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The Growing Impact of Wearable Technology

By Shanique (Nikki) Hall, CIPR Manager

◆ Introduction

In such an increasingly mobile and connected world, many of our daily activities have been streamlined and made easier by the Internet and technology. Devices such as smartphones ensure we are always connected, even when we're away from home. Wearable devices seem to be the latest trend in consumer technology and have revolutionized the way we stay connected on a daily basis. Wearables are usually worn or incorporated into the body, thus providing sensory and scanning features facilitating biofeedback and tracking. The market is now flooded with wearable devices including wristbands such as Fitbit, attachable baby monitors such as Mimo, smartwatches such as the Apple iWatch, and jewelry such as Cuff. While these devices are often categorized as fun novelties and interesting gadgets, some predict they have the potential to disrupt the modern business world.

Insurers have taken a keen interest in wearables because of the potential benefits the technology could provide. Wearables amass huge amounts of data. Insurers have the opportunity to harness the information from wearable devices to better assess risk and tailor their business approaches across all segments. However, while consumers like the potential benefits wearable devices promise, there are concerns related to the potential for privacy invasion and security breaches. This article will provide an overview of wearable devices, discuss how they are currently being used in the insurance sector, as well as some of the concerns surrounding the technology.

◆ What are Wearables?

The terms "wearable technology", "wearable devices," "wearable gadgets," or simply "wearables" all refer to electronic technologies or computers incorporated into items of clothing and accessories worn on the body.[1] These devices are small enough to wear and include powerful sensor technologies which can collect and deliver information. A wearable device is often used for tracking a user's vital signs or certain types of data related to health and fitness, location or even his/her biofeedback indicating emotions. For example, a polo shirt can now come equipped with biosensing silver fibers which can track the number of calories you burn and your heart rate, and stream this real-time biometric data directly to your phone.

The most popular types of wearable devices include various brands of smartwatches for monitoring health, wristbands for tracking exercise and fitness and headsets for gaming and entertainment. Other examples include; glasses (i.e., Google Glass) as well as contact lenses, smart fabrics, headbands, beanies and caps, jewelry such as rings or bracelets, and hearing aid-like devices. Although wearables typically refer to items put on and taken off with ease, there are also more invasive versions of the concept such as implanted devices (e.g., micro-chips or even smart tattoos).[2]

While it may seem like a trendy new concept, wearable technology has a long-ranging history. People have been incorporating gadgetry into their outfits even before the dawn of computers. For example, eyeglasses, hearing aids, the ubiquitous Sony Walkman and even the first digital watch introduced in 1972 are all considered wearables (Figure 1 on the following page).

We all remember Captain Kirk's wrist communicator on the television show, Star Trek. Now, more than 50 years later, wearable technology is taking hold and influencing how people live and work. Wearable technology achieved mainstream popularity with the Bluetooth headset in 2002. Between 2006 and 2013, iconic wearable technology devices Nike+, Fitbit and Google Glass were released. In 2014, dubbed "The Year of the Wearable" by several media outlets, activity trackers grew in popularity and the Apple iWatch was introduced.[3]

Wearable technology is now more popular than ever. Fitness trackers and smartwatches have become an everyday part of our lives. One in five consumers wears a piece of technology on their wrist on a daily basis. According to Statista, Fitbit has sold more than 38 million devices worldwide since 2010, and currently has over 16 million active users.[4] The Apple iWatch has the largest share of the wearables market, shipping 3.5 million watches just in the first quarter of 2017.[5] These statistics are expected to increase significantly over the next couple of years as more businesses and industries adopt wearable technology. The rise in wearables reflects an increasing desire to know about and manage our own health. Statistics show 65% of consumers believe wearable technology has a strong part to play in their overall health and wellbeing.[6]

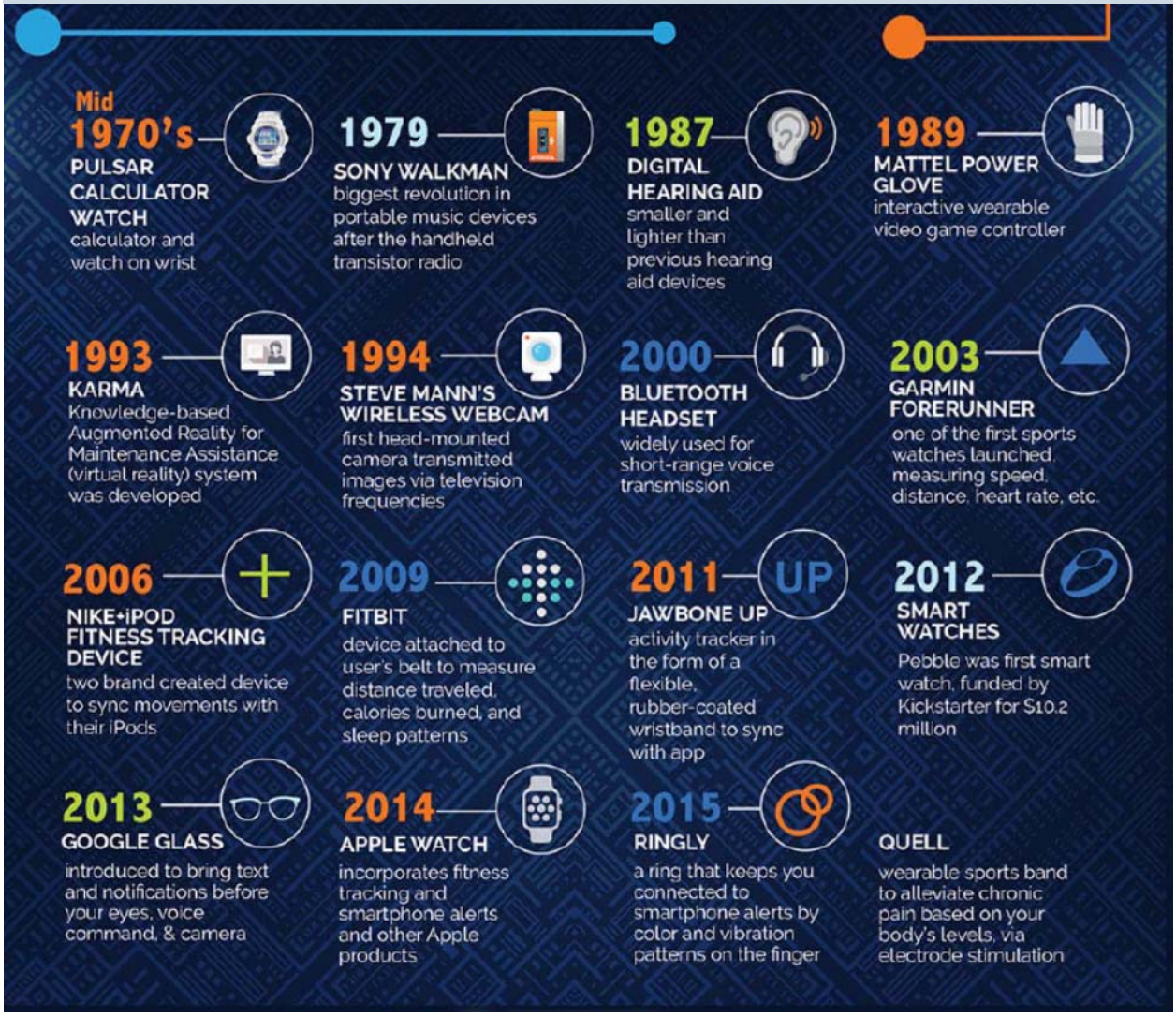
◆ Wearables Impact on Insurance

This trend hasn't gone unnoticed in the insurance world. Some of the potential uses within insurance for wearable technology include underwriting, risk management, new

(Continued on page 3)

[1] "Wearable Technology and Wearable Devices: Everything you Need to Know." March 2014. www.wearabledevices.com/what-is-a-wearable-device/
[2] Ibid.
[3] "The Past, Present and Future of Wearable Technology." Business News. https://online.grace.edu/news/business/the-past-present-future-of-wearable-technology/
[4] https://www.statista.com/topics/2595/fitbit/
[5] www.theinquirer.net/inquirer/news/3009561/apple-watch-topples-fitbit-in-q1-sales-hit-35-million
[6] "Can Wearable Technology Increase Business Productivity." Talk Business. https://www.talk-business.co.uk/2017/08/08/can-wearable-technology-increase-business-productivity/

FIGURE 1: HOW WEARABLE TECHNOLOGY DEVELOPED



Source: PwC Analysis.

product development, workers' compensation and claims management. Wearable devices can provide a wealth of insight into consumers' lifestyles and behavior. When a device is worn, the technology is capable of collecting detailed information on consumers including video and audio on their driving, as well as their eating, sleeping, heart rate, calorie consumption and exercise habits and then communicating this data over computers or smartphones to insurers.

Wearable technology has already entered the life and health insurance space. Health professionals are using wearables like smart or implantable devices for patient monitoring, diagnostics and drug delivery. When enabled with analytics, wearables can be used by consumers to manage their health and by insurers and employers to improve wellness and potentially reduce costs through systems such as remote patient monitoring.[7]

Some insurers already offer wearable fitness trackers to policyholders for recording their physical activity. An increasing number of corporate wellness programs are also incorporating wellness fitness trackers and insurers are gaining access to customers' wearable data. The idea is to promote fitness and wellness as an integral part of coverage, giving policyholders rewards in return for complying with set health goals. A recent PwC found consumers are strongly

(Continued on page 4)

[7] "Wearables in the Workplace." PwC Wearable technology survey. January 27, 2016. www.pwc.co.za/en/assets/pdf/wearables-in-the-workplace.pdf

motivated to use a wearable technology if it had a feature to monetarily reward them for using it frequently.[8]

UnitedHealthcare recently announced it was adding more device options to its UnitedHealthcare Motion, a wellness program providing employees with fitness trackers. The Motion program rewards participating eligible employees with financial incentives for meeting daily walking goals. UnitedHealthcare Motion participants have collectively walked 130 billion steps, earning more than $19 million in incentives since the program's launch.[9] Health insurer Aetna Inc. and Apple also recently announced a pilot program to bring Apple iWatches to Aetna customers.

In terms of underwriting, insurers have traditionally based their underwriting and pricing processes on a limited view of certain customer variables. Wearables devices go beyond broad demographic information insurers have relied upon in the past to assess risk—providing more detailed information in addition to their age, gender and past health history. Emerging technologies like wearables could potentially help insurers break from their traditional business models and streamline the underwriting process.

For example, if you're shopping for a life insurance policy, there's a good chance after you receive a quote, you will be asked to undergo an insurance medical exam. Traditional underwriting typically bases pricing on a detailed but static snapshot of a person's medical status. Instead, wearable data can be looked at to assess fitness at the time of issuance. This could offer a far superior customer experience to the traditional underwriting requirements such as fluid testing, medical records, stress tests, etc., which can take weeks or months to obtain, are inconvenient to the customer, and more costly to carriers.[10]

Life insurer John Hancock Vitality program breaks from the traditional approach to life insurance underwriting. John Hancock policyholders who enroll in the Vitality program have the opportunity to reduce their monthly payments by earning rewards for the everyday things they do to stay healthy like walking, eating well and going to the doctor. Policyholders who enroll in the program can receive an Apple iWatch for only $25. But the catch is they have to "earn" the discount through regular workouts or they will be required to pay off the rest of the wearable's price. [11]

Lastly, as wearable data can provide insights into the lifestyles of customers, it can relay real-time information to assist in claims processing. Some wearables can capture data near the wearer—providing a record of what the wearer is seeing and hearing—which can have use in claims assessments. For example, wearables such as Google Glass can capture video, pictures or audio to document damages to property and take statements from property owners and witnesses.

Claims adjusters at National ConnectForce Claims (NCC) tested the use of Google Glass in 2014 as a tool for field adjusters in its Catastrophe Division. The goal of the pilot was to determine whether smart glass technology might help improve the claim settlement process. Following the pilot, field adjusters noted smart glasses improve the process of scoping and documenting a loss, making it easier, quicker and more precise compared to fumbling with a hand-held camera or other device.[12] In 2015, Erie Insurance enlisted eight claims adjusters in a Google Glass pilot program. The adjusters in the pilot program were given Google Glass Explorers to replace the digital camera they carry during the claims investigation process. According to Erie, the adjusters "liked being able to take a bunch of photos and the quality was good. Being hands-free allowed them to juggle less and talk more to customers while they were doing the job."[13]

◆ CONCERNS SURROUNDING WEARABLE DEVICES

Wearables have expanded from fitness trackers, to devices collecting a far greater range of health data. Consequently, there are concerns surrounding the privacy and security gaps associated with the devices. With wearables, everything you do and everything you eat, depending on which bits of the information is collected, is sitting in someone's database. It is unclear who exactly owns the data and if companies are sharing the data generated by wearables. In the U.S., there are separate privacy laws for different types of information, such as financial, student, or health data. Some of the data collected by wearables includes information classed as protected health information (PHI) under the Health Insurance Portability and Accountability Act (HIPAA). However, HIPAA regulations only apply to so-called "covered entities," typically health-care providers like doctors and hospitals. The data the wearable collects, records and transmits for non-covered entities may not be covered by HIPAA.

(Continued on page 5)

[8] Ibid.

[9] "UnitedHealthcare and Qualcomm Integrate Wearable Devices From Samsung and Garmin into Wellness Program." BusinessWire. Nov. 17, 2017. www.businesswire.com/news/home/20171117005183/en/UnitedHealthcare-Qualcomm-Integrate-Wearable-Devices-Samsung-Garmin

[10] "Data is Wearable?" Munich Re. 2015. www.munichre.com/site/marclife-mobile/get/documents_E1856902192/marclife/assset.marclife/Documents/Publications/Data-is-Wearable-White-Paper.pdf

[11] John Hancock Introduces a Whole New Approach to Life Insurance in the U.S. That Rewards Customers for Healthy Living. PRNewsWire. Apr. 8, 2015. www.prnewswire.com/news-releases/john-hancock-introduces-a-whole-new-approach-to-life-insurance-in-the-us-that-rewards-customers-for-healthy-living-300062461.html

[12] "Top Features of Smart Glasses." Brain Xchange. https://brainxchange.io/4-features-smart-glasses-hands-free-documentation/

[13] Gough, Paul. "Erie Insurance tests Google Glass to help process claims." Pittsburgh Business Times. June 1, 2015.

Wearables also present potential security risks due to the various vulnerabilities created through the means of collecting, storing, and processing data. With wearable devices, data can be stored locally, or transmitted and stored in the cloud. When stored locally, data is vulnerable to being attacked by malware or being stolen by physical theft.[14]

Moreover, little has been done to evaluate the data's accuracy. There have been a number of studies comparing various wearables for tracking physical activity and results showed large variations in accuracy between different devices. If you wear five different fitness trackers on your arm in a day, you are going to get five different step counts. A study by Cleveland Clinic examined four popular devices and found their heart rate monitors are wrong 10%-20% of the time.[15]

Fitness monitoring devices are not considered medical devices and therefore are not regulated by the U.S. Food and Drug Administration (FDA). Therefore, the precision of the data can be dependent upon such things as the manufacturer, conditions of usage, customer's physical size and condition, and the quality and functionality of the specific device. Manufacturers' have noted sometimes people wear the wristbands incorrectly. The devices work by sensing blood flow beneath the skin. If wristbands are worn too loose, they can't accurately see the blood flow; if they are too tight, they constrict it.[16]

The accuracy of the data generated is a concern since fraud could easily be accomplished without sufficient steps in place to prevent it. Strapping a fitness tracker onto your dog and letting him run around in the park could be quite tempting if the cost savings from the data generated were substantial. ID verification measures may have to be put into place to help prevent fraud. For example, retinal scanning, fingerprints, or other unique identification criteria.[17]

Finally, just as social media websites (i.e., Facebook) have created interesting legal issues for litigants, so too now are wearable devices. We've all heard the workers compensation stories where someone is out of work injured, they're getting payments and then they Tweet a picture of themselves skiing. Because wearables present new sources of personal and physical data, legal experts have started to recognize wearable devices as the human body's "black box." Data from a Fitbit have recently been used in several personal injury claims cases.[18]

◆ SUMMARY

The use and implications of wearable technology are far reaching and can influence the fields of health and medicine, fitness, aging, disabilities, education, transportation, insurance, finance, gaming and more. However, more must be done to ensure consumers are informed about how their data will be collected and used and greater privacy controls must be put in place to ensure sensitive data are adequately protected. These privacy, security, and data accuracy concerns must be addressed to protect consumers before the implementation of any large-scale efforts to use wearable device data for insurance purposes.

The NAIC recently formed the Innovation and Technology (EX) Task Force to monitor emerging technologies like wearables in the insurance sector. The Task Force will provide a forum for discussion of innovation and technology developments in the insurance sector in order to educate state insurance regulators on how these developments impact consumer protection, insurer and producer oversight. The Task Force has already met several times to learn more about innovative insurance solutions, including a visit at Google to see the latest in their autonomous vehicle technology.

Moreover, the NAIC Center for Insurance Policy and Research (CIPR) recently conducted a 75 minute webinar titled, "Wearables and Their Implications in Insurance." The webinar provided an overview of wearable devices, explored some of their benefits and challenges, and discussed their insurance implications. A replay of the webinar is available free of charge on the CIPR website at [cipr.naic.org.](cipr.naic.org)

ABOUT THE AUTHOR

Shanique (Nikki) Hall is the manager of the NAIC Center for Insurance Policy and Research (CIPR). She joined the NAIC in 2000 and currently oversees the CIPR's primary work streams, including the CIPR Newsletter; studies; events; webinars and website. Ms. Hall has extensive capital markets and insurance expertise and has authored copious articles on major insurance regulatory and public policy matters. She began her career at J.P. Morgan Securities as a research analyst in the Global Economic Research Division. At J.P. Morgan, Ms. Hall analyzed regional economic conditions and worked closely with the chief economist to publish research on the principal forces shaping the economy and financial markets. Ms. Hall has a bachelor's degree in economics from Albany State University and an MBA in financial services from St. John's University. She also studied abroad at the London School of Economics.

[14] Phaik Lin Goh, Janice. "Privacy, Security and Wearable Devices." American Bar Association.

[15] Weintraub, Karen. "Wearable Health Monitors Not Always Reliable: Study Shows." USA Today. Oct. 12, 2016.

[16] Ibid.

[17] Data is Wearable?" Munich Re. 2015. www.munichre.com/site/marclife-mobile/get/documents_E1856902192/marclife/assset.marclife/Documents/Publications/Data-is-Wearable-White-Paper.pdf

[18] Technology—Fitbit Data Used as Evidence. Retrieved from: https://hhklawfirm.com/blog/technology-fitbit-data-used-evidence/

Risk-Based Capital Requirements on Fixed Income Assets to Change

By Anne Obersteadt, CIPR Senior Researcher

◆ Introduction

The NAIC is exploring the implementation of a new and more granular risk-based capital (RBC) structure for fixed income asset capital charges by 2019. The changes represent the first of their kind since the current asset capital charges were developed more than two decades ago.[1] If implemented, the new structure will expand the fixed income designations from six to 20 categories and revise the factor values. The expanded factors are intended to add more transparency to the varying degrees of risk within insurers' fixed-income securities. This will allow the capital charges for these investments to better reflect the capital needed over a 10-year time horizon. This article explores how the RBC bond factors may change for life insurers. It will also discuss the potential implications of these changes for life insurers.

◆ What is RBC?

The purpose of RBC is to help state insurance regulators identify weakly capitalized companies. It is a method of determining the minimum amount of capital an insurer should hold based on its risk profile. This amount is what is needed beyond what is held in policy reserves to offset future excess losses to statutory capital. Amounts below this threshold would require incremental levels of regulatory action, up to mandatory intervention. There are four levels of action an insurer can trigger if they fall under the threshold: mandated company action level; regulatory action level; authorized control level; and mandatory control level. More on these action levels is discussed below.

◆ Life RBC Formula Steps

Step 1: Generate RBC Required Capital Amounts

The RBC required capital is the level of capital estimated to be needed to support the risks of the insurer. The life RBC formula uses the book/adjusted carrying value (BACV) amounts for the included risk items from insurer's annual financial statements.[2] The BACV amounts are then multiplied by RBC risk factors to generate the RBC required capital.

The following is the formula for the RBC required capital:

BACV * factor = RBC required capital

Step 2: Segregate into Risk Components

The individual RBC required capital results are then summed and separated into risk components based on statistical correlation. Figure 1 illustrates these risk components for the life RBC formula.

Figure 1:
Life RBC Risk Components

C-0:	Aggregates most affiliate investment and (non-derivative) off-balance sheet risk
C-1cs:	Aggregates unaffiliated invested common stock asset risk
C-1o:	Aggregates fixed income asset & reinsurance credit risk (bonds, preferred stock)
C-2:	Insurance risk
C-3a:	Interest rate risk
C-3b:	Health credit risk
C-3c:	Market risk
C-4a:	Business risk – guaranty fund assessment and separate account risks
C-4b:	Business risk – health administrative expense risk

Step 3: Adjust the Risk Components for Taxes

After the base elements are combined into risk components, a tax adjustment is applied to most of the risk components before covariance. The tax amount used varies based on the base elements. It ranges from 26.25% to 35%.

Step 4: Apply Covariance Formula

The covariance formula is then applied to the values calculated for each category. This adjusts for the improbability all risks will materialize simultaneously.[3] The adjustment excludes affiliated equity investment risk and off-balance sheet risk (i.e., C-0 amounts).

Step 5: Generate Total RBC after Covariance

The results of the covariance formula produce the Total RBC after Covariance capital requirement. The authorized control level is half of this requirement.

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[1] It should be noted asset risk is only one of several risk components involved in the RBC calculations.

[2] The BACV is the statutory value of the investment before nonadmitted amounts based on the appropriate *Statement of Statutory Accounting Principle (SSAP) SSAP No. 26—Bonds* requires a life insurer's designation 1 through designation 5 bonds to be valued at amortized cost; designation 6 bonds are valued at the lower of amortized cost or fair value.

[3] NAIC. Life Risk-Based Capital Summary: Interactions between the Classification Decision, Annual Statement Reporting, and Life RBC Requirements. Retrieved from www.naic.org/documents/topics_hybrid_lrbc_hybrid_summary.pdf.

The Total RBC after Covariance formula is as follows:

Company Action Level RBC =
C0 + [(C1o + C3a)2 + (C1cs + C3c) 2 + (C2)2 + (C3b)2 + (C4b)2]1/2 + C4a

Step 6: Calculate RBC Ratio
An insurer's total adjusted capital is then assessed against the formula results to develop the RBC ratio.[4]

The RBC ratio formula is as follows:

$$\textbf{RBC Ratio} = \frac{\text{Total Adjusted Capital}}{\text{Authorized Control Level RBC}}$$

The RBC ratio is used to determine if an insurer's surplus level meets the minimum threshold to avoid company or regulatory action. If the ratio is 150% to 200%, the company must provide an RBC plan. If the ratio is 70% to 100%, the insurance regulator may take control of the insurer. If the ratio is below 70%, the regulator is required to place the insurer under control.

◆ WHY UPDATE?

The NAIC RBC system was placed into effect in 1991 after a series of insurer insolvencies. Over the years, some of the risk factors have been slightly modified and some structural changes have been made. However, the original factors are based on historical information from the 1970s and 1980s. Economic and interest rate conditions over the past decade have been considerably different than those during the development of the original RBC factors. Additionally, loss severity data has become more complete. Computer modeling capabilities have also become more sophisticated.

◆ C-1 REVIEW REVEALS REVISIONS NEEDED

In 2011, the NAIC began an initiative to review the current asset (C-1) risk structure and factors used in the RBC model. Figure 2 illustrates how RBC asset capital charge (C-1) factors reflect the risk of default and fluctuations in fair value of investments due to changes in interest rate. Thus, the C-1 component protects statutory surplus from events like bond defaults or common stock depreciation.

Asset risk heavily impacts the capital adequacy of life insurers. Bonds represent more than 75% of life insurers' invested assets. As such, the review process has included the treatment of fixed-income assets in the life RBC formula. The American Academy of Actuaries (Academy) has supported the examination process by providing statistical modeling support. This is consistent with the development of the original RBC factors.

As before, the Academy modeled historical default probability and loss recovery experience of public corporate bonds. The model derives C-1 capital charges from an industry representative bond portfolio. Losses are projected over 10 years assuming different economic conditions more than 10,000 economic scenarios and using a 96% confidence level. Default rate data and loss severities were provided by the nationally recognized statistical rating organizations (NRSROs). The Academy has proposed revisions to the structure and factors of the life RBC formula based on its analysis of the modeling results.

◆ PROPOSAL TO INCREASE C-1 BOND FACTOR GRANULARITY

The Academy recommended adding granularity in the life RBC formula by expanding the C-1 bond risk factors. Noting the Academy's data justified the need for additional granularity, the NAIC proposed expanding the factors from six to 20 designation categories. The 20 designation categories

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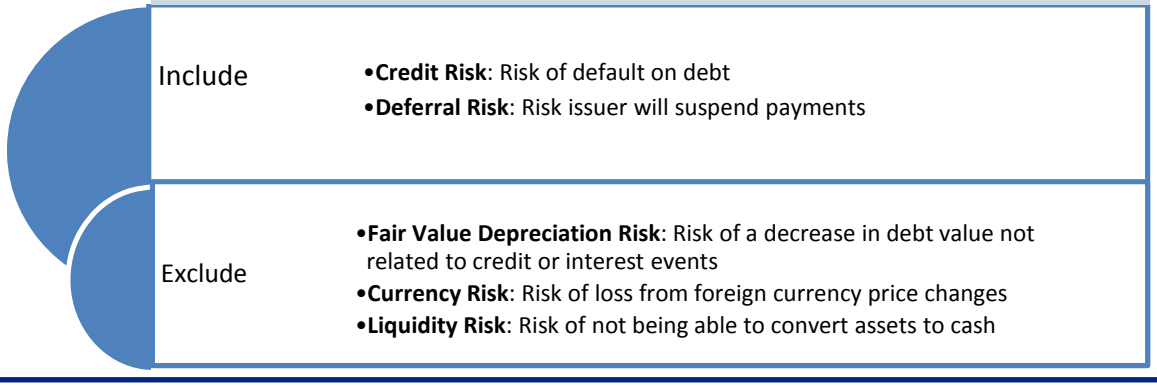
[4] Total Adjusted Capital = statutory capital and surplus + asset valuation reserve (AVR) + half of the liability for dividends + ownership share of AVR of subsidiaries + half of ownership share of subsidiaries' dividend liability.

FIGURE 2: C-1 COMPONENT RISKS



reflect NRSRO grades, although some grades will have the same factors.

The Academy's analysis found the current structure did not sufficiently align capital charges with varying degrees of credit quality relative to NRSRO letter ratings. Increasing the granularity of bond risk factors would allow RBC charges to more precisely map to capital needs for each RBC rating category. It will also allow state insurance regulators a more transparent view of insurers' credit risks. Figure 3 summarizes the benefits of adding granularity to the C-1 bond factor structure.

The current C-1 charges are based on the six NAIC designations. NAIC 1 and 2 classes are considered investment grade. There are seven Moody's bond categories in the NAIC 1 designation. The current RBC factors were developed under the assumption 25% of the bond holdings were in Aaa-rated bonds. However, both the market and insurers' investment holdings have changed significantly since RBC was first developed. Recent analysis by the NAIC shows insurer bond holdings include only about 5% in the Aaa-rated category.

The Academy's analysis noted life insurers' bonds were concentrated in the lower stratus of each NAIC designation. Besides market availability, it is also likely because a lower quality bond receives the same RBC charge as a higher quality bond, if it is assigned the same NAIC designation. For example, as seen in Figure 4, Moody's Aaa and A3 rated bonds both receive NAIC 1 designations. As such, they receive the same RBC charge, despite being six rating categories apart. Additionally, the charge for Baa1 rated bonds jumps to 1.5%, despite being only one rating category apart from A3 rated bonds. Increasing the granularity will reduce these "cliffs." This should eliminate the incentives created by having the same capital charge for bonds with substantially different risk profiles.

The 20 designations are anticipated to be applicable for RBC purposes only. The current six designation structure would continue to exist for investment law and statutory accounting purposes. The expanded designations are proposed to become part of a new required electronic-only column. The column will be part of Schedule D of the annual financial statement and feed into the RBC calculation. The proposal maps the new RBC designations directly to each asset's NRSRO bond rating.

The NAIC Investment Analysis Office has a separate, but related, proposal for bonds for which it assigns designations. The proposal modifies the NAIC designation by including a letter from A through G while also flowing through the traditional NAIC designation hierarchy. The results would be captured in a new NAIC designation category.[5] Figure 5 on the following page illustrates this relationship for NAIC designation 1 bonds.

FIGURE 3: WHY ADD GRANULARITY?

- ✓ **Eliminate NAIC designation "cliffs."**
- ✓ **Align more precisely with risks.**
- ✓ **Provide accurate asset distributions.**

◆ PROPOSAL TO UPDATE C-1 BOND FACTORS

The factor values for the 20 C-1 bond designations will be based on the analysis performed by the Academy in its modeling of corporate bonds. The Academy's most current proposal for base bond factors for life insurers is illustrated in Figure 6. The proposed factors provide lower capital charges for five NRSRO ratings. All but one of these changes is to below investment grade bonds. The factor for bonds in or near default remains unchanged. The remaining 14 NRSRO ratings receive higher charges. Overall, the proposed bond factors are expected to increase the RBC required capital for most insurers. However, it is important to recognize other changes could significantly reduce requirements for assets such as mortgage loans, real estate and receivables. These changes could also impact the proportion of capital required from bond investments versus other components of the life RBC formula.

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FIGURE 4: BOND GRANULARITY EXAMPLE

Current Designation	Current Factor	Bond Rating
NAIC 1	.40%	Aaa
		Aa1
		Aa2
		Aa3
		A1
		A2
		A3

[5] Carcano, B., Therriault, C. and Kolchinsky, C. (March 24, 2017). Comment of the Investment Analysis Office (IAO) on the Investment Risk-Based Capital (E) Working Group *Proposal for Life Bond Granularity and Related Issues* [Memorandum]. NAIC Valuation of Securities (E) Task Force. www.naic.org/documents/cmte_e_vos_exposure_iao_rep_irbcwg_life_bond_granularity.pdf.

FIGURE 5:
NAIC DESIGNATION CATEGORY EXAMPLE

NAIC Designation +	Designation Modifier =	NAIC Designation Category
NAIC 1	A	1.A
	B	1.B
	C	1.C
	D	1.D
	E	1.E
	F	1.F
	G	1.G

The increase in investment grade bond factors reflects data showing that losses on investment grade bonds have been higher over the past two decades than what was assumed in the current factors. Meanwhile, the decrease in charges for noninvestment grade bonds is lower, despite increased default rates for most of these bond classes. Another significant driver is a decrease in the discount rate to 3.5% after tax from 6% after tax, reflecting substantially lower interest rates from the late 1980s. The discount rate is based on the 10-year London Interbank Offered Rate (LIBOR) swap rate averaged over the past 20 years.[6]

◆ PROPOSAL FOR FACTOR ADJUSTMENTS

The current RBC formula contains portfolio adjustments for the 10 largest issuers in an insurer's asset portfolio (asset concentration) and for the size of the bond portfolio. The asset concentration factor reflects the additional risk of high concentrations in single exposures. The bond size factor reflects the higher risk of a bond portfolio containing relatively fewer bonds. The purpose of the portfolio adjustment is to scale the base factors from the 92nd percentile to achieve a safety level in 96th percentile and to include a diversification adjustment.

The Academy's October 2017 proposed base factors use an expanded number of securities in its representative portfolio. The expanded portfolio included 824 bonds designated as NAIC 1 or NAIC 2 to better reflect the average credit risk of a life insurer's bond portfolio. The resulting additional diversification in the base factors brings the results to the desired 96th percentile. This eliminates the need to scale results up to a higher safety level.

As a result, the Academy revised the portfolio adjustment scheme to reflect only an individual portfolio's diversification relative to the representative portfolio. For individual portfolios with the same number of bonds as the representative portfolio, the portfolio adjustment will be neutral (1.0). This update is not expected to change the average C-1 requirement across the life industry. Figure 7 on the following page compares the current portfolio adjustment factors with the Academy's most current recommended adjustment factors.[8]

(Continued on page 10)

FIGURE 6:
PROPOSED LIFE RBC BOND CAPITAL FACTORS[7]
(BEFORE TAX)

NAIC Designation	NRSRO Rating	NAIC Proposed Designation Category	Current Factors	Academy Proposed Factors – Oct. 2017
1	Aaa	1.A	0.40%	0.31%
1	Aa1	1.B	0.40%	0.43%
1	Aa2	1.C	0.40%	0.57%
1	Aa3	1.D	0.40%	0.72%
1	A1	1.E	0.40%	0.86%
1	A2	1.F	0.40%	1.06%
1	A3	1.G	0.40%	1.24%
2	Baa1	2.A	1.30%	1.42%
2	Baa2	2.B	1.30%	1.69%
2	Baa3	2.C	1.30%	2.00%
3	Ba1	3.A	4.60%	3.75%
3	Ba2	3.B	4.60%	4.76%
3	Ba3	3.C	4.60%	6.16%
4	B1	4.A	10.00%	6.35%
4	B2	4.B	10.00%	8.54%
4	B3	4.C	10.00%	11.82%
5	Caa1	5.A	23.00%	17.31%
5	Caa2	5.B	23.00%	23.22%
5	Caa3	5.C	23.00%	30.00%
6	Default	6	30.00%	30.00%

[6] American Academy of Actuaries, C-1 Working Group. (August 3, 2015). Model Construction and Development of RBC Factors for Fixed Income Securities for the NAIC's Life Risk-Based Capital Formula. Retrieved from www.actuary.org/files/imce/Academy%20C1WG%20Documentation%20Corp%20Bond%20Factors%20%20Aug%203%202015%20Final.pdf.

[7] American Academy of Actuaries, C-1 Working Group. (October 10, 2017). Updated Recommendation of Corporate Bond Risk-Based Capital (RBC) Factors [Letter]. www.naic.org/documents/cmte_e_investment_rbc_wg_exposure_rec_corporate_bond_rbc_factors.pdf.

[8] Ibid.

FIGURE 7:
PORTFOLIO ADJUSTMENT FACTORS[9]

Current		Recommended	
Issuers	Factor	Issuers	Factor
Up to 50	2.5	Up to 10	7.80
Next 50	1.3	Next 90	1.75
Next 300	1.0	Next 100	1.00
Over 400	0.9	Next 300	0.80
		Over 500	0.75

◆ FUTURE CONSIDERATIONS

The NAIC has been working to update its RBC requirements to reflect modern experience and risks since 2011. Its primary focus has been on reviewing the RBC structure and charges related to fixed income securities. The preference is to treat asset risk consistently for all RBC formulas for each of the statement types. This would minimize operational costs for insurers and software vendors. It would also ensure all bonds are treated equally with respect to default risk, regardless of the holder of the investment.

There is general consensus the C-1 factors for fixed income securities should increase from six to 20 in the life, as well as the property/casualty (P/C) and health, RBC formulas. The factors for the expanded rating categories are still being discussed. The NAIC is currently coordinating with the Academy to refine the bond factor values for the life RBC formula. Some hold the opinion different factors should be used for certain asset classes, such as municipal bonds and sovereign debt. The need to update bond factors for health and P/C insurers is also being considered. Health and P/C insurers differ considerably from life insurers in how they hold and use assets. It has been argued efforts to translate the C-1 factors across all lines will require taking these differences into account.

The NAIC plans to implement the revised structure and related factors being developed for investments in each of the RBC formulas for the year-end 2019 reporting purposes. This should provide sufficient time to evaluate the effect of the changes on each industry sector. The expansion of C-1 factors will eliminate the incentive for insurers to invest in lower quality bonds within the same NAIC designation. Insurers may also reconfigure their investment portfolio in light of the changes in capital charges. But most important, the added granularity will add transparency to the credit risks insurers hold in their investments and the updated factors reflect more current data. This should enhance insurance regulators ability to use RBC for its intended purpose: to identify weakly capitalized insurers.

ABOUT THE AUTHOR

Anne Obersteadt is a researcher with the NAIC Center for Insurance Policy and Research. Since 2000, she has been at the NAIC performing financial, statistical and research analysis on all insurance sectors. In her current role, she has authored several articles for the CIPR Newsletter, a CIPR Study on the State of the Life Insurance Industry, organized forums on insurance related issues, and provided support for NAIC working groups. Before joining CIPR, she worked in other NAIC Departments where she published statistical reports, provided insurance guidance and statistical data for external parties, analyzed insurer financial filings for solvency issues, and authored commentaries on the financial performance of the life and property and casualty insurance sectors. Prior to the NAIC, she worked as a commercial loan officer for U.S. Bank. Ms. Obersteadt has a bachelor's degree in business administration and an MBA in finance.

The author would like to thank the following for their contributions to this article: Ed Toy, Director of the NAIC Capital Markets Bureau, Julie Garber, NAIC Sr. Accreditation Manager and Kevin Fry, Illinois Deputy Director of Financial and Corporate Regulation.

[9] Ibid.

Natural Catastrophes, Insurance and Alternative Risk Transfer

By Dimitris Karapiperis, CIPR Research Analyst

◆ Introduction

Weather and extreme climate events, such as hurricanes and flooding, have significantly increased and intensified over the past several decades, causing billions of dollars in financial losses on an annual basis. These losses are of concern to the insurance industry as insurers are directly exposed through the coverage they provide for damages resulting from natural catastrophes. Governments are also financially exposed to natural catastrophes through government-provided insurance protection and their obligation to provide aid to victims and funds to restore and rebuild damaged communities, as economic losses typically far exceed insured losses.

Insurers, governments and other public entities, in order to reduce their financial vulnerability, as well as increase needed capacity to cover rising losses, can turn to reinsurance and the capital markets to shift part of the risk to them. Early on in the development of alternative risk transfer, it was only insurers using financial instruments such as catastrophe bonds (cat bonds) to pass part of their risk to investors. A number of public disaster programs and governments have also started recently employing these tools to better manage their exposures.

◆ Costly Natural Catastrophes on the Rise

The need to shift some of the risk from insurers and public insurance programs—and increase capacity to finance natural disaster risk beyond traditional insurance coverage—is primarily driven by the increasing frequency of multi-billion-dollar natural catastrophes, especially since the early 1990s.

To provide some historical context for the changing natural catastrophe profile of the country, the experience in the 100-year period from 1917 to 2016 can be instructive. The number of storms, hurricanes and floods—which are the most frequent and catastrophic event types affecting the U.S.—markedly increased during this period. In the first half of the century, the annual average was 1.6 events, while in the following 50 years, the average jumped to 14 events a year. In the past 25 years, not including 2017, the annual average rose even higher, to 19.7 events a year (Figure 1).[1]

In terms of insured losses, the annual average for billion-dollar catastrophes for the five-year period from 2012 to 2016 was 10.6 billion-dollar events, nearly double the 1980–2016 annual average of 5.5 billion-dollar events[2] (Figure 2 on the following page).

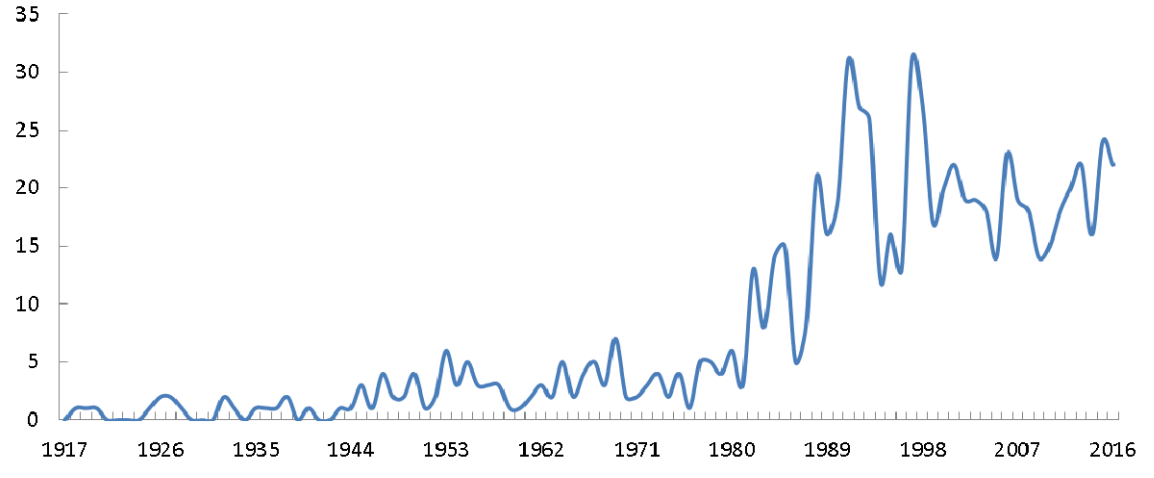
From an insurance perspective, it is the rate of growth of the frequency of high-loss natural catastrophes that raises weather and climate risk to one of the highest concerns and a primary focus for the property/casualty (P/C) insurance industry, state insurance regulators, and state and federal governments. It was not until the 1990s the insurance industry started experiencing billion-dollar events on a regular basis. While since 1980 the long-term average is five billion-dollar events, it has increased to an average of eight billion-dollar events since 2000.

(Continued on page 12)

[1] Storm and flood events to be included in EM-DAT used for this figure must fulfill at least one of the following criteria: 1) 10 or more people killed; 2) declaration of a state of emergency; ad/or 3) call for international assistance.

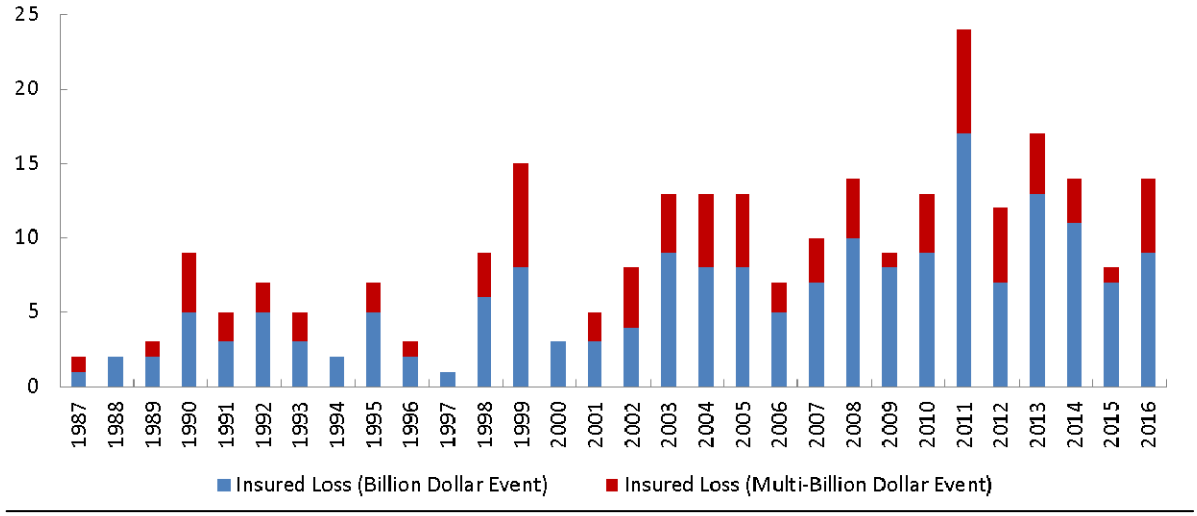
[2] Aon Benfield. 2017. "2016 Annual Global Climate and Catastrophe Report."

Figure 1: Flood and Storm Events in the U.S.



Source: EM-DAT: The Emergency Database.

FIGURE 2: GLOBAL BILLION-DOLLAR INSURED WEATHER EVENTS*



* Adjusted for Inflation Using 2016 U.S. Consumer Price Index.
Source: Aon Benfield.

Nine of the top 10 costliest natural catastrophes in U.S. history were hurricanes and floods, and all but one occurred after 2000. Moreover, the top 10 costliest hurricanes in the U.S. were all multi-billion-dollar events affecting, in all but one case, multiple states and ranging from $5.7 billion to $49.8 billion in insured losses (Figure 3 on the following page).

In 2016, insured losses from storm and flood events in the U.S. totaled almost $20 billion, surpassing the 2015 total by approximately $4 billion.[3] In the first half of 2017, direct insured property losses from catastrophes in the U.S. totaled $17.1 billion, up from $13.9 billion in first half of 2016 and from the $13.0 billion average first-half direct catastrophe losses for the past 10 years.[4] Also, according to the most conservative preliminary estimates, the insured losses from the three recent hurricanes (Harvey, Irma and Maria) total more than $70 billion.[5]

Regardless of whether one agrees anthropogenic climate change is the primary cause of extreme weather and climate events, the fact remains meteorological natural catastrophes have increased both in frequency and severity. From an insurance perspective, if natural catastrophes continue to occur at this rate, it is largely expected the amount of insured losses will keep increasing, possibly reaching a level that could, at some point, threaten the industry's financial stability.

While part of the increase in insured losses caused by natural catastrophes may certainly be a result of changing climate patterns, a significant part is due to huge increases in development in populous coastal regions. One catastrophe modeling company has estimated catastrophe losses would likely double every decade or so due to growing residential and commercial density, as well as more expensive construction.[6]

◆ REINSURANCE AND ALTERNATIVE CAPITAL

Insurers are at the front lines of providing protection from natural catastrophes to people and businesses at risk. The scale of insured losses caused by natural catastrophes, especially since 2000 (Figure 3 on the following page), could potentially exceed the collected premiums and capital an exposed insurance company has available to pay claims. Insurers, in order to make sure all their policyholders are protected—in addition to insulating themselves from catastrophic risk—seek and buy reinsurance coverage.

Reinsurance, which is often described as insurance for insurers, is a contract of indemnity between a reinsurer and an insurer. It is an essential mechanism by which insurers manage their risks and expand capacity. As the flow of third-party alternative capital into the alternative risk transfer market has increased in recent years, primary insurers can, and often will, turn to the capital markets instead of traditional reinsurance to shift part of their catastrophe risk.

(Continued on page 13)

[3] www.iii.org/fact-statistic/facts-statistics-us-catastrophes.
[4] Ibid.
[5] Milliman. 2017. "Surveying the damage: The impact of Harvey, Irma, ad Maria on the alternative capital market" October 2017.
[6] www.iii.org/issue-update/spotlight-on-catastrophes-and-insurance-issues.

The growing need for reinsurance coverage and the infusion of cheaper alternative capital sources have intensified the competitive pressures in the reinsurance sector, particularly in lines exposed to natural catastrophes.[10] With alternative capital possibly crowding out some of the more expensive traditional reinsurance, a number of reinsurers have also been issuing cat bonds and partnering with alternative capital investors to help them with underwriting and with forming companies.[11]

According to Aon Benfield, alternative capital capacity, which is provided by capital market investors, has more than tripled since 2011 and, as of June 30, 2017, it stood at $89 billion.[12] At $516 billion as of June 30, 2017, traditional reinsurance capital rose by a more modest 20% during the same period.[13] Consequently, rapidly rising alternative capital now (June 30, 2017) represents nearly 15% of the total global reinsurance capital, from just 6% in 2011, as more large institutional investors in search of yield and the diversification benefits of an uncorrelated asset class have entered the market. Some institutional investors, such as pension funds, enjoy a competitive advantage over traditional reinsurers. Their cost-of-capital targets are typically lower than reinsurers' weighted average cost of capital, enabling them to profitably assume catastrophe risks at prices uneconomical for traditional reinsurers.[14]

Collateralized reinsurance is the largest and fastest-growing component of the alternative risk transfer market, followed by the still-appealing and growing cat bonds, as new sponsors are coming in to this area of the market. Industry loss

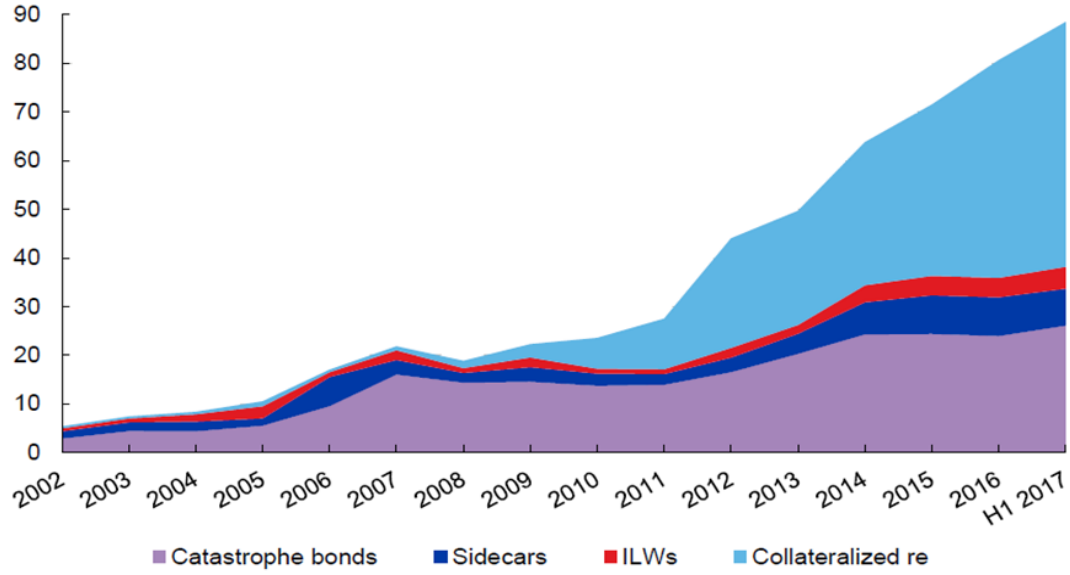
(Continued on page 14)

[7] The top 10 list includes hurricanes occurring through 2016.
[8] Losses include property coverage only. Flood damage covered by the federally administered NFIP is excluded.
[9] Amounts adjusted for inflation through 2016 by the Insurance Services Office Inc. (ISO) using the gross domestic product (GDP) implicit price deflator.
[10] S&P Global Ratings. 2017. "Global Reinsurance Highlights."
[11] Insurance Information Institute. 2015. "Alternative Capital and its Impact on Insurance and Reinsurance Markets." March 2015.
[12] Aon Benfield. 2017. "Reinsurance Market Outlook." September 2017.
[13] Ibid.
[14] S&P Global Ratings. 2017. "Global Reinsurance Highlights."

FIGURE 3: TOP 10 COSTLIEST U.S. HURRICANES (IN BILLIONS)[7]

				—Estimated Insured Loss[8]—	
Rank	Date	Location	Hurricane	Dollars When Occurred	In 2016 Dollars[9]
1	Aug. 25–30, 2005	AL, FL, GA, LA, MS, TN	Katrina	$41.1	$49.8
2	Aug. 24–26, 1992	FL, LA	Andrew	$15.5	$24.5
3	Oct. 28-31, 2012	CT, DC, DE, MA, MD, ME, NC,NH, NJ, NY, OH, PA, RI, VA, VT, WV	Sandy	$18.8	$19.9
4	Sept. 12–14, 2008	AR, IL, IN, KY, LA, MO, OH, PA, TX	Ike	$12.5	$14.0
5	Oct. 24, 2005	FL	Wilma	$10.3	$12.5
6	Aug. 13-14, 2004	FL, NC, SC	Charley	$7.5	$9.3
7	Sept. 15–21, 2004	AL, DE, FL, GA, LA, MD, MS, NC, NJ, NY, OH, PA, TN, VA, WV	Ivan	$7.1	$8.9
8	Sept. 17–22, 1989	GA, NC, PR, SC, UV, VA	Hugo	$4.2	$7.3
9	Sept. 20–26, 2005	AL, AR, FL, LA, MS, TN, TX	Rita	$5.6	$6.8
10	Sept. 3–9, 2004	FL, GA, NC, NY, SC	Frances	$4.6	$5.7

FIGURE 4: DEPLOYMENT OF ALTERNATIVE CAPITAL (2002–2017 IN $BILLIONS)



Source: Aon Benfield.

warranties and sidecars are by far the smaller components of alternative risk transfer but, nonetheless, successfully maintaining a steady presence in the market (Figure 4).

At more than $50 billion as of June 30, 2017, collateralized reinsurance has been the real growth engine of the alternative reinsurance capital in the past decade.[15] Collateralized reinsurance is most comparable with traditional reinsurance, particularly if it is fronted by a traditional reinsurance company, essentially being a fully collateralized version of a reinsurance program.[16] The collateral amount covering in full all potential claims, minus fees and charges, is put up by investors and kept in escrow for the life of the contract.

For institutional investors, such as hedge funds, collateralized reinsurance allows a broader risk exposure than cat bonds at a relatively lower cost. A concern for insureds and regulators is the special purpose vehicles set up for this type of transaction tend to be non-rated and thinly capitalized entities, and the availability of the escrowed collateral can be dependent on the exact separate trust agreement language.[17]

Alternative risk transfer growth will likely continue to outpace traditional reinsurance. Gaining more market share would sharpen competition, thereby squeezing traditional reinsurers' margins and making them more vulnerable to large catastrophe losses.[18]

◆ THE EVOLVING USE OF CATASTROPHE BONDS

As an alternative to traditional insurance and reinsurance, and as an innovative risk transfer product, cat bonds have enjoyed a long and successful history, having grown significantly since they were first issued in the mid-1990s.[19] Cat bonds were first seriously contemplated following Hurricane Andrew in 1992, as rising reinsurance prices and questions regarding the ability of traditional reinsurance to absorb extreme catastrophe losses led to thinking about alternative capital.[20] Until about five year ago, cat bonds were the primary investment vehicles to attract investors from the capital markets seeking favorable returns and willing to take on insurance risk uncorrelated to their existing investment portfolios.

Sponsoring a cat bond allows insurers to reduce their overall reinsurance cost and free up capital to underwrite new insurance business. As an alternative to traditional reinsurance, cat bonds are attractive, particularly for low frequency, high severity catastrophes. It was actually the insurance and traditional reinsurance market that facilitated the creation

(Continued on page 15)

[16] www.artemis.bm/blog/2017/07/24/collateralized-reinsurance-drives-alternative-capital-growth-in-q1-aon.
[17] Aon Benfield. 2017. "Reinsurance Market Outlook." September 2017.
[18] S&P Global Ratings. 2017. "Global Reinsurance Highlights."
[19] www.artemis.bm/deal_directory/cat_bonds_ils_issued_outstanding.html.
[20] Insurance Information Institute. 2015. "Alternative Capital and its Impact on Insurance and Reinsurance Markets." March 2015.

of cat bonds after realizing, for some peak exposures, it was ideal to transfer the risk to the capital markets in order to take advantage of their depth and liquidity.

Among the main benefits of cat bonds as compared to traditional reinsurance are: increased market capacity; competitive pricing; multi-year commitment allowing for pricing stability; and counterparty security as the claims-paying ability (credit rating) is not an issue. Conversely, the advantages of traditional reinsurance are: easy to understand; when supply is plentiful, pricing and terms are attractive; straightforward regulatory and accounting treatment; and proven historical track record.

A possible disadvantage of cat bonds issued by insurers may be related to their regulatory treatment regarding the allowed reinsurance credit. To ensure meaningful transfer of risk and collectability of reinsurance receivables, only indemnity cat bonds, triggered by the sponsor insurer's actual losses without any basis risk, are allowed to count as reinsurance ceded and to be reported accordingly.

Cat bonds are structured so payment of interest or principal to the ceding insurance company depends on the occurrence of a catastrophe of a defined magnitude, or one causing an aggregate insurance loss in excess of a stipulated and agreed-upon amount. If one of the designated catastrophic events takes place, all or part of the principal is paid to the ceding insurance company, investors' coupon payments cease or are reduced and, at maturity, there is either zero, or a reduced amount of principal, repaid. On the other hand, if the catastrophic event does not occur, investors get the enhanced coupon for the term of the bond, typically three years, and receive the principal back at maturity.[21]

The first cat bond was a $477 million deal issued in 1997 by Residential Re, a Cayman Islands reinsurer created by USAA to transfer its exposure to catastrophe losses from U.S. hurricanes[22] and, in the two decades since, the cumulative issuance has swelled to approximately $90 billion[23] (Figure 5).

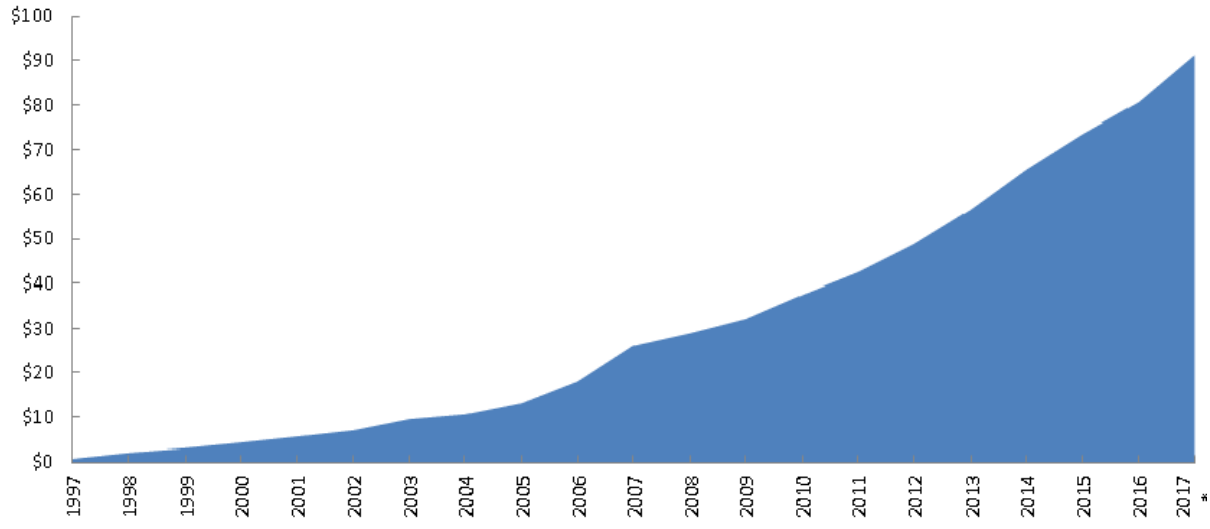
From 1997 to 2005, the market for cat bonds grew by an average of 25% per year. After hurricane Katrina in 2005, models were recalibrated to include increased assumptions for severity and frequency of hurricanes and enhancement in loss modeling. With the increase of risk perception and modeled expected loss, cat bond spreads widened along with reinsurance rates.[24] The first major cat bond default, Kamp Re, happened during that period, after being triggered by Hurricane Katrina with investors losing 75% of their principal.[25]

The financial crisis seriously tested the cat bond market, along with the overall structured securities market, as investors exited positions, generally selling at a discount, to pro-

(Continued on page 16)

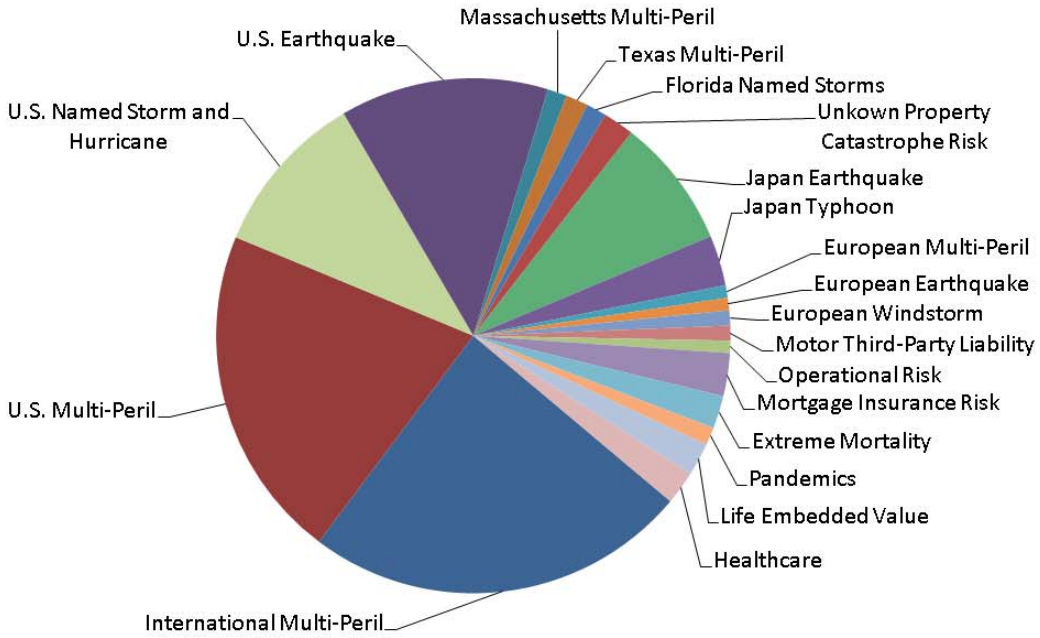
[21] Risk Management Solutions. 2012. "Cat Bonds Demystified."
[22] www.businessinsurance.com/article/19971221/ISSUE01/100010623/1997-risk-management-catastrophe-bonds-take-risk-financing-by-storm.
[23] www.artemis.bm/deal_directory/cat_bonds_ils_cumulative_issuance.html.
[24] Partner Re. 2015. "The Drivers of Catastrophe Bond Pricing," PartnerReviews, October 2015.
[25] www.artemis.bm/deal_directory/kamp-re-2005-ltd.

FIGURE 5: CATASTROPHE BONDS CUMULATIVE ISSUANCE BY YEAR (BILLIONS)*



* Includes other Insurance-Linked Securities. Source: Artemis.

FIGURE 6: CATASTROPHE BONDS AND ILS RISK CAPITAL BY RISK OR PERIL



Source: Artemis.

tect their liquidity. While the crisis showed cat bonds were not fully immune to the vagaries of the credit markets, they only experienced a low degree of correlation with other asset classes whose performance had been severely compromised.

Only four cat bonds defaulted during the global financial crisis when Lehman Brothers, the derivatives counterparty in the transactions, collapsed. The collateral structure used in these deals which incurred losses included liquidity swaps, a commonly used structure needed to facilitate draws. The structure is no longer in use and it is not found in any of the outstanding cat bonds.[26]

Challenging conditions in the structured securities market following the global financial crisis affected the demand for insurance risk by investors, slowing cat bond issuance for a couple of years. Issuance eventually started recovering by 2011 and surpassed the pre-financial crisis record of $8.3 billion, reaching a new record of $9.1 billion in 2014.[27] Issuance in the first half of 2017 rose beyond $9.7 billion, the most ever recorded in a single year. The cat bond market has grown to a new all-time record, with nearly $30 billion outstanding, despite having to manage a record $6.5 billion of maturities in the first half of 2017.[28]

Cat bonds are the largest part of the overall insurance-linked securities (ILS) market, accounting for about 88% of the total ILS capital outstanding by type of catastrophe risk or peril (Figure 6). Cat bonds have been primarily used by property/casualty insurers and reinsurers to transfer major risks on their books, such as hurricanes, to capital market investors.

The profile of ceding entities has become more diverse in recent years, as government, public agencies and corporates have joined primary insurers, who still dominate the cat bond market, followed by reinsurers. Among primary insurers, most are U.S.-focused large and regional entities, while large global insurers are conspicuous by their absence.[29]

Several non-insurer entities—ranging from corporates such as Disney and Universal Studios to governments and agencies such as the California Earthquake Authority and international organizations such as the World Bank—are increasingly using cat bonds and similar risk transfer tools to manage their exposure to natural catastrophes.[30]

(Continued on page 17)

[26] www.artemis.bm/blog/2013/02/12/the-death-of-the-total-return-swap-in-the-cat-bond-market-is-almost-upon-us.

[27] www.artemis.bm/deal_directory/cat_bonds_ils_issued_outstanding.html.

[28] Artemis. 2017. "Q2 2017 Catastrophe Bond and ILS Market Report."

[29] Swiss Re. 2017. "Insurance-Linked Securities Update," Volume XXVII, August 2017.

[30] Kunreuther, H., Michel-Kerjan, E. and Tonn, G. 2016. "Insurance, Economic Incentives and other Policy Tools for Strengthening Critical Infrastructure Resilience: 20 Proposals for Action." The Wharton School, University of Pennsylvania, December 2016.

Interestingly, about 10 years before the introduction of cat bonds in the U.S., the earliest cat bond deal involved the Swedish government agency Svensk Exportkredit, which sold earthquake loans to Japanese insurers. The $5 million bond was issued in December 1984 with a 20-year maturity. The insurers bought the bond, accepting lower-than-normal coupons in return for the right to sell the bonds back to the issuer at the nominal value should an earthquake over a defined magnitude occur.[31]

The World Bank designed and launched the MultiCat Program in 2009 to provide a cat bond issuance platform to be used by governments and other public entities to access the capital markets for coverage against natural catastrophe risks. The first cat bond issued under this program was the $290 million MultiCat Mexico 2009 to provide parametric insurance to Mexico's Fund for Natural Disasters (FONDEN) against earthquake and both Pacific and Atlantic hurricane risks.[32]

The World Bank also issued a $30 million deal in 2014 to provide reinsurance to the Caribbean Catastrophe Risk Insurance Facility (CCRIF) to transfer natural catastrophe risk of 16 member countries to the capital markets at highly competitive prices.[33]

Another World Bank-supported cat bond was the IBRD/ Fonden 2017 to provide Mexico with financial protection of up to $360 million against losses from earthquakes and tropical cyclones.[34] The deadly 8.1 magnitude earthquake in Mexico in September 2017 has placed this bond at risk, which could eventually be a 100% loss.[35]

The New York Metropolitan Transit Authority (MTA), a public-benefit entity governed by the state and city of New York, has also chosen to issue cat bonds to manage its catastrophe risk exposure. The MTA has issued two $125 million cat bonds: MetroCat Re (Series 2013-1) and MetroCat Re (Series 2017-1). The first deal provided storm surge reinsurance protection for MTA's captive insurance company, the First Mutual Transportation Assurance Company (FMTAC), while the second added coverage for risk from earthquake exposures.[36]

The California Earthquake Authority (CEA), the publicly managed residential earthquake insurance provider, has issued a number of cat bonds since 2011, starting with Embarcadero Re (Series 2011-1) to the most recent issuance in May 2017, Ursa Re (Series 2017-1), which secured $925 million of reinsurance protection.[37]

The use of cat bonds alongside traditional reinsurance has significantly helped the CEA to reduce its risk-transfer costs and better manage its risk exposure, thereby increasing the amount of protection it benefits from. The claims-paying capacity of the CEA now exceeds $15 billion, which is sufficient to pay covered losses if a major earthquake were to strike California today. Using cat bonds has also helped reduce homeowners insurance rates, as savings flow through to consumers.[38]

Helping the CEA to offer more affordable earthquake coverage to Californians and providing risk transfer should a major event occur, cat bonds play a key role in making sure the CEA has the ability to not only back up its nearly 1 million policies but also to expand coverage.[39]

Florida Citizens Property Insurance Corporation (Citizens), a not-for-profit insurer of last resort created by the Florida Legislature in 2002 and governed by the state, has been using cat bonds to manage its risk exposures, and it is responsible for the largest cat bond issuance in the world. The $1.5 billion Everglades Re (Series 2014-1) offers reinsurance protection against hurricanes on an annual aggregate basis using an indemnity trigger.[40] With this cat bond, in the event of up to a one-in-70-year storm, Citizens would have enough funds to pay all claims without needing assessments from Florida's taxpayers. According to Citizens, the risk to taxpayers was effectively reduced by more than 80%.[41]

The high estimated losses from hurricanes Harvey and Irma also brought to the forefront the potential utility cat bonds could have for the federally administered National Flood Insurance Program (NFIP). In 2016, the NFIP, recognizing the need to reduce the amount of flood risk it holds, secured its

(Continued on page 18)

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[31] http://en.entropics.se/blog/first-cat-bond-ever.
[32] http://treasury.worldbank.org/cmd/htm/MULTICAT-PROGRAM.html.
[33] http://treasury.worldbank.org/cmd/htm/FirstCatBondLinkedToNaturalHazards.html.
[34] www.worldbank.org/en/news/press-release/2017/08/04/world-bank-bonds-to-provide-360-million-in-catastrophe-protection-for-mexico.
[35] www.artemis.bm/blog/2017/09/08/mexico-m8-1-earthquake-puts-fonden-2017-catastrophe-bond-at-risk.
[36] www.artemis.bm/blog/2017/05/16/new-york-mtas-new-metrocat-re-2017-cat-bond-priced-below-mid-point.
[37] www.artemis.bm/blog/2017/08/01/california-quake-insurance-on-the-rise-cat-bonds-an-innovation-cea.
[38] www.artemis.bm/blog/2017/08/01/california-quake-insurance-on-the-rise-cat-bonds-an-innovation-cea.
[39] www.artemis.bm/blog/2017/08/01/california-quake-insurance-on-the-rise-cat-bonds-an-innovation-cea.
[40] www.artemis.bm/deal_directory/everglades-re-ltd-series-2014-1.
[41] Insurance Journal. 2014. "Florida's Citizens Readies $1.5 Billion Catastrophe Bond Deal," April 28, 2014.

first placement of reinsurance, which was expanded in the beginning of 2017 to $1.04 billion. According to the Federal Emergency Management Agency (FEMA), this reinsurance helps the NFIP become more resilient and has set the foundation for a multi-year reinsurance program.[42] Estimates suggest this reinsurance program will payout in full with losses from Hurricane Harvey alone.[43]

Among legislative efforts toward the reauthorization of the NFIP, there are a number of bills calling for a greater use of alternative risk transfer tools such as cat bonds, which can be an important part of covering extreme flood events without the additional stress on government finances and the burden on taxpayers.[44]

According to Standard & Poor's (S&P), there are significant modeling challenges for flood risk to be overcome before private capital participation in the NFIP in the form of cat bonds. Nevertheless, S&P suggests that, with reinsurer capital already in place and assuming greater assumption of NFIP risk in the near future by reinsurers, capital market investors would be asked to participate at a later stage to more efficiently spread risk. At this point, however, S&P believes it may be premature for the cat bond market to assume NFIP risk.[45]

◆ CONCLUSION

Natural catastrophes have happened in the past and will undoubtedly continue to happen in the future, albeit with increasing frequency and higher severity, triggering rising economic and insured losses. The ability to efficiently spread and share natural catastrophe risk is essential for the solvency of the insurance industry, the fiscal health of the government, the growth of the economy and the general welfare of all citizens. Expanding insurance can be a catalyst for resilience, as capacity and take-up rates increase. Tapping the capital markets through financial instruments such as cat bonds issued by insurers, in addition to government entities and public insurance programs, could help improve coverage, pricing, and relief and recovery efforts.

ABOUT THE AUTHOR

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Big Data Analytics: Changing the Calculus of Insurance

By Michael W. Elliott, CPCU, AIAF, Senior Director of Knowledge Resources for The Institutes

◆ Abstract

Big data, smart technology, advanced analytics, and automation are permanently changing the property-casualty insurance business. Innovative technologies, such as wireless sensor networks and computer vision, are enabling insurers to collect vast amounts of data previously unavailable to them. This, coupled with analytics involving advanced techniques such as machine learning and artificial intelligence, is challenging insurers to transform their organizations into fully digital enterprises in order to increase efficiency, reduce expenses, and remain competitive.

Across all industries, reports Accenture, 89% of large companies say big data is going to revolutionize business operations, with changes predicted to be on a scale comparable with how the internet changed the way people work in the 1990s.[1] Insurance companies are part of this revolution, which is upending the way they underwrite, handle claims, control losses, develop new products, and service customers.

Big data, as its name implies, involves large sets of data—too large, in fact, to be gathered and analyzed by traditional methods. Although insurers have always gathered and analyzed large amounts of data to make business decisions, the quantity of data available in recent years has increased exponentially because of increased sharing of information and virtually connected objects, through what is called the Internet of Things (IoT).

This increased volume of data challenges insurers to develop new ways to store, access, process, and analyze data. By mining big data for patterns and trends, insurers are able to gain a competitive edge through reduced expenses and improved processes relating to claims, underwriting, and operations.

At the same time, vehicles, buildings, and machines are becoming smarter, through innovative technologies such as wireless sensor networks and computer vision. As a result, many insured objects and workers are safer, causing industry experts to predict that insurance companies will experience significantly lower claims amounts.

Furthermore, technology will foster continuous engagement between insurers and their policyholders, resulting in increased adoption of loss-prevention measures and thereby adding to the downward trend in claims. Given today's technology, it is not hard to imagine your insurance company sending a text to alert you to replace your washing machine's water supply hose or to move your car into the garage because of an imminent hail storm.

But it is not only big data and smart technology that are revolutionizing insurance. Recent advancements in analytical techniques, including deep learning, and increasing automation of insurer underwriting and claims processes are also transforming the business. This mix of big data, smart technology, advanced analytics, and automation is permanently changing the calculus of insurance as we know it.

◆ Big Data Analytics

An insurer's big data arises from both internal and external sources and can be structured or unstructured. Insurers' internal underwriting data on losses and exposures is structured because it is organized into databases with rows and columns. An insurer's external data, such as that provided through vehicle telematics, is usually structured in a similar way. By contrast, unstructured data is not organized, with a prime example being text data from claims adjusters' notes. Analytics is a process that enables insurers to gain deep insight from big data to make effective decisions. Many of the big data analytical techniques employed by insurers are not new, such as exploratory data analysis, which is used to develop a basic understanding of data, and data segmentation, which is used to classify data based on its characteristics. However, automation using these techniques allows insurers to analyze data much more quickly and at more granular levels.

In addition, recent advancements in specific analytical techniques facilitate deep insight into data patterns and trends. A good example is the development of neural networks, which operate in ways similar to the human brain—but more powerfully. Neural networks can simultaneously perform thousands of mathematical calculations on large datasets.[2] Other advanced analytical techniques include text mining, which analyzes words, and social network analysis, which analyzes relationships.

Regardless of the specific technique applied, insight into patterns and trends is greatly enhanced through machine learning, in which computers continuously learn and make decisions based on data. Related to machine learning is artificial intelligence, including cognitive computing, which simulates human thought processes. Many of the underwriting- and claims-related applications being developed by

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insurers apply machine learning and artificial intelligence to one or more big data analytical techniques.

To achieve organizational goals, some big data analytics applications employ straight-through processing, in which computers make decisions and complete a process without human intervention. A good example is a small auto physical damage claim that, on first notice of loss (FNOL), is automatically scored for potential fraud. If, however, its score indicates that it is a meritorious claim, payment will automatically be made to the claimant. Straight-through processing applies to many other processes, including real-time, online premium quotes for many lines of business.

It should be noted that most big data analytics applications require a human with expertise in the field to analyze model outputs. While these applications serve as a useful tool to help underwriting, claims, or risk management professionals do their jobs, they do not replace the skill and experience of these professionals for most applications.

◆ THE EVOLUTION OF BIG DATA ANALYTICS IN INSURANCE

To understand the current influence of big data analytics on insurers, it is important to have a sense of insurers' historical use of data and analytics as well as of recent industry developments.

Data is a fundamental input to insurance, and underwriters have used data and analytics to conduct business ever since the industry started. In the early days, analytics was based on limited recall of events and little claims data. In the twentieth century, industrywide historical claims data was collected and summarized. In the last several decades, actuaries have made great strides using this data for ratemaking with the development of sophisticated analytical models, notably generalized linear models.

The 1990s and early 2000s ushered in what McKinsey & Company refers to as "born through analytics"[3] companies such as Amazon, Facebook, and Google. A distinguishing characteristic of these organizations is that they were built on a digital platform that influenced their structure and the processes they use for key operations, such as pricing, marketing, inventory control, and logistics. As a result, these organizations grew by scaling their data storage and processing systems and by using sophisticated data and analytics for marketing and operations.

Furthermore, customer-service innovations by these data-driven companies have greatly influenced customer expectations in general, including those of insurance consumers. As a result, policyholders often demand quick turnaround on underwriting and claims decisions and twenty-four-hour access to account information through multiple channels, including phones and tablets.

Throughout the early 2000s, insurers of all sizes experimented with big data analytics projects for specific applications, such as customer segmentation analysis for marketing and link analysis for identifying fraudulent claims. After some early successes, insurers expanded their use of big data analytics and applied it to areas ranging from medical management for workers compensation to reputational risk assessment, using data from social networks.

To remain competitive and meet increasing customer expectations, insurers are now challenged to go further by transforming their organizations into fully digital enterprises that are largely driven by data for making decisions. Accordingly, many insurers employ large teams of data scientists with high-level math and statistics backgrounds to work alongside marketing, actuarial, claims, and underwriting professionals.

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SOME COMMON APPLICATIONS OF BIG DATA ANALYTICS

Claims	Risk Management
• Complex claims detection • Fraud detection • Return-to-work analysis (workers compensation) • Medical management	• Accident analysis • Reputational risk assessment
Marketing	**Underwriting**
Customer segmentation	• Risk selection • Pricing

It is imperative that core business users have a basic understanding of the language of data science and predictive modeling so as to ensure good communication among all groups for planning and implementing big data analytics applications. Some large personal lines insurers seem to be the furthest along in these efforts.

◆ SEGMENTING BIG DATA TO MAKE PREDICTIONS

Data segmentation is central to many big data analytics applications for marketing, underwriting, claims, and risk management. The concept of data segmentation is not new, but its application to big data using machine learning is enabling insurers to discover previously unforeseen patterns and trends, allowing insurers to make better decisions and improve processes.

To make predictions using segmentation, it is important to start with a large sample dataset that has known values for certain variables, called explanatory variables, as well as known outcomes representing the event the insurer would like to predict. Examples of explanatory variables from vehicle telematics data are rate of vehicle acceleration and number of left turns, with the outcome being whether the policyholder had an auto accident. Taken by itself, this historical dataset with known accident outcomes is not organized in a way that provides information to predict future accidents.

However, the explanatory variables and known outcomes can be used to train a model that predicts whether a policyholder with certain driving characteristics will have an accident. A computer algorithm applies an iterative process in which various combinations of explanatory variables are sequenced and compared with the outcome data. This process can get quite complex, with the number of explanatory variables sometimes ranging as high as thirty. Then, the results are analyzed to determine how well each variable sequence divides the data into segments that correctly predict outcomes. Data scientists often illustrate the process with a classification tree that shows explanatory variables as nodes, their values as branches linked to other nodes (other explanatory variables), and various outcomes as nodes at the bottom of the tree.

This process of segmenting data using a predictive model is key to many big data analytics applications. When a newly reported claim is identified as complex or when a policyholder is categorized as not renewing a policy, a segmentation process is working behind the scenes to score and categorize the outcome. The segmentation algorithm applied by the model is usually invisible to the business user.

It is important to note that models do not always make correct predictions—in fact, they will often generate a false positive. For example, an injured worker might be categorized as unlikely to return to work based on his or her characteristics and behaviors, when indeed, this is not the case. This underscores the importance of not relying solely on the model and of having someone with expertise in the field review the facts of the case along with the model output. A claims or underwriting professional is a good choice for this work.

Using Link Analysis to Discover Hidden Data Relationships
Link analysis (sometimes called association analysis) is another big data analysis technique used for analyzing the associations among various entities to discover patterns that are not obvious by looking at raw data alone. This type of analysis has been successful in analyzing data involving complex relationships among claimants, claims adjusters, and providers—such as auto body shops, home contractors, and doctors—to determine the likelihood of fraud based on patterns of referrals and payments. A computer algorithm typically conducts the link analysis and shows the results in graphical form, known as a link chart.[4]

Data generated through link analysis is often combined with an insurer's other claims data to develop a series of if-then rules to determine whether a newly reported claim is suspicious. However, as with any predictive model, even if a claim is identified as suspicious, it is not necessarily fraudulent. An experienced adjuster should review such claims to determine whether they should be further investigated.

◆ UNDERWRITING WITH A RISK POOL OF ONE?

For pricing many lines of business, actuaries use classification ratemaking, which bases rates on the average frequency and severity of loss for policyholders within large pools of similar risks. This system has served insurers well for many decades. But with this rating method, how much does an insurer know about the details of a policyholder's risk, including the specific behaviors he or she exhibits that affect the risk level? Does the insurer know how well a policyholder maintains his home appliances? No. Does it know how well a policyholder drives her car and that she avoids congested intersections? No.

Certainly new technologies make it possible for an insurer to collect this risk data, which is unique to each policyholder.

Conventional ratemaking tools are much less precise than the tools that can be developed with modern technology and big data analytics. Connected objects, or the IoT, allow

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an insurer to collect precise data on a policyholder's risk, and advancements in analytics allow the insurer to quantify the policyholder's characteristics and behaviors and develop a unique premium for that policyholder. In effect, this enables an insurer to place each policyholder in a rating class for which the policyholder is the only risk in the pool.

Industry veterans say that this violates the principle that a well-functioning insurance mechanism is based on risk pooling and the law of large numbers. However, a sea change in automobile ratemaking based on the unique driving characteristics and behaviors of individual policyholders is already taking place through the use of vehicle telematics. Soon there will be additional rating applications based on technological advances that affect other lines of business, most notably homeowners. These changes are reducing the size of risk pools—in some cases, down to a level of one. For many lines of business, insurers need to lessen their reliance on class rating and focus more on pricing risks at individual policy levels.

There is ample evidence that traditional analytical methods for risk pricing and selection are being displaced by big data analytics. In addition to vehicle telematics-based rating, there are now by-peril ratings based on big data for some property lines. In the future, the historical exposure and claims data currently used for ratemaking and underwriting many lines of business will have less predictive power than the information provided through big data analytics.

A recent A.M. Best Special Report provides evidence of these changes: "In personal lines, use of data to stratify customers into ever more targeted price groups, and to focus marketing on those groups, is now expected by the market. Companies that have not effectively adopted these technologies find themselves actively selected against." Even commercial lines companies need to pay attention to the influence of data analytics on pricing. That same A.M. Best report states: "Among commercial lines companies, use of data and analytics to determine technical price at a risk level has become critical in maintaining underwriting discipline as conditions have deteriorated."[5]

◆ PREVENTIVE ANALYTICS FOR LOSS CONTROL

A relatively new application of big data analytics and technology is preventive analytics, which is an extension of traditional accident analysis. Technological innovations, such as wireless sensor networks and computer vision, allow for continuous monitoring of workers. As a result, when a root cause potentially leading to an accident is triggered, it is immediately dealt with to help prevent the accident.

Sensor-enabled wearable devices, such as smart safety helmets and smart vests, can measure physical and environmental conditions that may lead to accidents. Such conditions include hazardous chemicals, body temperature, hydration, stress, heartbeat, energy output, and surrounding air quality. Motion sensors can detect repetitive motion and alert workers when to change tasks. Sensors in shoes can detect whether a worker is exceeding weight restrictions for lifting objects.[6] The data generated by these smart devices is helping improve root cause analysis and leading to better predictions of worker accident outcomes.

Preventive analytics concepts also apply to physical objects, such as buildings, machines, and vehicles. For example, sensors and analytics are used for preventive maintenance on industrial and commercial buildings, production machines, and commercial vehicle fleets. Sensors monitor prepared food at restaurants to help prevent the spread of foodborne illnesses.

◆ AUTOMATING PROCESSES TO GENERATE COST SAVINGS

It is a well-known fact that the majority of data generated in real time quickly becomes stale, underscoring the need to use it quickly for making decisions. For example, suppose a manager reviews claims once every other day to determine which ones are likely to increase in size and, therefore, should be assigned to an experienced adjuster. An automated process would improve this process by using machine learning and advanced analytical techniques to score claims using a rules-based engine that immediately assigns the claims most likely to increase in size to experienced adjusters. This would occur right after the insurer receives FNOL, providing it with the opportunity to generate substantial savings by quickly deploying appropriate resources for the claim.

To fully capture the potential of big data analytics, a predictive model needs to be continuously applied to a process. A good example is medical management for workers compensation claims whereby data such as utilization review, case management, and pharmacy benefits is collected and assessed as a claim progresses.[7] Machine learning uses this data to continuously score each claim throughout its life and deploy appropriate resources, such as a nurse case manager, at various stages of the claim. Furthermore, the system continuously learns by analyzing past recommendations and new data to optimize the organization's overall claims process from a cost-benefit standpoint.

Automated processes have vast potential to reduce insurer expenses across most lines of business. For example, insur-

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ers report substantial savings by reducing the number of motor vehicle reports ordered for personal auto insurance based on analyses of applicant profiles. As another example, automated analysis of vehicle telematics data allows an insurer to determine whether an auto physical damage claim is a total loss immediately upon receiving notice of an auto accident, giving it the opportunity to send the damaged auto directly from the accident scene to a salvage yard rather than to an auto body shop, saving substantial storage and towing charges.

◆ BUILDING A DATA-SAVVY TEAM

Big data analytics has the potential to redefine how insurance companies are structured, breaking down traditional barriers between departments like IT, actuarial, data science, claims, and underwriting. A critical component to creating successful and lasting change is for frontline employees in departments like claims and underwriting to develop a data-driven mindset and for data scientists and data managers to better understand the workings of the insurance business.

This data-driven approach to operations must flow seamlessly from data scientists and data managers to every level of the organization, from the C-suite down. That starts with building the right team to oversee the development and adoption of data analytics and predictive modeling processes throughout the company. Finding talent to run big data analytics projects is a huge challenge to implementing big data techniques at many insurers, and integrating big data into existing systems is a further challenge.

Different organizations build these teams differently. Early data science efforts were siloed at most companies, with a few core data analysts sifting through information and getting the preliminary analytical tools ready for more widespread use. Other organizations embed data scientists within operating departments. Both of these structures are efficient in certain aspects, especially early in an insurer's transformation to a digital enterprise.

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But as analytical efforts mature at insurer organizations, it becomes increasingly important to build cross-functional teams where data-driven decision making is the primary focus. These steering committees can help guide an organization's overall big data analytics efforts to prioritize the most significant projects and maximize their value.

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