the-counter through half a dozen significant broker-dealers. On average, according to data from the Trade Reporting and Compliance Engine (TRACE) and Tullet Prebon, around \$4 billion of securities are traded each year, translating to an average of \$15 million per day, with lot sizes of \$250,000 to \$10 million. Larger sales can also occur through organized Bid Wanted in Competition auctions (BWICs). Liquidity has tended to improve as the total market and the average deal size has increased.

Liquidity is somewhat seasonal: data from TRACE shows that trading volumes tend to be lower during the peak risk season of July through October.¹³ Liquidity is also likely to be scarcer when events are expected or have recently occurred. The liquidity of individual bonds can dry up when a payout is triggered or while final losses are being calculated; bonds will usually exhibit very wide bid-ask spreads, indicating that liquidity is available, but usually at a cost.

It should be noted that, while TRACE data shows sustained secondary-market trading at non-distressed pricing in the fourth quarter of 2018, during Hurricanes Florence and Michael and the California Camp wildfire, these events were not expected to materially affect CAT bonds, and the market remains relatively untested by a large loss event since its significant growth following Hurricane Katrina in 2005.¹⁴

How Have CAT Bonds Performed?

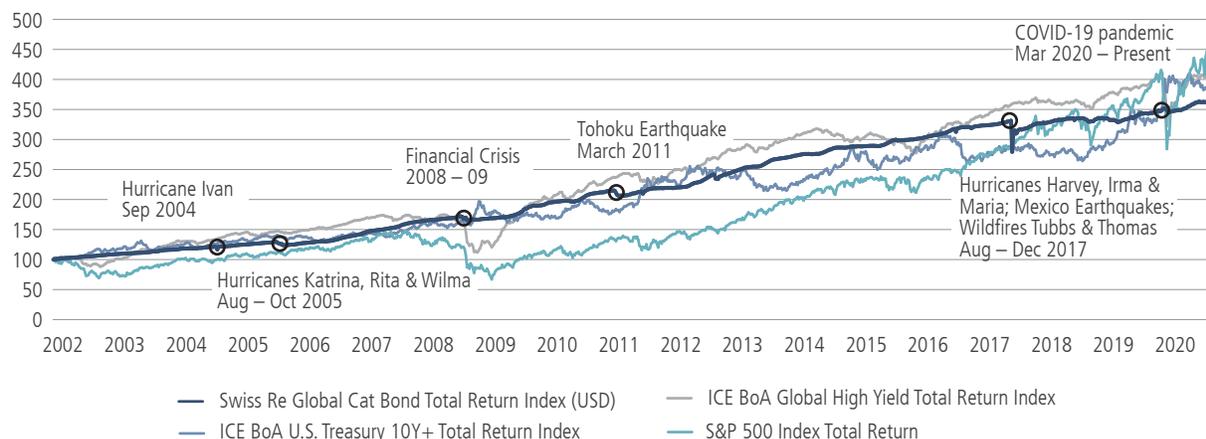
Figure 4 shows the performance of the Swiss Re CAT Bond Total Return Index against long-dated U.S. Treasuries, high yield bonds and U.S. equities since its inception in 2002. Major market events and natural catastrophes are also marked on the time series.

¹³ Source: Swiss Re 2019 Mid Year ILS Market Update.

¹⁴ Source: Swiss Re 2019 Mid Year ILS Market Update.

FIGURE 4. LOW CORRELATION WITH FINANCIAL ASSETS AND MODEST IMPACT FROM MOST NATURAL DISASTERS

Cumulative total return, 2002 – 2020



Correlation of monthly returns, 2002 – 2020

	CAT Bonds	U.S. Treasuries	High Yield	U.S. Equities
CAT Bonds	1.00			
U.S. Treasuries	-0.03	1.00		
High Yield	0.27	-0.24	1.00	
U.S. Equities	0.20	-0.34	0.72	1.00

Summary Statistics

	Cat Bonds	U.S. Treasuries	High Yield	U.S. Equities
Annual Return	7.00%	1.30%	8.00%	8.70%
Standard Dev	3.20%	0.40%	9.40%	14.80%
Sharpe Ratio	1.8	0	0.7	0.5
Highest	3.10%	0.50%	12.10%	12.80%
Lowest	-6.50%	0.00%	-15.90%	-16.80%
% Positive Months	89%	86%	71%	67%

Source: Bloomberg, FactSet, Neuberger Berman. For the period February 2002 – December 31, 2020. The benchmark performance is presented for illustrative purposes only to show general trends in the market for the relevant periods shown. The investment objectives and strategies of each fund in the benchmark may be different than the investment objectives of private markets funds and may have different risk and reward profiles. A variety of factors may cause this comparison to be an inaccurate benchmark for any particular private markets strategy and the benchmarks do not necessarily represent the actual investment strategy of a fund. It should not be assumed that any correlations to the benchmark based on historical returns would persist in the future. Indexes are unmanaged and are not available for direct investment. Investing entails risks, including possible loss of principal. **Past performance is not indicative of future results** and there can be no assurance or guarantee that the catastrophe bond market will achieve similar characteristics in the future. Note: Please see the Important Valuation and Other Financial Analyses Endnote for details concerning, among other things, COVID-19, including its impact on valuations and other financial analyses.

Over this period, the Swiss Re Cat Bond Index posted an annualized return of 7%. While this is slightly lower than high yield bonds or equities, CAT bonds have delivered significantly better risk-adjusted returns, with a Sharpe Ratio of 1.8. Correlation with other asset classes, as shown in the table, has also been low, indicating CAT bonds' potential effectiveness as a portfolio diversifier. This stands to reason given the main determinant of CAT bond performance over time will be insurance events, whereas credit and equity performance is more tightly linked to broader economic and financial cycles.

Despite incidences of material global insured losses in the past 15 years, catastrophe bond performance has been relatively resilient. Significant reinsurance losses were incurred during 2017, largely due to the three Atlantic hurricanes Harvey, Irma and Maria. In the first week of September 2017, the Swiss Re Cat Bond Index dropped by almost 16%; however, within eight months the index had recovered its value.

While longer-term correlation to other asset classes remains low, in some periods CAT bonds appear to move in tandem with equity markets. For example, the Swiss Re Cat Bond Index did trade down during September and October 2008 for three reasons. The first is that four CAT bonds structured with total return swaps traded down materially after Lehman Brothers, the swap counterparty, filed for bankruptcy. These bonds fell into technical default, either failing to make a scheduled interest payment or return principal at the bond's expiration date.¹⁵ Second, this period saw notable selling pressure as a number of market participants, in particular hedge funds, looked to exit liquid instruments, including CAT bonds, to meet very significant redemption liabilities. Third, Hurricane Ike, the sixth costliest U.S. hurricane in history, made landfall on September 13. Nonetheless, the market dislocation normalized by year-end and the Swiss Re Cat Bond Index rallied in November and December to finish 2008 up 2.3%. The Lehman bankruptcy was also the catalyst to formalize the SPRV, increasing the quality of the collateral structure to avoid future counterparty risk.

One consequence of the continued institutionalization of catastrophe bonds as an asset class, and the ongoing growth and diversification of CAT bond investors, has been to introduce an element of mark-to-market and flow-based risk into pricing. This was seen in March 2020, when a handful of large investors looked to sell down a part of their CAT bond portfolios in order to raise liquidity to access other short-term non-ILS opportunities, to pay investor redemptions, and to meet margin calls. The Swiss Re CAT Bond Index posted a modest loss in March 2020, when credit and equity markets were also negative, but recovered quickly as the supply-and-demand balance normalized and dedicated ILS funds stepped in to buy.¹⁶ These periods of flow-based price moves can correlate with other financial markets, therefore, but they also represent opportunities for dedicated buy-and-hold ILS managers, and we would expect correlation to remain low over the medium and longer term.

In our view, the strong historical performance of the CAT Bond Index indicates not only that investors have been well compensated for the risks, but also that, while U.S. wind risk remains the dominant exposure in the universe,¹⁷ investors are increasingly able to diversify across peril, region and trigger. This helps limit the impact of one catastrophe event on the entire index and has allowed solid performance through large loss events and high loss years such as 2017. Nonetheless, it is worth noting that U.S. wind is typically the best-modelled and most attractively priced risk exposure, and that some of the bigger losses in ILS in recent years have come from "diversifying" risks such as California wildfire and Japanese typhoon.¹⁸

Have CAT Bonds Ever Been Triggered?

While CAT bonds do trigger on occasion, overall, we believe they are relatively risk-remote compared with other reinsurance products. Many bonds cover only "super-catastrophe" events on the scale of the 1906 San Francisco Earthquake or 1926 Great Miami Hurricane. The average expected loss for CAT bonds issued in 2020 through December 31 stands at 2.5%.¹⁹ This is another reason why the overall bond market has typically not been severely hit over recent years, despite significant insurance losses.

¹⁶ Source: <https://www.artemis.bm/news/cat-bonds-again-show-investor-benefits-during-a-crisis-anger-gc-securities/>.

¹⁷ Source: <https://www.air-worldwide.com/publications/air-currents/2013/Uncovering-Florida-Hurricane-Risk-with-the-Catastrophe-Bond-Database/>.

¹⁸ In March 2011, the earthquake and subsequent tsunami in Tohoku, Japan, resulted in \$38.2 billion of damages. This resulted in the full loss of principal to the Muteki Ltd. bond issued by the Japanese insurer Zenkyoren. This write-down and subsequent mark-to-market loss due to negative investor sentiment saw the Swiss Re Cat Bond Index fall 3.92% during the month.

¹⁹ Source: <https://www.artemis.bm/dashboard/cat-bonds-ils-expected-loss-coupon/>.

Nonetheless, as expected in a healthy reinsurance market, CAT bonds have seen and will continue to see either full or partial loss of principal following triggering events. One of the first principal losses to a CAT bond occurred in 2005, the year of Hurricane Katrina.²⁰ The Swiss Re Cat Bond Index still finished the year in positive territory, even after trading down in September through November. The reinsurance industry also incurred substantial losses during 2017 and 2018, but since 2017 only 19 CAT bonds out of approximately 250 transactions have seen any loss of principal.²¹

Most recently, in April 2020, the Class B notes of the World Bank-issued pandemic bond saw a full trigger and its less risky Class A notes a partial trigger. This resulted in a total payout of close to \$200 million to 64 of the world’s poorest countries affected by COVID-19. The overall market impact was negligible, however, and we believe the result was a good one for the risk transfer market and could motivate new entrants, while also providing useful lessons in structuring and modelling for the future.²²

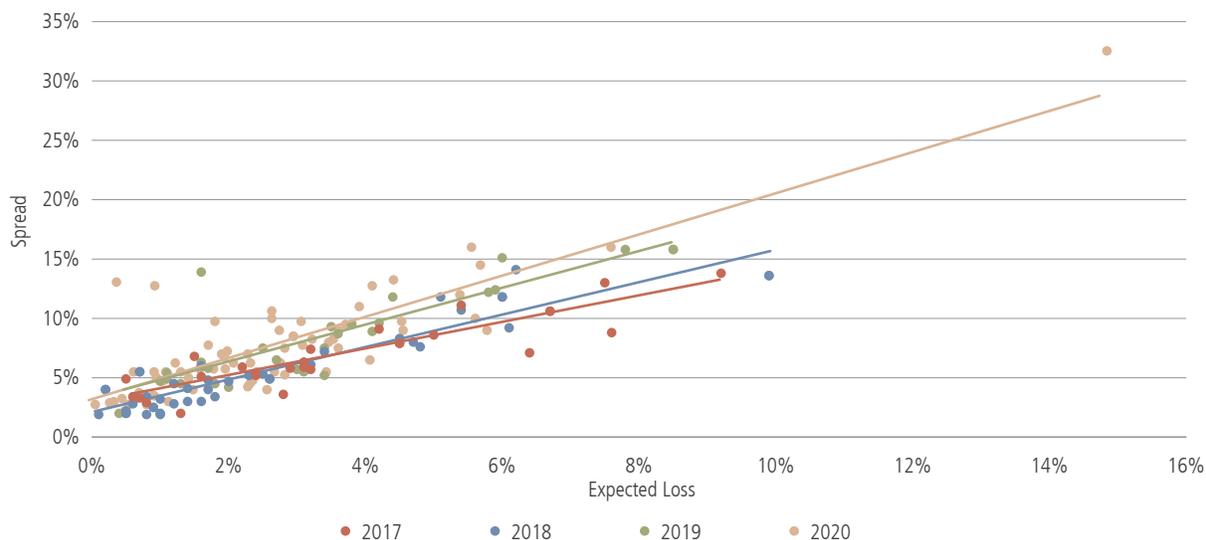
Furthermore, although losses are never palatable, risk spreads have widened materially following major catastrophes in the past. This was the case in 2006, and in 2012 following losses in 2011 in Japan and New Zealand, resulting in attractive returns from the Swiss Re Cat Bond Index over subsequent months. In addition, triggering events typically enable the market to update and refine its risk models for new issues, resulting in a “cleaner,” more transparent bond universe over time.

What Is the Current Outlook for Catastrophe Bonds?

Global insured losses have been high again in 2020.²³ We could already see the lasting impact of the loss events of 2017 and 2018 on market pricing and we believe this could now be magnified. Several new issues over the summer of 2020 came to market with spreads at all-time highs, suggesting potential for wider CAT bond spreads to persist into 2021.

FIGURE 5. PRICING HAS MOVED IN FAVOR OF INVESTORS OVER RECENT YEARS

Floating Spread by Year of Issue



Source: Neuberger Berman. Data represents catastrophe bond deals reviewed by the NB ILS team that are 144A notes covering natural catastrophe risks only and that were still on risk as of December 31, 2020.

²⁰ Kamp Re 2005 Ltd. saw a 75% loss of principal following losses in 2005, including those from Hurricane Katrina.

²¹ Source: <https://www.artemis.bm/cat-bond-losses/>.

²² Source: <https://www.insurancejournal.com/news/international/2020/12/10/593490.htm>.

²³ Source: <https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2021/2020-natural-disasters-balance.html>.

Current supply-and-demand dynamics support wider CAT bond spreads. Demand for cover continues as rating agencies and regulators continue to enhance solvency requirements—Lloyd’s so-called “Decile 10” initiative stands as a good example.²⁴ Collateral trapped from the last few years’ loss events is likely to limit the availability of ILS capital needed by reinsurance companies for retrocession (reinsurance for reinsurers), and we believe they are likely to turn instead to ILWs and CAT bonds. This effect could be reinforced as some ILS managers meet redemptions and see reductions in their assets under management as certain investors reconsider their allocations. We have also seen non-specialist investors reduce ILS allocations during this year’s market volatility in order to realize liquidity and fund other strategies.

Other positives into 2021 are less tangible, but still compelling. In a hard market, investors tend to be more demanding about bond structures, focusing on enhancements to transparency and model clarity, particularly around hard-to-model perils, as well as on refinements in contract language. In addition, new perils, regions and sponsors continue to come to market. Over the last 12 months, we have seen issuance covering standalone flooding, standalone wildfire and more granular parametric deals, including California earthquake coverages.

The strong new issuance calendar is positive for increased liquidity and breadth in the catastrophe bond universe. While at some stage the 2017 and 2018 issued paper will start to roll off, the structural growth story for CAT bond issuance remains strong. We believe it is likely that maturing bonds will therefore be replaced, potentially at more attractive pricing, given that the market is currently “harder” than it was before 2018.

Conclusion: An Attractively Valued, Genuinely Diversifying Asset Class

We believe that insurance-linked securities are one of the very few genuinely, structurally diversifying asset classes, where valuations are determined by the incidence and severity of natural catastrophes rather than by global macro, political or financial-market events. We believe that CAT bonds offer a transparent, liquid way of gaining exposure to this asset class, offering the promise of diversification potential along with a history of attractive returns.

Entering 2021, we believe that the combination of attractive pricing following several years of high insurance losses and structural supply-and-demand dynamics will sustain CAT bond spreads at attractive levels. Moreover, as the market continues to grow, it offers more scope for diversification and portfolio customization via different regional, peril and trigger-mechanism exposures, as well as supporting market liquidity.

Barriers to entry remain relatively high when compared to other fixed income instruments. Strong relationships with major brokers and other intermediaries are critical, particularly in new issue allocations. Specialized modelling resources are also crucial for portfolio construction and risk management. We argue that strong risk management and portfolio construction capabilities are necessary in order to strike the right balance between diversification and compensation, as well as the experience to seek short-term opportunity from dislocated secondary market pricing.

We believe that Neuberger Berman’s ILS team has the long-standing presence in the reinsurance industry, the asset scale across the broad ILS market, and the market experience required to make us a preferred partner for CAT bond investors.

²⁴ See, for example, “Lloyds Update: Redefining the Future” (September 2019) at <http://thoughtleadership.aon.com/Documents/20190904-lloyds-update.pdf>.

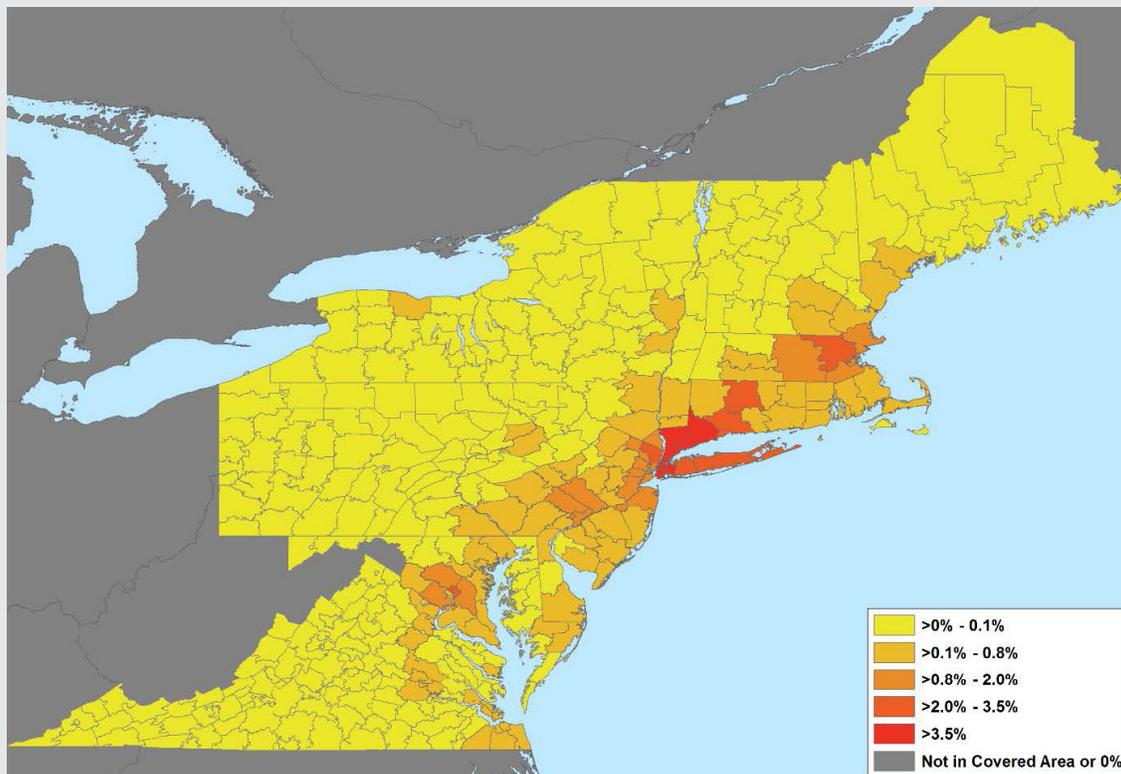
An Example of an Indemnity Bond: Long Point Re III Ltd. (Series 2018-1)

Long Point Re is a Cayman Island-exempted company designed to provide coverage for The Travelers Indemnity Company against certain named perils (tropical cyclone, earthquake, severe convective storm and winter storm) on an indemnity, per-occurrence basis. In May 2018, Long Point Re issued a \$500m multi-peril CAT bond to renew a previous issuance that provided collateralized reinsurance across the U.S. northeastern states and extended the risk period to four years.

Indemnity bonds trigger based on the actual losses to the cedant's insurance portfolio. In addition to the perils and regions covered, the overall pricing and the cedant's portfolio, investors should also consider the cedant's ratings, outlook and the bond's structure in relation to other (re)insurance layers.

In this case, Travelers is an issuer with well-respected underwriting practices, rated "AA (stable outlook)" by S&P, "Aa2 (stable outlook)" by Moody's, "AA (stable outlook)" by Fitch and "A++ (stable outlook)" by A.M. Best Co, as of June 29, 2020. The Long Point Re III Ltd. structure is placed high within Travelers' (re)insurance layers and the limited covered area provides regional diversification within the U.S.

The contribution to annual expected loss by county for the area covered in Long Point Re III Ltd. 2018, based on the initial AIR Worldwide modeling results. This type of information allows investors to better understand the cedant's exposure to the covered peril(s).



Source: Neuberger Berman. For illustrative and discussion purposes only. The case study discussed does not represent all past investments. It should not be assumed that an investment in the case studies listed was or will be profitable. The information supplied about the investment is intended to show investment process and not performance.

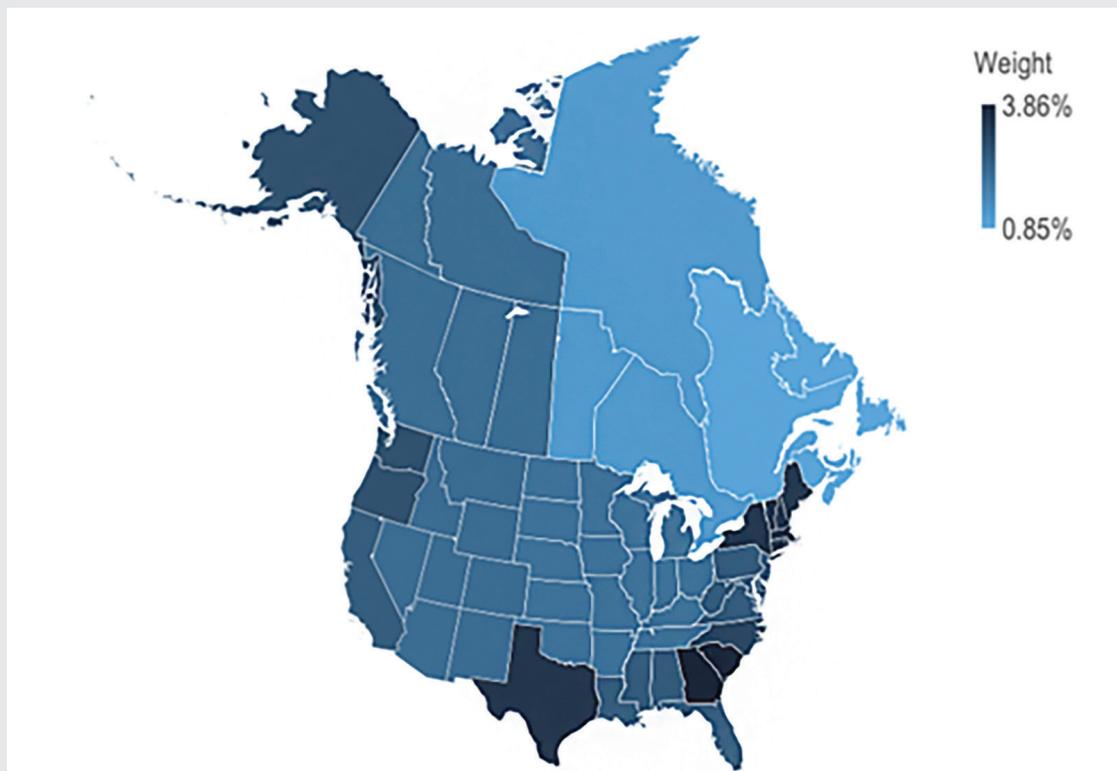
An Example of an Industry Loss Bond: Kilimanjaro Re Ltd. (Series 2015-1)

Everest Re issued \$625m worth of Kilimanjaro Re Ltd. (Series 2015-1) notes in December 2015. This issuance covers the U.S. (50 states and Washington D.C.), Puerto Rico, and all provinces and territories of Canada from hurricane and earthquake events on a per-occurrence basis over a four-year risk period. Everest Re split the notes into two tranches, Class D and Class E, which have varying risk profiles, but the same location-weighted industry loss trigger.

Industry-loss catastrophe bond issuances have increased in popularity due to the advantages that they offer for both the issuer and investors. For issuers, a weighted industry-loss trigger scales the state, territory or province losses by a set of payout factors to better represent the issuer's underlying exposure to risk. For investors, an industry-loss trigger provides greater transparency, as neither the issuer nor investor has an informational advantage over the other. The industry losses for this bond are provided by Property Claim Services (PCS), an independent surveyor of insured losses estimates.

The attachment point indicates the level at which an investor begins to face a loss, and the exhaustion point indicates a total loss. These levels are expressed in index points, which are calculated by scaling PCS-reported losses with the provided payout factors. The riskier Class D notes attach at 1.257 billion index points and exhaust at 1.816 billion index points. The more risk-averse Class E notes attach at 1.841 billion index points and exhaust at 2.521 billion index points. Any index point loss within those ranges will trigger a proportional payout.

Areas covered in Kilimanjaro Re Ltd. (Series 2015-1). As indicated by the darker shadings, states on the eastern seaboard generally had higher weights.



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VALUATION AND OTHER FINANCIAL ANALYSIS ENDNOTE

Epidemics, Pandemics, Outbreaks of Disease and Public Health Issues. Neuberger Berman's business activities as well as the activities of the Fund and its operations and investments could be materially adversely affected by outbreaks of disease, epidemics and public health issues in Asia, Europe, North America, the Middle East and/or globally, such as COVID-19 (and other novel coronaviruses), Ebola, H1N1 flu, H7N9 flu, H5N1 flu, Severe Acute Respiratory Syndrome, or SARS, or other epidemics, pandemics, outbreaks of disease or public health issues. In particular, coronavirus, or COVID-19, has spread and is currently spreading rapidly around the world since its initial emergence in December 2019 and has negatively affected (and will likely continue to negatively affect or materially impact) the global economy, global equity markets and supply chains (including as a result of quarantines and other government-directed or mandated measures or actions to stop the spread of outbreaks). Although the long-term effects of coronavirus, or COVID-19 (and the actions and measures taken by governments around the world to halt the spread of such virus), cannot currently be predicted, previous occurrences of other epidemics, pandemics and outbreaks of disease, such as H5N1, H1N1 and the Spanish flu, had material adverse effects on the economies, equity markets and operations of those countries and jurisdictions in which they were most prevalent. A recurrence of an outbreak of any kind of epidemic, communicable disease, virus or major public health issue could cause a slowdown in the levels of economic activity generally (or push the world or local economies into recession), which would be reasonably likely to adversely affect the business, financial condition and operations of Neuberger Berman and the Fund. Should these or other major public health issues, including pandemics, arise or spread farther (or continue to worsen), Neuberger Berman and the Fund could be adversely affected by more stringent travel restrictions (such as mandatory quarantines and social distancing), additional limitations on Neuberger Berman's (or the Fund's) operations and business activities and governmental actions limiting the movement of people and goods between regions and other activities or operations.

Valuation Risk. Due to the illiquid nature of many Fund investments, any approximation of their value will be based on a good-faith determination as to the fair value of those investments. There can be no assurance that these values will equal or approximate the price at which such investments may be sold or otherwise liquidated or disposed of. In particular, the impact of the recent COVID-19 pandemic is likely to lead to adverse impacts on valuations and other financial analyses for current and future periods.

INDEX DEFINITIONS

The **Swiss Re CAT Bond Total Return Index** is a non-investable index that tracks the total return of a representative basket of the global catastrophe bond market, excluding life and health catastrophe bonds and zero-coupon bonds. Bonds within the index are weighted by notional size. Swiss Re launched its CAT Bond Index in 2007, tracking the performance of CAT bonds since 2002.

The **S&P 500 Index** consists of 500 U.S. stocks chosen for market size, liquidity and industry group representation. It is a market value-weighted index (stock price times number of shares outstanding), with each stock's weight in the Index proportionate to its market value.

The **ICE BofAML Global High Yield Index** tracks the performance of below investment grade, but not in default, U.S. dollar denominated corporate bonds publicly issued globally, and includes issues with a credit rating of BBB or below, as rated by Moody's and S&P.

The **ICE BofAML U.S. Treasury 10 Year + Total return Index** is market value weighted and is designed to include U.S. dollar denominated, fixed rate securities with minimum term to maturity greater than or equal to 10 years.

DEFINITIONS

Industry Loss Warranties ("ILWs") are private investment contracts enabling the transfer of catastrophe risk from the protection buyer to the protection seller. The term "industry loss" refers to the fact that the triggers for the contracts are typically based not on the losses of a specific insurance company but rather on insured losses across the insurance industry as reported by a third-party, independent reporting agent. ILWs are typically fully cash-collateralized by both parties, reducing credit risk. ILWs are short-term instruments, typically 180 days to 365 days in duration, and are self-liquidating. In addition, as they are privately negotiated instruments, ILWs allow for greater customization of risk and return profiles.

Catastrophe Bonds are typically 144A securities structured as floating-rate principal-at-risk notes of 3- to 5-year maturity, and designed to transfer reinsurance risk to the capital markets. A central feature of a catastrophe bond is its trigger mechanism, which defines the type of event that would cause a principal reduction to the notes. The trigger mechanism could be based on actual insured losses of the issuer (known as indemnity cover), industry-index losses (aggregating all insured losses in the covered area) or even parametric data (e.g. wind speed measurements). Today, most catastrophe bonds are indemnity-based, approximately a quarter index-based and the rest in parametric form.

Correlation with Other Asset Classes. Catastrophic events are unpredictable and it is entirely possible that major losses will occur at or about the same time as other components of an investor's portfolio are also declining in value. In addition, the amount of global capital investing in insurance-related risks may be impacted to some extent by interest rates and other events affected traditional asset classes within the broader capital markets.

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