

The Changing Nature of Risk





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Executive Summary

The global risk landscape is changing rapidly. cursory glances at studies conducted over the last decade on the risks that have commandeered businesses' and (re)insurers' agendas show that economic concerns dominated 10 years ago (at the height of the financial crisis) while technology, extreme weather and climate change prevail today. The last two factors in particular should come as no surprise given the number of catastrophes that devastated communities worldwide in 2017 and 2018.

The accumulation of losses from a range of diverse perils during this time has brought an end to years of soft (re)insurance market conditions. The series of hurricane and typhoon strikes in the United States (2017/2018) and Japan (2018) cost the sector tens of billions of dollars. Although the loss potential associated with such "peak" peril events is monitored closely by risk carriers, the emergence of complex loss components for most of these storms has surprised the market as losses continue to develop adversely. Costs for "non-peak" perils have also made a significant contribution to industry losses, with unprecedented wildfire costs in California being the most arresting.

Ominously, the specter of climate change points to a future that will see only more frequent and severe weather events. Risk models will need to be recalibrated to accommodate this. If the last two years provide any sort of template for what can be expected in years to come, loss development for major events will be uncertain and the scale and severity of "attritional" perils will accentuate protection gaps. This raises important questions about insurability and relevance in the long term.

Technology is another factor that looks set to reshape the risk landscape over the next decade. The magnitude of change associated specifically with digitalization is huge: The way people live, relate and work is being revolutionized, and virtually every industry is being impacted. Equally important, increased loss frequency and severity in a number of long-tail business lines are starting to squeeze carriers' margins as social inflation appears to be driving loss cost trends higher. This is significant because the casualty market has been the main catalyst of nearly all past market turns and it comes at a time of diminishing reserve redundancies.

Given this challenging backdrop, it quickly becomes apparent why the sector is now undergoing a period of transition. Fortunately, the reinsurance market is strongly positioned to support insurers through this period of change. Capitalization is key to this position of strength. Although capital inflows into the reinsurance sector have slowed this year as loss experiences have deteriorated, reinsurers' desire and ability to underwrite risks remain healthy overall. Crucially, the sector has more than sufficient levels of capital relative to risk: Capacity was still adequate during this year's mid-year renewal season, even as underwriting assumptions were adjusted to reflect the changing nature of risk.

Based on recent market behaviors, a more sophisticated and tailored approach to renewals is likely to prevail over the volatile and often indiscriminate reinsurance rate movements of the past, as reinsurers scrutinize cedents' performance and loss experiences and allocate capacity accordingly. By working closely with their reinsurance and intermediary partners, insurers can minimize earnings volatility, reduce capital requirements, improve solvency and, ultimately, innovate and grow — crucial attributes when looking to manage and prosper in an increasingly complex risk environment.

The impending degree of change that is to come over the next decade looks set to transform the risk landscape like never before. Guy Carpenter is uniquely positioned to support clients through this process. By applying best-in-class analytical tools and creating innovative and bespoke solutions, we are committed to obtaining the best cover and structures available in the marketplace.

Ominously, the specter of climate change points to a future that will see only more frequent and severe weather events. Risk models will need to be recalibrated to accommodate this.

Key Takeaways from Our Research

1. The accumulation of losses from a range of diverse natural catastrophe perils in 2017 and 2018 has brought an end to years of soft (re)insurance market conditions. This is not down only to the quantum of the losses, as demonstrated by the initial muted pricing response in 2017 and 2018. The magnitude of loss creep for virtually every major peak peril loss sustained in the last two years has surprised the market, and losses continue to develop adversely. As a result, carriers have reassessed their views of risk over the last year or so.
2. Costs for non-peak perils have also made a significant contribution to industry losses, with unprecedented wildfire costs in California being the most arresting. Insured losses from wildfire activity in California in both 2017 and 2018 surpassed the combined costs of any previous decade: A striking statistic. Such outsized losses are not commensurate with a view of risk that has traditionally considered wildfire to be an attritional or secondarily peril.
3. The specter of climate change points to a future that will only see more frequent and severe weather events. Excessive rainfall and rising sea levels clearly bring an enhanced threat globally for more frequent and severe freshwater and coastal flood events. And sustained trends around increased wildfire activity and stalling hurricanes are thought to potentially have some link to the changing climate.
4. Risk models, already under scrutiny due to loss creep and spiraling costs from attritional events, will need to be recalibrated to better understand the risk potential associated with these exposures. If the last two years provide any sort of template for what can be expected in years to come, loss development for major events will be uncertain and the scale and severity of attritional perils will accentuate protection gaps.
5. It is not just about natural catastrophes. Digital technology is another factor that looks set to reshape the risk landscape over the next decade. A world driven by software is going to change everything. The bad news is that a number of innovations rely on legacy software that may be outdated or “rushed to market” for which cyber security is often a distant afterthought.
6. Equally important, increased loss frequency and severity in a number of long-tail business lines are starting to squeeze carriers’ margins as social inflation appears to be driving loss cost trends higher. This is significant because the casualty market has been the main catalyst of nearly all past market turns and it comes at a time of diminishing reserve redundancies.
7. How the risk landscape evolves from here will be pivotal in shaping the future of (re)insurance. Insurability is likely to become a key challenge for the sector as there is a dearth of data and modeling solutions for many new exposures. There are even questions around the insurability of some established risks such as extreme weather events, given that the long-term trends associated with climate change remain difficult to measure, predict and, ultimately, model.
8. Whatever the future holds, reinsurance will be an important part of the solution. Reinsurance exists to protect against the unexpected. The expertise, support and partnership on offer empower insurers to innovate and grow. By working closely with their reinsurance and intermediary partners, insurers can minimize earnings volatility, reduce capital requirements, improve solvency and, ultimately, innovate and grow — crucial attributes when looking to manage and prosper in an increasingly complex risk environment.



(Re)insurance Resolve

Today’s complex risk landscape poses both opportunities and challenges to the (re)insurance sector. At several forums this year, senior Marsh & McLennan Companies leaders have described the world as being in a constant state of VUCA – volatility, uncertainty, complexity and ambiguity.

Extreme weather, climate change, water scarcity, unfunded social liabilities, cyber security, artificial intelligence (AI) and robotics have been identified as the “risks of our age.” Perhaps not coincidentally, all this is unfolding at the same time that major global political upheaval challenges the established, postwar international order.

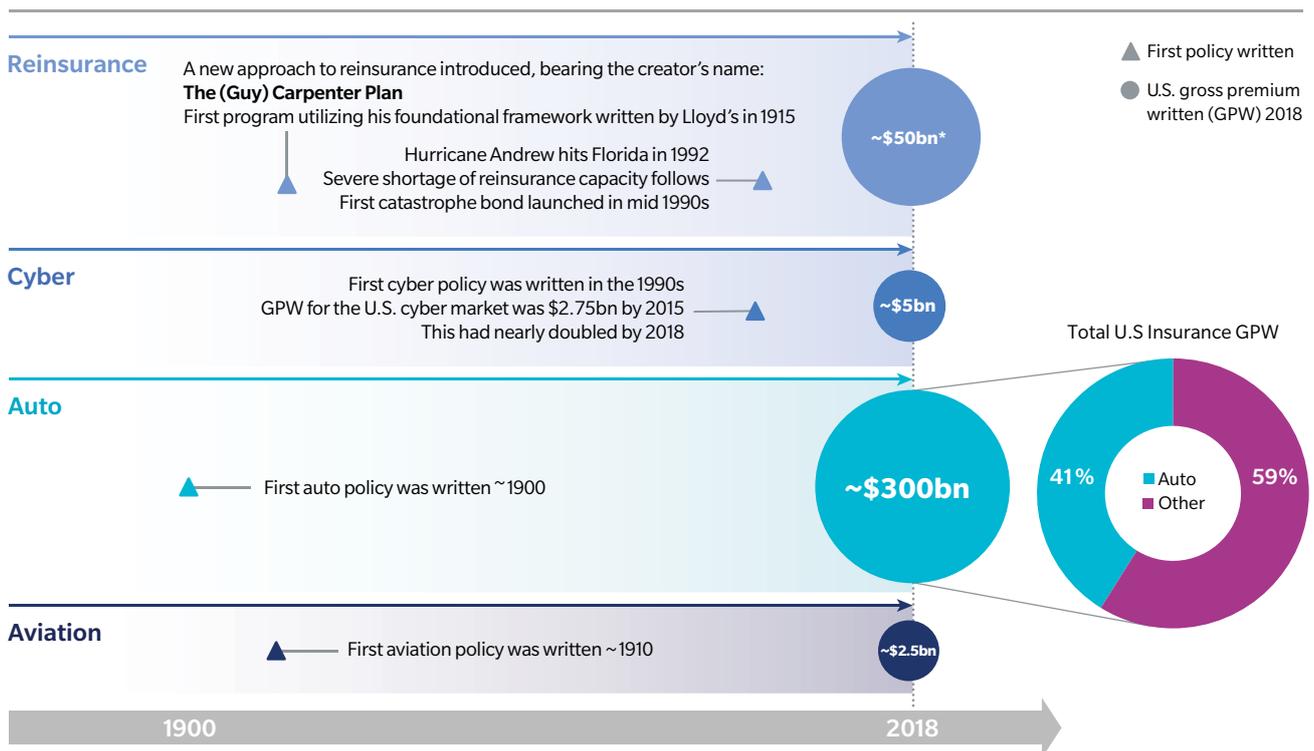
Societies and economies are being transformed by these developments. Technology has reinvented the way people live, work and communicate, while the digital revolution is radically changing the nature of risk within the commercial world. The tangible impact of climate change may be more contentious, but weather extremes and the loss development associated with recent natural catastrophe events (such as Hurricane Irma in 2017, Typhoon Jebi in 2018 and consecutive years of unprecedented wildfire losses) underscore how risks, even those that are thought to be well understood and modeled, have the potential to surprise.

Value of (Re)Insurance

This heightened state of flux only elevates the importance of (re)insurance. Clearly, the risk transfer sector will need to adapt in order to keep pace with the fast-changing world and to meet clients’ changing expectations. In such a delicate, competitive environment, the balance between possibility and disruption will be decided by how risk carriers choose to confront this new world order.

Fortunately, the sector has a strong track record in responding to periods of change. Transformative events have led to (re)insurance product innovation many times before, starting with marine insurance in the 1700s. Exhibit 1 illustrates how this trend continued in the 20th century, as new forms of transport in the early 1900s were followed quickly by the creation (and dramatic growth) of new insurance markets. The reinsurance market has also seen important innovations over the last 100 years. Cyber is the latest example of the risk transfer sector responding to evolving and complex risks, even if more work needs to be done in providing the coverage clarity buyers require.

Exhibit 1: Important Developments and (Re)insurance Innovation



*Excess of loss

Source: Guy Carpenter, SNL, The Betterley Report

The relationship between economic progress and (re)insurance innovation bodes well for coverage adaptation at this time of risk evolution. It also reinforces the crucial role (re)insurance plays in encouraging invention and enabling risk-taking. No sector benefits modern economies and societies more than (re)insurance. At its core, (re)insurance facilitates enablement and creation: without it, there would be no investment, no movement or no advancement.

Resilience would also be significantly reduced without (re)insurance. The protection element allows policyholders to go about their business without fear of the financial consequences when the unexpected happens. Today, insurance protection is available to cover virtually any type of risk. The considerable size of the insurance market continues to grow as a result, with global non-life premiums rising to approximately USD 2.4 trillion in 2018.¹

Market Cycles

Despite the premium base of the non-life reinsurance market being less than one-tenth the size of the primary market, it has long played a crucial role in supporting the capital efficiency and solvency of its larger counterpart. By deploying reinsurance strategically, insurers can reduce capital requirements, improve solvency, minimize earnings volatility, write more business and, ultimately, pursue profitable growth — important attributes when looking to manage and prosper in an increasingly complex risk environment.

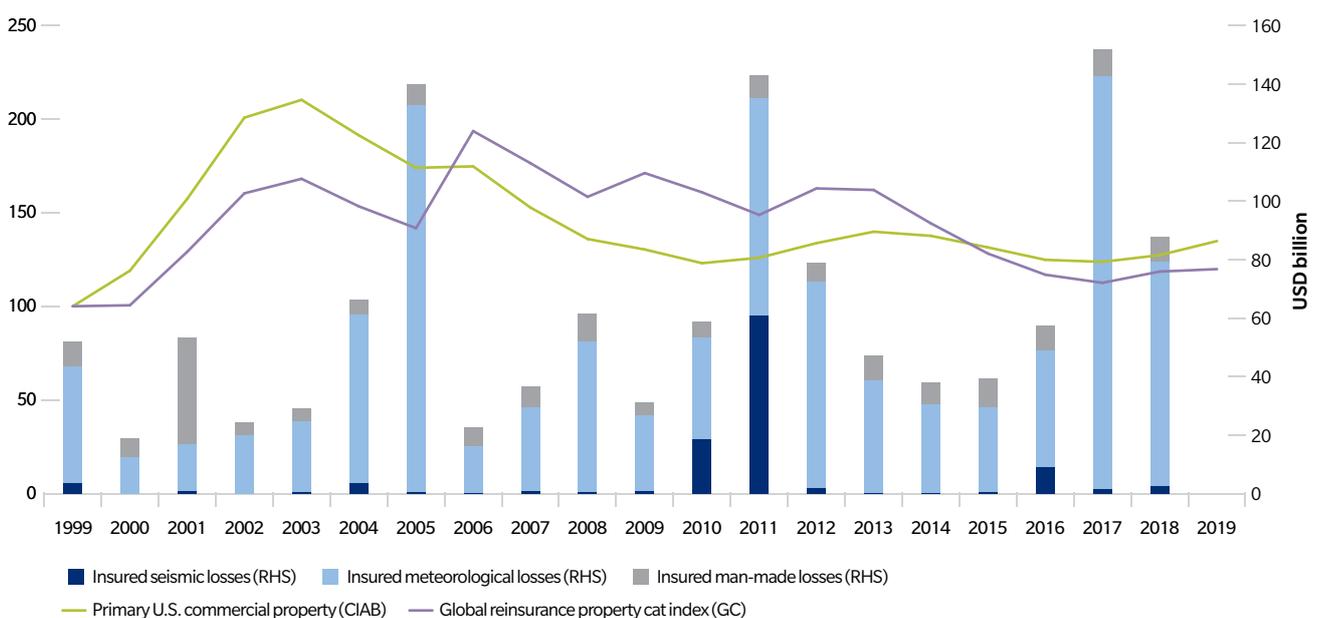
Reinsurance has been a reliable and efficient source of contingent capital for insurance companies through several different market

cycles. By absorbing major losses following exceptional and unforeseen events, reinsurance acts as a stabilizing force for cedents, thereby ensuring that insurance capacity is available at lower prices than would otherwise be the case.

This point is demonstrated by Exhibit 2, which shows primary and reinsurance pricing movements going back to 1999, as well as global inflation-adjusted insured catastrophe losses. Three key points emerge from this analysis:

1. Reinsurance pricing has predictably been more responsive to extreme catastrophe losses, although supply and demand dynamics have seen volatility decrease significantly in recent years, due in large part to the influx of new capital into the market — for example, the muted pricing impacts in 2018/2019 after the costliest two-year period ever for insured catastrophe losses in 2017/2018.
2. Insurance pricing has exhibited more stability over the last 20 years, reinforcing the point made earlier that reinsurance acts as an effective shock absorber for the primary market.
3. Factors such as reserving (in)adequacy and macroeconomic developments therefore play a more prominent role in driving primary pricing, although exceptional catastrophe events that challenge conventional views of risk are still capable of exerting significant upward pressure — for example, the terrorist attacks of September 11, 2001, which was exacerbated by the liability crisis between 2001 and 2005, as well as the dotcom equity market crash.

Exhibit 2: Reinsurance and Primary Pricing vs Global Insured Catastrophe Losses – 1999 to 2019²



Source: Guy Carpenter, CIAB, Swiss Re

1. World Insurance Report, Swiss Re (2019).

2. Data from the Council of Insurance Agents & Brokers (CIAB) has been used to show U.S. primary (commercial property) pricing, while reinsurance pricing is represented by Guy Carpenter’s Global Property Catastrophe Rate-on-Line index (which is updated annually at January 1).

Overcoming Shock Events

Both insurance and reinsurance pricing increased significantly in the early 2000s. The unprecedented, multi-class loss from the terrorist attacks of September 11, 2001, forced carriers to reset their perceptions of risk as unforeseen property, life and liability claims costs spiraled to more than USD 40 billion. It also led to the formation of several public-private terrorism backstops and pools to ensure continued coverage availability. Combined with the liability crisis, where years of technically deficient underwriting ultimately cost the sector hundreds of billions of U.S. dollars as reserve inadequacies were recognized belatedly, insurance and reinsurance pricing rose for four consecutive years. This was the most sustained period of firming in the last 20 years, and it also represented the high-water mark for insurance pricing during this time.

Hurricane Katrina also seriously challenged underwriting assumptions after its landfall, as rating agencies enforced stronger capitalization requirements for catastrophe risks. On this occasion, however, the impact on insurance and reinsurance pricing was bifurcated. Whereas reinsurance rates jumped substantially, the cost of insurance remained relatively stable overall. This once again reflected the nature of the event: The reinsurance market assumed the bulk of the costs for a well-protected hurricane loss, albeit one with costly and unexpected secondary consequences. As capital flowed from reinsurance carriers to insurance carriers during the claims settlement process, the replenishment of lost reinsurance capital was slow to occur for two key reasons: 1) Katrina's characteristics and magnitude of loss deviated from reinsurers' previous assumptions and 2) capital was less accessible in 2005/2006 as risk-takers took time to put new risk metrics into practice, creating a short-term, but significant, supply and demand imbalance. Insurance carriers' balance sheets also benefited from the release of redundant reserves into earnings at this time, as they recognized that loss picks during the post-liability crisis had been too high.

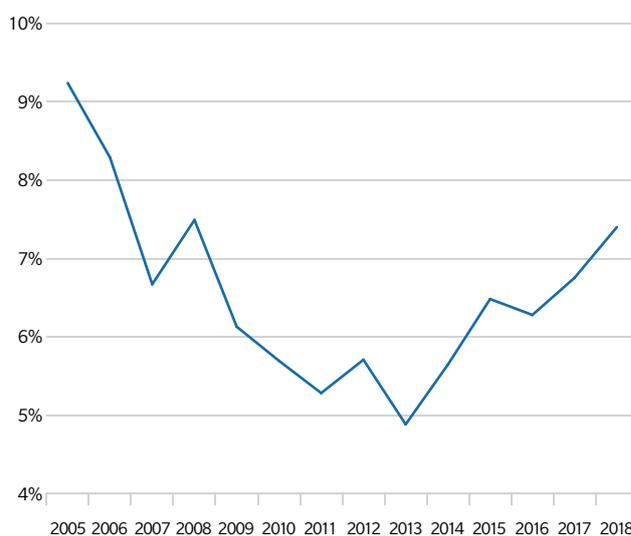
The role reinsurance has played in supporting insurers through periods of uncertainty is unsurpassed.

Even events in 2011 brought an element of surprise as diversification strategies were called into question by an exceptional cluster of expensive "cold spot" losses, including powerful earthquakes in New Zealand (Christchurch) and Japan (Tohoku), devastating floods in Thailand (nationwide) and Australia (Queensland) and the landfall of Cyclone Yasi (also Queensland). These events led to significant reinsurance pricing increases in local markets and a realization among retrocessionaires that exposures not previously considered needed to be priced into assumptions. Loss creep from all these events was also significant for the reinsurance market.

Buying Behaviors

The sector is therefore well versed at navigating market-changing events. The role reinsurance has played in supporting the insurance market through periods of volatility and uncertainty is unsurpassed. Exhibit 3 provides a snapshot of cedents' purchasing behaviors over the last 15 years. After ceded premiums reached a long-term cyclical peak in the early 2000s, demand for reinsurance fell for the most part during the post-KRW (Hurricanes Katrina, Rita and Wilma) decade as loss experiences were unusually muted, catastrophe reinsurance costs were high and several large carriers consolidated their reinsurance panels out of a desire to lower operational costs.

Exhibit 3: Simple Average Cession Rate of Global P&C Carriers – 2005 to 2018



Source: Guy Carpenter, Bloomberg

This trend started to reverse before Hurricanes Harvey, Irma and Maria (HIM) made landfall in 2017 as cedents started to reexamine their reinsurance purchases. Crucially, the cost of reinsurance had fallen significantly during this period, due in large part to a significant influx of new capital. This manifested itself in the form of new quota share programs, aggregate covers, excess-of-loss buy-downs, additional top-end coverage and adverse development covers.

Carriers with robust reinsurance protection benefited from reduced earnings volatility in 2017/2018. The devastating losses sustained during this time only accelerated demand. A number of buyers are therefore now ceding significantly more premium to the reinsurance market as they recognize that reinsurance offers a valuable and efficient form of capital, particularly during such volatile and uncertain times.



Future +

Technology +

System +

Corporate +

Strategy +

Connection +

Internet +

Location +

Plan +

Finance +

Innovation +

Future +

Engineering +

Employment +

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Economy

Changing Views of Risk

The ability of the reinsurance market to support insurance companies in offering the structures needed for today's (and tomorrow's) risk environment will be crucial to securing the sector's long-term relevance. Whether it be by alleviating some of the unexpected consequences of catastrophe losses, mitigating loss costs pressures in longer-tail lines or preparing for risks associated with climate change and technological disruption, reinsurance is an important part of the solution.

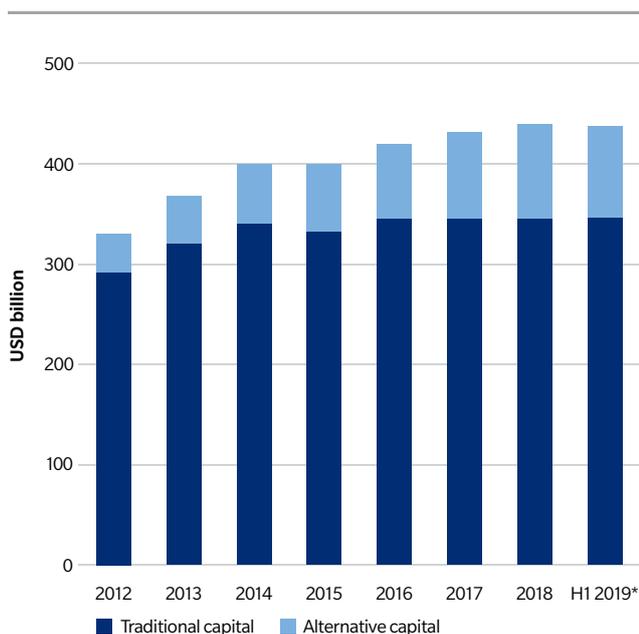
Reinsurance exists to protect against the unexpected. The expertise, support and partnership on offer empower insurers to innovate and grow. The sector is certainly well placed to do this today, even when acknowledging the challenges encountered in recent years and the magnitude of change that looks set to impact the market and broader economy over the next decade.

Capital

Capitalization is key to this position of strength. The reinsurance sector has been operating in an environment of plentiful capacity and abundant capital for several years now, with total reinsurance capital increasing by close to USD 110 billion, or a third, between 2012 and the first half of 2019 (see Exhibit 4).

Higher asset values, net reserve releases since 2006/2007 and, crucially, the entry of tens of billions of dollars of alternative capital into the sector have driven this sustained increase.

Exhibit 4: Dedicated Reinsurance Sector Capital – 2012 to H1 2019



* Estimated

Source: Guy Carpenter, A.M. Best

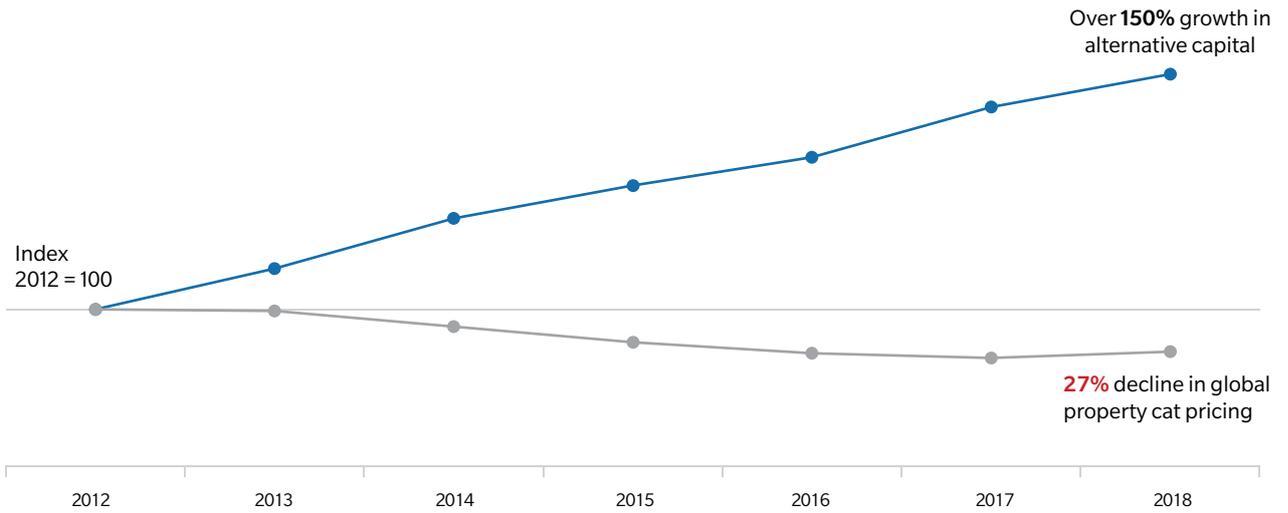
This asset manager and pension fund-provided capital started to flow into the sector more rapidly in 2011/2012 as yields on certain insurance-linked securities (ILS) reached as high as 12 percent, with expected losses as low as 3 percent. Such a proposition proved to be very attractive to investors in the wake of the global financial crisis, especially given its additional appeal of low correlations to other asset classes. It also coincided with an unusual lull in catastrophe loss activity prior to 2017.

This culminated in alternative capital rising by 150 percent between 2012 and 2018 and played a crucial role in driving down reinsurance pricing at the same time (see Exhibit 5 on page 13). It should also be noted that current alternative capital inflows represent only a small fraction of the volumes that could potentially arrive from the capital markets, although market conditions would, of course, dictate the opportunity to deploy additional capacity at acceptable risk parameters.

This goes a long way toward explaining the resilient market reaction to the record insured catastrophe losses of 2017 (of USD 150 billion). The sustained growth of alternative capital meant losses were spread more broadly across the reinsurance sector. And the ability of capital markets to reload so quickly after the largest loss year ever seemingly confirmed a structural change in how capital is provided to the reinsurance market, with third-party capital entering the sector post-loss to fill gaps more or less immediately.

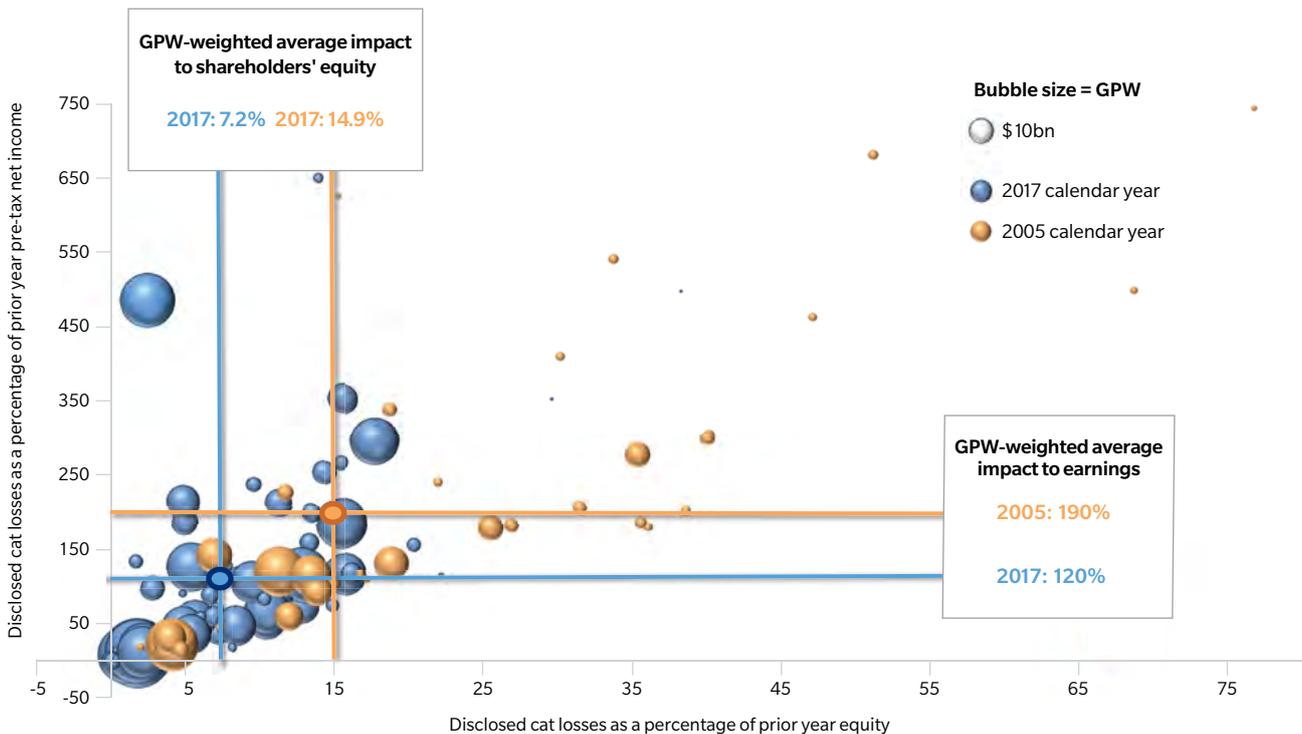
The strength of traditional carriers' balance sheets was also an important factor in minimizing market volatility post-HIM. Exhibit 6 provides a carrier-level comparison of the relative impact of catastrophe losses in both 2005 and 2017. It illustrates why KRW dislocated the property market, while HIM barely dented capacity availability: The GPW-weighted average loss to shareholders' equity was 14.9 percent in 2005 compared to 7.2 percent in 2017 — that is, more than double. With less divergent impacts to sector earnings, the key difference between the two periods was the relative amount of dedicated sector capital that was displaced by the catastrophes. After more than 100 percent growth in shareholders' funds in the 12 intervening years, only three carriers lost a quarter or more of their shareholders' equity in 2017 — compared to at least 18 carriers in 2005.

Exhibit 5: Alternative Capital Inflows vs Global Property Catastrophe Pricing – 2012 to 2018



Source: Guy Carpenter

Exhibit 6: Impact of Catastrophe Losses on Major Carriers – 2005 vs 2017



Source: Guy Carpenter

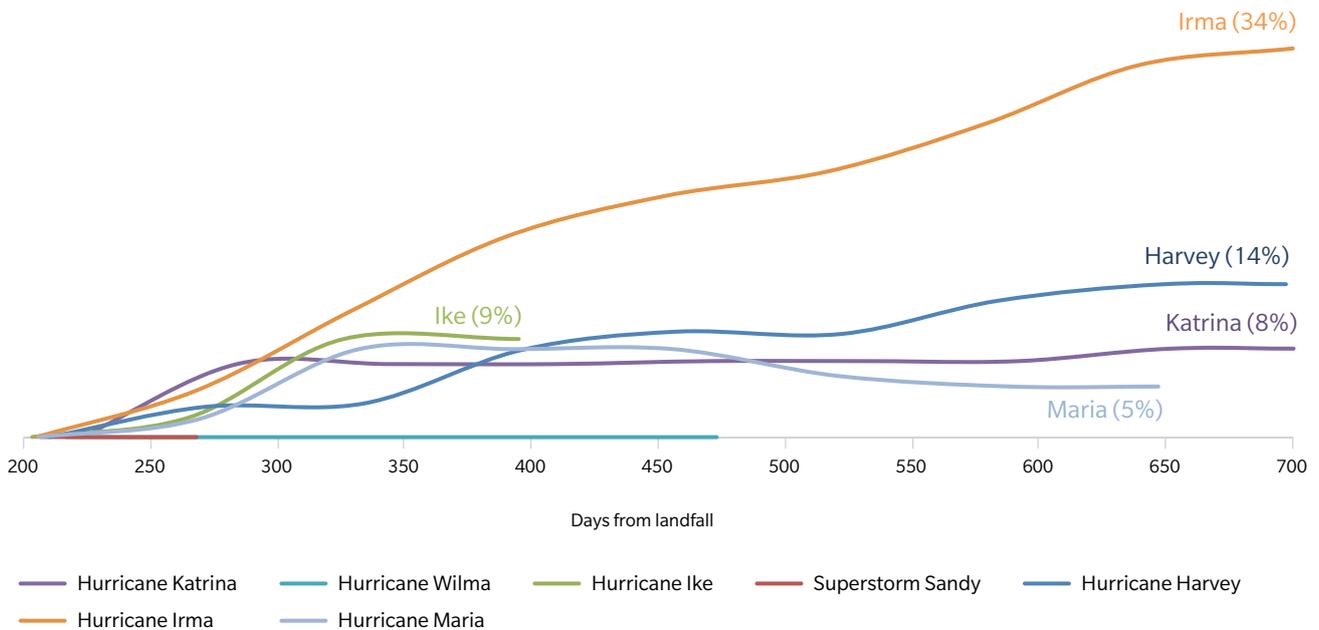
Risk Perceptions: Peak Perils

Given the reinsurance sector’s healthy capital position, conditions remain favorable to cedents as they look to innovate and pursue more profitable business. This is a market that has matured materially since the days when large catastrophes created massive price volatility. But as demonstrated by developments over the last 12 months, events that challenge underwriting risk assumptions can still impact capacity deployment.

Reinsurers operating in the Florida market, for example, have reassessed their views of risk to reflect increased social inflation costs associated with Hurricane Irma. Due in large part to complex (and longer-tailed) loss drivers such as loss adjustment expenses (LAE) and assignments of benefits (AOB), no other hurricane loss in recent history has developed adversely to the duration and extent of Irma (see Exhibit 7). In fact, loss creep from Irma, as well as other 2017 losses, has been one of the more significant “events” to impact the sector over the last year or so, with reinsurance carriers incurring the bulk of the incremental costs.

There was no respite for the sector after additional insured catastrophe losses in 2018 came to approximately USD 90 billion, the fourth-highest figure ever in real terms. This included Typhoon Jebi, the strongest typhoon to hit Japan in 25 years, and yet another prominent example of adverse development that has seen losses end up significantly higher than initially expected. Most insurance and reinsurance carriers have been forced to increase loss provisions for Jebi by meaningful levels this year, and, as a result, it has become one of the largest events to hit the market so far in 2019. Creep from Hurricane Michael has exacerbated the situation. Even though the storm only made landfall in the Florida Panhandle in October, and there was severe property damage in affected areas (potentially resulting in less scope for AOB claims), estimates from PCS at the time of writing show losses have developed adversely by approximate 45 percent from initial expectations.

Exhibit 7: Claims Development for Costly North Atlantic Hurricanes – 2000 to 2017³



Source: Guy Carpenter, PCS

3. This graphic uses data from Property Claim Services (PCS) to show the development of claims (in percentage terms) for a selection of U.S. hurricanes since 2000, starting at 200 days post-landfall and leading up to 700 days. All incurred an ultimate insured cost in the U.S. of more than USD 10 billion.

Risk Perceptions: Non-Peak Perils

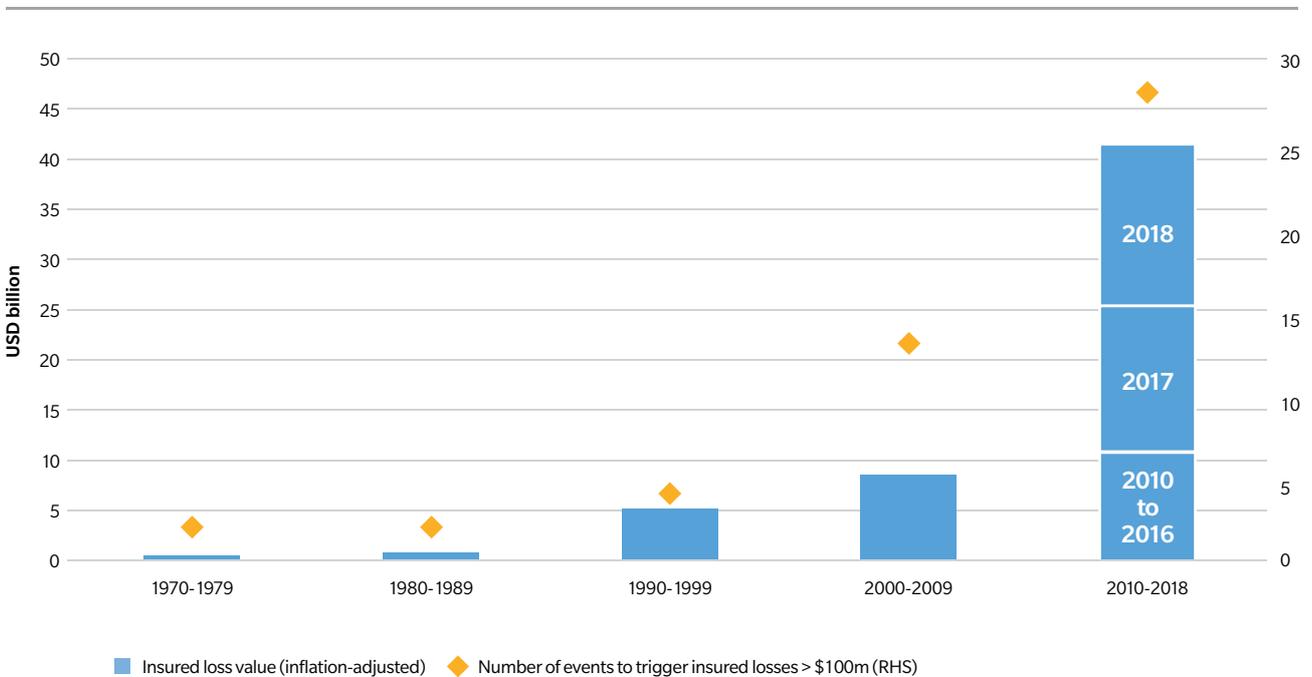
Costs for non-peak perils in recent years have also accumulated to make a significant contribution to industry losses. Wildfires especially have come under close scrutiny after losses in California in 2017 and 2018, as well as in Canada in 2016, spiraled to become significant reinsurance and retrocession events. In fact, wildfire-related insured losses in California alone have totaled more than USD 25 billion in the last two years. Such outsized losses are not commensurate with a view of risk that has traditionally considered wildfire to be an attritional or secondarily peril (see Exhibit 8). Attention (at both carrier and regulatory levels) is now focused on how to manage and price wildfire exposures going forward.

Underlying assumptions are therefore being reassessed to reflect more closely the contribution wildfires and other attritional perils can make to overall expected losses. The accumulation of losses from diverse perils is a trend that is occurring globally. Carriers have generally believed that a global spread of risk provided diversified premium, and that capital could be “reused” in non-correlated zones — until multiple peak zones were hit by a series

of events in a relatively short period of time. Risk perceptions are changing as a result, which inevitably impacts supply and demand dynamics. While carriers are pursuing several different approaches in responding to this trend, demand for reinsurance cover is increasing in aggregate.

Underwriting assumptions are being reassessed by (re)insurers to reflect more closely the contribution wildfires and other attritional perils can make to overall expected losses.

Exhibit 8: Global Wildfire Insured Losses – 1970 to 2018



Source: Guy Carpenter

A Modeled Response

The magnitude of loss creep for virtually all major losses sustained in the last couple of years raises questions about the utility of existing catastrophe models, even for well-modeled perils like tropical cyclones. Although conventional (wind-driven) hurricane losses are often captured adequately by models, costs associated with loss amplification, event clustering, social inflation and other “super-cat” characteristics are extremely difficult to predict and model, as demonstrated by HIM. And the significant loss development associated with Typhoon Jebi also underscores the variability that can occur with other peak hazards.

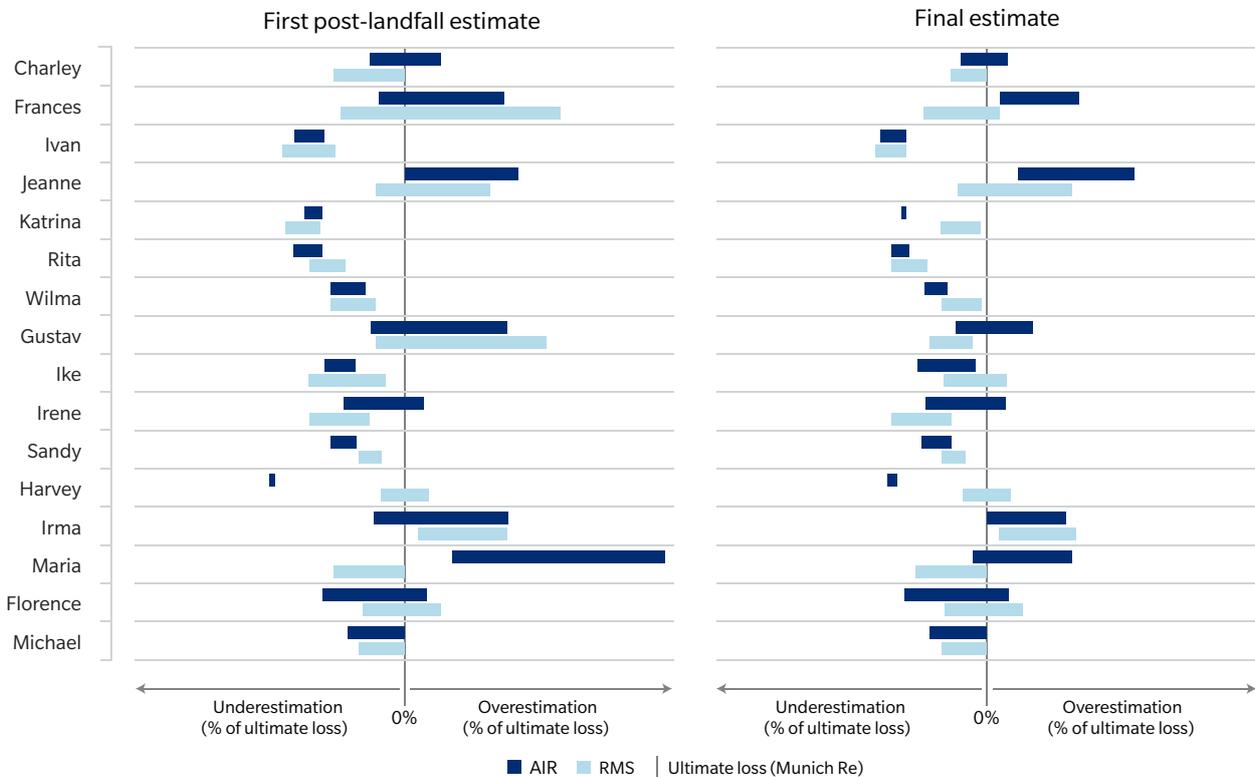
The industry also faces considerable work in developing new solutions for non-peak risks, the scale and severity of which have little or no historical precedent in some cases. This applies not only to standalone attritional perils such as wildfires and convective storms, where losses are often localized and difficult to model, but also to secondary consequences that occasionally accompany primary perils, such as hurricane-induced flooding.

To reaffirm the second point, a comprehensive study conducted last year⁴ on how major commercial catastrophe modeling firms

performed in predicting industry-wide losses showed accuracy deteriorated for hurricane events that are both costly and complex (see Exhibit 9). Hurricanes Harvey and Florence are two recent examples where the secondary consequences of severe flooding eclipsed wind losses. Superstorm Sandy is another. These types of events often bring unforeseen consequences that cause losses to spiral, due in large part to the prevalence of secondary loss components, such as flood. Although modeling companies readily disclaim these nonmodeled sources of loss, they present important gaps when comparing total insured losses to those that are modeled and estimated in real time.

Given the multiple areas of uncertainty in determining the hazards, exposures and vulnerabilities of major events, and the crucial role models now play in setting initial loss guidance, modeled results are always likely to struggle to meet the standards desired by the market. Market participants nevertheless need to draw on lessons learned during recent events to improve and refine their models to better incorporate nonmodeled perils. Contributions from the academic and engineering communities will also continue to assist them in this area. Following recent events, hurricane-induced flood and LAE are likely to be key areas of focus in the near term.

Exhibit 9: Evolution of Modeled Loss Estimates for Select U.S. Hurricanes – 2004 to 2018⁵



Source: Guy Carpenter, AIR, RMS, Munich Re

4. Catastrophe models: In the eye of the storm, Guy Carpenter.

5. Note that for Harvey and Florence, AIR’s estimates (both “first post-landfall” and “final”) do not include National Flood Insurance Program (NFIP) losses, while RMS’s and Munich Re’s figures do.

A Market In Transition

Overall catastrophe loss trends are clearly up. As Exhibit 10 shows, the potential for insured catastrophe losses has increased at an exponential rate since the 1970s, with the 10-year moving average currently hovering above USD 70 billion. The diverse and dispersed events over the last two years show that carriers need to be prepared for higher levels of catastrophe loss potential in the future as climate change and the continued appeal of living in areas exposed to weather-related risks — for example, the wildland-urban interface (WUI) or coastal regions — influence the frequency and severity of events. Some (re)insurers are already taking action by adjusting their underwriting models and repricing business to reflect these new assessments.

There was evidence that this occurred during the 2019 mid-year reinsurance renewal season as a number of traditional and ILS markets adopted tailored approaches in applying their new views of risk to individual programs. Cedents' long-term performance and loss experiences were often decisive factors in determining capacity priority and price.

All of this has inevitably impacted the market and brought about a period of reflection as capital inflows into the reinsurance sector have slowed. Approximately USD 20 billion of trapped capital was not deployable at the January 1, 2019 renewal. Some USD 5 billion of announced new capital through sidecars and catastrophe bonds had entered the alternative market by the end of the first half of 2019, a decrease of roughly 50 percent compared to the amount raised during the same period in 2018 (see Exhibits 11 and 12 on page 18).

This has curtailed ILS capacity so far this year, with investors more disciplined in deploying capital and more determined to achieve higher returns. Significant loss creep from multiple events, disappointing returns, multi-year collateral reserve requirements and uncertainty surrounding weather-related losses (as well as model credibility) have been the key drivers in bringing about this change in sentiment. Concerns around changing weather patterns and climate change have also led to more cautious allocation strategies.

Notably, catastrophe bond issuance has been muted so far in 2019 relative to recent trends. The impact on the retrocession market has been particularly acute, given that the bulk of its capital is provided by third-party investors. This, in turn, has cascaded down the market, forcing reinsurers that rely more heavily on retrocession capacity to reassess their positions.

It is nevertheless important to stress that the property market has emerged relatively unscathed when compared to the disruption caused by other large-loss years. After years of strong capital growth, the sector has more than sufficient levels of capital relative to risk, even after suffering the costliest two-year period ever for insured catastrophe losses. Despite the challenging backdrop, capacity was still adequate during this year's mid-year renewal season, even as underwriting assumptions were adjusted to reflect the changing nature of risk. But market conditions have clearly tightened, and further sizeable losses in the coming months and years — particularly if they include "shock" catastrophe events — could still create conditions for additional market corrections.

Exhibit 10: Global Insured Inflation-Adjusted Catastrophe Losses – 1970 to 2018

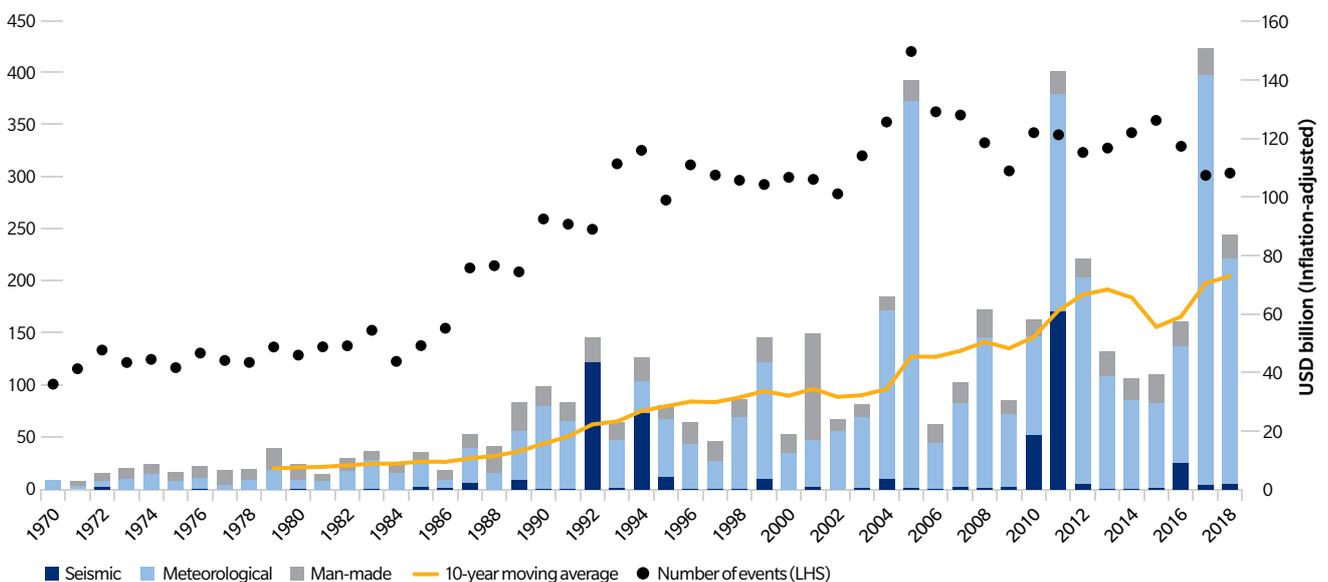
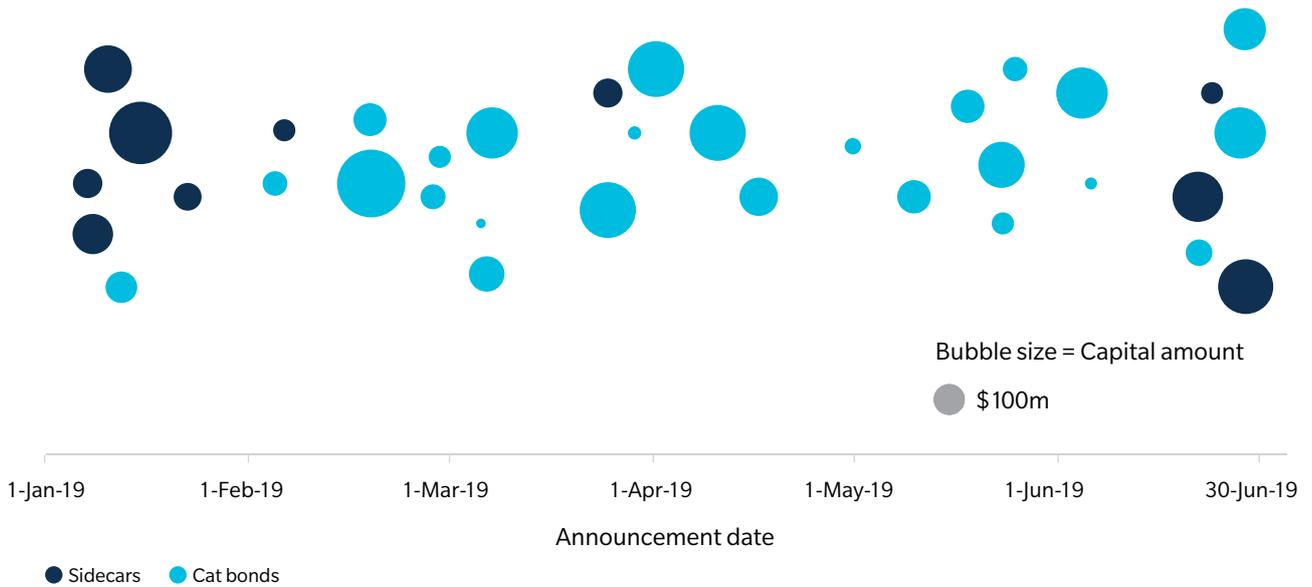


Exhibit 11: Announced New Reinsurance Capital – H1 2018⁶



Source: Guy Carpenter, Artemis

Exhibit 12: Announced New Reinsurance Capital – H1 2019⁶



Source: Guy Carpenter, Artemis

6. Excluding capital dedicated to mortgage transactions.

Lurking Long-Tail Threats

Another possible challenge to capital resilience comes from a more adverse claims environment in certain areas of the casualty market. After years of largely favorable conditions in longer-tail lines — for example, a benign inflationary environment and historically low loss experiences — a combination of social inflation, increased severity and growing instances of adverse reserve development are starting to squeeze carriers’ margins in a number of liability classes. Adding to this pressure is the erosion of property lines’ margins, dampening any cross-subsidization.

In the United States specifically, social inflation appears to be driving loss cost trends higher across a number of liability lines. Indeed, spiraling litigation, a more active plaintiff bar (thought to be fueled in some instances by the growing influence of litigation finance⁷), higher costs and more generous jury awards (and attitudes) have coincided with some prominent carriers rethinking underwriting appetites and pulling back or withdrawing capacity.

Although these factors can be difficult to quantify, some areas are clearly seeing increasing pressures. Exhibit 13 shows that federal securities class actions (and costs) in the United States have risen in recent years. The number of companies being sued

for securities claims has nearly doubled in the last three years as more suits are being filed for mergers and acquisitions deals and significant stock price movements. Median settlement values jumped last year to reach a decadal high of USD 13 million, according to National Economic Research Associates (NERA). This has also coincided with rising legal services costs (see Exhibit 14).

This is indicative of increased loss frequency and severity observed in a number of long-tail lines, commercial auto most prominently, but also directors and officers, medical malpractice, general liability and other liability lines. It typically takes a significant amount of time for long-tail claims trends to emerge fully and market conditions vary significantly by class of business. Long-tail risks are particularly vulnerable to unanticipated (medical, legal or economic) developments that are not priced at policy inception.

Another possible challenge to capital resilience comes from a more adverse claims environment in certain areas of the casualty market.

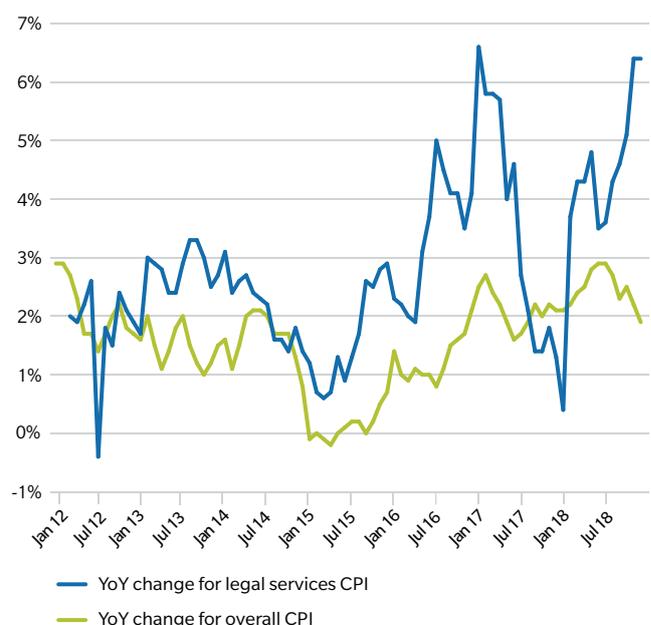
Exhibit 13: Number and Median Settlement Values of Securities Class Actions – 2009 to 2018



Source: Guy Carpenter, NERA

* Excludes settlements over USD 1 billion and merger objections

Exhibit 14: U.S. Legal Services CPI vs Overall CPI – 2012 to 2018



Source: Guy Carpenter, Bureau of Labor Statistics

7. Litigation finance is the practice in which a (unrelated) third party helps fund plaintiffs involved in litigation in return for an agreed portion of any financial settlement from the lawsuit.

The loss potential associated with opioid addiction is just one example that could have serious implications for the sector on this front. Multiple lawsuits have been filed against pharmaceuticals and other companies involved in the distribution and sales process, and a surge in claims has already led to coverage disputes between these companies and their insurers.

While the long duration and lack of clarity around overall claims for long-tail business makes it difficult to gauge the adequacy of underwriting, there is growing evidence that loss cost pressures are building in certain areas. The recent (and often notable) pricing increases observed in several business lines support this theory.

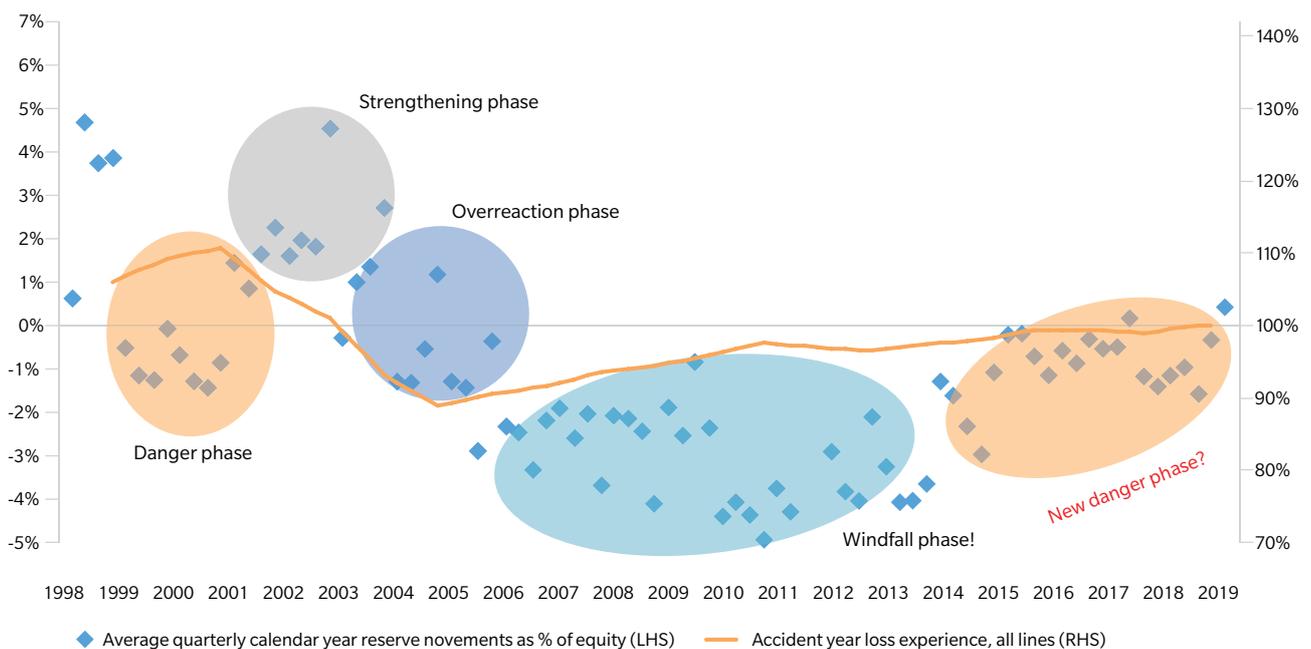
This is important because the casualty market has been the main catalyst of nearly all past market turns (while deficient loss reserves have been the main cause of financial impairment in the sector). Given the smaller pool of carriers operating in the global casualty market, replacing lost or reduced capacity can be difficult, making it more vulnerable to capacity constraints should carriers' claims assumptions change.

The potential implications of a tightening casualty market are therefore clear. The difficulties posed by estimating total ultimate losses for long-tail business mean sector capital levels become uncertain when reserves, which can represent multiples of annual earned premiums and equity, begin to appear deficient – even at the margin.

While reserve adequacy is notoriously difficult to predict, the analysis shown in Exhibit 15 implies that the sector may be in a danger phase in which carriers are continuing to release reserves even as accident year experience indicates that redundancies are diminishing. The overriding trend in recent years towards fewer reserve releases is clear to see and may partly reflect the deteriorating claims environment. At the very least, our proprietary research indicates that carriers can no longer rely on reserve redundancies to protect or enhance profits as they have done since the mid-2000s.

The overriding trend in recent years toward fewer reserve releases is clear to see and may partly reflect the deteriorating claims environment.

Exhibit 15: Calendar Year Reserve Development by Quarter for Top 35 Global P&C Carriers vs Accident Year Reserve Experience – 1998 to Q2 2019⁸



Source: Guy Carpenter

8. This research shows reported calendar year reserve movements by quarter for the top 35 global P&C (re)insurance companies up to the second quarter of 2019. For comparison purposes, it also includes accident year loss development for all lines of business (shown by the orange line).



A Glimpse Into the Future

How the risk landscape evolves from here will be pivotal in shaping the future of (re)insurance. After back-to-back years of sizeable losses and seemingly accelerating loss cost trends, shifting views (and appetites) of risk have already had a discernable impact as market conditions have firmed in several areas.

In an important break from the past, reinsurers' approach in applying these new views has been tailored to individual renewals and is a key driver in determining price and capacity allocation. At the Florida property catastrophe renewal on June 1, for example, differentiation between programs was significant and produced one of the broadest ranges of price change that Guy Carpenter has tracked for a single region. This systematic approach represents a strong and stable market that is experienced in navigating market-changing events and unwavering in supporting buyers through difficult times.

Complex Risk Landscape

But the impending degree of change that is to come with climate change, technological disruption, the shift from tangible to intangible assets and the transfer of liability from individuals to large manufacturers looks set to transform the risk landscape like never before. These developments will redefine risk transfer, with new coverages needed for exposures such as intellectual property, reputational risk and non-damage business

interruption, to name a few. Insurability is likely to become a key challenge for the sector, as there is a dearth of data and modeling solutions for many of these new exposures. There are even questions around the insurability of some established risks like extreme weather events, given that the long-term trends associated with climate change remain difficult to measure, predict and, ultimately, model.

Exhibit 16 shows how perceptions of the global risk landscape, as conceived by the World Economic Forum in the *Global Risks Report*, have shifted over the last decade. Whereas economic risks featured heavily in 2009 during the height of the global financial crisis for both likelihood and impact, environmental concerns are prevalent today, reflecting no doubt the series of extreme weather events in the last two years and concerns about climate change. Unsurprisingly, technological risks also feature prominently in 2019.

Exhibit 16: The Global Risk Landscape – 2019 vs 2009

2019		2009	
Top 5 risks in terms of:		Top 5 risks in terms of:	
Likelihood	Impact	Likelihood	Impact
1 Extreme weather events	1 Weapons of mass destruction	1 Asset price collapse	1 Asset price collapse
2 Failure of climate change mitigation and adaption	2 Failure of climate change mitigation and adaptation	2 Slowing Chinese economy	2 Retrenchment from globalization
3 Natural disasters	3 Extreme weather events	3 Chronic disease	3 Oil and gas price spike
4 Data fraud or theft	4 Water crisis	4 Global governance gaps	4 Chronic disease
5 Cyber attacks	5 Natural disasters	5 Retrenchment from globalization	5 Fiscal crises

Categories — Economic Environmental Geopolitical Societal Technological

Climate Change

Climate change is “the single biggest threat to life, security and prosperity on Earth,” according to the United Nations. It is a huge (and controversial) issue, worthy of an entire paper in its own right. Impacts are not just limited to increased frequency and severity of natural catastrophes, as there are also implicit secondary societal effects such as water shortages and potential large-scale (crisis-driven) migration to consider.

Although there is evidence that climate change has been occurring for thousands of years, escalating global mean temperatures in recent decades have surpassed natural year-to-year variability seen in the observed historical record. Furthermore, atmospheric carbon has also increased since the industrial revolution, and the statistical association between the two cannot be ruled out as noise. Recent climate change is attributable to human activity and independent of natural climate variability. Although the debate is often polarized, scientific consensus has resolved that human-induced climate change is a fact: The evidence is undeniable and includes increasing air and ocean water temperatures and ice cap retreat.

Attributing a single event to climate change remains difficult at present, although it is an emerging arena of academic research. But excessive rainfall and rising sea levels clearly bring an enhanced threat globally for more frequent and severe freshwater

Climate change is “the single biggest threat to life, security and prosperity on Earth,” according to the United Nations.

and coastal flood events. And as discussed earlier, sustained trends around increased wildfire activity and stalling hurricanes have been observed and are thought to potentially have some link to a changing climate. In both 2017 and 2018, insured losses from wildfire activity in California surpassed combined losses in any previous decade, while three of the heaviest hurricane-induced flooding events impacted the United States.

But is there any evidence that these events are the new normal, and can we expect to see more losses of these types and magnitudes in the future?



Wildfire

Addressing wildfires in California first, Exhibit 17 shows how temperatures in the state have not only increased significantly over the last decade but also how spring heat has become more pronounced earlier in the year and persists through the summer. The well-above-average temperatures help to accelerate the drying out of vegetation during the summer season, contributing in part to the increased risk profile of wildfire in recent years.

At least four other factors point to a heightened period of wildfire activity in California going forward:

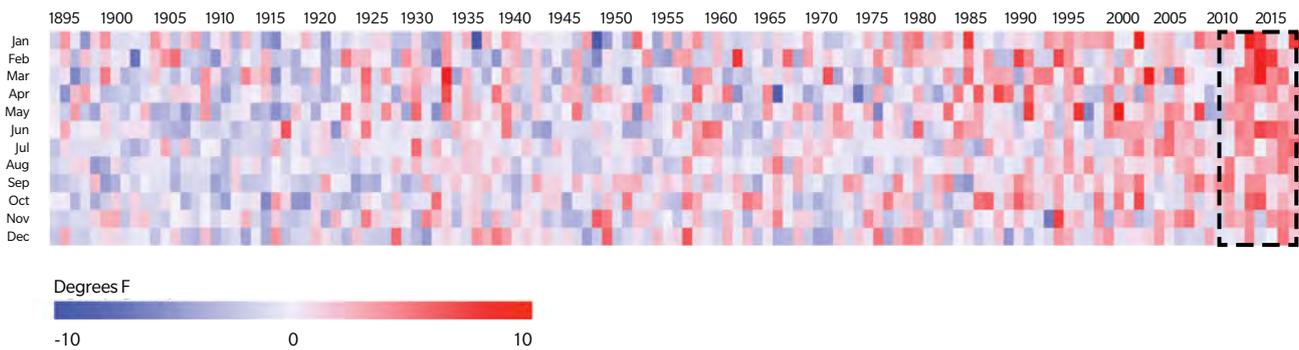
1. A multi-year mega-drought (starting in 2013) has damaged tree vitality due to a lack of water.

2. This prolonged drought has also resulted in a larger beetle population, thereby increasing susceptibility to beetle infestation and resulting tree damage.

3. Insufficient forest management practices have added to the problem, overwhelming state and/or federal resources to remove dead vegetation (more than 125 million trees are thought to have died in the state; see Exhibit 18).

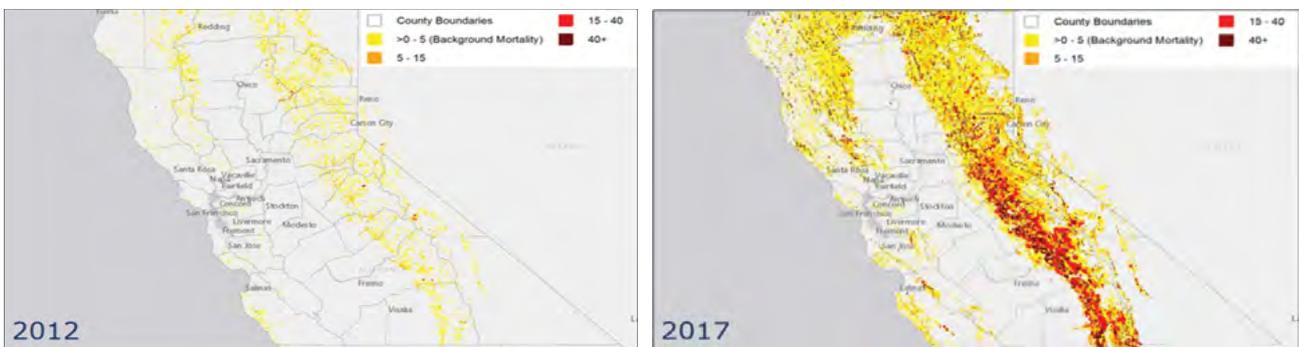
4. Other healthy/vibrant vegetation at the end of the wet winter season now has ample time to dry and become fuel sources later in the year, due to the earlier onset and delayed end to the dry season, particularly in central and southern California.

Exhibit 17: Temperature Trends in California



Source: NOAA

Exhibit 18: Forest Mortality in California – 2012 vs 2017



Source: Cal Fire

Changing weather patterns are therefore clearly influencing wildfire activity in California. Indeed, a recent study carried out by researchers at the Earth Institute at Columbia University⁹ linked climate change to the increased size and frequency of wildfires in California. In the past decade alone, the state has seen five of its 10 largest wildfires on record and seven of its 10 most destructive blazes. The study warns that wildfires in California could get exponentially worse over the next 40 years.

But climate change is only part of problem. It is important to point out that losses are also being driven by more people living in wildfire-prone areas. In fact, the WUI in California has expanded by 60 percent since 1970 and now contains 4.5 million homes. The infrastructure required to support people living and working in these spaces is also a potential ignition source. Crucially, human activity remains the predominant source of wildfire ignitions in the state, at roughly 80 percent.

A recent study carried out by researchers at the Earth Institute at Columbia University linked climate change to the increased size and frequency of wildfires in California. In the past decade alone, the state has seen five of its 10 largest wildfires on record and seven of its 10 most destructive blazes.

As discussed earlier, the likelihood of more frequent and costly wildfire events in the future has compelled (re)insurers to reset long-held views that have considered the peril to be attritional. Incorporating a longer-term view of climate risk will inform strategic planning going forward. This will inevitably require new tools to better understand the risk potential at both an individual location level and aggregated across portfolios. Work is underway to achieve this. Innovative risk transfer solutions are also being developed, such as wildfire catastrophe bonds and parametric products that pay out once a threshold level of burned area is reached.

Stalling Hurricanes

Hurricane-induced flooding in the United States has been another prominent loss driver over the last couple of years. In fact, the three heaviest hurricane rainfall events in the country's history occurred in 2017 and 2018: Harvey (Texas, 2017), Lane (Hawaii, 2018) and Florence (North Carolina, 2018).

This is not coincidental. Several academic studies focusing on climate and hurricane activity and Arctic/jet stream connections in summer have identified five key factors that are thought to be associated with an increased likelihood of slower-motion hurricanes stalling over land for several days.

1. There has been a 5 percent to 20 percent slowdown in hurricane forward motion since the middle of the 20th century, depending on ocean basin.
2. Excessive rainfall events associated with hurricanes above 30 inches require a forward motion of less than five miles per hour.
3. Warming oceans further north allow hurricanes to form and move west at a higher latitude (Kossin et. al, 2018).
4. More rapid warming in the Arctic than in mid-latitudes results in a more stagnant jet stream pattern, occasionally trapping tropical cyclones due to a ridging of high pressure to the north of the system (Mann et. al, 2017; Coumou et. al, 2018).
5. A warmer Arctic is also associated with weaker jet streams and steering flows, which, in turn, has the potential to slow hurricane forward speeds.

The prospect of more flood-related losses in the United States raises an important point about relevance. At present, flood is not covered by standard residential policies and commercial policies usually contain sublimits. For the relatively small number of U.S. homeowners and small businesses that do purchase flood protection, the federally backed National Flood Insurance Program is the go-to carrier. The financial cost of recovery for flood events therefore currently falls in large part to U.S. taxpayers, rather than to the well-capitalized (re)insurance sector. Strikingly, less than a quarter of Harvey's total economic loss was insured by private carriers.

There is clearly scope for the private market to take on a greater proportion of flood risk than it does presently. This task is not without its challenges: Increasing correlations between climate change and flood risk, raising public awareness about standard exclusions and private cover availability, underinvestment in resiliency efforts and developing new models, to name a few. But by doing so, the sector will make an important step in mitigating a key protection gap, create a potentially significant business opportunity and, in turn, help secure its long-term relevance.

9. *Observed impacts of anthropogenic climate change on wildfire in California*, Earth's Future.

Digital Technology

Technology is another factor that looks set to transform the nature of risk over the next decade or two. Digitalization brings great promise and opportunity, but also new risks. The magnitude of change associated with digital technologies is huge: The way people live, relate and work is being revolutionized and virtually every industry is being (or will be) impacted.

The future, if the past two hundred years are any indication, will be fantastic, unclear, chaotic, messy and litigious. Although attempts have been made to prophesize what this tech-dominated future will look like, the simple truth is it is still too early to know fully what the consequences of digitalization will be. But underwriters still need to prepare for what is likely to come, and the past could hold important lessons for the future of underwriting. Access to professional, sophisticated and up-to-date technical expertise is the key to remaining competitive, enhancing operations and delivering successful 21st century underwriting.

The magnitude of change associated with digital technologies is huge: The way people live, relate and work is being revolutionized and virtually every industry is being (or will be) impacted.

Lessons From the Past

There have been at least six boom and bust cycles since the late 1700s, including the latest digital technological revolution. (Re)insurers have learned the hard way during this time that surprises are inevitable, rules often change and solvency depends on being conservative, careful and smart. Risk carriers know that damage, injury and litigation follow in the wake of every agricultural, industrial and technological boom cycle. They also know that new “public risks”¹⁰ are created during periods of transformational change.

The asbestos crisis of the 1980s, which took seven or so decades and a revolution in injury law to manifest, has meaningful lessons for managing the risks associated with today’s digital technological revolution. It taught (re)insurers, for example, that they have a hard currency stake in the future and the past, especially those that write occurrence and accidents policies. These policies will respond to bodily injury, property damage and personal injury claims that occurred during the policy period but are reported decades later.

One of the most challenging aspects of designing coverage grants for casualty catastrophe reinsurance products is anticipating and appreciating the forces and processes that make the transition from public risks to a potential insured loss. This journey often begins by eliminating or reducing the provisions of contract law that insulate manufacturers or service providers from the liabilities that may result from their products or services (which takes time) or imposing strict liability on such manufacturers or service providers.

Public risks during the 20th century were a product of significant investments in infrastructure, global manufacturing plants, transportations systems and various types of labor. The average person could not manufacture most items at scale in a home workshop. And these manufacturing facilities were fairly easily monitored, taxed and regulated. After all, it is easier to ascertain who is responsible for a specific, or class of, injury or damage when there is a discoverable manufacturing and distribution chain.

A world driven by software will be much different. Software has been the common denominator of all the latest technology so far this century. Increasingly sophisticated coding, as well as increases in computing power, cloud storage and high-speed connectivity, have made advances possible in telecommunications, data science, genetics, nanotechnology, robotics, autonomous vehicles, sensors, image recognition, virtual reality, additive manufacturing, the Internet of Things and AI. In addition, the internet is becoming increasingly powerful, and people and things all over the world are becoming more connected. These technologies and advancements may still be in their infancy, but they are going to change everything.

Bad Code

The bad news is that many of these innovations rely on legacy software that may be outdated or rushed to market, for which cyber security is often a distant afterthought. Although there are many estimates of KLOC (errors per 1,000 lines of code), the industry average is 15 to 50 per 1,000 lines of code. As an example, Jaguar Land Rover estimated that genuinely autonomous cars would need around 1,000,000,000 lines of code; using industry KLOC averages, that might work out to 15,000,000 to 50,000,000 potential errors. These errors provide hackers with possible access points.

In a decade or two from now, bad code may well join natural catastrophes, plague and war as one of the most prominent and dangerous public risks. In the 21st century, access to accomplished scientists, data scientists and engineers will be as crucial for successful underwriting as having adequate capital.

10. In this context, “public risk” is defined as injuries, damages and costs whose economic value are not captured in the price of the product or service (rather than risks that may affect any part of society in which government is expected to respond – often a more traditional definition).

Conclusion

The (re)insurance sector is today operating in a rapidly changing and uncertain risk landscape. The growing complexity of risk is unlikely to relent any time soon: Digital technology and the changing climate put societies and economies on the cusp of one of the most significant periods of change in recent times. As this report describes, impacts are already starting to manifest in the (re)insurance sector as views of risk shift, and capital inflow levels and risk appetites respond accordingly.

The level of sophistication and expertise residing throughout the (re)insurance market bodes well for future resilience. Areas such as enterprise risk management and capital modeling have enhanced carriers' risk management capabilities and overall balance sheet strength. Technology will also help carriers expedite the claims and adjustment process, as well as develop more sophisticated modeling solutions to better anticipate (and prepare for) potential losses.

Mitigation is another area that will prove essential in alleviating the impacts of future events. Taking the example of extreme weather events in isolation, continually increasing dollars at risk from climate change (as well as population growth in catastrophe-prone areas) can be mitigated by relatively simple, and in many cases cheap, measures such as building code adherence. Embracing and supporting the research and implementation of such initiatives is essential to the health of the sector and the broader economy. Even more importantly, it reduces the personal impact and distress of those unfortunate enough to be involved.

Guy Carpenter looks forward to assisting clients in this process. Our broking and analytical teams provide insight using the sector's most tailored solutions and best strategic advisory services. This paper is the first in a series of reports that seek to create impactful analysis of highly pertinent client issues. By bringing important sector trends to the fore, we hope to inform the discussion while also, crucially, facilitating the most innovative solutions for our clients.

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