MEKETA
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Insurance-linked Securities

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CONTRIBUTORS
Colin Bebee, CFA
Frank Benham, CFA, CAIA

Insurance-linked securities ("ILS") is an asset class that generally derives its return and risk from property damage insurance contracts related to natural catastrophes (e.g., earthquakes, hurricanes, etc.). In this class, investors provide insurance-related, at-risk capital in exchange for pre-defined premium payments. Investors assume the role of an insurer, as the underlying risk sources are insurance policies and/or derivatives that are analogous to insurance policies. The archetype of ILS is natural catastrophe property reinsurance where investors effectively assume insurance policies from the original insurers of global property damage that stem from natural perils.

ILS generally provides a moderate level of return whose risk sources are completely unrelated to the traditional capital markets. This type of investment provides a unique source of uncorrelated and economically intuitive returns that are typically absent from most investment portfolios. Moreover, ILS has the potential to provide societal benefits by lowering the cost of insurance for end policyholders and diluting the risk of ruin for the most susceptible companies and regions. For institutional investors that are willing to accept the complexity, modest returns, and relatively small market size, we believe that ILS, and in particular natural catastrophe property insurance/reinsurance, can benefit a total portfolio when included as an illiquid diversifying strategy.

Key takeaways

- Insurance is one of the world's oldest commercial activities, and ILS/reinsurance offers institutional investors the ability to participate in this endeavor via the capital markets.
- Reinsurance is best described as insurance for insurance companies. ILS represents a broader category that is generally dominated by reinsurance but also includes other related segments (e.g., direct/original insurance, insurance for reinsurance companies, etc.).
- The underlying risks of this asset class primarily stem from insurance policies related to natural catastrophes (e.g., earthquake, hurricane, etc.).
- Although ILS/reinsurance is an illiquid asset class, investors can generally fully redeem their investments within one year (unresolved insurance claims may extend this window).

- → Compared to other illiquid asset classes (Private Equity, Real Estate, Infrastructure, etc.), ILS offers greater diversification benefits but typically a lower expected return.
- → The asset class is unique, complex, and smaller than most traditional markets, but its returns/risks are generated from truly independent sources.
- → Similar to other insurance markets, investments in ILS/reinsurance exhibit truncated upside scenarios and the potential for severe drawdowns.
- → With mid-to-high single-digit returns and de minimis correlation to traditional markets, ILS/reinsurance can potentially benefit numerous types of investment portfolios as a diversifying strategy.

Introduction

Insurance is predicated on the concept of risk transfer. In a particular transaction, one party (the insurer) receives a known, upfront payment in exchange for assuming a defined but unknown risk that another party (the insured) is unable or unwilling to bear. Properly functioning insurance markets allow for a given set of risks to be more evenly distributed across a larger community. Due to risk aversion, purchasing insurance is perfectly rational despite it being a negative expected return exercise (i.e., a cost). This is most easily exemplified by the fact that insurance lowers the risk of ruin for a given entity. Furthermore, a lower risk of ruin allows for increased economic activity as entities are no longer required (either by law or self-determination) to hold a cash reserve to potentially cover a certain set of risks. Without getting too deep into utility theory (i.e., explanations for how individuals subjectively value outcomes), both policyholders and insurance companies mutually benefit from insurance transactions. This is possible because policyholders are able to reduce risks and have a narrower distribution of outcomes and insurance companies are able to receive a payment for this service – both of which are attractive events for the respective entities.

Reinsurance is the most common form/segment of ILS. At its most basic level, reinsurance is insurance for insurance companies. Like many investment strategies that are utilized by institutional investors today (e.g., middle market direct lending), reinsurance began as a relatively common transaction among corporate entities that has since expanded to the capital markets. For reinsurance, this has resulted in the growth of the "alternative capital" reinsurance market. Whether for regulatory or portfolio/risk management reasons, insurance companies of all sizes utilize the reinsurance marketplace (the combination of traditional and alternative capital) to modify and transform the risk on their books.

Although ILS is a relatively young asset class (e.g., mid-1990s) for institutional investors, it has continually evolved since its inception. Originally, the terms "ILS" and "reinsurance" were used interchangeably and they have both tended to refer to natural catastrophe property reinsurance. Due to the evolution of the asset class,

and the insurance industry more broadly, this is no longer necessarily the case. While the utilization of ILS has been sparse among US institutional investors, it has been widely adopted by institutional investors outside the US. This delayed adoption by US institutions has been seen in a wide variety of other asset classes over time (e.g., Infrastructure). Although the focus of this paper is on natural catastrophe property reinsurance, we will also review other areas that the ILS market has expanded into more recently.

History

Insurance is one of the world's oldest industries. There are examples of insurance-like behavior dating back to the Babylonians where maritime loans could be forgiven in the event of the loss of the ship.[1] Similar agreements occurred from this time up through the Middle Ages. As it relates to formal documentation, historians have traced some of the oldest insurance contracts to roughly the 1300-1345 A.D. timeframe, and the oldest law dealing with insurance is believed to be found in a Barcelona ordinance from 1435.[2] Moreover, it is believed that the earliest reinsurance agreement stems from a 1370 transaction where the risk of a sea voyage from Italy to Belgium was transferred from one insurer to another via contract.[3]

[1] Peter L. Bernstein, Against the Gods (New York: John Wiley & Sons, Inc., 1996).

[2] Society of Actuaries. Reinsurance News (February 2009 – Issue 65).

[3] Society of Actuaries. Reinsurance News (February 2009 – Issue 65).

Reinsurance eventually became a mainstream business in the mid-1800s when Cologne Re (1848)[4], Swiss Re (1863)[5], and Munich Re (1880)[6] were founded as dedicated reinsurance companies. This industry expanded throughout the 1800s and 1900s, and both insurance and reinsurance companies were tested in the early-1900s as major catastrophes shook the world (e.g., 1904 Baltimore fire, 1906 San Francisco earthquake, 1912 Titanic sinking, World War I, etc.). As a result of these events, there was a divergence among insurers as several were unable to pay claims, and ultimately folded, whereas others began to build their reputation as reliable firms. While there were numerous events that affected insurance companies during the 20th century, the next major crossroads for the industry occurred in the early-1990s with Hurricane Andrew (1992) and the Northridge Earthquake in California (1994). These two events highlighted the need for a larger reinsurance marketplace, as it became evident that the demand for reinsurance exceeded the available supply.

[4] "History of Gen Re." Retrieved from *www.genre.com.*

[5] "Our history." Retrieved from *www.swisre.com*

[6] "Facts and figures." Retrieved from *www.munichre.com.*

As a response to the need for additional reinsurance supply, the capital markets began to provide alternative risk capital that allowed insurance and reinsurance companies to transfer portions of their risk to other entities in exchange for a premium payment. Catastrophe bonds ("cat bonds"), first issued in 1997, was one of the first methods of transferring risk from insurers/reinsurers to the institutional capital markets.[7] This marketplace has since grown to include other forms of risk transfer such as private collateralized reinsurance, industry loss warrants, and reinsurance sidecars and quota shares, among others (see Appendix). These other forms are analogous to the evolution of private equity (e.g., private collateralized

[7] "Catastrophe bonds: A primer and retrospective." The Federal Reserve Bank of Chicago. Chicago Fed Letter 2018 Number 405.

reinsurance), co-investments (e.g., sidecars and quota shares), and equity index futures (e.g., industry loss warrants) if compared to public equity (e.g., cat bonds). All of these instruments are potentially used by ILS asset managers, a market segment that began in the late-1990s and expanded considerably after the Global Financial Crisis. For most ILS asset managers, private collateralized reinsurance makes up the majority of their portfolios.

Insurance is a heavily regulated industry across the globe. In order to abide by various rules and regulations, reinsurance companies (and related asset managers) have naturally gravitated towards certain reinsurance "capitals" of the world such as Bermuda, London, Zurich, and Singapore. All of these areas tended to be early-adopters of functioning insurance/reinsurance markets and thus centers for expertise. Moreover, this geographical positioning has been reinforced by the fact that market participants naturally want to be close to one another as transactions are still largely private in nature.

Strategic mechanics

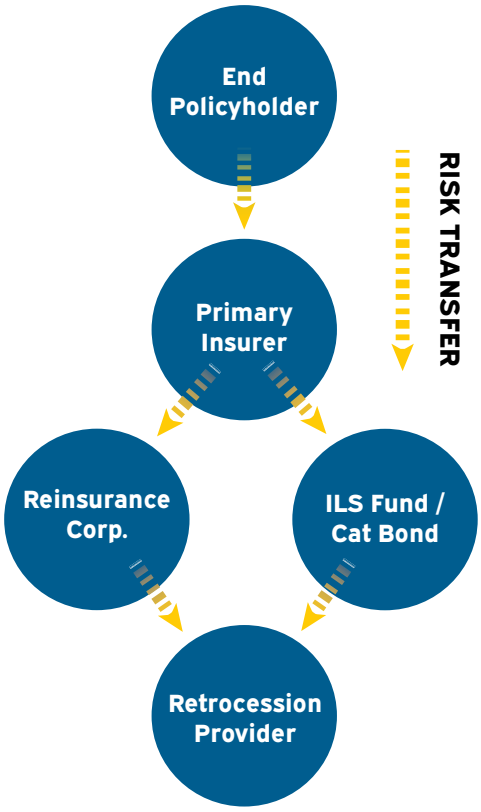
The following diagram details the basic lifecycle path of how risks are transferred from the original entity/individual to the insurance/reinsurance market. Of note, the risk is divisible across various facets (e.g., region, peril, deductible/attachment level, etc.) at each point and may be transferred in part or in whole.

A homeowner of business seeks insurance for a given risk (e.g., hurricane)

A primary insurer underwrites/sells a direct insurance policy to the end policyholder

The primary insurer transfers part or all of the risk to a reinsurance company, ILS fund, or cat bond

In certain incidents, a reinsurer can further transfer part or all of the risk via retrocession (insurance for reinsurance)



As highlighted above, reinsurance companies/ILS funds can purchase their own insurance (i.e., transfer the risk) via the retrocession market, which is served by other reinsurance companies and ILS funds.

As mentioned previously, insurance is a heavily regulated industry. It is for this reason that a unique mechanism must be used to transform insurance policies into investment securities. This is not too dissimilar from traditional financial securitization where special purpose vehicles ("SPVs") are used to create new investment securities that consist of other assets. The following diagram provides a basic illustration of how this process works for ILS.

In the simplified example above, a cedant transfers the risk of an insurance contract (or more specifically, a collection of contracts) by utilizing a "transformer" mechanism via an SPV in order to transfer the terms and conditions of the policies into an investable security. The SPV, which is typically registered as a reinsurer, is nothing more than an intermediate vehicle that allows the cedant to enter into a risk transfer contract that is collateralized by a corresponding collateral trust. Proceeds from the insurance premium (from the cedant) and the equity injection (from the ILS fund) are held in a collateral trust account and invested in money market-like instruments. The exposures are valued at regular periods based on realized claims, potential claims, and returns on the collateral. Upon expiration of the underlying contracts, the remaining value in the SPV/collateral trust is distributed to the ILS investor. In a best-case scenario, this value includes all of the original equity and insurance premiums, as well as a modest return from the money market-like exposure. In a worst-case scenario, all of the capital in the collateral trust account must be transferred back to the cedant to help pay for claims.

The schematic above represents a simplified version of how insurance exposure is transformed into an investable security, and it is important to note that all ILS transactions use similar methodologies, although they may be more complex in certain circumstances (e.g., partnership transactions may involve multiple SPVs, etc.). This applies to both catastrophe bonds as well as private collateralized reinsurance. To further complicate matters, the holdings of a given fund may be stated as various structures/entities (e.g., SPVs, ISDA swaps, etc.) that obscure the true exposures to an extent. This is due to regulations on what type of entity can actually trade these securities. In particular, certain investments, such as catastrophe bonds, can

be traded by a variety of entities (i.e., open market investments), whereas private collateralized reinsurance can only be transacted/traded by registered reinsurance companies. These registered insurance companies are effectively the SPV entity highlighted above. The registered reinsurance company is typically set-up by the ILS fund manager, and it is important for investors to understand how the costs of this entity are or are not amortized (i.e., does the asset manager pay for these costs from their management fee or are they borne by the fund as an operating expense?). Furthermore, these various constructs have evolved and will likely continue to evolve over time. The complexity that can be embedded in these constructs/vehicles is a reason why operational due diligence is a crucial endeavor when investing in ILS strategies. There can potentially be layers upon layers of SPVs and other entities, and it is important to understand the setup and management of these operationally complex structures. Moreover, it is important to understand how leverage may or may not be embedded into the fund structures.

Market size

The reinsurance market has grown considerably in recent years. As of Q3 2019, it is estimated that the reinsurance marketplace had approximately $625 billion of capital with over $90 billion originating from alternative capital sources. Traditional capital originates from dedicated reinsurance companies (e.g., Munich Re), whereas alternative capital comes from ILS-related investment strategies/funds. Prior to the Global Financial Crisis, the majority of the alternative capital stemmed from catastrophe bonds, but that has since declined to roughly one-third of the alternative capital amount (currently there is approximately $30 billion in outstanding catastrophe bonds). The limited size of the alternative capital market acts as a headwind for large investors to utilize ILS strategies. In addition to potentially impacting pricing, the majority of ILS funds are capacity constrained and will not allow large (e.g., greater than $1 billion) allocations. The largest managers in the segment currently manage approximately $5 to $10 billion and have closed their funds and/or have explored returning capital at points in recent history. This capacity issue, combined with the fact that ILS is a relatively complex private markets asset class, implies that investing in ILS requires careful consideration of an investor's individual portfolio and corresponding resources. ILS funds are also expanding into the direct insurance market (for similar perils), which allows ILS funds to access a materially larger market size (over $5 trillion).[8]

[8] Nephila Capital Ltd.

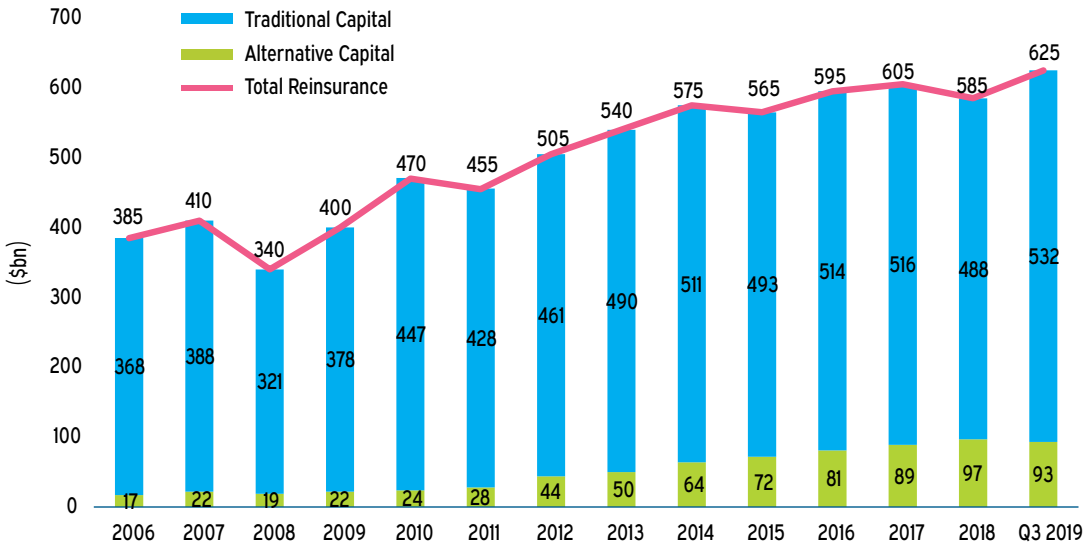


CHART 1
Global Reinsurance Capital

Source: Aon Securities, S&P Global

Contract/market pricing

Reinsurance has a similar payoff structure as fixed income asset classes (e.g., high yield bonds): the best-case scenario is an investor keeps 100% of the yield/premium income and the worst-case scenario is an investor loses both the yield/premium and the principal/collateral value. Considering this asymmetric payoff, investors need to pay close attention to the yields/premiums that are available in the ILS market. This is no different from a high yield bond investor seeking a reasonable credit spread in order to compensate them for the risk of default. The graphic below details regional Rate-On-Line[9] indices from Guy Carpenter (a global insurance company) that depicts how premium levels have changed over time.

[9] Rate-On-Line ("ROL") is the premium of a contract divided by the contract limit (e.g., a premium of $2 million to cover up to $10 million in damage would be a 20% ROL).

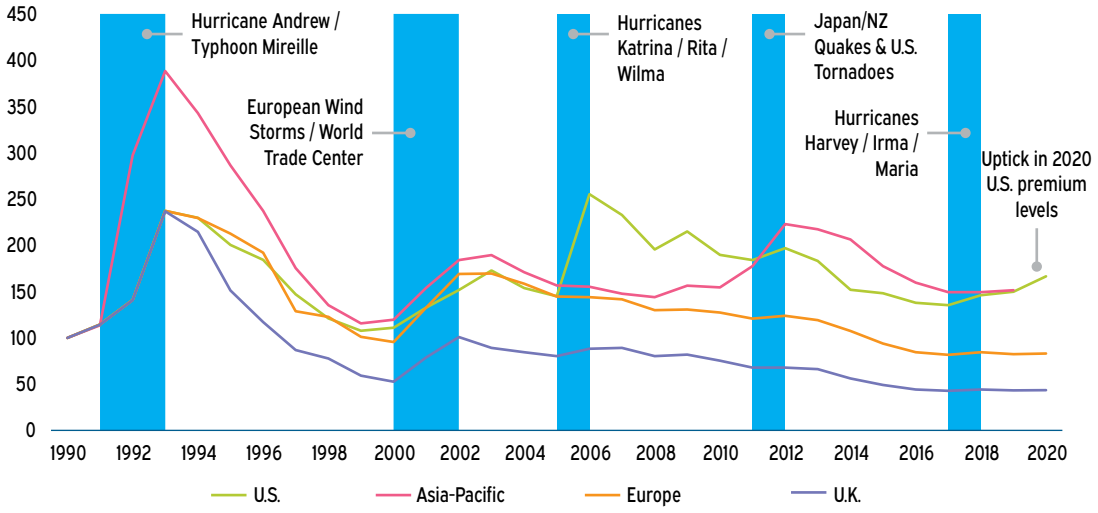


CHART 2
Global Reinsurance Premium Levels[10]

[10] 'Source: Bloomberg, Artemis

As illustrated in the previous chart, premium levels tend to increase after major events occur (highlighted in blue). One major exception was after the 2017 timeframe that saw several major hurricanes. This lack of a premium increase in 2018/2019 has been attributed to several causes:

1. The events of 2017 occurred after several years of relatively light natural catastrophes. As such, insurers/reinsurers were generally in sound financial condition and willing to take on risk.
2. As shown previously, the supply of risk capital had increased since 2012 and thus, reinsurers were naturally willing to accept lower premium levels.
3. This timeframe also occurred during the latter part of an extended equity bull market. The investment portfolios of insurance/reinsurance companies had thus appreciated significantly and further increased their risk appetite and willingness to accept lower premiums.

The explanations above all point to two things: 1) supply/demand for reinsurance and 2) risk appetite among insurers/reinsurers. Monitoring both of these elements (e.g., both have shifted in favor of higher premiums in 2020) are crucial to understanding market pricing.

Historical performance

One of the challenges with examining reinsurance as an asset class is the relatively small amount of representative historical performance data. This is not too dissimilar from other asset classes that have more recently transitioned from traditional commerce transactions to the capital markets (e.g., middle market direct lending). Generally speaking, most practitioners examine two sources of historical data: 1) catastrophe bonds and 2) multi-manager composites.

As it relates to catastrophe bond indices, there are several providers that produce these, each of which tends to be a major reinsurance broker or market participant. For the purposes of this paper, we examined a commonly used cat bond index from Swiss Re, a dedicated reinsurance company who also produces market data. As it relates to multi-manager composites, the most commonly referenced index is from EurekaHedge, which consists of roughly 32 ILS managers. It is important to note that neither of these data sources are perfect representations of what investors would have historically experienced or what they should expect to experience going forward.

As it relates to catastrophe bonds, this is merely a subset of the ILS market and, as publicly traded assets, catastrophe bonds can be subject to public market influences (e.g., yield compression). Catastrophe bonds are structured by securitizing underlying insurance policies into an investable form (identical to the SPV/transformer mechanism highlighted earlier) that are then traded among institutional investors,

typically subject to Rule 144a (i.e., there are various restrictions on who, how, and when they can be sold/resold). From the standpoint of an investor, cat bonds looks similar to a corporate bond with a principal/par value, regular coupon payments (e.g., quarterly), and a maturity (anywhere from one-to-five years but most commonly three).

The tables and graphics below provide basic performance analysis since inception for catastrophe bonds.[11]

	1-year	3-year	5-year	7-year	10-year	Since 2/2002
Catastrophe Bonds[12]	5.6	2.5	3.9	4.6	5.8	6.9
Global Equity[13]	2.1	6.1	6.5	7.8	9.2	6.7
Investment Grade Bonds[14]	8.7	5.3	4.3	4.0	3.8	4.7

TABLE 1
Trailing Period Performance — as of 6/30/2020

	1-year	3-year	5-year	7-year	10-year	Since 2/2002
Catastrophe Bonds	2.9	4.7	3.7	3.3	3.4	3.0
Global Equity	21.6	16.3	14.5	13.2	14.0	15.6
Investment Grade Bonds	3.7	3.3	3.1	3.0	2.9	3.4

TABLE 2
Trailing Period Volatility — as of 6/30/2020

	Catastrophe Bonds	Global Equity
Global Equity	0.20	
Investment Grade Bonds	0.15	-0.01

TABLE 3
Historical Monthly Correlations — as of 6/30/2020

[11] We have opted not to provide performance analysis for the EurekaHedge ILS Advisors Index. The diverse strategy types and opaque underlying risk/insurance sources requires numerous caveats that materially detract from the analytical value. With respect to multi-manager indices such as that from EurekaHedge, several issues stem from risk level and insurance-type heterogeneity. In other words, ILS managers/funds vary with respect to their risk targets (typically stated as a 99% Value-at-Risk expectation), underlying source of risk (e.g., property, life, cyber-risk, etc.), and overall objective (e.g., long-short absolute return vs. long-only). This level of characteristic variation, unfortunately, potentially results in a misrepresentation of the asset class.

[12] Swiss Re Global Catastrophe Bond Index

[13] Global Equity = MSCI ACWI Index

[14] IG Bonds = Bloomberg Barclays Aggregate Index

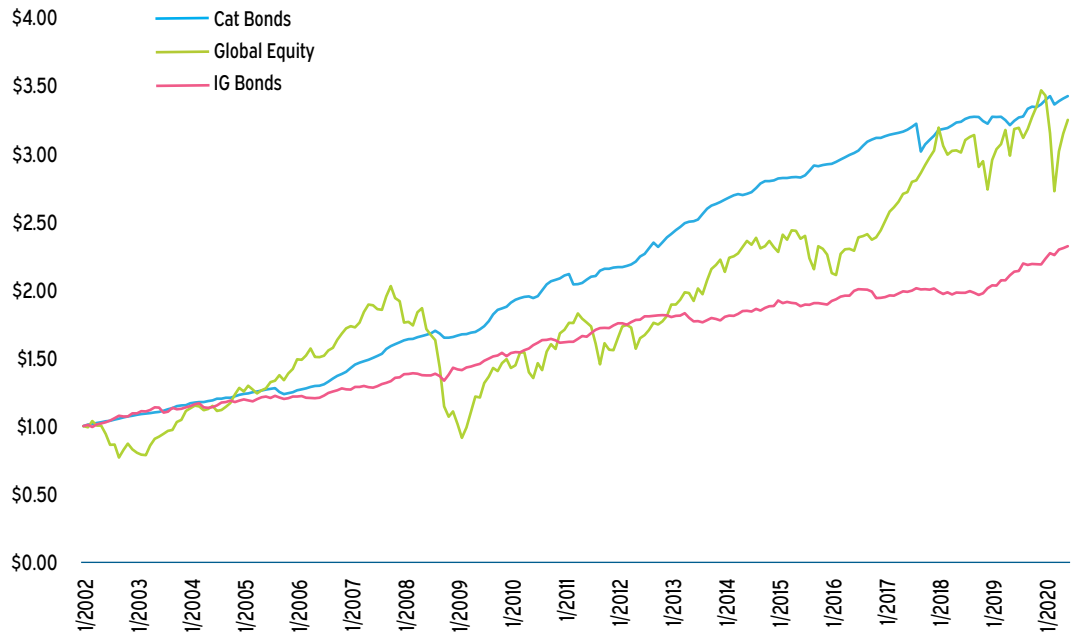


CHART 3
Growth of $1 — as of 6/30/2020

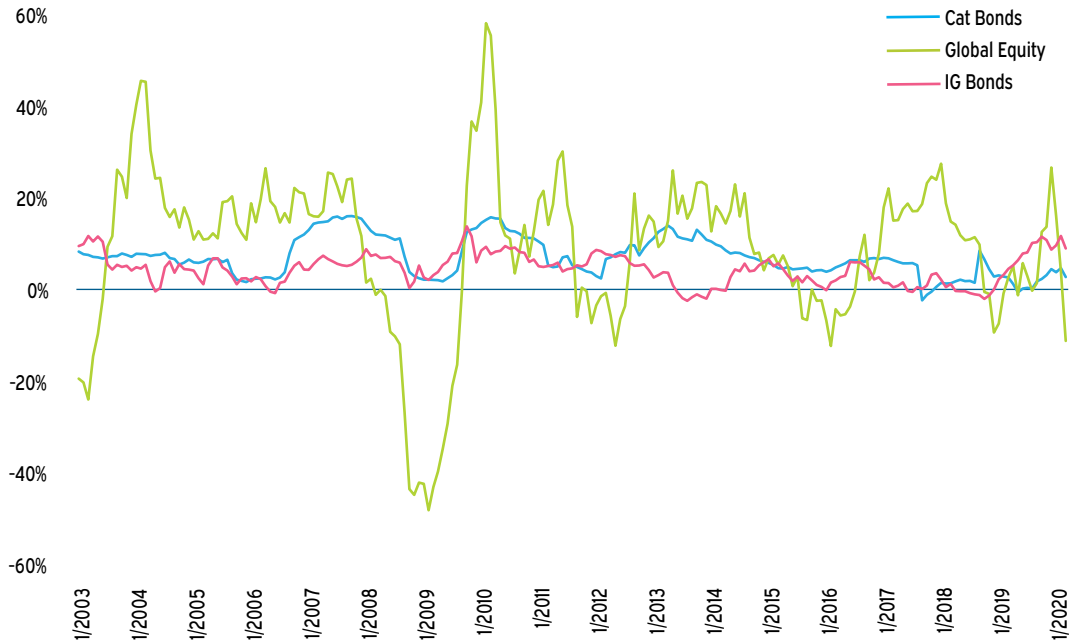


CHART 4
Rolling 1-Year Returns

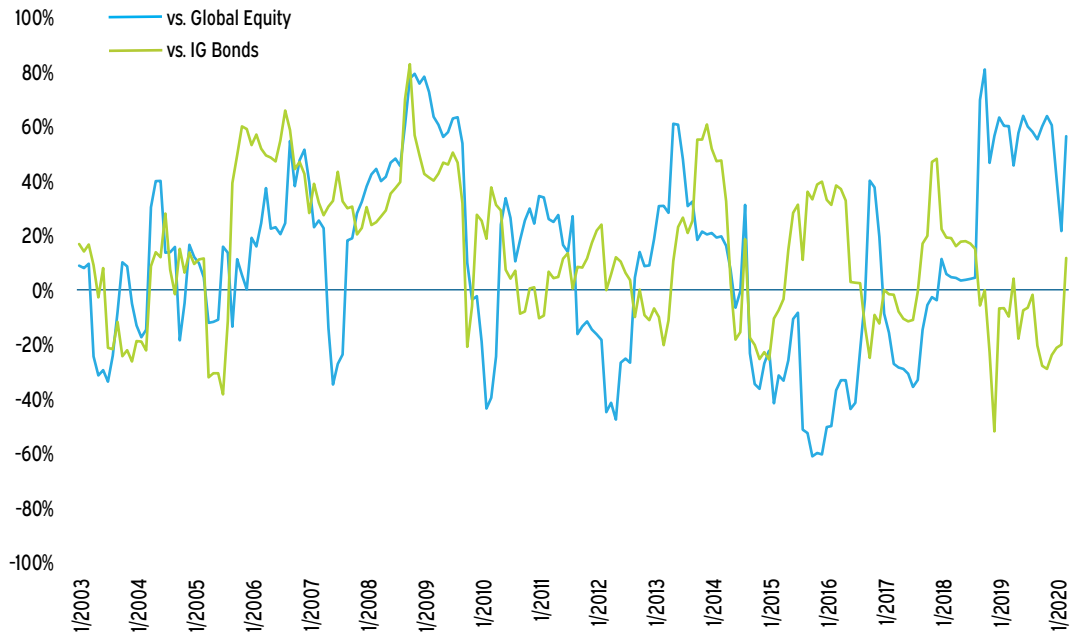


CHART 5
Rolling 1-Year Correlations

As detailed in the rolling 1-year correlation graphic above, the linear relationship between cat bonds and global equity can vary immensely when examined over short time periods. This is exactly what one would expect when examining two relatively uncorrelated assets. It is important to note that having a high correlation during a certain period does not necessarily mean that if one asset experiences a material negative return that the other asset also will. A high correlation simply means that both assets are likely to produce below average returns at the same time. This fact is commonly lost when examining correlation data.

To further highlight this point, below is a table that describes four material drawdowns for cat bonds and global equity, respectively. As shown in this table, when equity markets drawdown, cat bonds have tended to produce positive to marginally negative returns. Similarly, during natural catastrophe periods, when cat bonds have experienced negative drawdowns, global equity has tended to be unrelated (in 2008, however, there were both hurricane events as well as the Global Financial Crisis). In summary, the table below further demonstrates the relatively independent behavior of these two assets even during times of material stress.

Event/Backdrop	Dates	Cat Bonds	Global Equity
Equity Drawdowns			
Global Financial Crisis	Nov 07′ – Feb 09′	5.4%	-54.9%
European Debt Crisis	May 11′ – Sept 11′	4.8%	-20.5%
Geopolitical Turmoil & Rising Rates	Oct 18′ – Dec 18′	-1.6%	-12.8%
COVID-19	Jan 19′ – Mar 19′	-0.1%	-21.4%
Natural Disaster Drawdowns			
2005 Hurricanes (Katrina/Rita/Wilma)	Sep 05′ – Oct 05′	-3.4%	0.2%
2008 Hurricanes (Gustav/Ike)	Sep 08′ – Oct 08′*	-3.1%	-29.8%*
Japan Earthquake/Tsunami	Mar 11′	-3.6%	-0.1%
2017 Hurricanes (Harvey/Irma /Maria)	Sep 17′	-6.3%	1.9%

TABLE 4
Example Market Drawdowns

*This period coincides with the Global Financial Crisis

As illustrated in the tables and graphics above, catastrophe bonds have experienced strong performance since the inception of the Swiss Re Global Catastrophe Bond Index. In particular, this index has produced returns in-line or above investment grade bonds with a similar level of volatility. Catastrophe bonds have also managed to perform in-line with global equity over this timeframe. While this data makes catastrophe bonds (as a proxy for the broader ILS asset class) seem highly attractive, it comes with several significant caveats:

- This period has multiple biases against global equity. The January 2002 to June 2020 timeframe includes the end of the tech bubble crash, the Global Financial Crisis, and the COVID-19 pandemic. In other words, this period had three historically challenging events in the beginning, middle, and end for global equity.
- Catastrophe bonds are sometimes used as fixed income replacements and/or within fixed income portfolios (e.g., PIMCO has traded catastrophe bonds in traditional fixed income strategies since their inception). Due to this, catastrophe bonds have been, at least in part, influenced by dynamics in the fixed income markets.
- It is important to note that the size of the catastrophe bond market changed throughout this timeframe but has never been near the scale of other yield-oriented asset classes such as investment grade or high yield corporate bonds.[15] The market has increased from several hundred million in the late 1990s to $30 billion in 2020.[16]

From Meketa's perspective, a key element of the historical performance analysis of catastrophe bonds is the correlation data. Over the last 18+ years, and despite being a publicly traded asset, catastrophe bonds have demonstrated little relationship with the world's most prevalent asset classes (i.e., global equity and investment grade bonds). This is aligned with economic intuition (i.e., that natural catastrophes tend to

[15] As of 6/30/20, the US investment grade and high yield corporate bond markets were approximately $6.6 trillion and $1.4 trillion, respectively (as represented by Bloomberg Barclays indices).

[16] Source: Aon Securities (excludes most non-catastrophe related risks)

be uncorrelated with the broader economic cycle), and Meketa would expect these correlations to be close to zero on a forward-looking basis, especially as investors implement ILS in private fund structures rather than as a publicly traded subset. While most private markets strategies provide illusory correlation benefits, private ILS strategies have realized gains/losses at very short intervals (i.e., monthly valuations and annual realizations/renewals) and, thus, their observed correlation behavior is a better representation of economic reality.

Implementation

As detailed under the *Risk and Utility Theory* section in the Appendix, the key to any insurance strategy is properly evaluating the probabilities and magnitudes of scenarios and pricing policies accordingly. For ILS/reinsurance managers, this comes down to deal flow/access, actuarial/modeling experience and expertise, negotiating power[17], and portfolio/risk management. Reinsurance can generally be accessed via three methods: 1) cat bond mandates, 2) hedge funds, and 3) private reinsurance funds.[18] From Meketa's standpoint, private reinsurance funds represent the most attractive offerings. As it relates to cat bonds, there are a few primary drawbacks: 1) there is no information edge or negotiating ability as they are public securities, 2) the market size is variable and can be of insufficient size (currently around $30 billion in aggregate), and 3) dedicated offerings are relatively scarce. For hedge funds, they commonly utilize reinsurance in an opportunistic fashion or as part of a larger insurance book that contains other forms of risk (e.g., life settlements). When used in an opportunistic fashion, the funds typically lack one or more of the ideal attributes listed above. When used as a part of a large insurance book, there are other risks that may increase the strategy's correlation to the traditional capital markets or that may increase the risk an institutional investor already bears (e.g., longevity risk as it relates to life settlements).

Private reinsurance/ILS funds, and more specifically, natural catastrophe property reinsurance/ILS–focused funds, offer investors the best avenue for achieving success in the reinsurance/ILS space. When it comes to evaluating these funds, it is best to focus on the four key attributes highlighted above: 1) deal flow/access, 2) actuarial/modeling experience and expertise, 3) negotiating power, and 4) portfolio/risk management. It should be expected that fees are similar to other private markets strategies (e.g., 1-2% management with the potential for a performance fee of 10-20%). The reinsurance marketplace is continually evolving, and event risks outside of natural catastrophe risks (e.g., cyber security) are growing as potential areas of investment. It is important to remember that one of the most attractive elements of natural catastrophe reinsurance is its uncorrelated behavior to traditional investments, and thus, investors need to examine each new event risk category and its potential relationship to the capital markets prior to investing.

[17] With private reinsurance, there is typically a back-and-forth negotiating process on a given deal where better pricing can potentially be achieved.

[18] Large-scale, sophisticated investors could also set-up separate accounts/entities that can act as a reinsurance company, but this is beyond the scope of this paper.

	Cat Bonds	Hedge Funds	Private/Dedicated Reinsurance/ILS Funds
Pros	→ Relatively liquid (more frequent commitments and withdrawals). → Lowest cost option.	→ Potentially more opportunistic exposure to ILS. → Typically diverse insurance-related risks.	→ Dedicated expertise. → Strongest industry relationships and operational infrastructure. → Best-in-class portfolio and risk management tools and approaches. → Customizable risk levels (i.e., multiple funds at each manager).
Cons	→ Higher correlation to traditional asset classes. → Transaction costs and access can be limit implementations. → Generally minimal actuarial and insurance expertise among managers. → Highly variable underlying market size. → Potentially the most capacity constrained. → Minimal ability for portfolio managers to customize the underlying exposures.	→ Variable levels of transparency. → Moderate actuarial and insurance expertise among managers. → Underlying policy-types (e.g., pandemic, cyber security, life insurance, etc.) may increase correlation risks already borne by the investor. → Potentially non-ILS exposures within the funds. → Poorer access to deal flow and relationships. → Liquidity can vary immensely.	→ Strategic exposure to the segment — may be forced to put money to work at unattractive prices. → Partial liquidity is generally only at the major renewal periods.

TABLE 5
Tradeoffs of Investment Options

Additionally, due to the complex structures, legal entities, and operations of reinsurance markets and funds, in-depth operational due diligence is an absolute must prior to investing in reinsurance funds. Reinsurance is a private markets strategy and should be treated in a similar fashion as other private markets investments when it comes to due diligence.

Expected return/risk and strategic allocation

Reinsurance has a large amount of variability with respect to expected returns and risks. While these metrics vary at the instrument level, the most relevant divergences for an investor occur at the strategy or implementation level. In particular, managers commonly offer a suite of strategies that meet different risk/return objectives. A close analogy would be that of credit: investments can range from relatively safe and low returning investment grade credit bonds, to distressed debt investments that have significant levels of risk with commensurate expected returns. A nice feature of reinsurance, unlike credit, is that expected correlations with traditional capital markets should not be impacted by the different risk levels/implementations. This allows us to keep a constant correlation assumption while varying the expected return and risk levels based on the implementation.

For the purposes of this paper, we will provide a framework to use when developing expected returns and risk assumptions and analyzing reinsurance within the context of a total portfolio allocation. We will keep this relatively simple, as this could be an entire paper in and of itself. Moreover, we will focus on private reinsurance/ILS funds as that is Meketa's recommended implementation.

For expected returns, there are four metrics to examine: 1) current publicly traded catastrophe bond yields, 2) historical returns of catastrophe bonds and/or reinsurance strategies, 3) current market pricings/premiums and historical loss rates, 4) manager expectations. These metrics typically range from the low single digits (e.g., 3% cat bond yield) to the mid-teens (e.g., 15% target returns for the riskiest private reinsurance strategies). In general, however, most of these metrics will point to an expected long-term return in the 4-8% range (in excess of cash)[19] for commonly used private reinsurance funds.

[19] In order to approach the higher end of this range, a considerable amount of additional downside risk is typically taken on in the strategy.

For expected risks, it is very important to use as forward-looking metrics as possible. Since reinsurance exhibits truncated upside potential and a significant left tail, historical data may not be the most indicative of the level of risk. For example, specific catastrophe bonds have exhibited de minimis drawdowns and volatility levels by pure chance simply because the underlying events/triggers did not occur (e.g., they were high severity but low probability events). This does not mean that there was no risk embedded in those securities, however. Luckily, private reinsurance funds are typically constructed based on a 99% value-at-risk ("VaR") level (i.e., a 1 in 100 event loss). Managers use very similar, if not identical, tools to estimate these levels.[20] While a normal distribution does not perfectly align with the return outcomes of reinsurance/ILS, we can use a z-score methodology to back into an expected volatility level for simplification and framing purposes. For example, if we assume a given fund has an expected return of 6% and a commonly referenced 99% VaR level of -25%[21], we can estimate an expected volatility of 13.3%.[22]

[20] While the tools are similar, managers will modify certain inputs and parameters based on their viewpoints and research. This is similar to how public equity managers use systems such as BARRA and Axioma, among others.

[21] In this instance, we are removing the dollar value in the VaR metric. These levels often range from -20% to -50% for ILS funds of different risk levels.

[22] 99% (or 1% depending on frame of reference) VaR is 2.33 standard deviations away from the mean.

$$6\% - 2.33 \times 13.3\% = -25\%$$

An interesting observation is that this return/risk ratio is very similar to other asset classes with expected volatilities close to this level (e.g., high yield debt, equity option put-writing, etc.). Once again, due to the truncated upside potential and significant left tail exposure, traditional mean-variance optimization, and corresponding volatility metrics, are not the most optimal methods/metrics for examining ILS strategies. With that said, using a z-score methodology for backing into an expected volatility is useful for obtaining a high-level grasp of the relative "riskiness" of ILS strategies. The takeaway from the example above is that the example ILS fund is fairly risky and expectations should be managed in a similar fashion as those of high yield bonds, for example. Additionally, the distribution of ILS fund returns can vary based on a given fund's design. The probability and severity of the underlying risks can vary significantly, and this adds another challenge to incorporating ILS into a portfolio optimization and/or expected return/risk exercise.

The decision to include reinsurance in a total portfolio should only come after one gains a solid understanding of its intricacies and as part of a comprehensive asset allocation optimization exercise. Due to the relative stability of its correlation to other asset classes, however, one can use a very simple framework[23] to determine if adding reinsurance to a portfolio would improve its Sharpe Ratio. In particular, if the following is true, adding reinsurance can prove beneficial:

$$S_i > S_p \times \rho_{i,p}$$

Where:
S_i = Sharpe Ratio of reinsurance
S_p = Sharpe Ratio of the existing portfolio
$\rho_{i,p}$ = correlation between reinsurance and the existing portfolio

Considering that a fundamental underpinning of reinsurance is its lack of correlation to traditional investment strategies, it could have nearly any positive Sharpe Ratio and its inclusion would improve a portfolio's Sharpe Ratio. While very few institutional investors seek to solely maximize the Sharpe Ratio of their portfolio, the fact that reinsurance/ILS exhibits an expected return in between traditional stocks and bonds while also exhibiting near zero correlation to both implies that its inclusion can be beneficial from a risk/return standpoint while maintaining a similar expected return of the total portfolio. As discussed earlier, the decision to include reinsurance in a total portfolio should only come as part of a comprehensive asset allocation exercise.

Summary and recommendation

Insurance is one of the world's oldest and most consistently profitable industries. With insurance-like transactions occurring for hundreds (if not thousands) of years, insurance has history and economic intuition supporting its continued existence. Insurance represents a crucial part of the global economic system that can improve economic growth by spreading risk and minimizing the risk of ruin. This service, however, is not free, but both insurance sellers and buyers can be considered rationale economic actors, reinforcing insurance as a foundation of a developed society.

Insurance-linked securities (i.e., reinsurance) is a unique asset class that generally derives its return and risk from property damage insurance contracts related to natural catastrophes. Most commonly described as insurance for insurance companies, reinsurance/ILS generally provides a moderate level of return whose risk sources are completely unrelated to the traditional capital markets. As a private market, reinsurance has various intricacies that must be fully understood, but it represents an illiquid diversifying strategy that can enhance the risk-return tradeoff of most any portfolio.

[23] This uses mean-variance analysis/ preferences. In practice, investors should utilize multi-parameter optimization approaches that are customized to their situation.

Meketa believes that insurance-linked securities represents an attractive asset class to generate a moderate level of return with tremendous diversification benefits. As a moderately illiquid class, however, investors need to consider its inclusion within their broader liquidity budget. Additionally, due to the annual variation in policy premium levels and the potential for severe left tail events (which will need to be recouped), investors should only invest in reinsurance/ILS if they are willing to stick with the strategy for periods of at least 5-10 years.

Moreover, the asset class's relevance for investors can vary. Investors that are too large may run into sizing issues, unlikely to allocate enough to the class for it to be meaningful, whereas small institutions that are inexperienced with private markets classes may not have the resources to properly manage and oversee the strategy. For institutional investors that are willing to accept the complexity, modest returns, and relatively small market size, we believe that an allocation of 2%-7% to reinsurance may be worthwhile.. When combined with other diversifying strategies (relative to equity-like investments), reinsurance can help create a more efficient portfolio.

Appendix

Contract basics

This section provides basic information on two key elements of standard private reinsurance contracts: 1) issuance and 2) risk type.

Similar to home or automobile insurance, reinsurance is an insurance policy that is in effect for a specified amount of time (typically one year) and must be renewed. One of the unique features of reinsurance is the renewal periods, which are detailed in the table below:

	January	Majority of global transactions are renewed.
	February	
	March	
	April	Most Japan transactions are renewed.
	May	
Hurricane Season	June	Most US wind and Australia/New Zealand transactions are renewed.
	July	
	August	
	September	
	October	
	November	
	December	

As detailed above, there are three major annual renewal periods: January 1st, April 1st, and June/July 1st. With a standardized renewal cycle (both traditional reinsurers and ILS funds participate at the same time), reinsurance is able to create a more efficient marketplace for sellers and buyers to transact. With that said, once reinsurance contracts are bought/sold (i.e., risk is transferred from a cedant to a reinsurer), the contracts are effectively illiquid. While there may be mechanisms to reduce certain exposures (e.g., retro, ILWs, etc.), most reinsurance will be held until expiration, at which point, the same contract is commonly renewed the following year. This liquidity characteristic is the primary reason why ILS funds generally have quarterly (at best) liquidity. ILS funds commonly obtain liquidity by waiting for renewal periods, holding cash, or buying/selling catastrophe bonds or quota shares. Additionally, due to the unique renewal cycle, ILS funds must re-create regional exposures at the major renewal dates.[24]

[24] This also poses a challenge for new funds entering the market – they cannot get exposure to all regions/perils at inception. Due to this, most new funds will use quota share engagements to obtain a diversified portfolio on day one.

Another important element of the issuance process is how the transactions actually occur. It is not an exaggeration to state that reinsurance is a relationship business. Reinsurance will typically flow through a broker of some kind, but ILS funds may also be able to source transactions directly from cedants, via quasi-marketplaces (e.g., Lloyd's Syndicate), or via other partnership mechanisms, including direct insurance programs[25]. A vital element for successful ILS funds is deal flow, which manifests itself via relationships, reputation, and operational infrastructure (e.g., direct insurance programs).

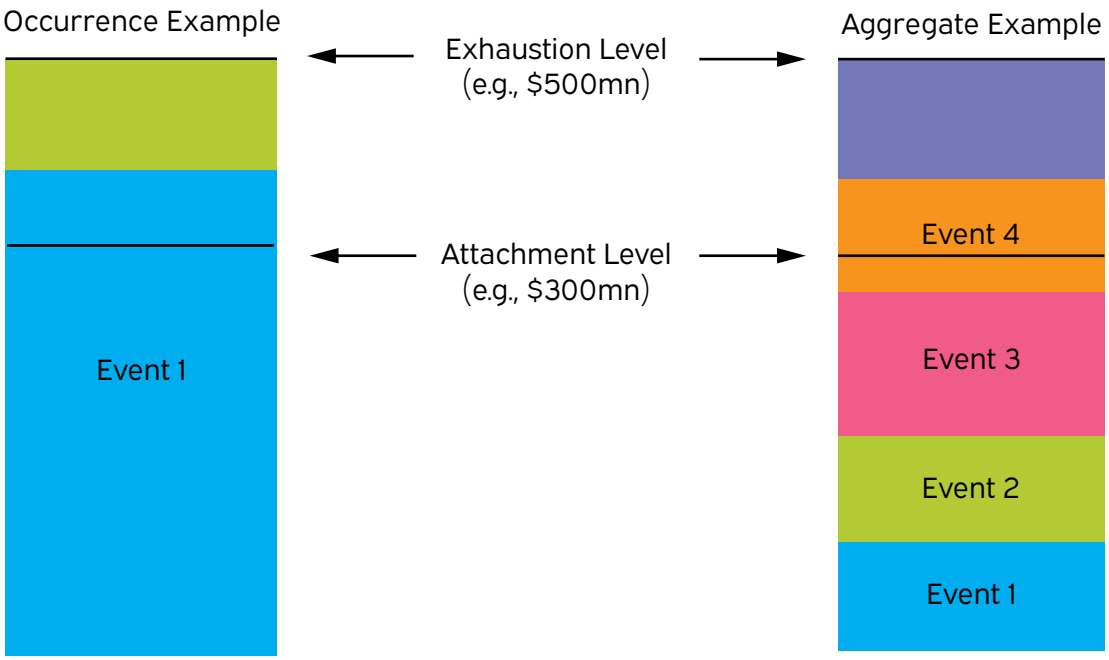
[25] With direct insurance programs, ILS funds are able to go straight to the underlying policyholder, bypassing the original insurer/cedant and, thus, obtaining a higher portion of the premium. This mechanism requires additional operational infrastructure and relationships (e.g., fronting) that are beyond the scope of this paper, but this is a key area of growth for ILS funds at the moment.

A second important element of reinsurance contracts is the risk type.[26] At a high-level, this can be separated into proportional vs. non-proportional risks. For proportional risks (e.g., quota shares), risk is shared on a proportional basis where premiums and losses are distributed pro rata. For non-proportional reinsurance, risk is shared based on a specified threshold (i.e., once claims reach a level, the reinsurer bears 100% of the exposure up to a limit). A close analogy for non-proportional reinsurance is that of tail risk protection (with a limit).

[26] There are additional "types" of risk (e.g., facultative vs. treaty) that could also be described, but proportional vs. non-proportional is a common area to compare/contrast.

Non-proportional risk is generally broken up into two groups: aggregate and occurrence. The basic difference is that aggregate contracts cover multiple events that occur within a window whereas occurrence contracts only cover one event/risk (with an agreed upon definition)[27]. It is important to note that as a private market, there is a high degree of customization that can occur. The graphic below pictorially describes these variants. The "attachment level" can be thought of as a deductible and the "exhaustion level" can be thought of as an upper threshold amount. The maximum loss for a given reinsurance contract is the difference between those two amounts and is called the notional limit.

[27] For the purposes of this paper, we do not discuss per risk vs. per event differences.



Additionally, if contracts hit their limits or otherwise expire (e.g., a single event exceeds the attachment level but does not hit the exhaustion level), there is a mechanism for cedants to renew/continue their coverage. This is referred to as the "reinstatement clauses" in the contracts and can be significantly customized.

Geographic/peril exposures

Despite the fact that certain security types are held within publicly traded assets (i.e., cat bonds), reinsurance is a private market. As a private market, obtaining accurate and up-to-date market-level data is challenging. This issue is exacerbated even further by the fact that contracts are relatively short in maturity, the insurance industry is continually changing, and reinsurance is technically "derived" from another private market: direct insurance. Given all of these caveats, it is still useful to explore data that is indicative, even if not precise, of the aggregate market.

There are degrees of granularity that can be explored, but for the purposes of this paper, we will focus on the highest levels: geographies and perils. While not exactly analogous to market capitalization, one can examine "economic losses" and "insured losses" to gauge the potential size of various insurance/reinsurance markets. Economic losses represent the total amount of damage incurred in a given area for a given peril, and insured losses represents the subset of that which was covered by insurance (and potentially by reinsurance). These figures will differ from what is actually transacted in the reinsurance market, but nonetheless, they provide indications of the aggregate natural catastrophe insurance market. The graphic below provides estimated economic and insured loss data for the last decade (2010-2019) across major regions and perils.

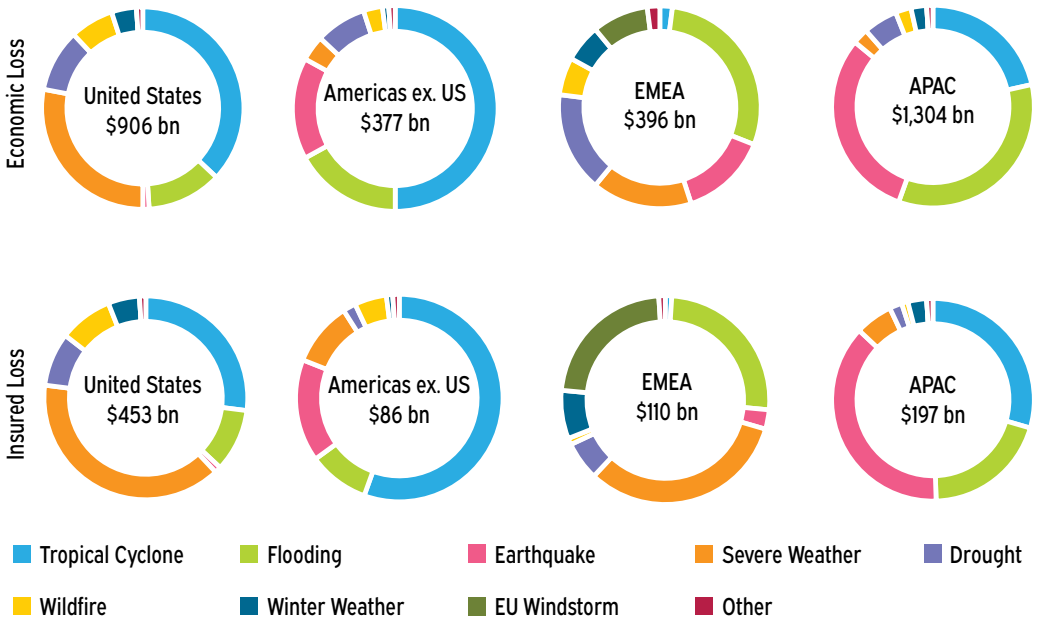


CHART 6
Economic and Insured Losses (2010—2019)

Source: Aon plc

There is a variety of general takeaways from the graphic above:

- The types of perils that impacted the different regions are aligned with what one would expect given their geographies.
- Tropical Cyclone (i.e., Hurricanes and Typhoons), Severe Weather, and Flooding were the dominant events across the globe.
- While insured losses generally resembled the economic losses on a peril percentage basis, there were slight variances in certain regions (e.g., minimal earthquake insured losses compared to economic losses in EMEA).
- The US is better insured than the rest of the world. Roughly half of the economic damage was insured over this time period.
- The APAC (Asia-Pacific) region had the largest economic losses but was significantly underinsured ($197bn in insured losses vs. $1.3tn in economic losses) compared to the US. This equates to only a 15% insurance penetration rate.
- For both the Americas (ex. US) and EMEA (Europe, Africa, and the Middle East), only about 25% of the economic losses were insured.
- The economic losses in the EMEA (Europe, Africa, and the Middle East) region were fairly diverse (as expected given the geographic diversity of the region).

Additionally, in regions where insurance penetration is low (e.g., developing Asia, Africa, etc.), there can be a significant drag on economic growth, as these costs are then shared across governments and individual entities (i.e., households and companies). This provides further support for insurance/reinsurance as a societal benefit and an important element of economic growth.

We can also examine how many natural disaster events occurred over time in the various regions. This measure partially normalizes the regions for property values and other variations. The graphic below details the number of natural disaster events that meet all of the following qualifications:

- Economic loss = $50+ million (inflation-adjusted)
- Insured loss = $25+ million (inflation-adjusted)
- Fatalities = 10+
- Injured = 50+
- Structures damages/filed claims = 2,000+

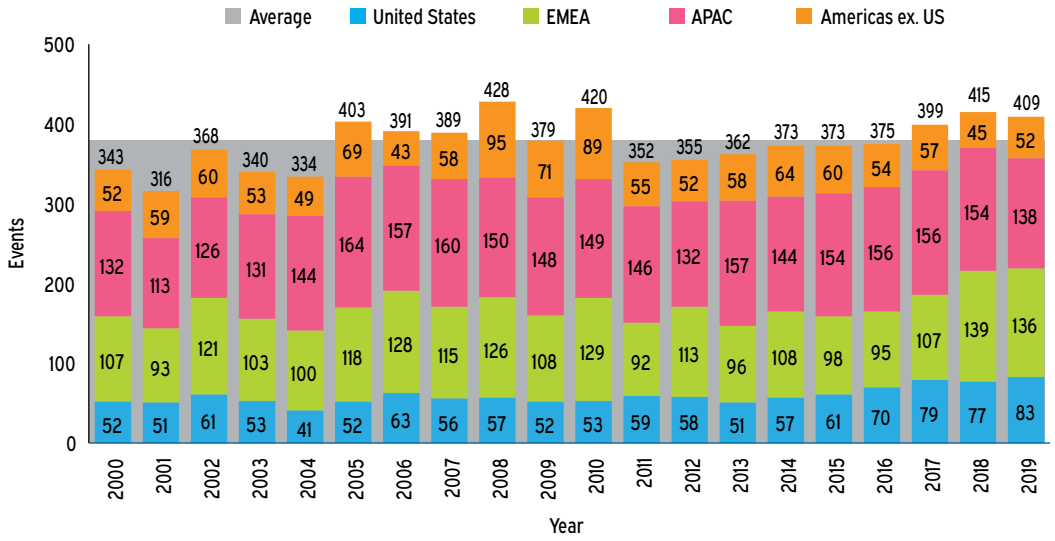


CHART 7
Global Natural Disaster Events

Source: Aon plc

As detailed in the graphic above, the number of events that have occurred across the globe has been somewhat stable in aggregate, but regions have experienced material variation. For example, the United States experienced a material increase in the 2016-2019 timeframe compared to earlier in the 21st century. This metric can be compared/contrasted with the number of billion dollar economic losses (inflation-adjusted) across the globe as shown below.

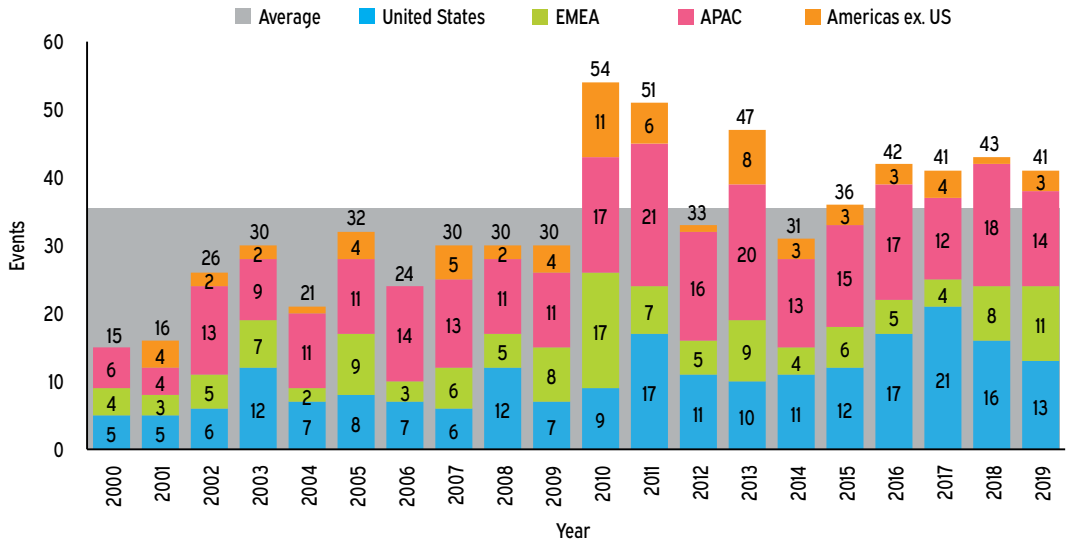


CHART 8
Global Billion Dollar Economic Loss Events

Source: Aon

When examining the *Global Billion Dollar Economic Loss Events* graphic, there is an obvious trend that large-scale economic losses have been increasing over the last twenty years. Reconciling this takeaway with the fact that the total number of global natural disaster events has remained relatively stable over this same time period leads to three major takeaways (i.e., hypotheses):

1. The magnitude of events have increased.
2. Infrastructure development and/or migration to more susceptible areas (e.g., coasts) has increased.
3. Real property values have increased.

The takeaways above are widely accepted by the insurance/reinsurance industry and are key elements to their decision-making processes. While the purpose of this paper is not to dive into climate change as a topic, this is a significant point of interest for the insurance/reinsurance industry. The widely accepted industry view is that climate change is occurring and vendors are adapting their models and policy pricing accordingly.

Security types/market segments

An ILS portfolio can consist of a variety of security types. These often range from publicly traded catastrophe bonds to privately negotiated sidecar structures. We define the most common security types (i.e., implementations) below:

- **Publicly traded reinsurance companies** Several of the world's largest reinsurance companies (e.g., Swiss Re, Munich Re, etc.) are publicly traded corporations. As such, certain ILS funds may include their common stock (or debt) as holdings within a portfolio. While their revenue, operations, and profits are derived from the reinsurance industry as a whole, there is a large equity market beta component in their returns (i.e., commonality with traditional equity portfolios) that negates most perceived benefits. Meketa does not believe that these securities should be utilized within a client's ILS portfolio as they increase its correlation to traditional markets by definition.
- **Catastrophe bonds ("cat bonds")** These securities are publicly traded debt instruments that are typically created by insurance/reinsurance companies to cover certain risks. In-line with the SPV structure shown previously, the collateral and premiums are held at a separate entity and invested in money market-like investments. The cat bond investor receives a coupon payment (typically a floating rate) and will receive the principal back when the bonds expire. If there are claims, the collateral account will decline and the principal value will decrease. The bonds are commonly three years in maturity.
- **Sidecars** These legal structures allow insurers/reinsurers to separate specific exposures into a separate entity. This separate entity can be used to aggregate risk capital from different entities or simply isolate certain exposures (e.g., impaired policies).

- **Quota share** An agreement in which risk is shared across multiple entities. This is a form of proportional reinsurance where the parties share premiums, losses, and costs of a specific reinsurance portfolio. Quota shares are commonly used in funds that want to gain quick access to an existing portfolio or hard-to-access exposures.
- **Industry loss warrants ("ILWs")** These are derivative contracts that provide payoffs based on losses across the entire insurance industry, although they are customized to specific regions and perils. The contracts contains specific parameters (i.e., triggers) that are then measured by widely accepted third-party entities. Like all reinsurance, these can be highly customized and can include payoffs during and/or after events have occurred.
- **Private collateralized reinsurance** This is the most common security type and what most practitioners refer to when discussing the asset class. These privately negotiated contracts utilize the SPV structure that was previously discussed, and while similar to cat bonds in structure, they are typically only one year in maturity.
- **Retrocessional reinsurance ("retro")** This is simply reinsurance for reinsurance companies. Retro represents an additional transfer of risk from the second cedant to a third reinsurer.

Example resinsurance contract metrics and outcomes for California earthquake

Notional limit = $10 million

- One-year maturity for single event earthquake damages within a specified region in CA

Attachment = $30 million | Exhaustion = $40mn

- Event loss less than $30mn = nothing paid
- Event loss greater than $40mn = $10mn paid
- Event loss $30mn-$40mn = pro rata $0-$10mn paid

Expected Return Calculation

Premium paid	= $2.8mn
Collateral posted = $10mn - $2.8mn	= $7.2mn
Expected loss (based on models)	= $1.0mn
Expected profit = $2.8mn - $1.0mn	= $1.8mn
Cash return on collateral + premium = $10mn * 1%	= $0.1mn
Expected return = ($1.8mn + 0.1mn) / $7.2mn	**= 26.4%**

Risk utility thought experiment

The below describes a basic thought experiment for this concept:

- Suppose one has been offered to participate in a game where the payoff is based on the flipping of a fair coin. If it is heads, the player wins $100, and if it is tails, the player wins $0.
- Since there is a 50% chance of landing on either side, the expected value (i.e., the statistical average payoff if one were to conduct this experiment over and over again) is $50 (50%*$0 + 50%*$100 = $50).
- Now, suppose the same individual was offered the choice between: 1) a guaranteed payoff or 2) the chance to play the game. At what value would someone be indifferent between the two? That depends on their risk preferences.
  - A risk averse individual would be willing to accept a guaranteed payment less than $50 rather than potentially receiving nothing by playing the game.
  - A risk neutral individual would be indifferent between a guaranteed payment of $50 compared to playing the game.
  - A risk seeking individual would require a payment more than $50 in order to not play the game.
- This same game can be reversed with the following parameters. If it is heads, the player loses $100, and if it is tails, the player loses $0.
- In this game, the expected value is -$50 (50%*$0 + 50%*-$100 = -$50).
- Similar to the prior game, is there a value at which individuals would be indifferent between paying versus playing the game? This also depends on their risk preferences.
  - A risk averse individual would be willing to pay more than $50 (i.e., accept a known loss more than $50) rather than potentially losing $100.
  - A risk neutral individual would be indifferent between a guaranteed loss of $50 and playing the game.
  - A risk seeking individual would only pay less than $50; otherwise they would play the game.

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