SOCIETY OF ACTUARIES
REINSURANCE SECTION

Reinsurance News

ISSUE 92 • NOVEMBER 2018

Interview: Tomoatsu Noguchi, president and chief executive, The Toa Reinsurance Company, Limited

Page 8

By *Ronald Poon-Affat*

Reinsurance News

Issue 92 • November 2018

Published by the Reinsurance Section Council of the Society of Actuaries

475 N. Martingale Road, Suite 600
Schaumburg, Ill 60173-2226
Phone: 847-706-3500 Fax: 847-706-3599
www.soa.org

This newsletter is free to section members. Current issues are available on the SOA website (www.soa.org).

To join the section, SOA members and non-members can locate a membership form on the Reinsurance Section Web page at http://www.soa.org/reinsurance.

Call for articles for next issue of *Reinsurance News*.

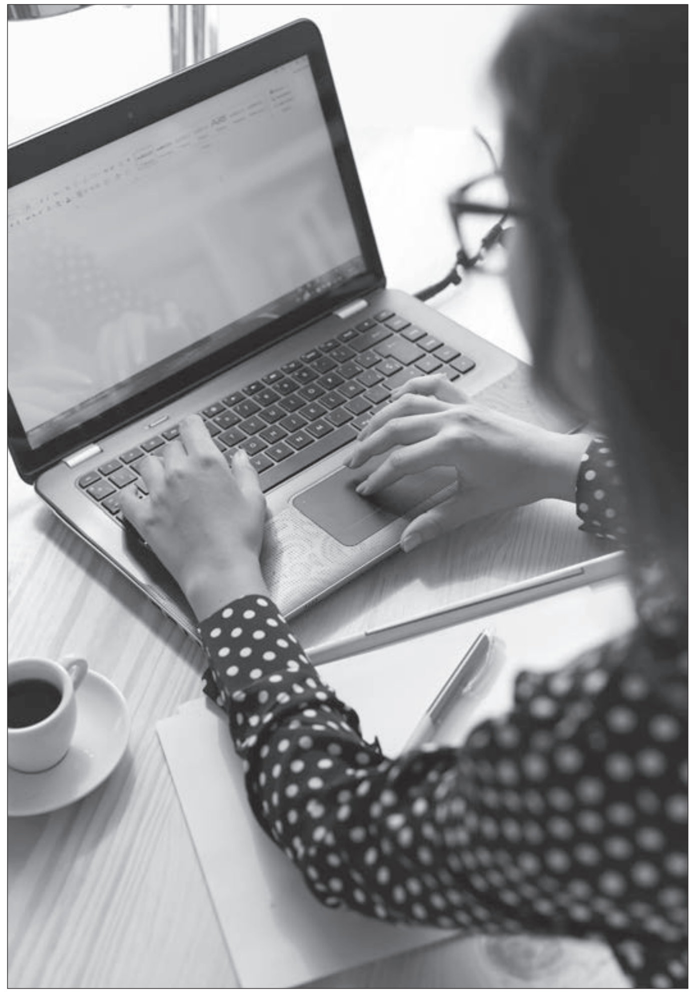
While all articles are welcome, we would especially like to receive articles on topics that would be of particular interest to Reinsurance Section members.

Please email your articles to Ronald Poon-Affat (rpoonaffat@rgare.com) or Dirk Nieder (nieder@genre.com). Some articles may be edited or reduced in length for publication purposes.

Publication Schedule
Publication Month: March 2019
Articles Due: Jan, 2, 2019

Chairperson's Corner

By Mike Kaster



The days are growing shorter now. And so is my time with the Reinsurance Section Council.

It has been a great run for me personally, having been involved with the Reinsurance Section Council for seven years, serving two terms as a council member with a volunteer year in between. I have seen us accomplish a lot over this time. But, as I end my final year, and my year as chair of the council, the thing I know I will miss the most is working with all the other outstanding volunteers involved with this council.

What does it take to volunteer? For some, it requires a supportive employer who understands the added value you obtain by being involved in an industry council. Not only do you get to network with other professionals with a common interest (in our case, reinsurance), you also learn about what is going on with other companies and within the industry. For our group, we have spent this past year focused on a number of hot topics, and we have worked hard to make sure that we are addressing these topics. But for me personally, I also have learned a lot about these topics, and that is something that would not have happened had I not been involved. So, even if your employer won't support you as a volunteer, I know you will find it very worthy of your personal time.

> Actuaries are pretty likable folks! ... I have probably met no less than 30 new friends and contacts.

Our council is now in the habit of meeting in person twice a year. One time is at the SOA Annual Meeting & Exhibit, as most of us tend to be at that meeting anyways. But, the other time is shortly after the section year kicks off, usually in January. This past year, we met as we have for several years now, in January in New York City. It seems that there is an awful lot of reinsurance activity in NYC, so it makes sense to meet there. And while this is a great opportunity for the entire council to focus a day on what we look to accomplish, probably the best part of the day is when we all get together at the end of the day for dinner and get to socialize and get to know each other a bit better.

As it turns out, actuaries are pretty likable folks! Through this process, I have probably met no less than 30 new friends and contacts, and countless others who I have run into as a part of our efforts. This year's council has been great to work with, so if you are taking the time to read this, I thank you! Because it is giving me the opportunity to thank these great volunteers, and recognize their efforts for your benefit.

Joining me in ending our three-year terms as council members this year are Tim Paris and Katrina Spillane. It has been fabulous working with them both for the past three years. Over the last couple of years, Katrina has been responsible for all of our continuing education sessions at the major meetings (SOA Annual Meeting & Exhibit, Life & Annuity Symposium and Val Act). This is no small task, as anyone knows who has worked on the large SOA meetings. And while it hasn't happened yet at the time I am writing this, I'm very much looking forward to a successful luncheon at the SOA Annual Meeting & Exhibit, which is Katrina's swan-song. Tim has also helped in the area of continuing education, by coordinating our annual Reinsurance Seminar. This annual event has now been occurring for six years, the past two due to the efforts of Tim and several other volunteers. Tim's swan-song was this year's event held in Washington, D.C. just four weeks ago. It was outstanding, as I personally can attest to. Thank you Katrina and Tim for all your efforts.

There are six other section council members, all returning next year to continue their efforts. Taking over for me as section chair will be Dave Vnenchak. Dave has been very helpful this past year as vice-chair of the council. Our group has grown well beyond the nine council members, so having Dave's help over the past year has really been vital to our success. Following in Dave's footsteps will be Kyle Bauer, who moves from secretary/treasurer into the vice-chair role. Working with Dave and Kyle has been a pleasure, and I will miss our leadership calls. I know that Dave and Kyle will be providing great leadership to the group going forward.

Each of the four other returning council members have worked to help us accomplish many of our goals over the last year. I'd like to express my thanks to Jeremy Lane and Emily Roman for completing their second year on the council, and to Laura Muse and Jean-Marc Fix for completing their first year. They each contributed many things to the council's success this year, not only for their specific roles, but also in general with their creative thoughts and ideas. Thank you for your efforts, and I know I leave the council in very good hands.

This group, and a long list of additional volunteers, helped us all accomplish a lot. The following is a list (hopefully inclusive, but I can't promise I didn't miss something) of the various items we have completed over the past year.

Continuing Education

- Twenty to 30 different reinsurance-specific sessions at the large meetings.
- One full-day reinsurance focused seminar, with networking.

Research

- Finalized two research projects: "Impact of Genetic Testing on Life Insurance" and "Mortality of the 1900 Birth Cohort."
- Began research on three topics: "Accelerated Underwriting Survey," "Recapture Provision Survey," and "Extreme Events."
- NOTE: The Reinsurance Section research team is a separate group, led by Jean-Marc Fix, and they are always looking for additional volunteers. Contact Jean-Marc for details.

Webcasts—Completed three this past year.

- "Global Ageing and (Re)insurance,"
- "Reinsurance Tax Reform Considerations," and
- "In-force Management."

Podcasts

- Completed three specific podcasts for reinsurance, thanks to Jing Lang the Reinsurance Section's podcast director/producer—check the iTunes store.

Newsletter

- Three very substantial newsletters have been completed each year.
- The past year with new newsletter editors, Ronald Poon-Affat and Dirk Nieder.

LEARN

- This is our educational initiative for state insurance regulators.
- Completed education for three major states (Fla., N.Y. and Calif.)
- Recruited four new volunteer presenters to help keep this program going.

Web media

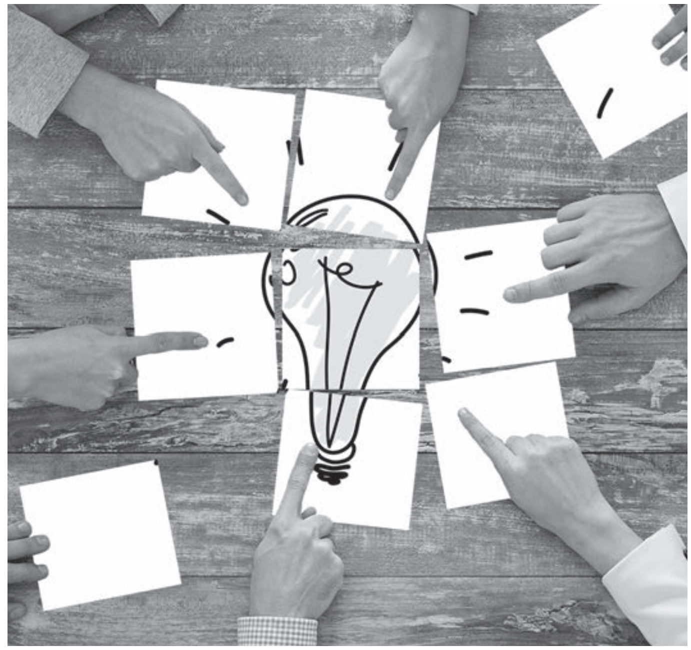
- The reinsurance LinkedIn group is now a public group and open to all.
- We also have improved our website (on *SOA.org*) to make it easier to find our content.

I'm sure there is more, but I think you get the idea. As a group, we accomplish so much in the area of education, research and networking for our Reinsurance Section members. It has been a privilege and an honor to serve as the chair of this auspicious group. ■

Mike Kaster, FSA, MAAA, is EVP—Life Solutions Group, Willis Re. He can be contacted at *mike.kaster@willistowerswatson.com.*

Letter From the Editor

By Dr. Dirk Nieder



Welcome to another issue of *Reinsurance News*! I am an actuary. Like many of you, I studied mathematics. I was taught to think logically, and to structure and solve problems. Typically, our goal was to look for a solution to a problem and to ensure the uniqueness of this solution. The existence of multiple solutions was considered undesirable and indicated the need to reframe the problem.

An example of the problems which can occur with multiple solutions comes from the field of Differential Equations. A brigade of soldiers was marching in step across England's Broughton Suspension Bridge in April 1831. Their rhythmic marching amplified the frequency of the natural vibrations of the bridge, and the resonance was strong enough to make the bridge vibrate until it collapsed. The bridge broke apart, and dozens of soldiers fell into the water.[1] Since then, soldiers are not allowed to march in step when crossing a long bridge. Another more recent example occurred in June 2000 when the London Millennium Bridge was opened. The bridge started to sway as large groups of people walked onto the bridge. The widening swings caused many pedestrians not to fall down but to fall into step with the bridge's vibrations, amplifying the vibrations—and the swaying.[2]

My entire mathematical education was focused on framing problems and finding unique solutions. I am convinced that this problem-solving approach was a decisive factor in my success when applying for and getting my first job. It also served me well throughout the actuarial exams.

However, my thinking process was challenged when I started my MBA studies. We were given a case study to prepare for class. As you might expect, I was looking for "the" solution to the case study. You may imagine my confusion when the case study triggered an intensive discussion in class that did not converge on one solution but allowed opposing solutions. Obviously, the situation was a set-up: These case studies were designed to initiate discussions and to allow multiple solutions. It was an important learning experience to look not only for my unique solution, but to appreciate the enrichment that comes with multiple, sometimes also opposing solutions.

To jump-start creative thinking, inspirations from places beyond our usual comfort zone are very important.

I am thus very happy about the diversity and variety of articles that we collected for this issue of *Reinsurance News*. Geographically, the articles move from the Far East to the North Atlantic Ocean—with topics as varied as issues that exist with mortality improvement, principle-based reserving, and a very personal volunteer experience. I would like to thank all of the writers who have contributed to this edition of the newsletter.

I would like to take this opportunity to encourage all readers to share their experiences and knowledge, whether professionally or personally. We rely on your input and we are looking forward to your contributions to Reinsurance News.

I hope that you will find inspiration in this great collection of articles in this issue of *Reinsurance News*. ■

Dr. Dirk Nieder, FSA, is regional director, Gen Re, Life/Health North East Asia. He can be contacted at *nieder@genre.com.*

ENDNOTES

1 Elizabeth Howell, Why Do Soldiers Break Stride On A Bridge?, Live Science Contributor, 22 May 2013, www.livescience.com.

2 Strogatz et al, Theoretical mechanics: Crowd synchrony on the Millennium Bridge, Nature, volume 438, pages 43–44 (03 November 2005).

Interview: Tomoatsu Noguchi, president and chief executive, The Toa Reinsurance Company, Limited

By Ronald Poon-Affat

RP: Thank you, Mr. Noguchi, for giving us this opportunity to interview you. Could you tell us a bit about yourself?

TN: My pleasure. I first joined Toa Re in 1995, and throughout my career here I have worked mainly in the Investment and Information Technology departments. Then, in 2012, I was named president and chief executive, and since then have been responsible for steering the Toa Re Group.

RP: Toa Re has a long history in Japan, and some recent changes both in Japan and worldwide.

TN: Yes. Toa Re was established in 1940. This year we are celebrating the company's 78th anniversary. Since our founding, Toa Re has focused mainly on reinsuring direct non-life insurers in Japan. From our subsidiaries in the U.S. and Switzerland and branches in Singapore, Hong Kong, and Kuala Lumpur, we reinsure non-life insurers around the world.

In 1997, we obtained a license to reinsure life insurers. Since then, we have actively expanded this segment of our business. We initially focused on reinsuring Japanese life insurers, and over the years, gradually expanded our geographic reach. Currently, Toa Re reinsures life insurers in Japan, North America, Europe and Asia.

RP: Can you explain Toa Re's value proposition?

TN: Toa Re's corporate philosophy is based on these commitments: providing clients with peace of mind, growing together with them by maintaining prudent financial stability, and providing them with high-quality services in a continuous and stable manner. In today's increasingly severe and challenging business environment, maintaining this philosophy is more important than ever.

For example, we sometimes receive questions from clients regarding solvency margins, wondering if Toa Re's solvency margin level is too high in terms of capital efficiency. We certainly aim to maintain a certain capital efficiency level, but under the philosophy of providing peace of mind to our clients, we place a greater focus on financial stability to support our business activities.

We also provide many services to meet a range of client needs, and have a reputation for extremely high-quality administrative work. We are proud that we have earned our clients' strong trust.

RP: I have heard that 2018 is the first year of Toa Re's "Mission 2020" three-year business plan. What was behind the decision to choose that name?

TN: Although Toa Re was originally established to handle non-life reinsurance in Japan, over the past two decades we have actively diversified our business portfolio to build a more solid business base. To this end, we have worked to expand our domestic and overseas life reinsurance business and our overseas non-life reinsurance business.

Against this backdrop, we formulated a new growth strategy, "Mission 2020," which launched earlier this year. Through this strategy, we aim to achieve sustainable growth. More specifically, we aim to further diversify our business portfolio and focus on enhancing the foundation of Toa Re's business. For example, we plan to focus on developing our human resources and IT functions in ways that will both underpin and strengthen Toa Re's future.

The Mission 2020 motto, "Embracing the new era with an ingenious spirit" expresses our wish that all Toa Re Group directors and employees work ingeniously more than ever. This is especially important now, as changes in business environments and increasingly complex issues are expected to emerge.

RP: Can you discuss Toa Re's life reinsurance business?

TN: Toa Re Group's entire net written premium in fiscal 2017 (ending March 31, 2018) was approximately ¥238 billion (US$2.239 billion). This figure includes the approximately ¥78 billion (US$738 million) generated from life reinsurance, which accounted for about one-third of our total net written premium. (Rate: ¥106.24 = US$1)

Our life reinsurance portfolio consists mostly of yearly renewable term (YRT). Net written premium in Japan accounts for approximately 40 percent of our total life reinsurance portfolio, and our Japan market share for YRT is nearly 30 percent. The remaining 60 percent is mainly written in North America, East Asia, ASEAN countries and Europe.

We started to reinsure life insurance treaties in North America in 1998. Our volume of underwriting mortality and other life risks has expanded every year, and today, North America is one of Toa Re's most important markets. Facultative reinsurance in Japan and reinsurance treaties on morbidity risks in Japan and East Asia have been successful.

Looking to medical insurance in Japan, Japanese products pay a cash benefit, in contrast to the reimbursement products in the U.S. Medical reinsurance in Japan and East Asia is generally whole life protection. Such protection is required because direct insurance policies sold by life insurers provide whole life protection coverage. This seems very surprising to people in countries outside of Japan and East Asia. We have solved this challenging issue by carefully conducting medical examinations during the application process and also by taking effective risk avoidance measures during product development.

If a reinsurance company wishes to increase life reinsurance transactions, it is important to provide incidental services on reinsurance treaties to cedants. We currently provide such services mainly in Japan, and also in East Asia and ASEAN countries. The services include facultative reinsurance, support for development of automated medical underwriting systems, provision of assessment manuals, cooperation on product development, and access to various seminars we offer. For our North American clients, we currently offer facultative reinsurance and are planning to increase our list of available services to meet client requests.

RP: Please tell us more about Toa Re's facultative business.

TN: Facultative reinsurance in Japan is characterized by individual treaties on facultative reinsurance only, without provision for automatic reinsurance.

Amid market saturation in Japan due to our country's aging population and falling birthrate, there is active movement toward selling life insurance even to applicants with health problems. These individuals have rarely been able to purchase life insurance before. To meet these needs, we have established a unit specializing in underwriting facultative (or facultative obligatory) reinsurance.

Our life underwriting experience and knowledge are highly rated by clients. We currently receive about 70,000 requests for facultative reinsurance every year.

RP: What do you think is the future of the life reinsurance industry? How is Toa Re dealing with future changes?

TN: From a global standpoint, life reinsurance transactions providing financial solutions will continue to gather attention and be conducted in the future.

In addition, the complex new risks emerging due to InsurTech's development may require reinsurance. For example, insurance products with wellness benefits are becoming popular in Japan and other East Asian countries. These products enable a discount to be applied to premiums depending on the applicant's "health age" rather than actual age. Reinsurance could be used to assess the risk of such insurance.

We also pay attention to accelerated underwriting, which is currently a hot topic in North America, and wonder if it could lead to increased need for reinsurance.

In addition, we are keeping an eye on possible changes in reinsurance needs after last year's adoption of Principle-Based Reserves (PBR) in the U.S. Since the implementation of Solvency II in Europe, life reinsurance has been used more widely to improve capital efficiency. We are currently holding internal discussions about whether capital relief needs may increase in the U.S. due to the adoption of PBR and the types of solutions that could be provided in case such needs arise.

Whatever changes emerge, we will provide client-oriented services in more creative ways than ever under our corporate philosophy. ■

Ronald Poon-Affat, FSA, CFA, FIA, MAAA, is co-editor of the Society of Actuaries' Reinsurance News newsletter. He can be contacted at *rpoonaffat@rgare.com.*

Past, Present and Future of Risk Factors

By Scott Rushing and Yunus Piperdy

Actuarial science and the assessment of mortality risk has evolved slowly over the past few centuries. This is all set to change. Exponential growth of data coupled with massive increases in computer processing power are accelerating the ability of insurers to understand and quantify mortality risk.

This paper presents a brief history of life insurance risk assessment, highlighting the major chronological milestones (see Figure 1). The last 50 years have seen important innovations and a rapid and relentless acceleration in the rate of change. Gazing into the future, wearable devices, genetic testing and digital health data will have a transformational impact on life insurance risk selection processes.

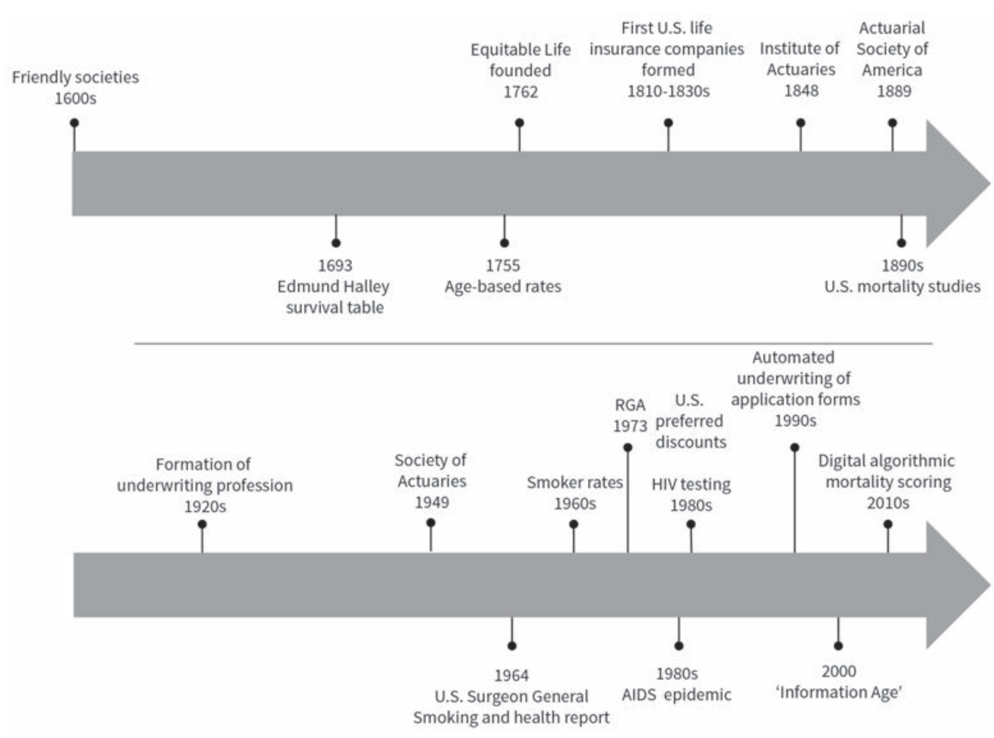
CREATION OF MODERN INSURANCE AND AGE-BASED PREMIUMS

In the early days of formal life insurance there were virtually no underwriting barriers to obtaining life insurance cover. In the 1600s and 1700s, in England, friendly societies provided financial and social services. In exchange for money collected from members, they paid out emergency funds to help survivors with burial costs. The contributions did not vary by age and group sizes were fixed, limiting the ability to bring in new members. This meant most friendly societies struggled to keep up with rising claim costs as mortality rates increased as their members aged. To reduce the risk inherent in an aging portfolio, membership (both new and existing) was restricted to a maximum age of 45 or 50.

Royal astronomer and mathematician Edmund Halley made the first important attempt to quantify human mortality when he created the first survival table in 1693.[1] But it wasn't until another 70 years had passed that age-based life insurance premiums were introduced.

In 1755, English mathematician James Dodson, a fellow of the Royal Society, was declined due to being over age 45. Undeterred and building on Halley's earlier work, Dodson

Figure 1
Major Milestones in the Modern History of Life Insurance (*Source: RGA*)



demonstrated how insurance applicants could be accepted regardless of age as long as the annual premium reflected the applicant's mortality risk. Sadly, Dodson died soon after he was unable to buy life cover. Five years after Dodson's death, Equitable Life was founded in 1762 as the world's first mutual insurer. Using Dodson's mortality tables, age-based premiums allowed Equitable Life to offer cheaper cover, older ages at issue and for longer terms than ever available previously.[2]

GENDER MORTALITY

Due to the prevailing gap in gender mortality rates, evidence suggests gender-differentiated premiums were introduced in the U.K. before the mid-19th century and many years later in the U.S. The gender mortality gap grew steadily in both countries until the 1970s, primarily due to higher male smoking rates and major improvements in maternal mortality. Since the 1970s, the gender gap has tapered due to better male working conditions and lower tobacco consumption by men.[3,4]

In pursuit of fair and equal treatment of the sexes, gender-neutral life insurance pricing was introduced throughout the European Union in 2012, resulting in unisex rates based on the gender mix within each insurer's portfolio.

PHYSICIAN "GATEKEEPERS"

For most of the 18th and 19th centuries, infectious diseases were the top causes of death. Epidemics of tuberculosis, malaria, cholera, typhoid fever, diphtheria and scarlet fever occurred frequently. No one knew what caused these diseases, and unfortunately effective treatments and prevention (vaccines) were not yet available.

During this period an insurer's primary concern was to avoid the risk of insuring someone already suffering from an infectious disease. An insurance company physician, who was also typically a major shareholder of the company, acted as gatekeeper by medically examining all applicants to assess their acceptability. Additionally, this time period also saw the first crude attempts to screen out higher mortality risks. Applicants provided personal statements about their own and their family's health history, along with written references from friends about their health, lifestyle and habits.

Although most applicants were either accepted or rejected, the concept of "rating up" riskier-than-average lives was introduced. This was typically achieved by "years to age" ratings; i.e., charging applicants as if they were older than their actual age.[5]

BIRTH OF UNDERWRITING

The insurance industry changed very little until the beginning of the 20th century. Mortality data remained scarce, and without meaningful experience data insurers had to rely heavily on the clinical experience of their company medical doctors.

These doctors used medical knowledge and intuitive observations about family history and individual habits to form an opinion of a proposed risk. Actuaries worked alongside the doctors to set premiums for those who were accepted.

In the Roaring Twenties (1920s), increasing business volumes and rising medical fees made it impractical for every applicant to be assessed by a doctor and an actuary. To deal with the demand, insurers created clerical roles to take over the assessment process, leading to the formation of the underwriting profession in that decade.

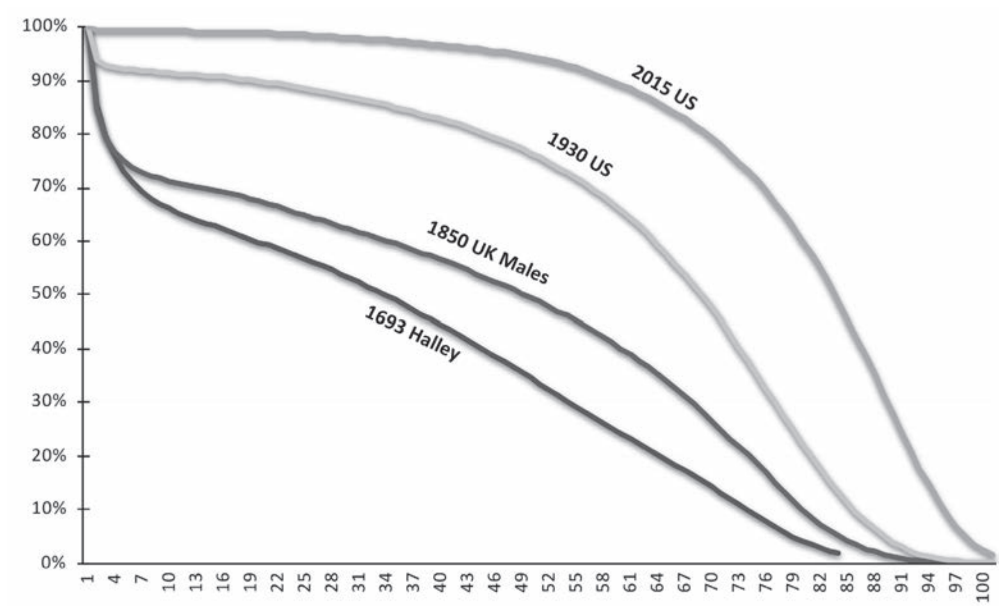
At about the same time, an increasing number of insurers introduced detailed application forms. This allowed insurers to accept applicants who could not be easily assessed in person (e.g., those living in rural areas). Indeed, more than 150 years after the formation of Equitable Life, insurance applicants could now be accepted without a medical examination and without involving a doctor or an actuary.

THE RISE OF NON-COMMUNICABLE DISEASES

In the early 20th century a major shift occurred in the most common causes of death, which changed the focus of insurance underwriting. Along with the benefits of economic development came better disease control through cleaner water, better sanitation and improved personal hygiene. The emergence of antibiotics (1928) and the launch of large-scale vaccine production (1940s) supported the fight against the deadly infections that had plagued humans for millennia. For the first time in history, non-communicable diseases such as heart disease, stroke and cancer surpassed infectious diseases as the primary causes of death.

Survival curves from four points in time are illustrated in Figure 2 (pg. 12) and show a significant improvement in the 1930 survival curve.

Figure 2
Life Survival Curves 1693 to 2015 (*Source: created by RGA from various sources*)



SMOKER MORTALITY (1960S)

In 1964, U.S. Surgeon General Luther Terry issued the landmark report alerting the nation to the deleterious health consequences of tobacco use.[6] The smoking of tobacco had been growing in popularity since the 1920s; consequently, between 1940 and 1980, male incidence rate of lung cancer increased by a factor of seven. Female lung cancer incidence rates did not take off until the late 1960s. At that point, a few U.S. and Canadian carriers started to differentiate premiums for applicants by whether they were cigarette smokers, and doing so became common by the late 1970s. It should be noted that in many countries aggregate rates are still used, due to insufficient medical evidence obtained at underwriting stage to allow reliable classification of non-smokers.

FLUID COLLECTION, LABORATORY TESTING AND THE AIDS EPIDEMIC (1970–2000)

In the 1970s, fluid collection and laboratory testing was first introduced as an underwriting tool for large amounts of cover. By the 1980s however, the AIDS epidemic had led insurers to institute widespread laboratory testing at much lower policy amounts.

Insurance companies were quick to realize the advantages of laboratory testing beyond screening for HIV. Important mortality insights were gained from lipid profiles, liver and renal function tests and other blood biomarkers, and screenings for tobacco and recreational drugs.

The 1980s also saw the widespread introduction of "preferred rates" in North America. Using the additional information available from medical examinations and laboratory tests, insurers could now offer a preferred customer discount to applicants in excellent health. However, preferred segmentation was also a marketing tool: it was not uncommon for 75 percent to 80 percent of applicants to qualify.

In the 1980s and 1990s, companies assessed mortality risk using three main categories of data:

- **Medical history**: obesity, diabetes, high cholesterol, hypertension, cancer, heart disease, stroke, and mental and nervous disorders;
- **Family history**: parents or siblings suffering from inherited diseases such as Huntington's disease or from the early onset of diseases with a hereditary predisposition such as coronary artery disease, certain types of cancers and type 2 diabetes; and
- **Lifestyle**: tobacco use, excessive use of alcohol and/or recreational drugs, driving records, personal aviation, involvement in hazardous avocations, sports or occupations, foreign residence or travel, and past felony conviction(s).

The 1990s also saw an increasing number of insurers introduce rules-based expert systems to automate the assessment of application forms. For the first time, underwriters were replaced by computerized processes.

The latter third of the 20th century saw significant advances in medicine's understanding of human mortality and ability to extend life. Insurers also gained a more comprehensive view of mortality but data was still lacking. Reductions in tobacco use, better detection and treatment of numerous diseases, and socioeconomic progress allowed U.S. life expectancy at birth to increase by six years in the 30-year period from 1970 to 2000, according to the National Center for Health Statistics.[7]

THE INFORMATION AGE (2000 TO DATE)

The new millennium saw the advent of the Information Age. Big data, data analytics, data lakes, data science and digital data are all now commonplace in insurance.

Greater access to data and better tools to analyze the data means life actuaries and underwriters can gain a holistic view of mortality through multivariate analysis of ever-expanding datasets. Deeper and broader mortality analysis is also enabling insurers to confirm and refine assessment of traditional risk factors and to identify new risk factors.

As an example, recent expansion of the mortality data from the National Health Interview Survey (NHIS) supports granular risk assessment across the spectrum of smoker activity. Figure 3 shows hazard rates for a range of cigarette smoking activities, allowing more refined mortality assessment of this important risk factor.

New data sources are allowing the introduction of mortality algorithms leading to the digital transformation of the underwriting process. Major examples include the use of prescription histories, credit-based data and clinical laboratory test results to digitally calculate algorithmic mortality scores.

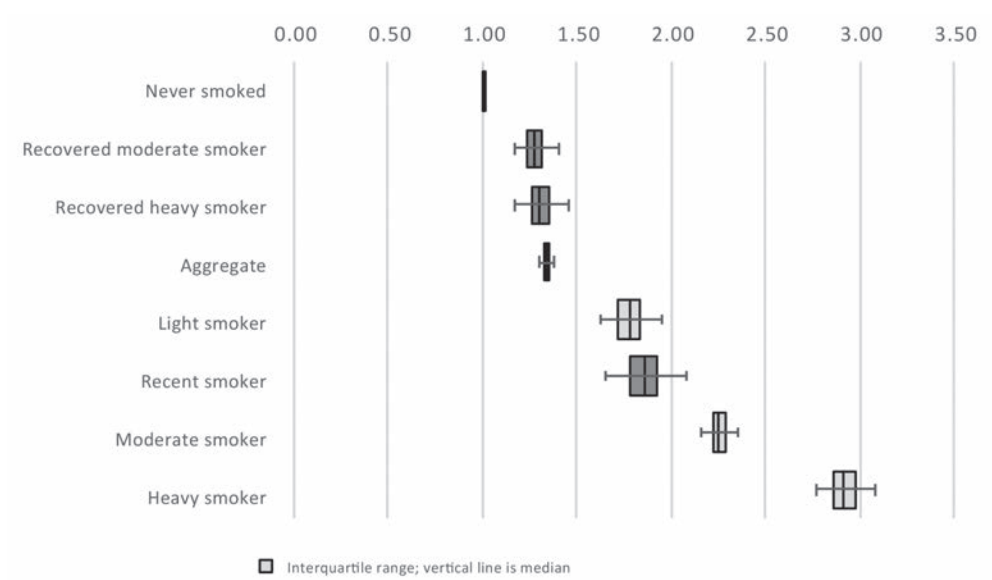
Today's actuaries and underwriters need a good working knowledge of multivariate data modeling and the fundamentals of data science. Multivariate analysis is enabling a better segmentation of the business of life insurance, allowing underwriters to fine-tune applicant ratings at ever more granular levels (e.g., refining the assessment of people with diabetes based on their exercise, alcohol and smoking habits).

GAZING INTO THE FUTURE

American inventor and futurist Ray Kurzweil, writing about exponential change in his 2001 article "The Law of Accelerating Returns," said: "We won't experience 100 years of progress in the 21st century—it will be more like 20,000 years of progress … There's even exponential growth in the rate of exponential growth."[8]

Kurzweil's prediction has so far held true for the insurance industry. Exponential growth in data and computing

Figure 3
All-cause Mortality by Smoker Status Controlling for Many Health Variables (*Source: created by RGA from NHIS data*)



technology looks likely to continue apace. Within the next decade wearable devices, genetic testing and digital health data are set to transform the risk assessment process. Other changes such as epigenetics, liquid biopsies, nanotechnology and our growing understanding of the microbiome, along with inventions that we cannot yet even imagine, will be important risk factors in the following decades.

Wearable devices offer unique opportunities for insurance companies to assess lifestyle and mortality risk. Currently these devices measure metrics with a known connection to mortality such as physical activity, heart rate and sleep. Future sensors are expected to offer even more data to evaluate mortality, such as blood pressure, heart rhythm, pulse wave velocity, sitting time, stress levels and even attempts to detect smoking habits.

Insurers are already starting to use data from wearable devices to motivate customers to improve their lifestyles. In return, insurers are giving appropriate premium discounts to customers engaging in healthy habits. In the future, adoption of wearable devices is likely to grow as the devices become more advanced, cheaper and better connected. Within the next few years we anticipate insurers will have much greater opportunities to use wearable data in the insurance assessment process.

During the past five years, direct-to-consumer genetic testing has seen extraordinary growth. More than 16 million people now have access to their genetic data, with upward of 11 million individuals tested since the start of 2017.[9] Although genetic data is not typically available to life insurance companies, genetics has the potential to transform all aspects of medicine, including prevention of disease manifestation, accurate diagnosis and prognosis of disease, pharmacogenomics, and motivating lifestyle changes to improve health. Genomic medicine will almost certainly lead to major improvements in human mortality and longevity.

The UK Biobank is a cohort study of over 500,000 U.K. volunteers.[10] It was established to identify the biometric, genetic and lifestyle determinants of disease and death. Through a joint research study on the UK biobank data with King's College, London, RGA has quantified the importance of genetic risk information alongside traditional insurance underwriting risk factors. The study provided significant insights into the potential for genetic anti-selection. [11]

This research collaboration focused on the utility of polygenic risk scores (PRSs) for mortality risk assessment. PRSs combine information across many genetic variants to give a single measure of genetic liability to disease. For example, Figure 4 shows

Figure 4
PRS for Coronary Artery Disease Offers Significant Risk Stratification (*Source: RGA-KCL research collaboration.*[11])

Total Participants: 261,204
Number of CAD events: 2,334 (0.89%)

Decreased risk

Percentile	Standard cohort: Hazard ratio (95% CI)
0-1	0.66 (0.4-1.11)
1-5	0.41 (0.29-0.57)
5-10	0.77 (0.61-0.97)
10-20	0.78 (0.65-0.93)
20-40	0.81 (0.7-0.93)
40-60	1 (reference group)
60-80	1.15 (1.01-1.3)
80-90	1.54 (1.33-1.77)
90-95	1.43 (1.19-1.72)
95-99	1.92 (1.61-2.29)
99-100	2.78 (2.11-3.67)

Increased risk

the coronary artery disease PRS can predict incidence and death above and beyond traditional underwriting risk factors: a PRS in the highest 1 percent, for example, confers almost a threefold increased risk of coronary artery disease compared to the reference range.

As genetic testing increases in importance in mainstream medicine, the insurance industry will need to find ways to mitigate the anti-selection risk.

Increased access to digital health data is already changing the risk assessment process. Prescription history reports grew in popularity starting in 2010 and are now commonplace in the U.S., with about 80 percent utilization by companies today. Online access to both current and historical clinical laboratory test results are becoming available as well.

Several leading U.S. insurers are exploring access to electronic health records, particularly coded data which is readily amenable to automated assessment using machine learning and other artificial intelligence techniques. In the U.K., access to electronic health records by insurers is more advanced due to centralized storage of medical data with the family doctor.

We predict that digital health data will likely have the biggest transformational impact on life insurance assessment since the introduction of age-based premiums in 1762. Digital health data, supported by data from wearable sensors and other novel sources, will enable real-time, automated risk assessment, leaving assessment of only the more complex risks to human underwriters.

DON'T BE LEFT BEHIND

Understanding the history of the life insurance industry can help explain where we are today and offer great insights into its future. Insurance assessment has seen massive changes over the previous two decades and even bigger and more exciting changes are sure to emerge in the next couple of decades. The major challenge for actuaries and underwriters alike is to keep pace with technological and medical advances.

More data available at the time of underwriting and advances in data-driven solutions will allow greater underwriting accuracy and allow pricing decisions to be tailored to the individual applicant. Just 250 years after the introduction of age-based premiums, perhaps actuarial tables based on age alone will be replaced by complex rating algorithms where age is just one factor.

Understanding the past and predicting the future can not only inform insurance and reinsurance companies' plans and investment strategy, but can also change how the industry might influence the future. Predicting the future is difficult, but as U.S. President Abraham Lincoln once said, "the best way to predict your future is to create it." ■

Scott Rushing, Vice President, Head of Global Research, GRDA, RGA.

Yunus Piperdy, Vice President, Head of Underwriting Innovation Strategy (UK), RGA.

ENDNOTES

1 wikipedia.org/wiki/Edmond_Halley

2 wikipedia.org/wiki/James_Dodson_(mathematician)

3 How has life expectancy changed over time? ONS (2015)

4 United States Life Tables (2014)

5 Regulated Lives: Life Insurance and British Society, 1800–1914 - Alborn (book review (2011)

6 The 1964 Report on Smoking and Health - U.S. Surgeon General

7 National Center for Health Statistics

8 The Law of Accelerating Returns - Ray Kurzweil (2001)

9 The DNA Geek

10 U.K. Biobank

11 The risk of anti-selection in protection business from advances in statistical genetics (2018)

LEARN—Going Strong and Growing!

By Larry N. Stern

LEARN—life, education and reinsurance navigation—is a Reinsurance Section sponsored program created for the purpose of educating regulators about reinsurance; from the life, annuity and health insurance perspective. A by-product of a 2009 request from the Delaware Department of Insurance, Ronnie Klein—then chair of the section—had the idea of creating a team of individuals who would spend a day with regulators assisting them in understanding various reinsurance topics/issues such as:

- What is reinsurance,
- Types of reinsurance,
- Risk transfer rules and reserve credit,
- Treaty provisions, and
- Employer stop-loss and health care reinsurance.

Over time as new issues have arisen in the industry, current topics have been added to cover:

- Health care reform (Patient Protection and Affordable Care Act),
- Captives,
- Actuarial Guideline 48,
- Principle-based reserves (PBR), and
- Longevity.

Each presentation involves one life and one health Reinsurance Section volunteer. Since 2010, 33 states plus four offshore jurisdictions—Bermuda, Trinidad & Tobago, Puerto Rico, and Cayman Islands—have been visited. Some regulators have asked for a repeat presentation as turnover in their staffing occurs! For several years, six volunteer individuals—Mike Kaster, Jeff Katz and Larry Stern (life), Michael Frank, David Nussbaum and Tim Robinson (health)—have carried the ball of presenting. Recently new volunteers—David Addison, Tom Colbrook, Mark Costello and Mike Mulchay—have been recruited to take over presentation responsibilities. Emily Roman is the Reinsurance Section Council member responsible for LEARN activities.

The PowerPoint presentation consists of 160 slides. In 2016 through the efforts of the SOA staff, the presentation received the approval of the NAIC for continuing education credit. This aspect has increased the number of insurance department staff attending the presentation. Usually there are close to 25 in the audience, however, for the California Department of Insurance (DOI), there were close to 50 in Los Angeles and another 15 in San Francisco via teleconference, and about the same number attending in three locations for New York State Department of Financial Services (NYSDFS). Most of the attendees are analysts or examiners with a few actuaries. Several Commissioners or Deputy Commissioners have come for all or part of the presentation and were active participants at the meeting.

In June 2016 LEARN was presented to the CA DOI (as referenced above there was wide attendance). As an outgrowth of this presentation, later in the year they requested a separate presentation on PBR and its impact on reinsurance. PBR had recently been approved to become effective during the three-year phase-in starting in 2017. PBR had been covered as a current topic in the presentation, but not to the extent of what CA DOI requested. A special team of Julie Becker, Donna Megregian, Martin Snow and Larry Stern worked for over six months to create a separate PowerPoint presentation of 100 slides.

In November 2017, PBR/Reinsurance LEARN was presented to the CA DOI covering topics such as:

- Review of risk transfer rules and reserve credit,
- Changes in computation of reinsurance reserve credit,
  - Issues that arise in the computation of reserve credit,
  - Practical results of the PBR calculation,
- Practice issues,
- Concerns,
- Internal reinsurance,
- Key insights from research, and
- Future issues.

Both “regular” LEARN and PBR/Reinsurance LEARN have been well received and appreciated. Some accolades:

- “The presentations were exceptional and better than I ever expected based on a quick review of the slides. The Q and A was great. Thanks to you, the team, and the SOA for this meaningful and timely CE.” Perry Kupferman—CA DOI
- “On behalf of myself, the DFS training unit and our Life Bureau, I wish to express my complete appreciation and gratitude to you and your staff for the outstanding delivery of LEARN Overview of Reinsurance. We received positive feedback on both the live presentation and the training content.” Yvonne Fusco-Towasser—NYSDFS
- “Thank you once again for your time and expertise yesterday. The feedback has been highly positive and the training was very beneficial to all of the Insurance Division. Please pass on our thanks to the Society of Actuaries for providing the LEARN program to the Authority.” Suzanne Sadlier—Cayman Islands Monetary Authority
- “On behalf of the staff that attended your presentation, we would like to thank you for taking the time to come to our office and share your reinsurance knowledge. Everyone that I spoke to had positive comments, said they learned a lot, and were very appreciative.” Lisa Parker—FL OIR

Through the hard work and dedication of the LEARN volunteers, this has been a highly successful endeavor for the Reinsurance Section. We’re not done yet—there are still several jurisdictions to which we have not presented. Plus, now with PBR/Reinsurance LEARN, we need to leverage the work involved in creating this timely presentation. We encourage you to reach out to promote the presentations to regulators. There has also been consideration giving shorter sections of the presentation to local/regional actuarial clubs, actuarial science university programs, and rating agencies. Please contact Emily Roman (eroman@munichre.com) if you have an interested connection.

Until next time, may all your experiences be “profitable” ones. ■

Larry N. Stern, FSA, MAAA, is president, Canterbury Consulting, LLC. He can be contacted at *lstern@canterburyconsultingllc.com.*

Life Reinsurance in Bermuda: A Closer Look at the Drivers Behind This Rapidly Growing Sector

By Gokul Sudarsana, Sylvia Oliveira, Scott Selkirk and Manfred Maske

Bermuda is already a well-known and well-respected global hub for insurance capacity. Although this market has traditionally focused on general insurance risks, life insurance and reinsurance has been one of the fastest growing sectors in recent years. A diverse range of business models have emerged in this sector, providing new options and opportunities to manage long-term insurance risk.

DRIVERS OF GROWTH

The number of licensed long-term (i.e., life and annuity) companies has grown to be almost 15 percent of total licensed insurers and, in terms of assets under management, the long-term sector now makes up over 30 percent of Bermuda's insurance market.

We have seen many new startups over the past several years due to a few reasons. One reason is the increased demand for life reinsurance, primarily driven by low interest rates and growth in the market for retirement products. Interest rates have been declining since the early 1980s and this has put a lot of pressure on investment yields. As a result, spreads are compressed on legacy blocks of business that typically have higher crediting rates. Insurers also have a harder time selling new business, because of lower crediting rates. Thus, companies are looking for solutions to these issues, and many companies are looking to exit legacy blocks or non-core lines of business to manage their capital and resources more efficiently.

Another reason is that stricter regulatory environments in the U.S., Canada, and the EU with Solvency II, have increased the demand for reinsurance globally. If you look at where the EU is in terms of its demographics, with an aging population and ever-growing retirement funding gap, you have a pronounced issue (which is also true in other jurisdictions around the world). If you overlay that with Solvency II, which increases both regulatory workload and capital required to back certain retirement and life savings plans, you end up with an environment that gives you a push and a pull. There is a push from insurers to review their portfolios and a pull factor to Bermuda for these types of businesses.

All these factors are driving the increased demand for reinsurance. In terms of capital supply, low interest rates are driving institutional investors to look for yield in non-traditional areas, and in seeking diversified yields they want to invest in the life insurance space which is known to generate a stable earnings profile.

Last but not least, we have to mention the environment of Bermuda. Bermuda is very conducive to startups, and the licensing process is very straightforward and streamlined, so companies can raise capital and deploy it relatively quickly.

WHY BERMUDA?

From an EU-facing perspective, we are seeing a lot of decision-making and review around portfolios that are either sub-scale or capital-intensive under the new Solvency II regime. Insurers are looking to take various management actions and have done so over the past two years, including reinsurance and divestiture.

With the specific provisions that Solvency II equivalence gives, Bermuda provides an ideal base for EU-facing reinsurers, essentially levelling the playing field with their EU-based peers. When you put that together, along with the Bermuda Monetary Authority's (BMA) pragmatic and collaborative approach, it makes Bermuda a very compelling choice of jurisdiction.

From a U.S.-facing perspective, Bermuda offers advantages in terms of capital efficiency; there are certain structures when compared to internal targets or U.S. standards that are more compelling in Bermuda. Also, the regulator in Bermuda is very accessible and is available to discuss regulatory approvals for large transactions, customized approaches for non-standard products or transactions, and similar issues. It will give you a decision in a matter of weeks, which is a lot more efficient than some other domiciles. Additionally, proximity to the U.S. is certainly a factor, and the ease of establishing a new company in Bermuda is also an advantage as you're dealing with one regulator as opposed to 50 different state regulators.

WHAT ABOUT TAX?

First, it's important to recognize that any reinsurance premium that's ceded from a U.S. company to a company in a jurisdiction that does not have a tax treaty with the U.S., or has a limited tax treaty like Bermuda, is subject to U.S. Federal

Excise Tax (FET) which is currently 1 percent for reinsurance premiums. On an in-force transaction, where the reserve transfer is considered the reinsurance premium, that can be a substantial amount. So, to make a ceding company neutral from their perspective, a reinsurer in these jurisdictions would often offer a ceding commission to offset that tax expense.

The FET can be expensive for different structures, so there are some companies in Bermuda that elect to be a U.S. taxpayer under the U.S. Internal Revenue Code Section 953d. The fact that there are several of these companies existing in Bermuda gives further evidence that tax is not the only reason why companies are in Bermuda.

The EU tries to harmonize its approach across a number of areas but does not do that with respect to taxation, so you get a range of treatments. As a reinsurer or acquirer, there are implications for us to think about. Some territories levy something similar to the FET called an insurance premium tax on reinsurance. For acquisitions, some territories levy withholding taxes on the payment of dividends from that country to Bermuda. So, tax is quite an important feature in terms of selecting and working with a domicile, and structuring the reinsurance or acquisition arrangement.

SOLVENCY FRAMEWORK

Bermuda has put a lot of effort over the last decade into achieving and maintaining Solvency II equivalence. It is one of only two jurisdictions worldwide, along with Switzerland, to have this distinction. Bermuda is also one of seven National Association of Insurance Commissioners (NAIC) qualified jurisdictions. These two attributes have really differentiated Bermuda among other international jurisdictions. Prior to these initiatives, Bermuda had a relatively limited solvency framework so these developments have really set Bermuda apart and reaffirmed its position as a robust and reputable insurance market.

Permanent Solvency II equivalence means the BMA needs to maintain an equivalent, albeit not equal, framework that is subject to periodic review. This is a key reason for a number of other life reinsurers to be based in Bermuda. It's no coincidence that Switzerland and Bermuda are the first jurisdictions to achieve equivalence—they are both recognized reinsurance hubs.

There are three specific articles that equivalence grants:

1. All Bermuda-based reinsurers are treated as if they are EU-based. In practice, this has a significant commercial benefit. We have an unfettered right to reinsure in EU markets.

2. The BMA is recognized as the group supervisor. Some Bermuda reinsurers are a group of companies, and the BMA would lead the college of supervisors and be recognized as an EU-standing supervisor.

3. The capital regime in Bermuda can be used instead of the Solvency II capital regime for a Bermudian subsidiary of an EU insurance group.

Moreover, even for U.S.-facing reinsurers, Solvency II equivalence is a positive in that it gives ceding companies a sense of comfort that the Bermuda regulator is experienced and well-respected, and the solvency framework is credible and consistent with leading practices.

Specifically, on the NAIC qualified jurisdiction, this allows a Bermuda reinsurer to become certified in the ceding company's state of domicile, which allows for more flexibility on the amount of collateral that is required in order for the ceding company to receive reinsurance credit on the transaction. This allows you to hold reduced collateral based on the credit rating of your company.

JOURNEY TO EQUIVALENCE

Around the mid-2000s, the property and casualty (P&C) industry decided they wanted to be equivalent to Solvency II, mainly for their Lloyd's and U.K. businesses. So, Bermuda initiated some changes to the capital framework. At the time, most of the life reinsurers were U.S.-facing and not particularly interested in Solvency II equivalence. We explored bifurcation (i.e., to only apply for equivalence on the P&C side), but the EU said no. The EU did allow us to break off the captives, so captives in Bermuda are not deemed Solvency II equivalent and have different capital requirements.

The BMA formed a long-term (i.e., life) working group with representatives from industry. We collaborated with the BMA on various sub-topics (longevity risk charges, asset risk charges, etc.) as they worked to form a risk-based capital model for the life sector. Around the same time, the life companies banded together to form the Bermuda International Long-Term Insurers and Reinsurers (BILTIR), an association to represent our industry. BILTIR started out with five companies in 2011, and we now have 43 member companies and 17 associate member companies.

If you recall at the beginning of Solvency II, regulators and governments wanted a risk-based regime that reflected market conditions on both sides of the balance sheet as well as greater public disclosure. Those principles still prevail in the Bermuda framework: it has a risk-based capital model through the Bermuda Solvency Capital Requirement (BSCR) (albeit factor-based but reflective of the risks); it is marked-to-market in that the value of assets and liabilities reflect current market conditions through the Economic Balance Sheet (EBS); and public disclosure is made through the Financial Condition Report (FCR).

A key difference is that the BMA did try to take a pragmatic approach to implement all this, recognizing that the full burden of Solvency II for Bermuda companies is onerous. The BMA has achieved the goals it put forth, but sensibly and supportively of Solvency II equivalence going forward.

The BMA has been very clear to the industry that they are committed to maintaining a solvency framework that is consistent with international leading practices and in line with Solvency II. As a result, there are already changes being outlined to be enacted in 2019. Once these were announced, the industry, through BILTIR, initiated dialogue right away with the BMA to agree on appropriate timelines for the phase-in of these changes.

LOOKING AHEAD

What does the future hold for long-term reinsurance in Bermuda, both in terms of regulatory developments as well as responding to global trends?

First, for in-force transactions, there are trillions of dollars of general account reserves in the long-term insurance market globally. Now, not all of that reserve is in spread compression, but the demand for this reinsurance conceivably could be more than the current capacity in the market. Second, everyone wants their new business initiatives to be more competitive and we can help companies through reinsurance make their new products more competitive.

In the short term, a key impact is regulatory change, as these often provide the kinds of opportunities we've discussed and that will continue for some time. In addition the long-term drivers are still going to be there, like the demographic changes, the aging population, the retirement funding gap, etc. That is going to be a source of business for a number of years yet.

With respect to regulatory trends for Bermuda, as we participate in many global transactions, the BMA regularly participates in supervisory colleges, and this puts the BSCR head-to-head with capital requirements worldwide. This highlights areas where Bermuda may be different. As an industry, we have to understand how these capital requirements make sense relative to the risks we have on our books.

We have seen tremendous growth over the past few years in Bermuda's long-term insurance sector and we see this continuing for all the reasons that have been stated, both for companies that are in existence as well as for startups.

If you want to find out more about the issues affecting the Bermuda life reinsurance marketplace, please visit the BILTIR website (www.BILTIR.bm) and consider attending the upcoming Bermuda International Life and Annuity Conference held on Sept. 27, 2018 at the Fairmont Southampton. ■

Gokul Sudarsana, FSA, CERA, FCIA, is senior manager for Deloitte. He can be contacted at *gokul.sudarsana@deloitte.com.*

Sylvia Oliveira, FSA, MAAA, is chief executive officer for Wilton Re Bermuda. She can be contacted at *soliveira@wiltonre.bm.*

Scott Selkirk, FSA, MAAA, is managing director Somerset Re. He can be contacted at *sselkirk@somersetre.com.*

Manfred Maske is chief executive officer for Monument Re Group. He can be contacted at *manfred.maske@monumentregroup.com.*

PTO: Dream it. Believe it. Achieve it.

By Peter A. Royek

Each year, New Jersey Special Olympics solicits volunteers to provide inspirational slogans for the backs of volunteer T-shirts to be worn at Special Olympics events. The headline of this story comes from the T-shirts that we volunteers wore at the New Jersey Special Olympics Summer Games for June of 2017. While the words on the back of the shirts that we wear change each time, those specific words strike a chord with me. They echo why I continue to volunteer for Special Olympics. I take these words to heart, as I am a dedicated volunteer at Special Olympics events in New Jersey and completely enjoy the experience while giving my whole self to the endeavor.

The Special Olympics started in the 1960s by Eunice Kennedy Shriver, sister of U.S. President John F. Kennedy. According to the Special Olympics website, the organization is "a global movement of people creating a new world of inclusion and community, where every single person is accepted and welcomed, regardless of ability or disability. We are helping to make the world a better, healthier and more joyful place—one athlete, one volunteer, one family member at a time."

When my two daughters were growing up, I was a coach or volunteer at every one of their extracurricular activities throughout their school years, whether they were sports, theater or otherwise. Now that my younger daughter is attending university, I have a bit more free time to dedicate to other interests.

I first became involved with Special Olympics about 10 years ago through a family friend who is a mentor and coach to a group of local residents. The enthusiasm, preparation, courage and skill of the athletes are both amazing and inspiring. After that first event, I was hooked.

Up until the end of 2016, I would volunteer at one to two local events each year for bowling, track or swimming. Athletes who medal at these local events move on to either regionals or directly to the state championships, depending upon the sport. Beginning in 2017, I became more and more involved in volunteering at New Jersey Special Olympics bowling and track events. In 2017 I volunteered at every event that led up to, and included, the state championship for both sports — five all-day events in total. I also took part in a 3K run on December 3, 2017, that raised funds for Special Olympics New Jersey. I resolved that my increased participation in 2017 would be the baseline for my continued involvement, and as such I volunteered at the same events in 2018 and will attend other events through the end of this year.

I attempt to make a personal connection with each athlete with whom I interact. I spend the day high-fiving and cheering on athletes on every attempt — whether strike or gutter ball, first place or last place — to celebrate their efforts. Over the years, I have seen many of the same athletes at the events; some of the athletes have become my friends. I have gotten to know them personally, and we share laughs and stories. My good friend, Rhonda, is the athlete I've known the longest. She calls me "Uncle Petey." We always joke about how much younger she is than I am, though we are pretty much the same age (but she hates when I reveal that).

Another story is about someone I have also known for many few years—my friend Chris. At this past 2018 NJ Summer Games, Chris was honored for having participated in NJ Special Olympics for FIFTY years, which is the entire time that Special Olympics New Jersey has been in existence. After fifty years, Chris still runs the 10,000 meter event! Chris is my one and only "hero." I am blessed to know him.

The days I volunteer are some of the best days of my life! I leave each event with the sincere and humbling feeling that the athletes have helped me so much more than I have helped them. While my hope is to make a difference in the lives of the athletes, even if for one day, I know that I have become a better person from these experiences. Through my years of volunteering, I have come to understand that there are no "disabilities" among us. It is just that we all have different abilities.

I know that we are all busy and don't have a lot of time to do all of the things that we would like to do. As a member of the CAS Committee on Professionalism Education (COPE), I also feel it is important to give back to our profession. However, if you are able to, I urge my fellow actuaries to give some extra time to whatever local event or organization makes a difference in your community. ■

Peter Royek, ACAS, is senior vice president & actuary for Toa Reinsurance Company of America in Morristown, New Jersey. He can be contacted at *proyek@toare.com*.

2019 CRC Insurance Conference: Platform Revolution for Insurance

By Blake Hill

You have probably heard the buzz word "Platform" used more and more throughout your work and personal life, to the point it may have started to lose some meaning and you likely suspect some are misusing it. The overuse of the buzzword has even been used as comic relief in the HBO TV show "Silicon Valley," where start-ups parade on stage to pitch, each beginning their pitch by saying they have created a platform. Kidding aside, platforms really are the future of the new economy, and most of you are using them seamlessly in your life today. Are you aware of the potential of a platform to transform a business, are you aware that many of the most valuable companies in the world are platform companies? Have you considered how the insurance and reinsurance industry can harness the power of a platform business model?

Most of the largest companies in our economy are platform owners, that create and maintain a marketplace for buyers and sellers to interact. Most make very little of the content or goods that is sold or consumed by the buyers of the platform. Amazon is one of the best examples of a platform that brings buyers and sellers together, and until recently was making nearly none of the goods sold. Insurance, and reinsurance will evolve to participate in these platforms, and a few will create and maintain platforms of their own. This evolution will arrive, will you be prepared to succeed when it does?

At the 2019 CRC Insurance Conference the industry volunteer committee is developing a packed agenda of main stage and break out sessions that will support your understanding of platforms, how they can be used and created by insurers. In addition, be sure to return to learn more from industry experts on the latest trends in underwriting, claims, operations, pricing and product development, and finance. The 2019 CRC Insurance Conference is April 11 and will once again be held at the Metro Toronto Convention Centre. The conference is great for senior executives to meet other senior executives and learn from experts at sessions tailored for their level of experience. The conference also caters to those eager to learn more and meet others in the industry. The CRC Insurance Conference is attended by more than 600 industry participants, and one that you should attend each year! ■

ABOUT THE CRC INSURANCE CONFERENCE

The CRC Insurance Conference, a premier insurance industry conference, is dedicated to providing a forum for industry participants to learn about developments affecting our business and providing an opportunity to network with peers. The CRC Insurance Conference was first held in 1956 and has continually been providing top-notch education and networking for over 60 years.

2019 CRC COUNCIL

Chair: Blake Hill
Vice President Life Insurance
dacadoo Americas

Incoming Chair: Amhlaoibh Lynch
General Manager
Hannover Re (Ireland) DAC Canadian Life Branch

Treasurer: André Piché
Chief Business Development Officer Canada,
North America life
PartnerRe

Council Members:

Francois Bernard
SVP, Business Development
SCOR

Jennifer Brodeur
Vice President, Underwriting
RGA

Greg LaRochelle
Head, Reinsurance Placements & Administration
RBC Insurance Company

Amit Malhotra
Vice President, Individual Reinsurance
Munich Reinsurance Company Canada Branch (Life)

David Moss
Head life & Health Client Markets, Senior Vice President Americas
Swiss Reinsurance Company Ltd, Canadian Branch

Event Manager: Laura Gutsch
Event Manager
CMG Marketing

Blake Hill, FSA, FCIA, is VP Life Insurance, dacadoo Americas. He can be contacted at *blake.hill@dacadoo.com.*

Mortality Improvement: The Ultimate Onion

By Jay Biehl and Ed Hui

Mortality improvement (MI) is such an easy topic. Mortality has improved for at least 100+ years … what's so tough about that? But as with most topics like this, it is the nuances and subtleties that make this a very interesting topic to discuss. The goal of this article isn't to present any new wild approach to thinking about mortality improvement, but hopefully it will help to surface some less obvious issues that do exist with this topic.

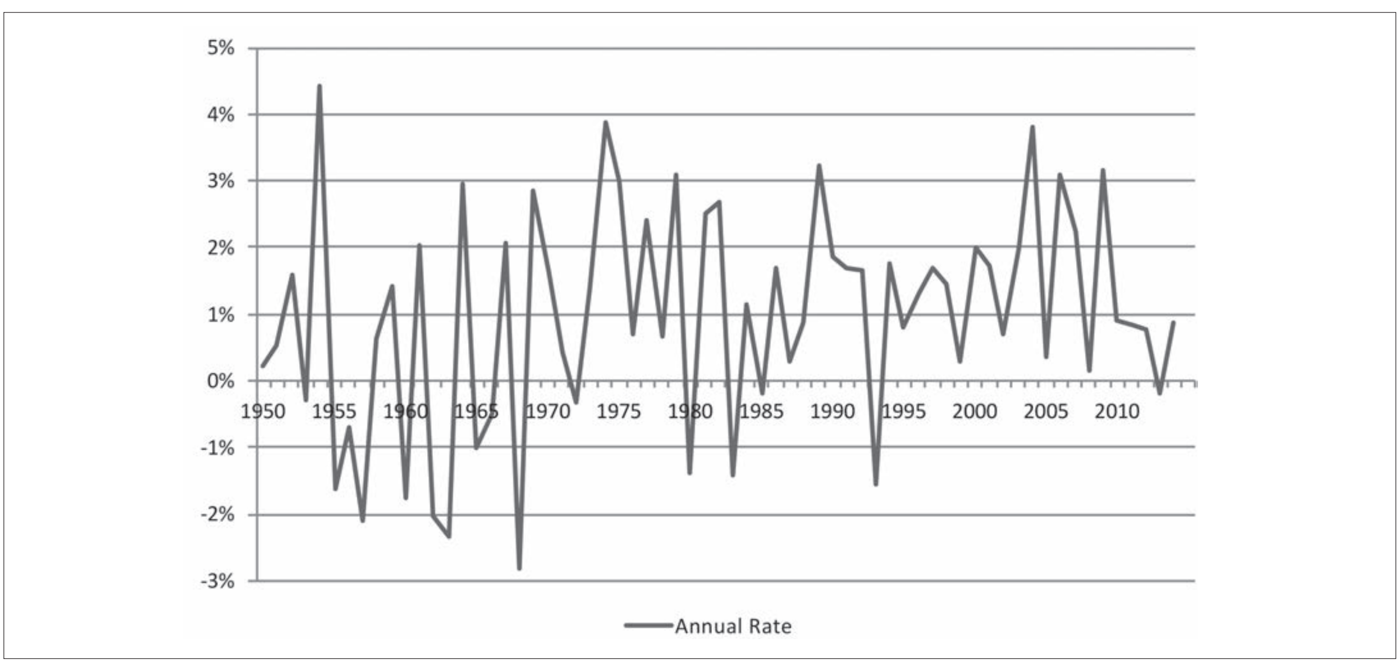
Population MI is quite easy to measure on a historic basis using either the Human Mortality Database (HMD) or data from the Social Security Administration (SSA). While easy to measure, these sources contain at least two significant shortfalls when looking for a basis to form an insured lives perspective. First, population measurements do not account for changes in smoking behavior, whereas insured experience needs to be analyzed on a smoker distinct basis. Clearly, the prevalence rate of smoking has been dropping for years, particularly since the initial Surgeon General's report in the early 1960s. According to the Centers for Disease Control and Prevention (CDC), the adult smoking prevalence is now roughly one-third of what it was immediately prior to the initial report. The decrease in smoking prevalence had a measurable impact on the amount of population MI observed through time. Second, there is basis risk as mortality improvement is impacted by the socioeconomic and age/gender distribution of the population as well as how underwriting and selection effects interplay with MI.

What percentile of the population equates to insured lives varies by age as the lower socio-economic classes die sooner resulting in generally higher average socio-economic status as age increases. For example, an insured life population can equate to roughly the top 25th–50th percentile from a socioeconomic perspective based upon research that we have done. The MI for this group has been greater than for the total population by roughly 0.5 percent to 1.5 percent points per year since 2001.

How we measure the past and how we make the movement from population to insured lives is really not the issue at all. The key is what is the expectation going forward and what are the implications of these assumptions. Alternatively said, fitting the past is different from predicting the future and it is a significant challenge for a model to do both well.

From a life insurance pricing and valuation perspective timing really matters and if anything is known about mortality

Figure 1
Age-adjusted Mortality Improvement Rates Ages 50–95; Males



Source: SOA; Mortality Improvement Scale MP-2016 Report improvement, it is not a long smooth ride through time. While there is a preference to use a forward looking base MI vector that is quite smooth and predictable, historic MI is anything but. As noted in "SOA Longevity Webcast Series: Components of Historical Mortality Improvement Webcast" and shown in Figure 1 (pg. 24), the MI using Social Security Administration (SSA) data produced a mean mortality improvement of 1.0 percent looking over a 60+ year time horizon. Much more important, however, is the standard deviation of 1.6 percent. To put that in context, roughly one-sixth of the time, the annual improvement for this group of lives was more than 2.6 percent and roughly one-sixth of the time the annual improvement was less than -0.6 percent. Because this is population-based data, it is important to note that it was not adjusted for smoking prevalence.

But what is even more interesting is that by studying the past mortality improvement one can observe cycles occurring in the data. We went back to 1937 to demonstrate the cyclical nature of historic MI.

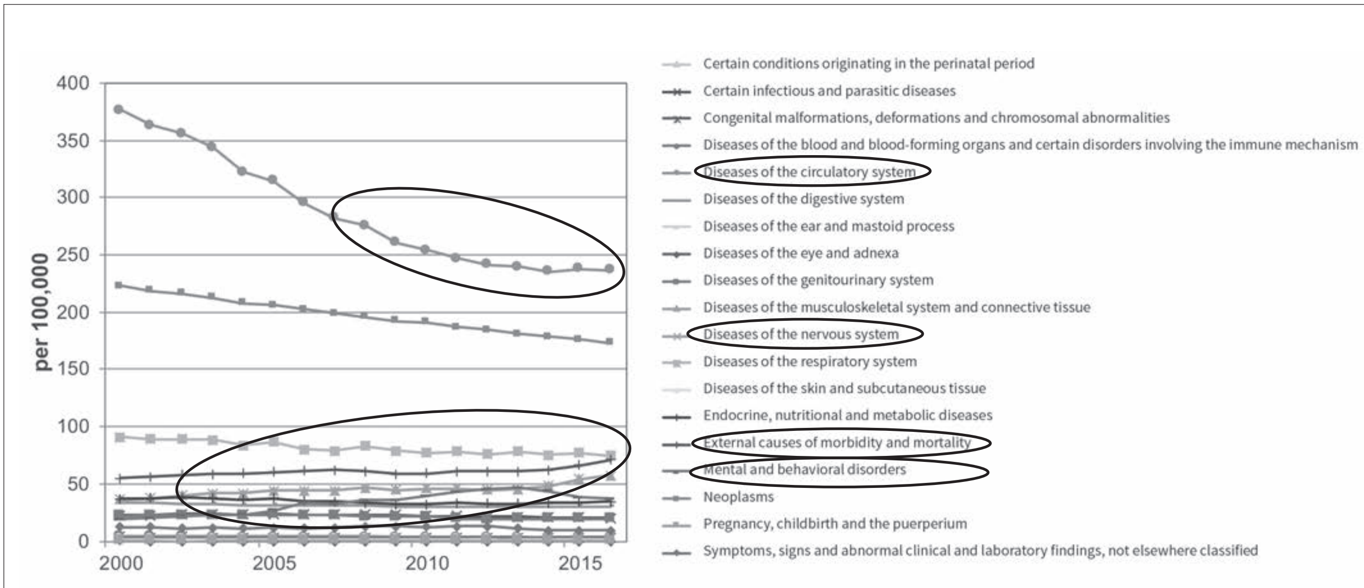
A power spectra shows the frequency of statistically significant oscillations in time-series. There is a broad statistically significant peak between frequencies (F) of 0.03 and 0.05 cycles per year observed when the line is above the 95 percent confidence interval mark. There is also a broad peak at lower frequencies that indicates the presence of a trend. The period = 1/F or 20–30 years for the peak in red. A signal with a period of 20–30 years has a time from peak to trough of 10–15 years noted as the relative points between F of .05 (20 years) and F of .1 (10 years). How one chooses to use this information is a different question, but one can see that mortality improvement has developed in cycles through time. While these cycles have occurred, there has been both a limited number of cycles as well as different root causes for each cycle. That makes anticipating the cycles into the future a difficult proposition at best and puts more emphasis on matching the timing of the expectations versus the reality of how mortality improvement plays out.

So, where in the cycle are we currently?

It is widely known that changes in cardiovascular care has been a major driver in mortality improvement for the past 50 years. It has had a profound impact on mortality improvement not only because of the types of advances that have been made in terms of both medications and surgical procedures, but mainly because of the sheer number of deaths that are due to cardiovascular reasons. Improvements here appear to have materially stalled recently.

At the same time over the past several years, there have been upticks in causes of mortality that historically have had much less impact on insured life mortality but are affecting insured lives much more recently. Two of these things include deaths related to both suicide and from the opioid crisis. These types of deaths are affecting both higher ages and higher socio-economic classes than would have been intuited from historical observations. With growing physically isolationist lifestyles fostered through the social media-dominated world, one has to wonder whether these social maladies become more impactful

Figure 2
Analysis by Cause of Death: By UCD–ICD Chapter; U.S. Population



before viable solutions can swing the pendulum the other direction. These issues strike at the heart of insured level mortality.

In addition, it is not a stretch to look at the lifestyle of many Americans to see a more sedentary lifestyle and increased BMIs across the spectrum. This leads to many diseases including an increase in prevalence of diabetes among other diseases. These trends can be seen in Figure 2 (pg. 25).

Putting all these developments together, it comes as no surprise that mortality improvement has slowed over the past several years and in some pockets mortality improvement has actually been negative.

So, does that mean we should just throw in the towel and expect no future mortality improvement? Well, frankly that is up to each individual to consider in the context in which that assumption is being applied. But to us the authors, the answer is no. We've already shown that mortality improvement has rolled forward in a very cyclical nature and the causes of those cycles has varied from one to the next. Medical research follows the money, and so the ages and conditions for which the best advances are being made are in a constant flux. Will dementia be the next coronary disease in terms of amount and duration of improvement? Extrapolating the future locations of this improvement wave from where it has been in the past is not likely to be accurate. In addition, we now live in a very technologically driven era and the pace of that technology will only increase. So, what will the impact of this technology be? Well, first let us think about the types of things going on from the mapping of the human genome and understanding pre-disposition of disease long before the diseases manifest themselves, to wearable devices that monitor how many steps we walked, to sleep habits, to monitoring blood glucose, and the potential of what will come is endless. As medical science merges with the technology industry it is not implausible to see some version of Moore's law kick in where improvements occur in an exponential manner.

None of this is intended to guide the thinking of what mortality improvement should actually be. There are far smarter minds than ours that have spent a large part of their lives thinking and researching on this topic and there are still basically two camps.

These can be summarized as:

1. James Vaupel is the leading proponent of the view that the human life span is not fixed, but is a function of life expectancy and population size.

2. On the other hand, S. Jay Olshansky is the leading proponent of the view that human life can only be extended so long before it reaches the upper limits of the life span.

Mortality improvement can be characterized in a lot of ways around the pricing and valuation of the life insurance marketplace but **if** mortality improvement is anticipated, then the implication is very straightforward. Whatever the level of mortality improvement that is assumed and more important **when** it is assumed means that mortality improvement **must** develop in that exact manner in order to meet the underlying expectations.

Much of the actuarial work around life insurance products is fundamentally around a present value mentality. Whether on a pricing basis or on a valuation basis, discounting all future cash flows is a basic fundamental principle.

It's really too bad that life doesn't actually cooperate in a present value mentality. When earnings or experience develops can you separate out the difference between:

1. The mean was set inappropriately,

2. the deviation is normal volatility, and

3. the deviation was a misestimation of the expected mortality improvement.

And if it is the last, then should I refine the mortality improvement assumption and make it higher or lower? Should I expect that in times when mortality improvement slows down that eventually the cycle will turn and it will speed up? Should I view a reversion to the long-term mean regardless of short term changes? Can I even measure it on a block of insured lives and separate out the amount due to underwriting grade-off or that driven by policyholder behavior?

There are lots of ways to determine a mortality improvement assumption and to decide how far into the future one is comfortable with that assumption. But the ultimate challenge is really to set the long-term estimate while understanding that the entity must be able to manage certain volatility within tolerable risk boundaries along the way. ■

Jay Biehl, FSA, MAAA, is senior vice president, Mortality Solutions Pricing with Hannover Re. He can be contacted at *Jay.Biehl@hlramerica.com.*

Ed Hui, FSA, MAAA, CFA, is vice president, Applied Research with Hannover Re. He can be contacted at *Edward.Hui@hlramerica.com.*

Redefining the Role of Reinsurance in a PBR World

By Alijawad Hasham, Bryan Amburn and Olivia Yang

In this world of technological, regulatory and market changes, the role of reinsurance is quickly evolving, not least due to the introduction of principle-based reserving (PBR). PBR is meant to right-size statutory reserves by shifting the focus from prescribed assumptions to ones derived from company experience with necessary guardrails for conservatism. While the fundamental purpose of reinsurance does not change, PBR creates for reinsurers various opportunities and challenges. In this article we explore the changing reinsurance landscape as a result of PBR through the lenses of capital management, volatility protection and assumption-setting.

CAPITAL MANAGEMENT

Capital management has long been one of the traditional uses of reinsurance. Such use has often revolved around the redundant reserves associated with Regulation XXX and AG-38 (AXXX) business. Financial reinsurance, captive reinsurers and coinsurance all serve as a means to help companies manage the capital strain of the excess "humped-back" statutory reserves over the economic reserves.

Financial reinsurance (that is, XXX and AXXX securitizations) has been sought by companies with a large enough scale. These securitizations largely function by obtaining capital, often, prior to AG-48, in the form of a Letter of Credit in the amount of the excess reserve, which is then paid back upon the release of the redundant reserves. The advent of PBR and right-sizing of reserves implies a lack of redundancy, and thereby significantly reduces the need for these financial transactions.

Another capital efficient means of managing redundant reserves has been to use a captive reinsurer. Captive reinsurer-based solutions have taken various forms. In a credit-linked note (CLN) structure, a captive and special purpose vehicle (SPV) would exchange a surplus note (SN) for a CLN in the amount of the excess reserve; the coupon difference is paid to a financing provider as a fee, in exchange for the financing provider covering the SPV's cash flow shortfall if the captive redeemed the CLN to pay reinsurance claims. In an excess of loss (XOL) structure, a captive enters into an XOL agreement with an XOL provider, who then pays claims up to the excess reserve once economic reserve assets are depleted. Captive reinsurance tends to be less expensive and allows for more efficient use of capital.

For both financial and captive reinsurer solutions, the advent of AG-48, which sets the minimum standard for economic reserves to mirror PBR, removes much of the capital incentive to transact when statutory reserves themselves are governed by PBR. Companies may still want to explore the financing of the mezzanine layer (that is, PBR less pure best-estimate liability), but that may be too thin for the benefits to outweigh the costs of transacting and setting up a structure.

The final and most common reinsurance arrangement that provides aid in capital management is traditional coinsurance with a reinsurer. Large first-year allowances aids in the surplus strain of initial acquisition expenses, and the ability to cede off a proportional amount of the reserve allows for less capital to be committed to establishing reserves.

Under PBR, this form of reinsurance continues, although some of the dynamics are changing. In particular, the need to reinsure will now be tied more so to a company's mortality experience and the level of their credibility. Companies lacking credibility in their claims experience either due to the size of their in-force portfolio that is relevant, or a significant recent change to their underwriting, target market(s) or distribution channel(s), may find themselves needing to hold reserves greater than what would otherwise be their best-estimate

Figure 1
Impact of mortality credibility on the Deterministic Reserve (DR)

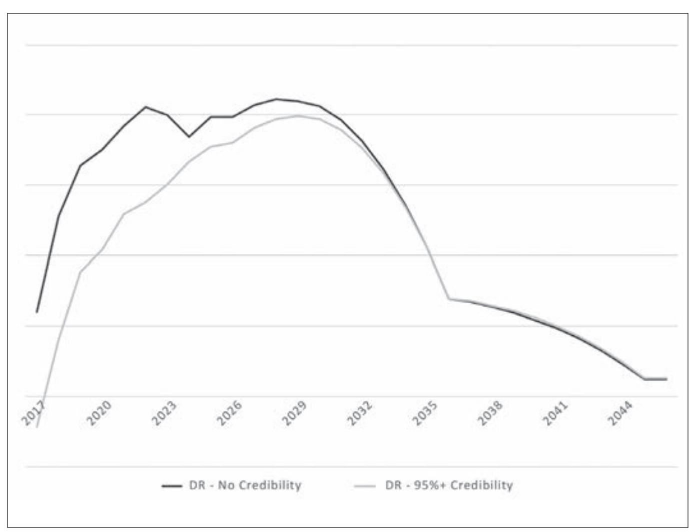
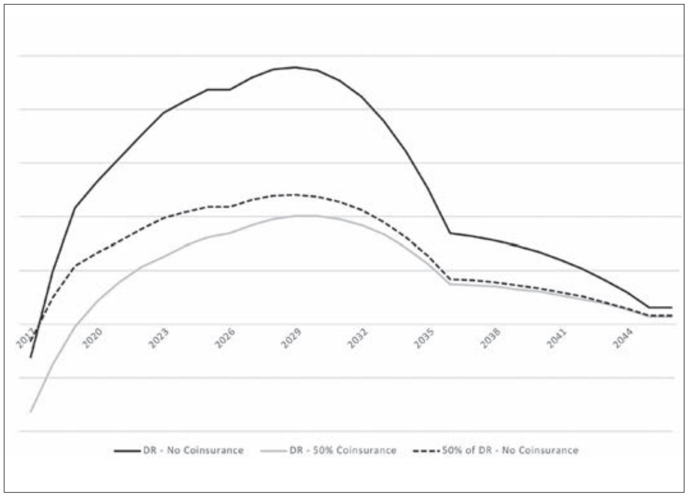


Figure 2
Effect of Coinsurance on the Deterministic Reserve



liability (see Figure 1, pg. 28), and with an incentive to seek relief through coinsurance. They may also look to reinsurers for support with their assumption-setting which is explored later in the article.

As mentioned previously, prior to PBR the reserve credit taken was proportional to the percent of coinsurance ceded. This will not be the case under PBR where the modeled reserve (Deterministic or Stochastic Reserve) dominates. Within PBR, modeled reserves are calculated both with and without reinsurance, with the reserve credit being equal to the difference between the calculations. Depending on the relationship of premiums, allowances and ceded death benefits, the reserve credit may be higher or lower than the proportional amount coinsured, as illustrated in Figure 2.

This raises another dynamic that is new in a PBR world—the need to bring reinsurers into the product development process earlier. Prior to PBR, product cash flows had no impact on the reserves held, but that is no longer the case under PBR where product design and reinsurance agreements are going to impact the balance sheet. This will lead to a more iterative approach between direct companies and reinsurers in pricing (compare Figures 3a and 3b).

VOLATILITY PROTECTION

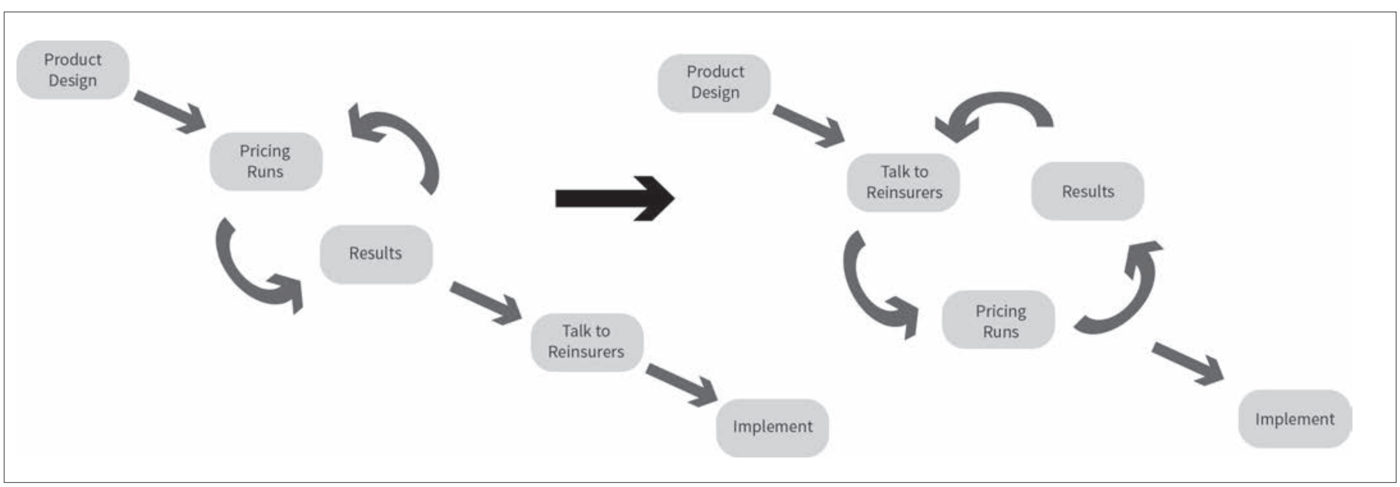
The other key traditional use of reinsurance is volatility protection. Reinsurance provides a means to protect earnings from volatility generated by worse-than-expected experience, large claims, seasonality and other factors.

Under PBR, the role of reinsurance serving as volatility protection continues but is enhanced. Of note is how volatility protection extends beyond the economic income statement into the statutory balance sheet and surplus due to the assumptions in the modeled reserves not being locked in at issue. When experience does not emerge in line with expectations and assumptions need to be revised going back to issue, reinsurance mitigates the impact from such an assumption update.

Reinsurance's impact on volatility has another potentially interesting side-effect under PBR—on assumption-setting. Credibility is defined as being amount-based in the Valuation Manual (VM-20 §9.C.4.a), but does not specify whether that is gross or net of reinsurance. While a theoretical argument may be made for it to be net of reinsurance, since that is the

Figure 3a
Pricing Process—Pre-PBR

Figure 3b
Pricing Process—Under PBR



amount a direct-writer would need to pay to settle a claim, there may be internal inconsistencies in using a net amount with credibility measures as defined in the Valuation Manual. This is more so the case with the Bühlmann Empirical Bayesian Method where industry parameters have been estimated on a gross-of-reinsurance basis. A thorough analysis of this concept is beyond the scope of this article.

Another area that has drawn significant attention is the treatment of Yearly Renewable Term (YRT) reinsurance rates as a non-guaranteed element (NGE) of the modeled reserve and any related potential evolutions to the structure of YRT reinsurance in a PBR world. The Valuation Manual (VM-20 §8.C.7) provides general guidance on assumption-setting for the NGE in reinsurance cash flows that "the company shall assume that the counterparties to a reinsurance agreement are knowledgeable about the contingencies involved in the agreement and likely to exercise the terms of the agreement to their respective advantage, taking into account the context of the agreement in the entire economic relationship between the parties." This implies the actuary should assume that the counterparty is likely to act efficiently.

Given the vague guidance, a wide range of approaches may be taken to model the YRT reinsurance rates in the modeled reserve. It is not uncommon for a direct-writer to assume less than 100 percent reaction from the reinsurer to adverse mortality, or to assume no change to the current scale of reinsurance rates, and this may be where there is a disconnect in the approach to modeling non-guaranteed YRT rates between ceding companies and reinsurers. Such a difference in treatment may draw the attention of the regulators. If the direct writer assumes that the reinsurer will immediately adjust the YRT rates to equal the modeled reserve mortality and therefore achieve break-even, the reserve credit for the reinsurance is effectively limited to half the tabular cost of insurance.

The modeling of non-guaranteed YRT rates was discussed by the NAIC Life Actuarial Task Force (LATF) and the American Academy of Actuaries at the 2018 Summer NAIC meeting. While no definitive guidance was given, a desire for a common approach to modeling non-guaranteed YRT rates was shared among the regulators who reacted to the discussion. The chair of LATF said it will be a priority to reach consensus on additional requirements for inclusion in the 2020 version of the Valuation Manual.

The complexities surrounding the treatment of YRT rates within PBR may lead to potential variants in the structure of YRT reinsurance. There has been some market interest in quotes for rate scale guarantees or lower caps. But it is important to recognize that such explorations are not "one size fits all." The interplay between the cost of the assumed increase in YRT premiums and the impact of guaranteed premiums on the VM-20 reserves can produce varying impacts on profitability. Because any guarantees will carry higher capital charges that will be reflected in the rates, YRT reinsurance with such structures may cease to be an inexpensive method to protect against volatility.

ASSUMPTION-SETTING

Reinsurers have a long history of assisting direct-writers with assumption-setting, in particular for mortality, given their rich claims experience. In a PBR world, this role can influence reserves held by direct-writers. The Deterministic and Stochastic Reserves require that the mortality assumption is informed by company experience, and the level of prudency on the assumption is linked to the underlying credibility. At the same time, the Valuation Manual (VM-20 §9.C.2) recognizes the need to enhance the reliability of the mortality assumption for companies that do not have credible experience on their own, and explicitly mentions reinsurance as a source.

This opens up new dimensions on how reinsurance is applied and when direct-writers engage with reinsurers during the product design journey. However practical challenges remain.

i). Relevancy: Not all of a reinsurer's claims experience is applicable, or relevant, to any single direct-writer as direct-writers function in certain target market(s), through certain distribution channel(s), and within certain underwriting methodologies. The result of these is a mix of policyholder demographics that would vary from company to company.

Reinsurance on the other hand is an amalgamation of the drivers of mortality mentioned above, and any assessment of relevancy needs to isolate them. Therein lie practical limitations since these splits have not always been captured within reinsurance administration systems to the level required to easily enable this. In addition to underlying drivers of mortality, reinsurance drivers such as first dollar quota share versus excess reinsurance need to be considered since they impact mortality experience.

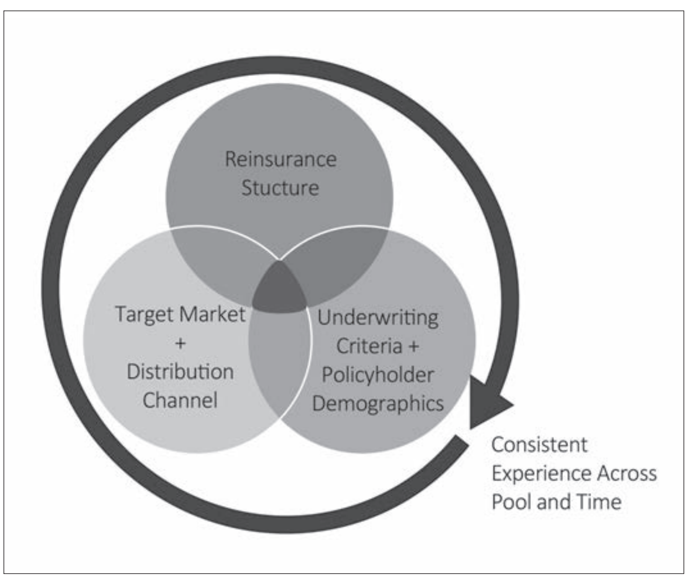
Finally, it should be noted that for any reinsurance experience study to be sound, there needs to be consistent experience across pool and time. The interplay of reinsurance relevancy drivers is captured in Figure 4.

ii) Confidentiality: Reinsurers not only need to assess what data they **may** be willing to share with direct-writers due to intellectual property and anti-trust concerns, but also what they **can** share given confidentiality constraints on certain data.

iii). Burden of proof: While the Valuation Manual clearly places responsibility of the assumptions on the qualified and appointed actuaries, when parts of the assumption come from an external source, the lines get blurred. Justification of assumptions in VM-31 will require direct-writers and reinsurers to work closer than they previously have on assumption-setting. The level of justification required by regulators and auditors will also influence reinsurers' appetite to engage in this space.

As demonstrated in this article, the role of reinsurance is being redefined in interesting ways as a result of principle-based reserving, while still maintaining its original purpose. And the evolution is still in its infancy. Many are watching with interest, awaiting the realization of the potential for reinsurance to play a larger role as companies explore product innovation and risk sharing enabled by a reserving framework built on a first-principles basis.

Figure 4
Relevancy Drivers



Alijawad Hasham, FSA, MAAA, is senior valuation actuary, vice president at Swiss Re. He may be contacted at *Alijawad_Hasham@swissre.com.*

Bryan Amburn, FSA, MAAA, CLU, is the director of Life Actuarial and chief life actuary for Farm Bureau Life Insurance Company of Michigan. He may be contacted at *bamburn@fbinsmi.com.*

Olivia Yang, FSA, CERA, MAAA, is a senior consultant at Oliver Wyman. She may be contacted at *Olivia.Yang@oliverwyman.com.*

SOCIETY OF ACTUARIES®

475 N. Martingale Road, Suite 600
Schaumburg, Illinois 60173
p: 847.706.3500 f: 847.706.3599
w: www.soa.org

NONPROFIT
ORGANIZATION
U.S. POSTAGE
PAID
SAINT JOSEPH, MI
PERMIT NO. 263

FSC
www.fsc.org
MIX
Paper from responsible sources
FSC® C004755
FPO