THE Actuary

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Global low interest rates: Hypotheses, implications and strategies

BY LARRY ZHAO

Larry Zhao, FSA, CERA, CFA, FRM, CMT, Ph.D., is senior director, head of Hedging Strategies, at AXA US in New York.

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More than seven years after the onset of the global recession, sluggish economic growth persists across all developed economies. Interest rates around the world hover at historically low levels. As of Oct. 1, 2015, the annual yield of 10-year government bonds was 2 percent in the United States, 0.5 percent in Germany, 0.3 percent in Japan and –0.2 percent in Switzerland, meaning the lenders must pay the Swiss government to hold their money!

WHY ARE INTEREST RATES SO LOW?

There are a few hypotheses as to why interest rates are so low:

1. Federal Reserve Bank hypothesis
2. Secular stagnation hypothesis
3. Global savings glut hypothesis

The *Fed hypothesis* is intuitive, but in my opinion, the most unlikely. While the Fed sets the benchmark nominal short-term interest rate, and its monetary policy impacts inflation and inflation expectation over longer terms, its ability to affect medium- to long-term real (inflation-adjusted) interest rates is limited. The goal of the Fed's monetary policies was to bring the short-term federal funds rate closer to market equilibrium. If the Fed wants to artificially push interest rates below the market equilibrium rate (i.e., the cost of borrowing is below the investment returns), the economy would overheat, leading to inflation. Seven years after the onset of quantitative easing (QE) programs, the inflation index in the United States is still only 1.3 percent.

The *secular stagnation hypothesis* suggests that an economy, after a huge financial shock, would experience inadequate aggregate demand for many years. Demographic shifts (aging and slow population growth), reduced capital intensity (social media replacing steel-making), tepid private capital investment and depressed household consumption would chronically prevent the economy from reaching full potential. If the return on capital is very low, then the real interest rate needed to achieve equilibrium real interest rate (at full employment) will likely be very low as well.

The recent pattern of slow economic growth, low capital spending, subdued household consumption, low inflation and low real interest rates is consistent with this hypothesis. However, skeptics point to its lack of international dimension. Secular stagnation requires that capital returns be permanently low everywhere, not just in the home economy. Availability of profitable capital investments globally should help defeat local secular stagnation because outflows of financial capital weaken home currency, promote exports and raise domestic production, which helps the home economy reach full employment and close the output gap.

The *global savings glut hypothesis*, championed by former Fed Chairman Ben Bernanke, attributes the low global interest rates to a global excess of desired saving over desired investment, emanating largely from China and other emerging Asian economies, and oil producers such as Saudi Arabia, to reduce borrowing and build international reserves.

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WILL THE INTEREST RATES REMAIN LOW?

In the eurozone, Germany's large and persistent trade surplus puts the burden on less competitive trading countries to undergo painful fiscal austerity measures to become more competitive. As the largest economy in the eurozone, Germany effectively relies on foreign rather than domestic demand. Today, the unemployment rate in Germany is 4.5 percent, while the unemployment rate in the ex-Germany eurozone is 13 percent. Because the eurozone is short on aggregate demand, if Germany continues to pursue imbalanced export policies without taking large fiscal and structural measures to increase domestic demand, the eurozone could fall into the secular stagnation trap. This implies the extremely low interest rates in the eurozone could persist for many years.

In the United States, excessive savings are in decline due to a variety of geopolitical and socioeconomic reasons:

1. In China, the very high investment rate of the past 30 years is not sustainable due to the exhaustion of the reserve of farmers and a slowdown in the rate of technological catch-up. Excessive supply, excessive leverage in the private sector and irrational exuberance in assets (stocks and housing) markets are the classic patterns for recession in a capitalist market economy. After the recent stock market crash, Bank of China employed a small portion of its $2 trillion foreign reserve to defend the depreciation of the yuan.
2. Oil prices have dropped from more than $100 a barrel last year to about $40 a barrel, and remain low. The excessive savings from oil producers are expected to decline significantly. Saudi Arabia has to draw on its foreign reserve to support domestic social programs.
3. The current account balances among other emerging economies started to decline a few years ago, and their foreign reserves have stabilized and even started to decline moderately.

These factors, combined with sustainable U.S. growth and a near full employment, may drive the real interest rate to escape the zero and start to normalize.

WHAT ARE THE IMPLICATIONS OF LOW INTEREST RATES?

The long-term government bond has three components: expected inflation, expectation of the future real short-term interest rate and a term premium. In the United States, inflation is about 1.3 percent. The short-term interest rate is expected to remain low, at about 0.25 percent. Given that the yield of 10-year Treasury bonds is 2 percent, the implied term premium is only 0.45 percent, which is substantially below the historical average of 1.6 percent.

The low-term premium reflects the market consensus of low inflation risk and low uncertainty about likely future interest rates. In a low, stable inflation or disinflationary environment, holding longer-term bonds not only increases portfolio yields due to positive carry and rolldown, but it also reduces the diversified portfolio risk. Holding longer-term bonds can also provide a hedge against deflation risk and meet new regulatory requirements for safe, liquid assets. With all of these benefits, investors should be willing to accept low compensation yield for holding bonds rather than short-term securities or cash.

Many actuaries worried that unconventional QE programs had artificially inflated the U.S. equity markets, and subsequent unwinding and eventual removal of the programs would inevitably cause stock markets to crash. The excessive worry might be misplaced, for two main reasons:

1. As argued by Bernanke, the QE programs just helped return the stock market to its normal trend.
2. The dividend yield on Standard & Poor's 500 index is on par with the 10-year Treasury yield. Any large decline of the index price would only make its dividend yield more appealing relative to yields of Treasury bonds.

However, for life insurance companies, persistent low interest rates have created asset and liability mismatch problems because their long-term liability assumptions are greater than the current market yields. As higher-yielding bonds mature and are replaced with lower-yielding bonds, the book yield of the investment portfolio will be insufficient, and liabilities will grow due to carry.

STRATEGIES IN RESPONSE TO GLOBAL LOW INTEREST RATES

To address the challenges to insurance companies worldwide created by the persistently low interest rates, we have invited a few experts to present their strategies on how to cope with the complex issues facing investment actuaries today in this issue of *The Actuary*. These authors are from a large insurance asset management firm, a large European insurer, an Asian consulting firm and two global investment banks. By combining opinions and insights from experts of different practices, perspectives and geographies, we intend to offer a comprehensive view on this complicated, yet critical, issue. ■

The views expressed are those of the author and do not reflect the views of AXA US.

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from the PRESIDENT

BY CRAIG W. REYNOLDS

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Embracing diversity and inclusion

The Society of Actuaries (SOA) is guided by the principles documented in our strategy map. The current version of our strategy map includes two key statements on which I would like to focus:

1. **PROMOTE** the value of SOA credentials … to attract the best candidates.
2. **ATTRACT**, nurture and retain volunteers and staff who bring diverse skills and perspectives.

Both of these statements require the SOA leadership to think about diversity and inclusion. A workforce that excludes underrepresented groups, even inadvertently, would leave behind some of the best candidates—candidates with skills, interests and talents that might otherwise be missed. We must seek to attract the "best and brightest" from all segments of the population and from a variety of educational backgrounds, cultures and experiences. To succeed in this effort, the SOA is making a commitment to focus on diversity and inclusion in the profession.

It is important to understand what we mean by diversity and inclusion. Diversity means respect for and appreciation of differences in ethnicity, gender, age, national origin, disability, sexual orientation, education and religion. Inclusion focuses on the needs of every individual and ensures that the right conditions are in place for each individual to achieve his or her full potential.

As I mentioned in my presidential address at the 2015 SOA Annual Meeting and Exhibit, we will thrive as a profession by bringing different perspectives to the table and creating a strong sense of camaraderie. The SOA has embarked on new activities to embrace diversity and inclusion among actuarial candidates and members, but we need your help in achieving these efforts on behalf of the profession.

Last year, the SOA Actuarial Diversity Task Force conducted an assessment of the current state of diversity at the SOA and in the actuarial profession. A number of diversity programs exist for actuaries and other science, technology, engineering and mathematics (STEM) careers, and there have been a number of programs and activities on diversity. However, women and racial and ethnic minorities remain underrepresented in the actuarial profession in the United States and Canada, and there is an opportunity to do more in support of these and other underrepresented groups.

The task force evaluated employer-established diversity programs, along with their successes and challenges. It also studied other professions and nonprofit association diversity programs. All of this analysis was provided to the SOA Board for consideration. This past October, the SOA Board approved the task force's eight recommendations,

including the creation of a standing SOA Inclusion and Diversity Committee that will manage diversity and inclusion strategy, and report regularly to the SOA Board on related progress and challenges.

This new committee will help us focus on ensuring diversity and inclusion throughout our organization and the profession. It will help build on and enhance current efforts and collaborations with other organizations inside and outside of the actuarial profession. The committee will work to:

- Develop an SOA statement on diversity and inclusion that connects with our mission and vision as an organization;
- Gather voluntary data on racial and ethnic demographic information from members and candidates;
- Conduct a research project to analyze the barriers to entry and the root causes of women and minority underrepresentation in the actuarial profession in the United States;
- Identify ways to establish diversity and inclusion guidelines for speakers at SOA meetings and events, as well as authors in SOA publications; and
- Ensure diversity and inclusion content for SOA publications and other forms of communication.

Change takes time, and together we can strengthen the profession through diversity and by incorporating new ideas to make it happen. Visit our new website, ***theactuarymagazine.com***, to read an article from the December 2015/January 2016 issue on why diversity matters for our profession.

You can help these diversity and inclusion efforts by accessing and completing the voluntary demographic information in your SOA profile (see sidebar at right). It only takes a few minutes, and it will allow us to better track our successes in these efforts. I also want to hear your thoughts and ideas on how the SOA and our Inclusion and Diversity Committee can further support and build upon these efforts on behalf of our profession. Please share your ideas with me by email at *craig.reynolds@soa.org*. ■

References

2015 SOA Annual Meeting Presidential Address Transcript
bit.ly/2015Transcript

"Building an Inclusive Work Environment"
theactuarymagazine.com/building-an-inclusive-work-environment

Additional link for reference, Heidrich article
https://www.soa.org/Library/Newsletters/The-Actuary-Magazine/2015/february/act-2015-vol12-iss1-heidrich.pdf

action

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Here's how to enter the voluntary demographics to your SOA account online.

1. **GO** to the following link: ***bit.ly/SOADemographics***
2. **ENTER** your username and password to log in.
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   - Country of residence
   - Country of citizenship
4. **CLICK** "save" on your account and the demographics information will be added.

If you have any issues accessing your account, contact SOA Customer Service at ***customerservice@soa.org*** or **1-888-697-3900**.

International affairs

A ROUNDUP OF NEWS FROM THE GLOBAL COMMUNITY

Whether you travel the world or never leave your home country, you are affected by global organizations, international requirements and the increasingly international nature of the actuarial profession itself. Here is some news from around the world.

STRENGTH IN NUMBERS

Under the banner "Strength in Numbers," the 25th Caribbean Actuarial Association (CAA) Annual Conference took place in Port of Spain, Trinidad & Tobago, Dec. 2–4, 2015.

The CAA Conference featured regional and international specialists in the fields of pensions, life insurance, investment, and property and casualty insurance.

The Society of Actuaries (SOA) president, Craig Reynolds, FSA, MAAA, presented on model risk as part of a panel session titled, "Technology, Risk and Opportunity." Reynolds discussed the definition of model risk, the impact of wrong models, validation and governance of models, and the importance of data quality.

Attendees at the conference also had the opportunity to take the SOA's Associateship Professionalism Course.

As part of his trip, Reynolds also traveled to Panama, where he met with Luis Martinez, president of the Actuarial Association in Panama (AAP), and Concepcion Moreno, vice president of AAP.

NEW SOA STAFF FELLOW IN BEIJING

The Society of Actuaries (SOA) hired a new staff fellow, Jessie Li, FSA, who will be the SOA's lead China representative.

"Having Li in Beijing means more real-time localized support for our members and candidates in China, providing us with the capacity to deepen and strengthen our long relationships with the China Association of Actuaries and the Chinese academic community," says Ann Henstrand, SOA senior director, International.

Jessie Li, FSA

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BUSINESS MANAGEMENT RESOLUTIONS AND SHIFTS

During its annual meeting near the end of 2015, *The Wall Street Journal* CEO Council covered key areas for businesses to invest in and support for the near future. This discussion among business leaders included the need to foster innovation and competitiveness, make the world safer to do business, build a stronger economy and help educate the global workforce.

RELATED LINKS

- ***bit.ly/ceocouncil***
- ***bit.ly/WSJCEOCouncil***

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BIG DATA AND INSURANCE

The real-life applications of big data continue to grow. For example, a new life insurance study looked at the digital implications of data with predictive underwriting in providing consumers with more customized insurance products. Data also helps to understand and prevent issues involving supply chain risks.

RELATED LINKS

- ***bit.ly/InsuranceXroads***
- ***bit.ly/BigDataChallengesReport***

ENDURING THROUGH RAIN OR FIRE

Some regions of the United States are experiencing droughts or heavy dry seasons, yet there is also the risk for heavy rains from El Niño. For example, Californians are discussing a number of issues for crops with the lack of water.

Additionally, home insurance policies now include access to privatized firefighter teams to help prevent the loss or damage of property. American Public Media's Marketplace identifies the challenges and opportunities in this space.

Conversely, flood insurance is receiving increased interest from both businesses and homeowners in preparation for rainy weather.

RELATED LINKS

California Drought
- ***nyti.ms/1UVH94f***

Privatized Firefighters
- ***bit.ly/CAInsuranceFire***

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THE WAITING

The fun began in August 2011 when the Federal Open Market Committee (FOMC) made an unprecedented announcement that it would be holding the federal funds rate at essentially zero through mid-2013. It further piled on the "good news" in September 2011, announcing "Operation Twist," a program intended to pull down longer-term interest rates through purchases of longer-dated Treasurys, up to 30-year issues. In addition, the FOMC announced plans to reinvest principal payments made from agency debt and agency mortgage-backed securities (MBS) back into MBS. That squeezed yield for those assets.

As a result of these decisions, Treasury rates dropped and reached historic lows for all maturities in 2012. In May 2013, the Federal Reserve announced it would be tapering back the bond-buying program; the "taper tantrum" ensued, a short-lived bump in interest rates in the last half of 2013. In 2014, rates decreased again, and in 2015, rate movement seemed more sideways.

As with Lucy van Pelt taunting Charlie Brown with a football, each meeting of the FOMC in 2015 brought the opportunity for the committee to decide to raise rates, but we kept hearing "not just yet."

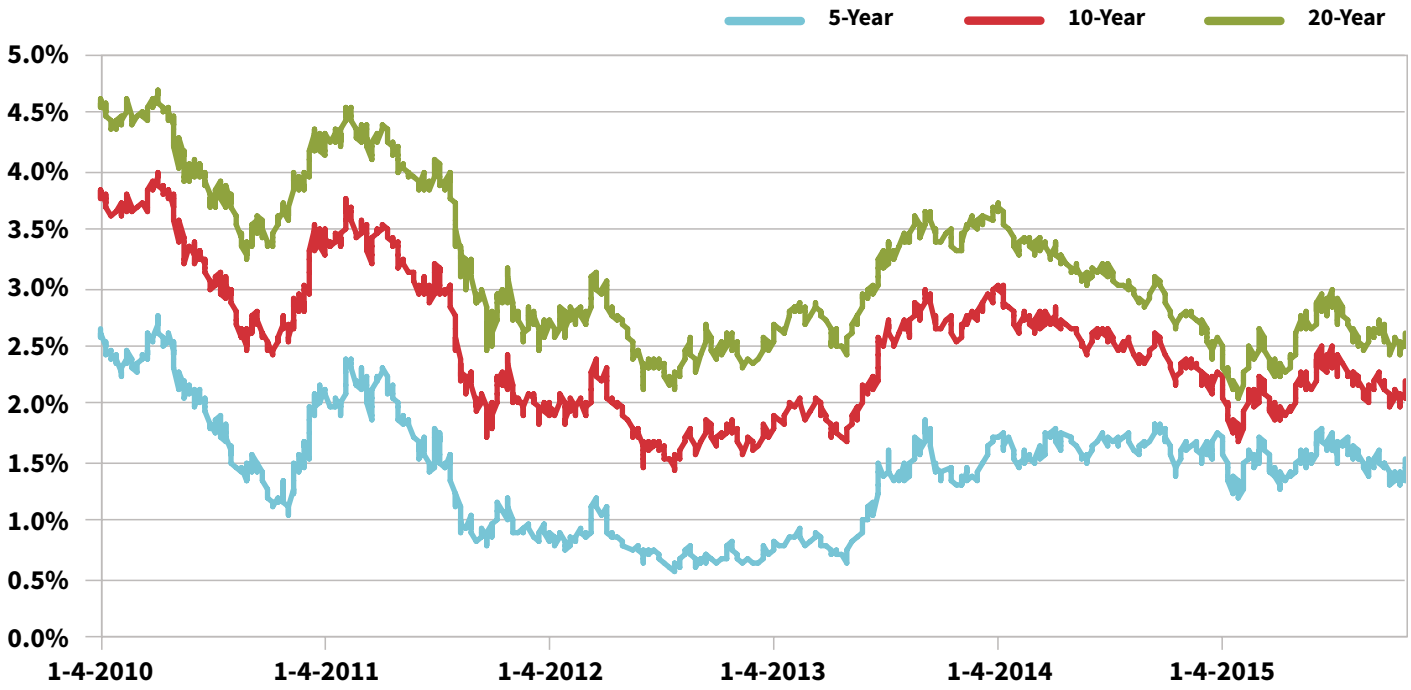
Finally, though, on Dec. 16, 2015, the FOMC moved the target range for the federal funds rate up 25 basis points (bps). It also projected four similar increases to come in 2016.

GAME…OVER?

THE JOY OF BEING A U.S. LIFE INSURER IN A LOW INTEREST RATE ENVIRONMENT

BY MARY PAT CAMPBELL

FIGURE 1 CONSTANT MATURITY TREASURY RATES



Source: Federal Reserve Bank of St. Louis

Does that mean the waiting game for higher rates is finally over? Over the past five years, the U.S. life insurance industry has been feeling the effects of the low interest rate policy especially hard, along with others heavily dependent on fixed-income securities. (See **FIGURE 1**.) The industry had been hoping for a "return to normalcy" after a long run of low rates, but it is not clear even with the recent move by the FOMC whether this normalcy will come anytime soon.

GHOSTS OF CRISES PAST

The specter of Japan's experience hangs over the U.S. life insurance industry. In Japan, an official regime of very low interest rates started in the early 1990s, and the rates there are still low. Japanese real interest rates occasionally became negative as inflation outstripped nominal rates. Several Japanese life insurers went insolvent due to overgenerous minimum crediting rates on popular savings products that could not be adjusted. In this long, dry period, Japanese insurers learned the harsh lesson of the results of asset and liability mismatch. They took a closer look at the risks inherent in their portfolios, adjusting accordingly to the extent possible.

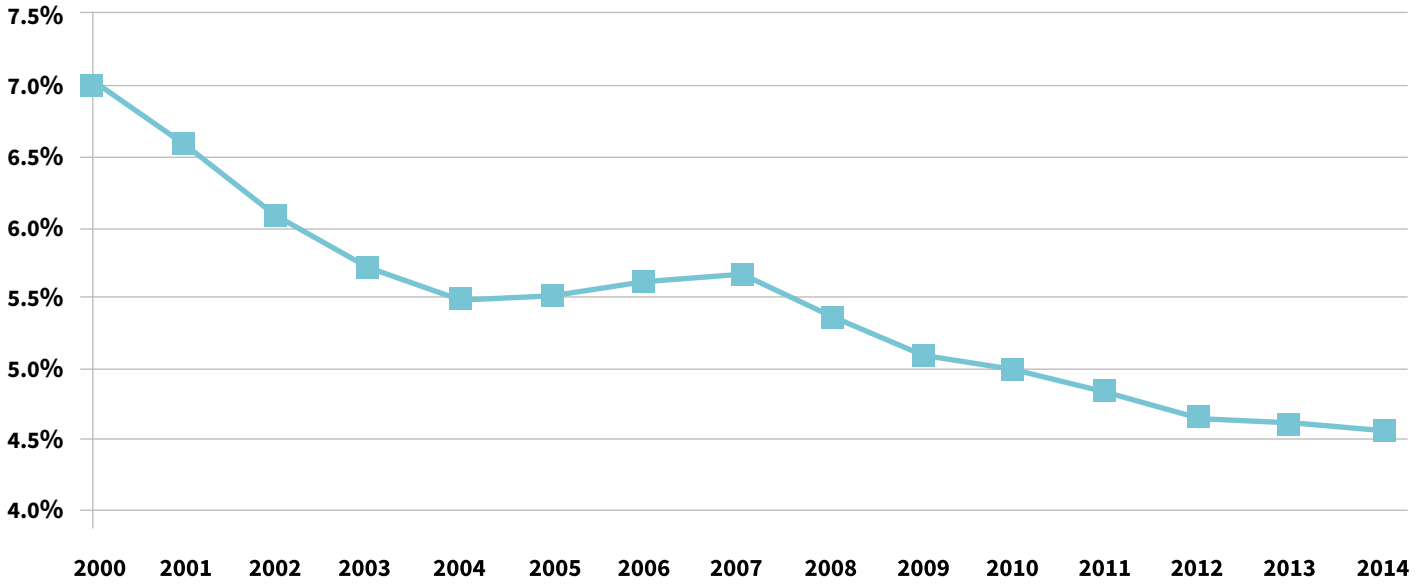
Likewise, U.S. life insurers have seen strain as their overall portfolio rates have decreased for more than a decade. (See **FIGURE 2**.) The U.S. life industry (including fraternals) showed a net investment yield decrease of more than two full percentage points from 7.02 percent in 2000, down to 4.58 percent in 2014.

This did not represent a steady decrease. Indeed, from 2004 to 2007, the industry seemingly defied the gravity of the low—and decreasing—interest rates over this period. Net investment yields increased from 5.48 percent in 2004 to 5.68 percent in 2007. What was happening? A run to the very assets whose siren song was luring institutional investors across the United States and the world: structured securities engineered to have particular credit rating profiles.

Insurers, seeking yield, invested more heavily in these assets, generally taking the highest-rated tranches. From 2004 to 2007, it seemed the bond portfolio was improving in credit quality due to this investment strategy shift. Bonds in the highest National Association of Insurance Commissioners (NAIC) credit risk rating (NAIC Class 1, covering bonds rated A to AAA) went from 63 percent of the bond portfolio in 2003 up to 69 percent of the portfolio in 2007.

FIGURE 2 **GENERAL ACCOUNT NET INVESTMENT YIELDS**

U.S. life, annuity and health insurers, including fraternals



Source: A.M. Best, Conning Research & Consulting analysis

However, in 2008, the risk hidden by these rosy credit ratings became apparent to all in the credit meltdown. U.S. life insurers decreased fairly rapidly in the aftermath of the credit crisis, dropping 31 bps between 2007 and 2008, and 26 bps between 2008 and 2009. Part of this decrease was due to impairments on the once-favored structured securities, and also the rush to cash and Treasurys in reaction to these losses. These decreases have slowed since 2010, as U.S. insurers have reduced their relative positions in cash and Treasurys after having rebuilt capital.

Hopefully insurers have learned that blindly chasing yield, without regard to hidden risks, may cause a similar hit to insurers' balance sheets. However, the re-risking of the asset portfolios has shown some convergent strategies yet again.

REACHING FOR YIELD THROUGH CREDIT RISK

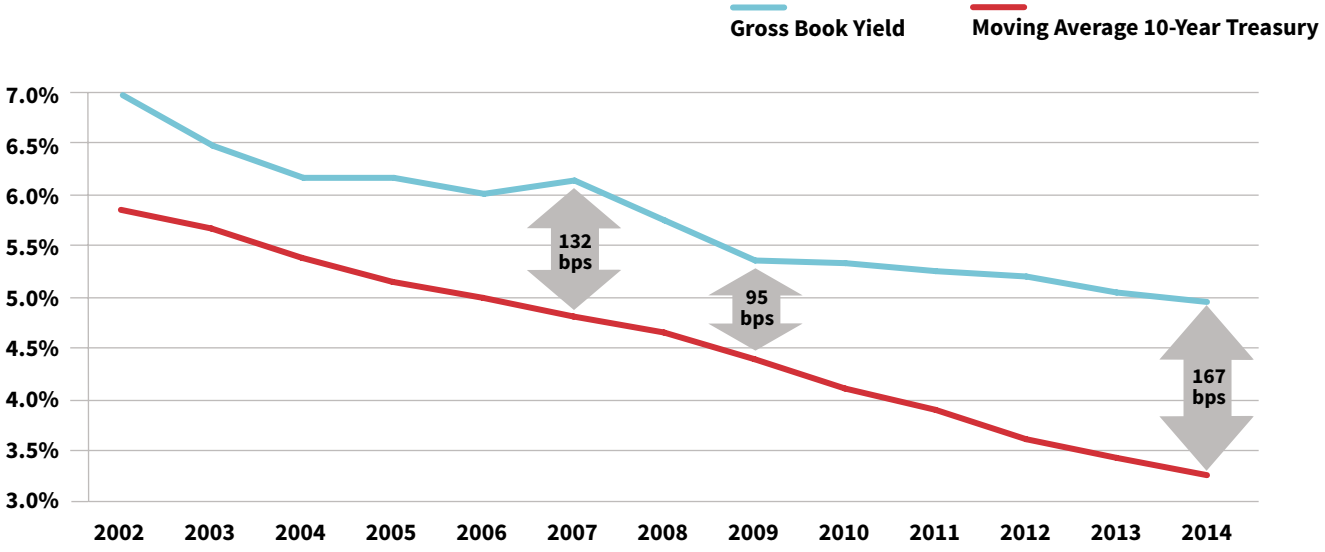
As experience has shown that credit ratings were not indicative of the hidden risk in structured securities in life insurers' portfolios, we need another way to see if we can compare the U.S. life industry investments pre- and post-crisis.

The 10-year Treasury rate is a good proxy for life insurers' investment results, as life insurer bond portfolios, the overwhelming constituent of General Account assets, have had an average maturity of about 10 years for more than a decade. However, the spot 10-year rate is not completely appropriate as a reference rate, as insurers have a mix of assets bought over time with cash flows being reinvested at current rates as older issues mature. Given that, a moving 10-year average of the 10-year Treasury rate was used as a reference rate instead of a spot rate, as shown in **FIGURE 3** on page 20.

In addition, the gross book yield was investigated to remove the effects of expenses on net yield and was measured against "investable assets," which excludes items such as owner-occupied real estate, derivatives used for hedging purposes, and debt or equity in parents/subsidiaries/affiliates. The point is to try to get at the result from purely investment decisions in the industry.

When the life/annuity industry's gross book yield is compared against this reference rate, an interesting pattern emerges. During the period from 2005 to 2007 immediately preceding the financial crisis, the gross book yield for the industry increased while the reference rate decreased. As a result, one sees an increasing spread that reaches a wide point of 132 bps

FIGURE 3 **GROSS BOOK YIELDS AND RISK-FREE RATES (AS PERCENT OF UNDERLYING INVESTABLE ASSETS)**



Source: A.M. Best, U.S. Treasury Department, Conning Research & Consulting analysis

in 2007. This spread against the reference rate was increasing as the weighted average credit quality of the bond portfolio was improving (when measured by NAIC credit risk categories). However, this increasing spread uncovers the extra risk being taken on in the industry.

In the aftermath of the crisis, insurers shed many of these assets and built up their cash positions, which is reflected in the low spread of 95 bps in 2009. Since 2009, this spread between the industry book yield and the reference rate has widened each year, possibly reflecting increased risk in the portfolio. The spread between the industry gross book yield on investable assets and the reference rate reached 167 in 2014, surpassing the prior maximum of 132 bps in 2007. Of course, even with this widening spread, gross book yields have been decreasing. The gross book yield on investable assets decreased to 4.98 percent in 2014, compared to 5.06 percent in 2013 and 6.16 percent in 2007.

Unlike the run-up to 2008, the average credit quality of bonds has been worsening in recent years. Some of this has been due to downgrades of bonds already in the General Account, but this impact was seen mostly over 2008 and 2009. Allocations to below-investment-grade bonds increased over those years due to downgrades, but since 2009, the industry overall has reduced the percentage of the bond portfolio in below investment grade.

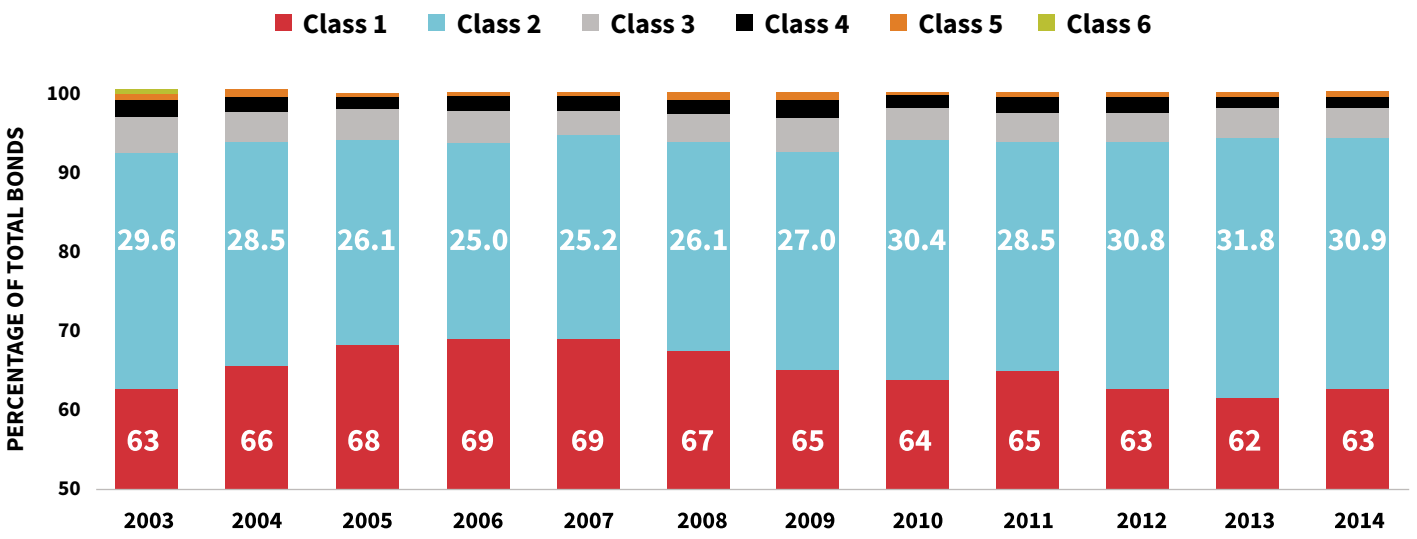
The most notable credit quality shift has been one of increasing allocation to NAIC Class 2 bonds, or BBB/Baa-rated, as opposed to higher-rated bonds. (See **FIGURE 4**.) While this is, again, partly due to downgrades, it is also partly due to what is available in the bond market and other shifts in allocation choices in bond maturity.

Insurers have a limited number of corporate bonds available to select among longer maturities. For example, the Vanguard Long-Term Corporate Bond Exchange-Traded Fund, intended to track the Barclays Capital Long Corporate Index, as of Sept. 30, 2015, was composed of 1,653 bonds with an average duration of 13.5 years and maturity of 23.9 years, with almost 9 percent of that portfolio rated Aa or higher. About 49 percent of this fund is rated Baa, equivalent to NAIC Class 2.

This mirrors the shift to NAIC Class 2 bonds in the life/annuity industry portfolio. In 2007, NAIC Class 2 bonds made up 25 percent of the industry's bond portfolio; by 2014, they made up 31 percent of the portfolio. This increase to NAIC Class 2 bonds came at the expense of NAIC Class 1 bonds (credit rating A to AAA), which dropped from 69 percent of the bond portfolio in 2007 to 63 percent in 2014.

The most noteworthy feature of these asset allocation shifts is that they have been industrywide. In Conning's research of U.S. insurer investment trends, some trends have been driven almost exclusively by the largest insurers. This is not

FIGURE 4 CREDIT QUALITY OF BOND PORTFOLIO



Source: A.M. Best, Conning Research & Consulting analysis

the case with the credit shifts: From the smallest to the largest insurers, there has been a noticeable increase in allocations to lower-rated bonds. There even has been a shift from AAA/AA-rated bonds down to A-rated. Again, much of this is driven by what is available in the market, not only explicit insurer strategy.

REGULATORY CHANGES COULD CONSUME CAPITAL

The difference between this recent addition of bond risk and what happened from 2004 to 2007 is that the asset risk is now more recognized. As noted previously, the weighted average credit quality of the bond portfolio has become more risky, unlike the case where unknowingly risky assets had top credit ratings. In addition, the credit shifts are occurring more in the medium-range maturity of 5–10 years, and not as much for higher maturity bonds (though one sees an increase of NAIC Class 2 in these bonds as well).

Insurers may be taking on risk by reaching for yield in lower credit quality, but they feel more comfortable when this credit risk is of a relatively short duration. Recent regulatory projects also reflect this view. The Solvency II project in Europe has looked at risk capital for corporate bonds not only by credit rating, but also term to maturity, greatly increasing risk charges for longer-dated bonds. The NAIC has a project to update credit risk charges (C-1) for corporate bonds. It looks like the NAIC will not be taking a duration-based approach for its credit risk factors on bonds, but preliminary modeling has shown that risk charges could increase noticeably for some investment-grade bonds.

In addition to Risk-Based Capital (RBC) charges possibly increasing for BBB-rated bonds, the extra yield provided by these bonds may be decreasing, as credit spreads have reduced. The risk-adjusted return would thereby be decreased in terms of less of a spread as well as increased capital requirements.

WHAT IS "NORMAL"? WILL WE EVER SEE IT?

As mentioned earlier, many insurers have been waiting for a "return to normalcy" in the interest rate environment. But looking at broader trends of interest rates, one must question if there is such a thing as a normal level of rates.

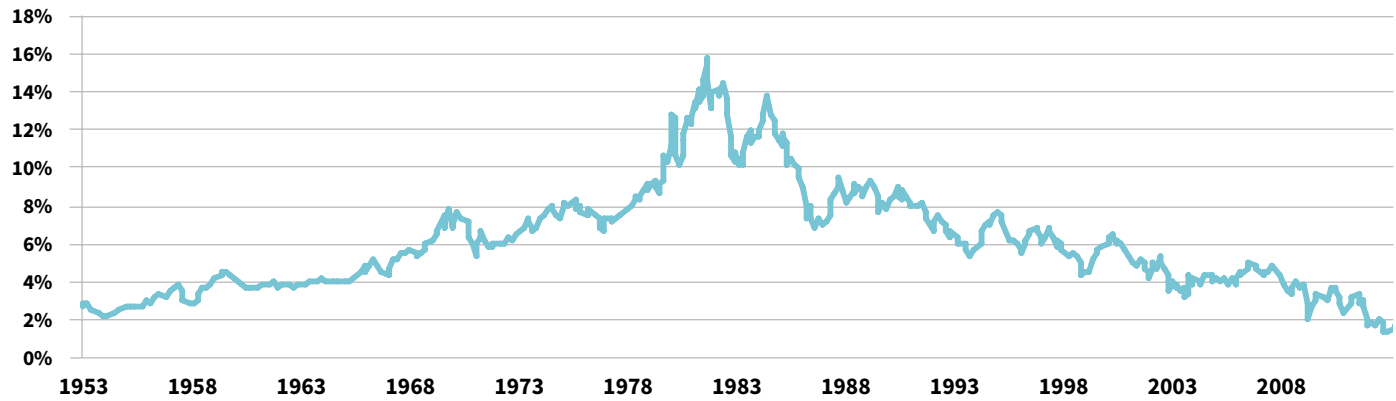
In looking at 10-year Treasury rates since 1953, one can see an overwhelming secular trend of increase up until the early 1980s, and then a general trend of falling rates. (See **FIGURE 5** on page 22.) Now, given that the industry did manage its way down from almost 10 percent at the end of 1987 to near 5 percent in 2000, one may wonder what the concern is now—especially as we saw similar low rates in the 1950s. Of course, much of it deals with product mix and especially flexible product features. Traditional pricing of crediting rates on life products has generally been a spread based on the portfolio rate. While declining rates are no fun, even

as rates were relatively "normal" there was plenty of room above minimum guaranteed rates, usually at 3 percent. In the 2000s, spread compression worsened. While there has been some change in regulations to allow reduction in minimum rates in low rate environments, there still is a practical lower bound.

The issues of managing through different rate environments aside, there still is the issue of what the longer-term trend will be. Some have pointed out that demographic trends may be influencing the level of rates as well as returns on all sorts of capital assets. In a December 2010 report titled "Interest Rate Effects of Demographic Changes in a New-Keynesian Life-Cycle Framework," by researchers at the European Central Bank, it was noted that both an increase in longevity and a decrease in population growth in Europe had been leading to an aging population.

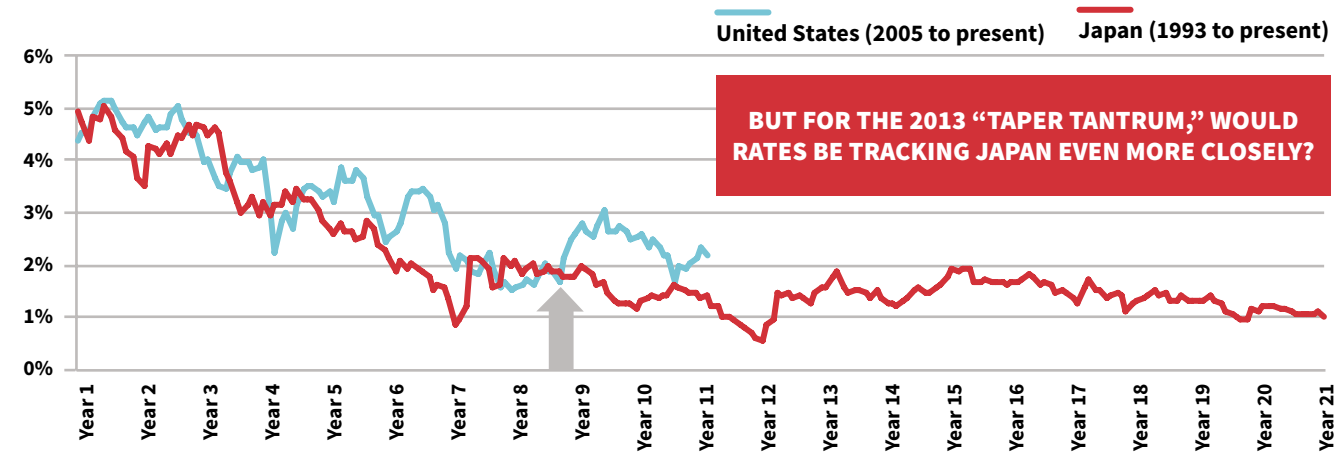
The results of these long-term trends were feeding into lower equilibrium real interest rates (even going negative) as model results under a variety of assumptions. While the ultimate levels differed, all results showed an overall decreasing trend. More recent research papers have shown similar results, including "The Effects of Demographic Changes on the Real Interest Rate in Japan," by Ikeda and Saito, and a 2014 International Monetary Fund (IMF) working paper titled "Impact of Demographic

FIGURE 5 **U.S. TREASURY 10-YEAR CONSTANT MATURITY RATES (BOND EQUIVALENT YIELD RATES)**



Source: Federal Reserve Bank of St. Louis

FIGURE 6 **JAPAN VERSUS UNITED STATES 10-YEAR TREASURY YIELD**



Source: Federal Reserve Bank of St. Louis

Changes on Inflation and the Macroeconomy." Results in the latter paper showed effects that the increasing elderly share of the population did reduce gross domestic product (GDP) per capita growth, which drives many macroeconomic results. This result came from sampling 30 countries from 1960 to 2013, showing this is not restricted to Japan. See **FIGURE 6** for a comparison between U.S. and Japanese interest rates.

Looking at the history of U.S. Treasurys, we see the peak rates in the years that the first baby boomers were reaching their late 20s, the traditional start of the most productive working years and the heaviest borrowing to fund activities like buying homes. This cohort reached net saver status in the late 1990s when the oldest boomers turned 50.

The cohort now in this net saver age range is Generation X, once referred to as the "baby bust," because the lowest number of births post-war in the United States occurred in the early 1970s. Their relative low numbers compared to the higher number of seniors makes for an imbalance in demand and supply in credit at higher rates. From a demographic point of view, the trend in lower rates was to be expected. Even if we take foreign investors in U.S. debt into account, these are dominated by countries that are aging faster than the United States—China and Japan are the current largest holders of these securities.

BRIGHTER PROSPECTS AHEAD

While the current demographics mean that interest rates may stay low in the near term, with or without Federal Reserve intervention, there is a possibility the trend may reverse. The first decade of the 21st century has seen a new baby boom, with 4.3 million born in 2007 in the United States, a number higher than the prior peak in 1957. While this represents a much lower fertility rate than previously, the imbalance between savers and borrowers may tighten and bring up rates again.

DEMOGRAPHIC TRENDS MAY BE INFLUENCING THE LEVEL OF RATES AS WELL AS RETURNS ON ALL SORTS OF CAPITAL ASSETS.

To be sure, insurers don't want to sit around waiting until 2027 to see "normal" again, but it may indicate that a regime of rising rates may come once more. Not only do life insurers need to weather the current lull of low rates, but they must remember the lessons of the late 1970s and early 1980s when rates precipitously rose, causing different sorts of destruction. The need for careful asset/liability management and risk analysis is more urgent than ever. ■

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LOCALIZED INVESTMENT MANAGEMENT FOR BURGEONING INSURERS IN ASIA

BY FRED NGAN, MICHAEL CHAN AND ERIC FORGY

The insurance story in Asia has been so dominated by "growth"—for example, China's doubling of insurance industry assets over the last five years[1]—that it is easy to lose sight of the many other interesting tides through which Asian insurers are navigating. The product demands in Asia are ultra-localized yet rapidly evolving, as are the regulations and capital markets. Coupled with continued strong growth,[2] these demands may pose many pronounced business management challenges for life insurers that can no longer simply focus on growth.

With the exit of several multinational insurers such as AIG and ING from the region to shore up capital back home, local offices often are left without the support of sophisticated group actuarial, risk and investment functions. While this may have relieved local offices from foreign requirements that were at times burdensome and incompatible with the domestic market, relatively new capital management functions need to set up their own frameworks while keeping pace with the rapid business developments. This article aims to share some experiences in insurance investment management from the Far East.

REGIONAL ASSET ALLOCATIONS

FIGURE 1 summarizes the allocation of assets for major life insurers across key Asian markets. Although a majority of investments are in fixed income, local circumstances lead to varying allocations and riskier assets. We immediately see a wide variation in practices; for example, Japan, Thailand and South Korea stand out with significantly higher allocations to government bonds than other countries. We see that Taiwan and South Korea are weighted toward loans and alternatives in a search for yield, while insurers in China have kept large cash holdings due to the attractive rates and the lack of bond supply. Sales in Indonesia remain dominated by investment-linked products, hence the significant equity exposure.

CHALLENGES FOR THE INDUSTRY

Asia is a complex arena that challenges insurance companies at all stages of their Asset Liability Management (ALM) processes. This article illustrates some of the interesting stories faced by investment actuaries along every step of the path, starting with finding suitable asset classes in which to invest, to the competition in sourcing the assets, to managing conflicting views across risk and constantly changing regulatory frameworks at all stages of development—and balancing all of these demands with relatively young risk and capital functions.

Much like the rest of the world, the low interest rate environment continues to challenge Asian insurers. This is particularly acute in Taiwan, Japan and South Korea, where pricing competition led to guaranteed rates of 6 percent and higher in some legacy products. Insurers have had to invest in riskier assets, often going offshore, in their quest for longer duration and higher yields. South Korean insurers invest significantly in floating-rate loans (over 10 percent of invested assets[4]) to boost yields, but take on substantial interest rate risk to back fixed-rate liabilities. In Taiwan, the insurers have invested heavily offshore,[5] right up to the regulatory limit of 45 percent, at the expense of taking on foreign exchange rates risk and significant hedging costs. In contrast, China recently relaxed the controls around overseas investments to address the lack of investment channels available, but other regulations such as currency controls do not always move in lock-step, resulting in different "effective" limits. In-force management practices that have emerged in the United States over the past few years are still nascent in Asia, and there remain significant opportunities for actuaries to better participate in this area.

> "The Asia region will continue to see varying stages of insurance regulations suited to each country's development needs."

Smaller insurers face significant competition in sourcing assets. The local debt markets are often underdeveloped, lacking the depth (size and diversity among issuers) and liquidity (limited secondary markets) for insurers to effectively manage their interest rate risks. Consider China, for example. Direct life premiums in 2014 were USD $177 billion,[6] compared to about USD $5 billion in corporate bond issuance the same year.[7] In Taiwan, the entire government bond market is only about half the size of life insurance industry assets. This has led to situations in which some larger local insurers lobby companies to issue bonds and private loans—an avenue that's clearly not always available to smaller or less-connected foreign insurers.

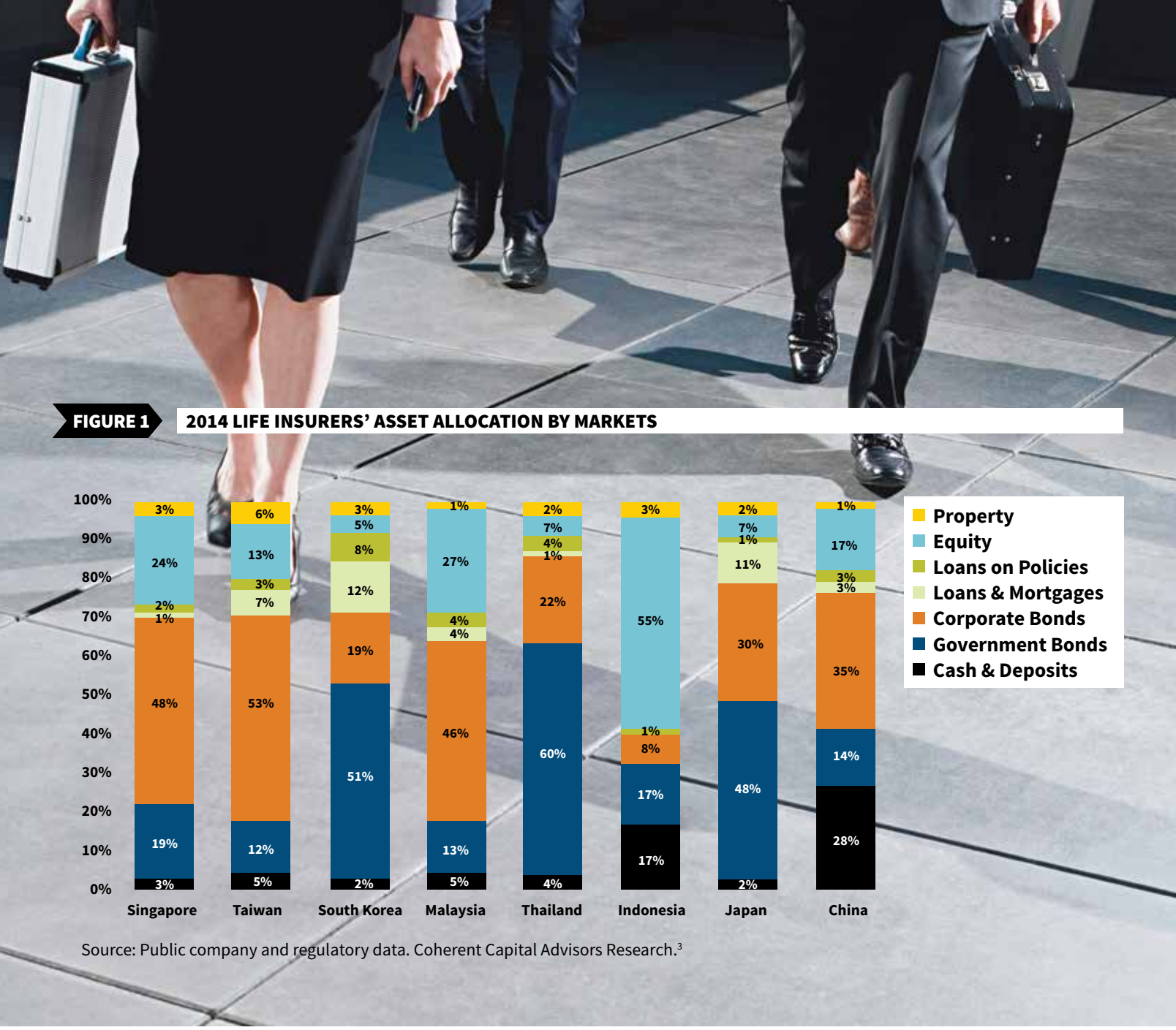

FIGURE 1 **2014 LIFE INSURERS' ASSET ALLOCATION BY MARKETS**

Source: Public company and regulatory data. Coherent Capital Advisors Research.[3]

Another dilemma is the basis for evaluating asset liability mismatches. With the rise of ALM capabilities, domestic insurers increasingly have been able to adopt market consistent frameworks, but this has led to conflicts with some of the more rules-based local statutory frameworks. For instance, under the Korea Risk-Based Capital (RBC) regime, risk charges are measured using a dollar duration gap with liability durations prescribed/capped for different products. For certain products, the economic duration can be much longer than the statutory duration, especially if internal models are used to value embedded options in the products, leading insurers to choose between "economic" and "regulatory" mismatches. Domestic insurers often find themselves optimizing on a set of metrics and constraints that are internally conflicting.

Coming to grips with these trade-offs is made more challenging when a country in the region is changing its solvency framework nearly every year. In more mature markets, there is an increased focus on prudent solvency regulations and more sophisticated frameworks, but for less developed markets, the regulators need to balance this against the need to encourage growth in the markets. Increasing insurance penetration requires insurers to finance their new business strain, which means the market needs to be able to offer attractive returns on capital.

SIMPLER PRODUCTS AND FEWER LEGACY SYSTEMS GIVE ASIAN INSURERS THE POTENTIAL TO LEAPFROG THEIR WESTERN COUNTERPARTS BY ADOPTING NEW TECHNOLOGY MUCH FASTER.

Ultimately, this means the Asia region will continue to see varying stages of insurance regulations suited to each country's development needs. In Singapore, a new "RBC2" framework is being developed, which should be conceptually similar to the Solvency II standard formula. Other Southeast Asian countries such as Thailand and Malaysia are watching the developments closely and could implement similar changes. Some of the proposed changes are likely to have fairly large effects on the asset allocation decisions. For example, the current consultation papers are proposing a 50 percent or higher increase in equity risk capital charges, and similar levels are seen for below-investment-grade assets.

In Hong Kong, although a regional hub for many life insurers, the regulator is still preparing to roll out its first RBC framework. The current solvency margin framework has no explicit capital charge for asset risks, although there are fairly complex rules around valuation interest rates and dynamic solvency testing. In China, a new solvency framework similar to Solvency II (China Risk Oriented Solvency System, or C-ROSS), will be effective in early 2016.

Keeping up with the regulatory changes is a challenge for the investment, risk and capital functions that have been busy keeping up with the business growth. In the past decade, the focus has been on building out the distribution channels, with ALM being a secondary concern as cash inflows significantly outpaced outflows and were growing every year. One consequence of this environment is that the tools and technology supporting a holistic view across the many different regions are often lacking, making it difficult to analyze company-level risk and capital positions.

EXPLORING OPPORTUNITIES IN ASIA

With the pace of business growth showing signs of slowing down in Asia and as more focus is paid to capital efficiency in the face of changing regulatory demands, insurers are

beginning to re-think their value proposition to shareholders. Capital-efficient investment strategies have gained popularity as the solvency margin is becoming better linked with "economic" views, and insurers expecting additional capital demands from the new regulations consummate with an increasingly mature market. This is also a unique opportunity to outperform the competition; i.e., differences in capital regulations across Asia present an opportunity for multinational insurers to optimize their product and capital positions. Examples include capital charges that can vary across countries and businesses, such as:

1. Is it more capital-efficient to buy risky assets in the Thailand portfolio or the Malaysia portfolio?
2. Should the portfolio be optimized at the stand-alone fund level or at the company level?
3. Can the regional office take advantage of diversification benefits across businesses?

We see plenty of opportunities for asset managers to present innovative, capital-friendly solutions that can provide attractive returns while improving an insurer's overall risk profile. Prerequisites include a deep understanding of how insurers make investment decisions and the trade-offs they face, plus the ability to effectively communicate the cost and benefits to the relevant ALM stakeholders. This is a challenge for traditional investment advisers who do not have deep insurance knowledge or the scale to support dedicated insurance specialists who understand the processes from the inside out.

Some of the more advanced insurers are beginning to adopt the concept of an efficient frontier in analyzing their Strategic Asset Allocation (SAA) decisions by customizing to embedded value, economic capital, solvency-at-risk and other insurer-specific metrics while incorporating constraints in the form of risk appetites/budgets. For instance, a company can scan through its asset universe to select an asset mix that provides the highest return at a given target level of capital. Another objective might be to minimize the interest rate risk charge by better aligning the assets and liabilities at different levels of aggregation across the company. Ultimately, insurers at different stages of development, with different business models operating in different markets and facing different regulations and investors, will need to develop investment strategies that best meet their own needs.

Rather than relying on the investment function alone, these SAA studies are increasingly undertaken jointly by actuarial, risk and investment functions, often in the form of ALM committees. Opportunities for improvements abound as local insurers may lack established governance and systems to industrialize the SAA analysis and further embed it into the decision-making process. Although this poses challenges, it also presents huge opportunities as the businesses are not yet encumbered by complex legacy systems or stifling processes, so they can embrace new technologies to leverage fast and flexible systems that capture the local characteristics in each country.

DIVERSIFYING INTO ALTERNATIVES

Historically, life insurers focused on conventional fixed-income assets, and occasionally ventured into domestic equities to back participating products. In response to low interest rates, well-capitalized insurers have shown greater appetites for nontraditional asset classes such as loans, offshore assets, real estate and other alternatives such as hedge funds, private equity funds and direct investments into infrastructure projects. Many regulators are loosening investment restrictions on alternatives and offshore assets in response to insurers' needs. In this section, we'll explore some examples of these trends.

Real Estate

Real estate is often the fourth-largest asset class for insurers.[8] South Korean and Chinese insurance and pension funds have directly invested in commercial real estate and sometimes reached for "trophy" investments by purchasing landmark properties such as the Waldorf Astoria in New York (2014) and the Lloyd's Building in London (2013). Under the current RBC framework, the treatment of property remains fairly attractive (6 percent for South Korea and 16 percent for Thailand) compared to equity and low-rating fixed income.

Furthermore, real estate provides a hedge to inflation and is assigned a low correlation with stocks and bonds, making it a popular addition to a multi-asset portfolio, particularly from the risk-adjusted perspective. With an average exposure of 2.7 percent,[9] and just 1 percent in China, the real estate exposure remains very low with a lot of room to grow compared to more developed markets, where the figure stands at nearly 7 percent in the United States and 5 percent in the United Kingdom.[10] As direct real estate investments tend to be quite large and "lumpy," a fairly large asset base is required to properly absorb the investment, and as Asian insurers grow in size, we expect this asset class to be increasingly attractive. The challenge, as is similar to Western markets, is the need to build up the internal infrastructure and personnel to support direct real estate

investments and management. Aside from the operational changes needed, the tax consequences (especially with foreign investments) will need to be properly evaluated.

Exchange Traded Funds (ETFs)

Exchange Traded Funds (ETFs) offer alternative strategies that open gateways to many new classes of assets around the globe. ETFs can provide operational efficiency for tactical allocations and portfolio rebalancing, as well as easier access to offshore assets. BlackRock reports that 74 percent of Asian firms will likely increase their use of ETFs over the next three years.[11] While most regulations permit the use of ETFs, the "look-through" treatment varies across the region. In South Korea, ETFs received a blanket treatment as equity and were subject to a higher capital charge of 12 percent even if the underlying assets were fixed income. The new regulations allow a look-through approach and open up another avenue for local insurers to manage their fixed-income exposures.

Infrastructure Investments

Other illiquid assets such as infrastructure investments have been well-received across Europe under Solvency II. Infrastructure assets offer reasonably predictable long-term cash flows that can be difficult to achieve through other asset classes. Domestic supply of such investment opportunities has been fairly limited in most markets, with the exception of China and India. To illustrate, Chinese insurance companies' investments into infrastructure projects rose 56.8 percent on a yearly basis to reach RMB 1.1 trillion in 2014,[12] and in June 2015 the government initiated an RMB 300 billion insurance investment fund to support infrastructure. For offshore investments, the pipeline for infrastructure projects stays strong across Europe, but the regulatory restrictions and associated foreign exchange risk inhibit Asian insurers from making significant investments.

Easing of regulatory restrictions on these asset classes is likely to continue in the face of growing appetite for diversification and better liability matching. Insurers are eager to see investment opportunities beyond the traditional assets, and their knowledge gap opens the door for asset management specialists to provide their services.

CONCLUSION

Insurers operating in Asia face a multitude of local ALM challenges that are distinct from those in the Western world, such as:

1. Operating under multiple regulatory regimes, all at various stages of maturity;
2. Investing in less-developed capital markets;
3. Making decisions without the support of fast and robust projection models; and
4. Working with young, multicultural teams that often communicate in different languages.

Asia has the appetite for more investment-savvy actuaries who not only have a solid technical foundation and a creative mindset, but also an unparalleled commitment to learning how to deal with business uncertainties in Asia. Rather than importing experts from the West, domestic firms are looking for local asset managers, consulting firms and software vendors to demonstrate local insights and develop solutions that meet their specific needs.

Asia is ripe with opportunities that reward those with creative solutions in these developing markets. Simpler products and fewer legacy systems give Asian insurers the potential to leapfrog their Western counterparts by adopting new technology much faster. A great example of this is China's digital insurance revolution that capitalized on its gigantic e-commerce industry. ALM practices may seem behind those of their Western counterparts for the moment, but with the exponential growth of insurance business and an ever-growing SOA membership base, combined with the rate of regulation and infrastructure transformation, Asia's life insurance market may come out ahead of the game in the not-so-distant future. ■

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[5] Source: Taiwan Insurance Institute—Foreign investments relative to total asset up to 44.4 percent in 2014 (from 26.4 percent in 2008) of the total asset, which is slightly below the current regulatory cap of 45 percent. Some firms are allowed to invest over half of their assets overseas under new rules passed in May 2014.
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Life insurance liabilities can be characterized by three main features: long-term duration, large volumes and significant market risk exposure. Specifically, guaranteed minimum income and withdrawal benefits greatly increase insurers' risk exposure to market volatility, while pension and other post-retirement benefits could be hurt if equity returns fall short of expected long-term rate-of-return assumptions.

Given the persistent low interest rate environment across the curve since the 2008 financial crisis, insurance companies need hedge assets, as illustrated by the significant recent increase from $786 billion as of fiscal year 2010 to $1,885 billion as of FY 2014. In that respect, the use of downside protection options is appropriate. However, buying large hedge portfolios requires taking into account transaction size explicitly, including market impact, because equity derivatives are highly sensitive to supply/demand balance. The primary tools used by insurers in 2014 were put options (44 percent, versus 24 percent for calls). Ninety percent of these put options were purchased, implying the growing cost of hedging.

USING DERIVATIVES TO HEDGE FINANCIAL RISKS EMBEDDED WITHIN INSURANCE LIABILITY GUARANTEES

Life insurers write long-dated guaranteed policies and attempt to hedge these guarantees using hedge assets (e.g., futures, options). As the guarantees embedded within the insurance liability hold a convex risk profile with respect to the underlying stock, insurance companies need to buy some convex equity hedge assets such as options (in contrast to linear instruments like futures) in order to match the liability risk profile to improve hedge effectiveness.

SOLVENCY II IS EXPECTED TO STRENGTHEN THE ISSUE OF HEDGE DERIVATIVES LIQUIDITY

There already has been significant evidence of illiquidity cost stemming from supply-and-demand imbalance for options, which Solvency II is expected to further strengthen as insurers will be forced to hold sufficient capital to remain solvent during periods of market stress. Solvency II aims to match insurance capital requirements with the economic risks embedded within the long-dated liability guarantees, which insurers used to hedge through, rebalancing cheap equity futures dynamically in contrast to costly static options.

However, futures are not given full credit under Solvency II (as stress is applied instantaneously rather than over a period of time), thus putting pressure on insurance companies to buy large quantities of options where prices will increase as a result of supply-and-demand imbalance.

A EUROPEAN RISK APPETITE PERSPECTIVE: OPTIMAL HEDGING TRANSACTIONS FOR LARGE LIFE INSURANCE LIABILITIES

BY AYMERIC KALIFE AND SAAD MOUTI

INTEGRATING MARKET IMPACT INTO LARGE HEDGING TRANSACTIONS

As a result, an explicit modeling of such increasing cost of options is made through a market impact function, the influence of which the insurance company will try to minimize. In this context, best execution cannot be defined as a single number within a single trade. Rather, the market impact on the option price depends on "temporary impact strength" that is proportional to the main empirically observed drivers: the speed of option trading (i.e., number of options per unit of time), the equity stock level and the option sensitivity to the equity stock.

OPTIMAL HEDGING TRANSACTIONS SIGNIFICANTLY DEPEND ON THE RISK APPETITE

Consider a life insurance company aiming to minimize the cost of buying a large quantity of put options to hedge liabilities. Such a strategy will depend on specific risk appetite, such as a maximization of the mean profit/loss objective (or minimization of the mean cost of buying options), or a risk-reward objective including the minimization of the dispersion of the profit and loss. The standard procedure of the Hamilton-Jacobi-Bellman (HJB) framework in stochastic control problems is applied, coupled with numerical schemes.

To maximize mean profit/loss, the optimal execution strategy provides a rather stable pace of trading as illustrated in **FIGURE 1**, depending only mildly on the stock price path. The pace is rather constant at the beginning and then gradually increases as it gets close to maturity, which is intuitive given the fixed quantity to buy within a fixed time period, implying the insurer must acquire at a faster rate as time passes.

In contrast, if the dispersion of the profit/loss becomes an additional driver of the risk appetite, then the optimal execution strategy significantly depends on the stock path, with a faster pace when the stock level is low compared to when the stock level is high (as illustrated in **FIGURE 2**). Indeed, as the stock decreases, the cost of the put option increases. The optimal execution strategy also depends on the impact of the option volume trade on the option cost. One needs to trade as soon as possible in order to minimize the hedge transaction cost. The opposite is true if the stock market rises. The mean-variance profit/loss framework prevents the insurance company from waiting until maturity to trade a large quantity and instead favors a decreasing trading pace as time passes.

CONCLUSION

Within the mark-to-market valuation framework under Solvency II, the size of hedging transactions may put significant constraints on an insurance company because of the higher cost of hedging liabilities that stem from their market impact. In that respect, the risk appetite has significant influence on the optimal transaction execution path. ■

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FIGURE 1 **TRADING PACE AS A FUNCTION OF THE STOCK LEVEL AND TIME PASSING UNDER MAXIMIZING MEAN PROFIT AND LOSS**

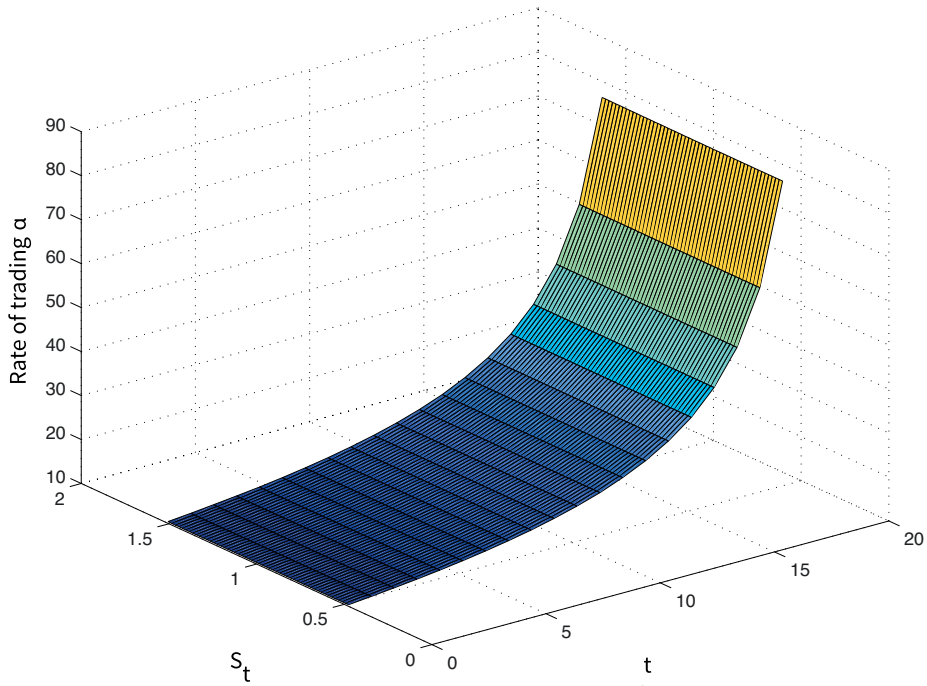
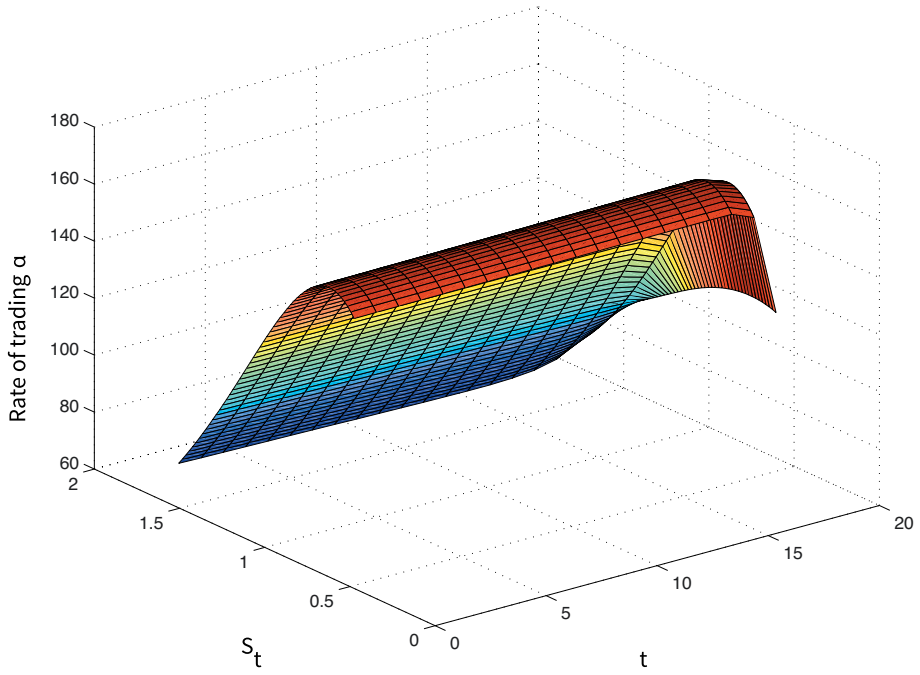


FIGURE 2 **TRADING PACE AS A FUNCTION OF THE STOCK LEVEL AND TIME PASSING UNDER MAXIMIZING MEAN–VARIANCE PROFIT AND LOSS**



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Bull Market Graph
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THE VOLATIL

WHY MANAGED VOLATILITY FUNDS EXACERBATE EQUITY MARKETS CORRECTION

ITY

REGIME

BY MARIE-LAURE CHANDUMONT

Back in August 2015, Standard & Poor's 500 index lost 11.2 percent in less than 10 days.[1] The devaluation of the yuan by the Chinese authorities was surely a catalyst, but technical factors exacerbated the move, including the trading activity of managed volatility funds.

In 2006, Prudential launched the Highest Daily Guaranteed Life Withdrawal Benefit (GLWB). The underlying algorithm used an asset transfer technique, which rebalanced between risky assets (separate accounts—usually actively managed equities funds) and risk-free assets (the fixed-rate account) based on a formula. The formula calculates the distance between the Net Asset Value (NAV) of the funds and the guaranteed curve on a daily basis, taking into account the potential "gap" risk associated with the funds, based on a measure of worst drawdown. Back then, many of Prudential's competitors mocked the technology and highlighted the risk associated

with the asset transfer, namely that of being close to fully delevered from risky assets and locked into the fixed-rate account.

Fast-forward to 2008, when any policyholder would gladly have been repositioned in cash instead of suffering 37 percent losses, which ended up being the performance for the S&P Total Return index that year.[2] Thus, Prudential definitely deserved credit for its product design, which protected its policyholders as well as itself. After the crisis, Prudential modified its algorithm by:

1. **ALLOWING** for a three-day rebalance of the portfolio,
2. **INTRODUCING** a 20 percent floor for equities (an increase from 10 percent previously) and
3. **MOVING** into investment-grade bonds as the safe asset versus rebalancing into the fixed-rate account.

The second innovator was arguably AXA, the first firm to introduce volatility target indices, thereby reducing the guarantee-rider cost and the basis risk simultaneously. Volatility targeting at the fund level is a way to control the volatility of the fund, although there will be instances when the rebalancing cannot keep up with corrections in equity markets. Still, the risk management technique mitigated against the whipsaws, i.e., sharp oscillations in the price trajectory of a security, which can be experienced in both short-dated as well as long-dated volatility. Launching volatility-control indices also enabled AXA to reduce the basis risk associated with hedging actively managed funds (traditionally regressed with proxy baskets) with mainstream indices.

However, in my opinion, it was MetLife that revolutionized the industry. While AXA had already used it, MetLife's Guaranteed Minimum Income Benefit (GMIB) Max—which came out in April 2011 with mandatory election of managed volatility funds—ended up flooding the industry, with 2011 sales totaling $28 billion[3] (not all in GMIB Max). The success was so great (and probably unforeseen) that MetLife terminated its other contract, the GMIB Open (that offered open architecture), and reduced the roll-up rate four consecutive times.

This marked the end of the volatility-target experiment and imposed the volatility-target concept as the new benchmark in variable-annuity (VA) guarantees. Transamerica, Lincoln, AIG, Ameriprise, Nationwide—in fact, all carriers except Jackson National, Pacific Life and Principal Life—have since launched versions of managed volatility funds.

AN INSIDE LOOK AT THE FUNDS

Volatility target funds make tremendous sense. Instead of selling long-dated puts on equity-like actively managed funds, the implied volatility of which can fluctuate widely, VA issuers are locking in their cost of goods sold by virtue of the contract design. Nevertheless, as everyone was proudly announcing their success in transitioning policyholders from open architecture to managed volatility funds on their earnings calls, I started adding up the assets under management (AuM) and thinking:

- If everybody uses the same risk management technique, does that not become counterproductive?
- Specifically, if VA annual sales continued in the $150 billion range, how many years would it take for aggregate AuM to create rebalancing needs that the equity markets simply cannot sustain?
- Did my finance professor not tell us about a 1987 constant proportion portfolio insurance (CPPI) liquidity squeeze?

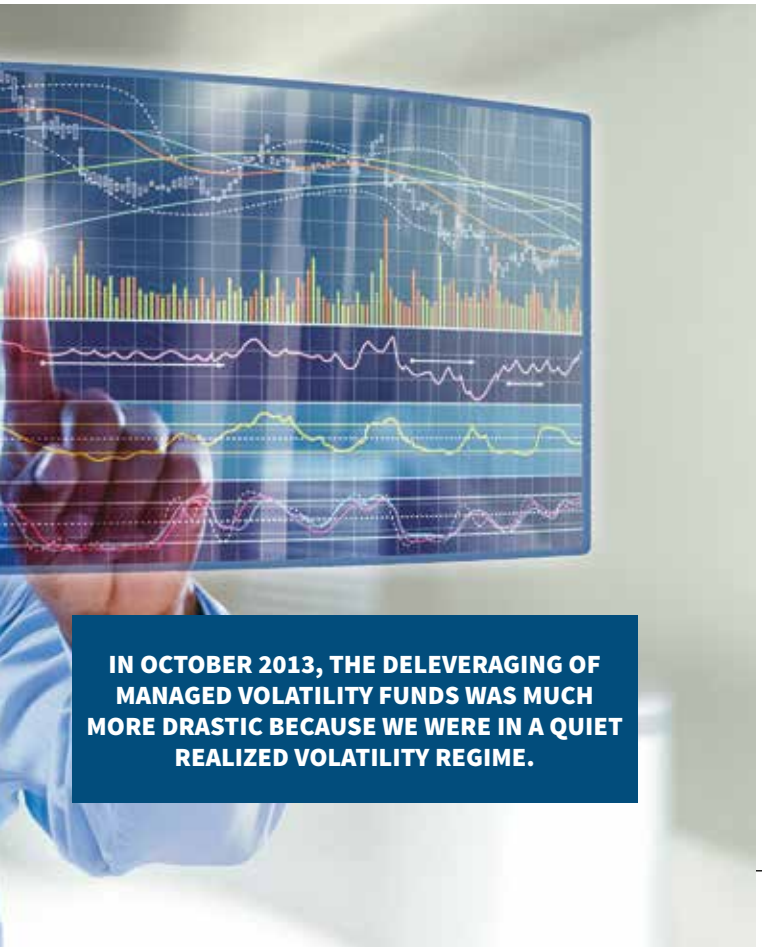
In listening to more earnings calls and making some election-rate assumptions, I came to $400 billion as of June 30, 2015. My inputs included public earnings calls, as well as estimates and assumptions as to when the managed volatility funds were introduced, the election rate and

overall sales of carriers. Annuity Insights[4] also produced its own estimates, although its study focused on managed volatility funds and did not include CPPI. Now, I recognize that managed volatility funds come in many flavors. Some fund managers have discretion pertaining to the rebalancing, i.e., they can rebalance intra-day or over several days. Some funds actually own optionality (and underperformed accordingly in 2013–2014 rallying markets); others have caps and floors inside the funds (which actually reintroduce Vega at these points); and a few rebalance intra-day based on implied versus realized volatility. CPPI also differs from this approach, as managed volatility funds could also delever in up markets, which is not the case with CPPI. Ultimately, though, these funds will, in the aggregate, act similarly.

THE SPXT10UT INDEX

So back to August 2015: Equity markets are shaken by concerns around China's growth. VIX spikes from 13 on Aug. 17, to 40 the following week.[5] Managed volatility funds' algorithms trigger the rebalancing. Barclays Research[6] calculated that, assuming two-thirds of the $400 billion tracks Standard & Poor's 10 Percent Volatility Target Total Return Index capped at 100 percent (SPXT10UT Index),[7] managed volatility funds would have sold $45 billion on Aug. 24, 2015, $57 billion on Aug. 25, 2015, and $37 billion on Aug. 26, 2015. That would equate to 9 percent, 16 percent and 11 percent, respectively, of the daily traded volumes for these three days,[8] as illustrated in **FIGURE 1**.

Please recall that the S&P 10 Percent Volatility Control Total Return Index uses the maximum of a short-term and a long-term realized volatility measure for the denominator, and rebalances on the second business day after the rebalancing is triggered. However, I am modifying the S&P 10 Percent Volatility Target Total Return Index algorithm to cap the equity exposure at 100 percent. Indeed, SPXT10UT allows for 150 percent leverage, but most volatility-managed funds do not, hence the modification.



IN OCTOBER 2013, THE DELEVERAGING OF MANAGED VOLATILITY FUNDS WAS MUCH MORE DRASTIC BECAUSE WE WERE IN A QUIET REALIZED VOLATILITY REGIME.

FIGURE 1 PERCENTAGE OF SPX FUTURES IN TARGET VOLATILITY FUNDS (AUGUST 2015)

Date	Target Volatility Fund Flow (in billions)	SPX Futures (in billions)	%
Aug. 24, 2015	–$44.87	$502.62	–9%
Aug. 25, 2015	–$56.71	$344.30	–16%
Aug. 26, 2015	–$36.51	$345.55	–11%

Source: Bloomberg, Barclays Research, Sept. 1, 2015

There are other periods of time when the volatility target flows represented an even greater fraction of SPX futures, as shown in **FIGURE 2**.

FIGURE 2 PERCENTAGE OF SPX FUTURES IN TARGET VOLATILITY FUNDS (2013–2015)

Date	Target Volatility Fund Flow (in billions)	SPX Futures (in billions)	%
July 1, 2015	–$47	$155	30%
Dec. 22, 2014	–$29	$88	33%
Jan. 28, 2014	–$61	$155	32%
Oct. 14, 2013	–$53	$129	41%

Source: Bloomberg, Barclays Research, Sept. 1, 2015

On Oct. 14, 2013, for example, the S&P index rallied 2.2 percent on the expectation that lawmakers would reach an agreement to increase the U.S. debt limit until Nov. 22, 2013, and thereby avoid a U.S. default (Oct. 10, 2013). Large outflow from volatility-managed funds was due to an increase in realized volatility from low levels (below 9 percent). Because we were in a relatively low realized volatility regime, our modified S&P 10 Percent Volatility Control Index had to delever. This illustrates how volatility-managed funds may delever from equities in both sell-offs as well as rallies.

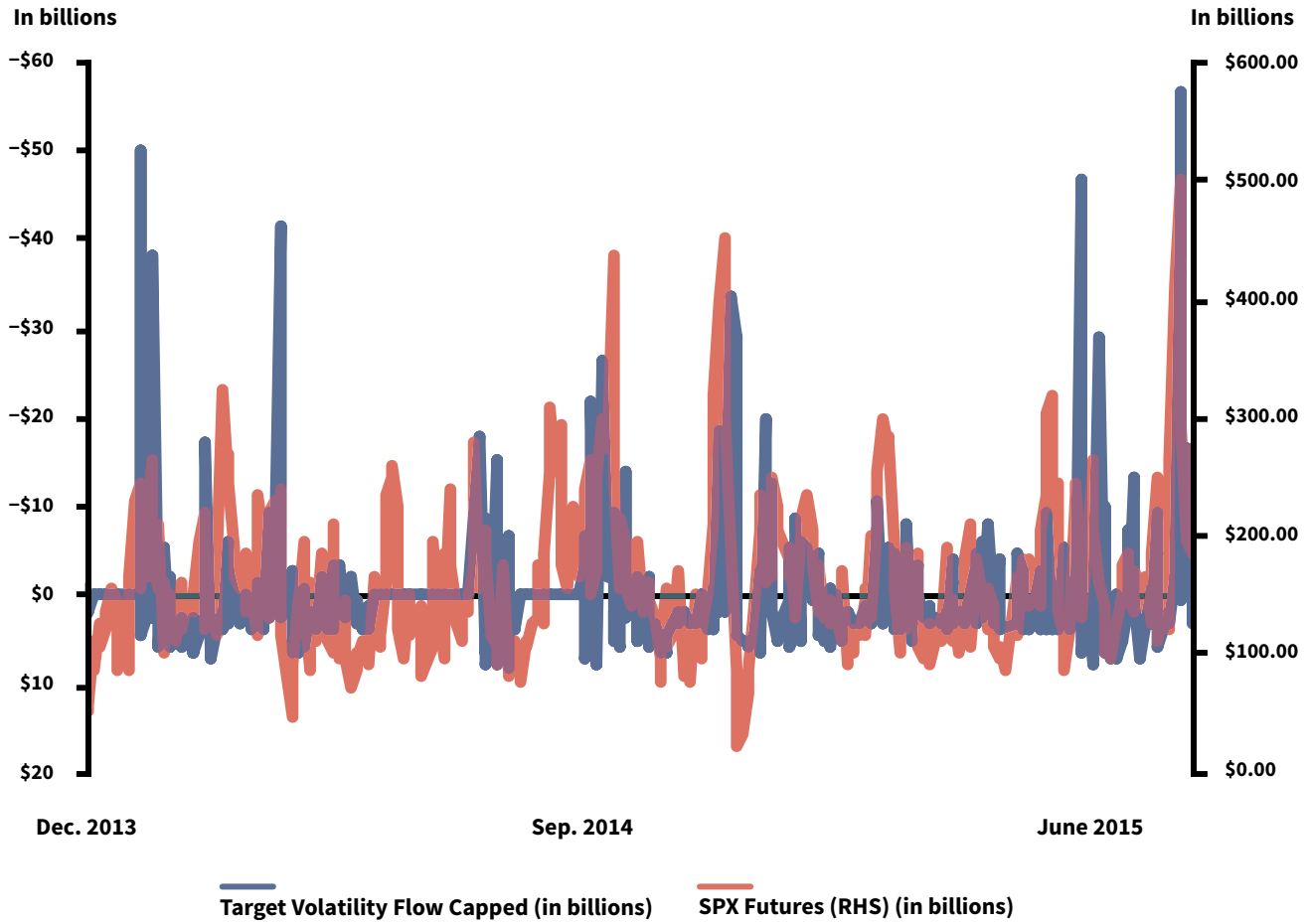
FIGURE 3 shows the dollar amount of rebalancing flows along with S&P 500 E-mini futures volume over the last year that would have been generated if we assume $275 billion benchmarked to SPXT10UT, capped at 100 percent.

OTHER TYPES OF FUNDS

Let's not forget, however, that there are managed volatility funds outside of VAs. In fact, Annuity Insights estimates $100 billion AuM.[9] And recall that Barclays Research used two-thirds of $400 billion as an estimate for its calculation.

What about the risk-free asset class? Most funds rebalance into cash, but for those that rebalance into bonds—even with several rebalance days—we know liquidity has decreased considerably. Now, as you know, bond trading is done over the counter (OTC), which makes it impossible to easily measure the liquidity of these markets. One would need to look at corporate bonds on a single-name basis, the number of daily trades, as well as the average size of these trades, which get reported to Trade Reporting and Compliance Engine (TRACE); however,

FIGURE 3 REBALANCING TARGET VOLATILITY FUND AND SPX FUTURES FLOWS



Source: Barclays Research, Sept. 1, 2015

IF VA ANNUAL SALES CONTINUED IN THE $150 BILLION RANGE, HOW MANY YEARS WOULD IT TAKE FOR AGGREGATE AuM TO CREATE REBALANCING NEEDS THAT THE EQUITY MARKETS SIMPLY CANNOT SUSTAIN?

above certain thresholds ($5 million for investment-grade bonds and $1 million for high-yield bonds), the exact sizes of the trades only get displayed by Financial Industry Regulatory Authority (FINRA) with an 18-month delay. Dealers have been under increased pressure to reduce their leverage ratios and the overall size of their balance sheets. Consequently, they have been reluctant to hold inventory. As such, buying/selling corporate bonds—on an unmatched basis—has become difficult, especially for larger positions.

LOOKING TO THE FUTURE

When the Federal Reserve starts normalizing interest rates, volatility in both equities and bonds markets will be affected, triggering rebalancing under the algorithms. We will need to be very aware of the selling pressure to which the managed volatility funds will subject equity markets. Gamma-hedging programs will become crucial in the form of variance swaps and short-dated puts.

Now, what was happening before the advent of volatility target funds? What was different when VA writers were hedging traditional funds with puts? Were the dealers not effectively creating the same selling pressure? VA writers were already rebalancing their deltas during market sell-offs, but the managed volatility funds introduce a compounding effect in the sense that they de-risk when a correction happens, in addition to the insurance carriers re-adjusting their deltas. The de-risking at the fund level tends to be more pronounced, especially when equity's volatility is realizing low, and the funds tend to be highly invested and potentially levered.

What about the impact on long-dated volatility? Well, volatility-managed funds have definitely dampened demand for volatility past the two-year point. In fact, when looking at Schedule DB's filings of insurance companies, it appears that 81 percent of Vega traded from June 2014 to June 2015 has a less than two-year tenor, versus 62 percent two years ago[10] when many VA writers were still purchasing long-dated puts from dealers. Also, much of the long-dated supply was sourced from institutional investors who were bullish on U.S. equity markets, meaning they were just holding the risk on their books and not actively rebalancing.

Let me also comment on fixed-indexed annuities (FIAs), the sales of which reached $48 billion in 2014.[11] I estimate that $10 billion of the $48 billion was invested in FIA crediting strategies tied to volatility-control indices. However, unlike in VAs, where separate accounts are actually invested, FIA policyholders access equity performance through a call option. In turn, only the delta equivalent of the option is effectively invested. Assuming a 50 percent delta for an at-the-money call option, that would be $10 billion times 50 percent, equaling $5 billion.

Finally, many of the recently introduced smart beta indices are already allocated to corporate bonds or treasuries. Thus, the equity exposure will even be less than $5 billion. For example, the Barclays U.S. Dynamic Balance II Index, which has been a crediting strategy alternative for products marketed by Allianz, is exposed to an index replicating the iShares Core U.S. Aggregate Bond Index, in addition to the S&P 500. In light of the foregoing, I do not see these smart beta indices creating technical pressure for now.

CONCLUSION

The VA industry needs to continue tracking the growth in volatility-managed funds. The emphasis on investment-only VAs will be essential to decelerate notionals.

Risk managers need to complement their volatility-managed funds with a solid gamma-hedging program, or even better hedging of the gap risk. Hedging a gap event is neither easy nor cheap.

However, some banks, including Barclays, are well-positioned to sell gap risk. Dealers who trade books of autocallable notes, which pay a high coupon but put the end-investors at risk of partial loss of principal, allow banks to recycle the gap risk.

How about going one step beyond volatility control and embedding the gap protection inside the annuity? That would still not change my recommendation to continue tracking AuM in managed volatility funds and assessing just how many of them the equity markets can sustain.

Embedding gap protection inside the contract would require further product development and a third VA generation. In light of all the innovation produced by the insurance industry—from VIX-linked fees and Treasury-linked roll-up rates—I believe distributors are ready to embrace new designs. Especially if these risk management features ultimately benefit policyholders by ensuring that creditworthy carriers are able to honor the lifetime-income feature. ■

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action

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[1] Bloomberg Aug. 17, 2015–Aug. 25, 2015.
[2] Bloomberg.
[3] LIMRA.
[4] Annuity Insights Oct. 3, 2014.
[5] Bloomberg.
[6] Barclays U.S. Equity Derivatives Strategy—Why are VIX Futures Grinding up? Sept. 1, 2015.
[7] Full Index methodology is available on http://us.spindices.com/indices/strategy/sp-500-daily-risk-control-10-usd-total-return-index.
[8] Barclays, Bloomberg.
[9] Annuity Insights Oct. 3, 2014.
[10] Schedule DB, Barclays.
[11] LIMRA.

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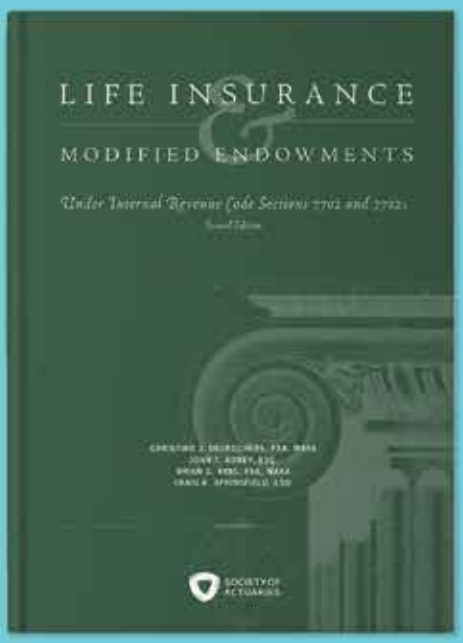

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FACTOR

WHY GLOBAL DEMOGRAPHICS MATTER FOR MACRO-FINANCE

BY AMLAN ROY

This article highlights unprecedented demographic changes affecting the world of macro-finance and investments in terms of both risks and returns. It is written in the spirit of sharing research at the interface of demographics, behavioral finance, financial economics and macro-economics used in discussions with policymakers, academics and investors in more than 50 countries globally. We normatively highlight that demographics do not only have effects on the liability side but also on the asset side by affecting gross domestic product (GDP) per capita, disposable income, savings, capital flows and asset returns.

THAT BACKGROUND?

We point to links between macro policy and macro fundamentals that affect asset pricing and returns, suggesting macro policy and investments are connected endogenously. We argue that the perspective of demographics relating to age alone or large numbers of young people is a narrow one, stressing instead that demographics are about "people characteristics." From an economic viewpoint, the important characteristics of people are that they are consumers (from birth to death) and workers for a significant part of their lives. There are approximately 7.35 billion consumers and 3.45 billion workers in the world today whose demographics affect global macro-finance.

FIGURE 1 POPULATION MEDIAN AGE (IN YEARS)

	1970	2015
Germany	34.1	46.2
Japan	28.9	46.5
United States	28.3	38.0

Source: UN, Credit Suisse Demographics Research

MISCHARACTERIZATIONS OF DEMOGRAPHICS

There are a few mischaracterizations relating to demographics. The first is that demographics is only about age. How people consume and how they work are not merely functions of their age, but also of other characteristics that matter such as gender, education, parental background, migrant status, where they grow up, their wealth, etc.

A second is the association of positive future demographic prospects with "large numbers of young people" in emerging countries. Many young people with poor health, poor education, poor skills and poor access to technology do not automatically make for great future demographic prospects.

Another mischaracterization has to do with believing that "demographics is predictable." While the age aspect of demographics is predictable, how people change as consumers and workers is not predictable as the workplace and consumer markets are evolving, too. Advances in behavioral finance and experimental economics research have shown risk behavior, investment behavior, etc., to be related to psychological and behavioral characteristics of individuals that have not yet been fully incorporated in actuarial and financial models.

The above-mentioned common misconceptions have led to us collectively paying less attention to historically unprecedented demographic changes. These changes are not homogenous, simple or occurring at a predictable pace due to the interplay of worker behavior with changes in the workplace and consumer psychology with increased product availability.

One example of an overlooked change is the fact that the median age changes have been large and very diverse across countries by historical standards (changes over the last 45 years used to take 200–300 years). **FIGURE 1** shows that the changes in median ages across the United States, Japan and Germany over the course of 1970–2015 are not uniform, and neither are the levels. The latest 2015 median age in the United States is 38 years; in Europe it's 41.7 years; and Japan and Germany have median ages of 46.5 years and 46.2 years, respectively. The overall global impact of these changes has been underestimated collectively by policymakers, financial services, insurance and pensions, contributing to worsening fiscal positions on account of growing public debt.

Another important example relates to the fact that the retiree population is not all homogenous. The 80+ age group was the fastest growing age group in the world from 1970–2015, growing at nearly four times the rate of the total population. In advanced countries, a person older than 80 years costs significantly more in terms of health care and long-term care than a 65-year-old individual. We need to pay greater attention to the heterogeneity across the very old age groups, as they are responsible for creating a fiscal and social burden unlike any that we have seen before.

FIGURE 2 illustrates the growth of the 80+ age group relative to the 60+ age group and the total population over 1970–2015. The growth rates of the 80+ age group are multiples of growth rates of the 60+ age group and of the total population. This is a challenge to conditional life expectancy models that have also fallen short of modeling these changes accurately and should combine different approaches.[1]

DEMOGRAPHIC LINKAGES TO GDP AND GDP PER CAPITA GROWTH

It is important from an investment perspective to understand GDP growth (China, United States or global) as it affects financial development, investments and trade. As per a standard macroeconomic framework,[2] GDP growth can be decomposed into three demographic components:

1. Working age population growth—people aged 15 to 64
2. Labor productivity growth—amount of GDP produced by an hour of labor
3. Labor utilization growth—number of hours worked

These factors are not constant for a country over time and vary across countries. As **FIGURE 3** shows, the GDP growth decomposition across the United States, Germany and Japan over the last 20 years is very different. The GDP growth number is displayed above the bar and the component contributions are shaded within the bars. While growth rates have declined, the factors have contributed differently to lower growth patterns.

While GDP growth is important to follow, we should note that GDP per capita growth is also very important. GDP per capita is a measure of living standards within

a country. A country may have high real GDP growth but low GDP per capita growth, or vice versa. **FIGURE 4** on page 48 makes this point.

GDP per capita growth and its accumulation over time lead to increased living standards for a country's citizens. Higher incomes then allow the citizens to allocate the income across savings and consumption. Savings from income gets invested and contributes to financing through banks and other financial intermediaries. Savings less investments at an aggregate macro level affect current account and capital flows, as well as equity premia, equity returns and bond returns. Through effects on income, savings, capital flows, current account and debt levels, demographics plays a role on the asset side of insurance and pensions in an application life cycle management (ALM) sense.

GENDER INEQUALITY, YOUTH PARTICIPATION AND GDP GROWTH

Although increasingly more women participate in the labor market, the labor force participation rate gap between men and women remains high.[3] In 2014, Japan had the highest gender gap of the G6 countries at 21 percent; Germany, the United States and the United Kingdom had gaps of 12 percent; France had a 9 percent gender gap; and the gap in Nordic countries was close to 5 percent. If this gap was close to zero, the GDP growth would be a lot higher compared to what it is today. Gender income differences (males versus females) also remain high, with Japan having the biggest wage difference by a factor of 2.32 times.

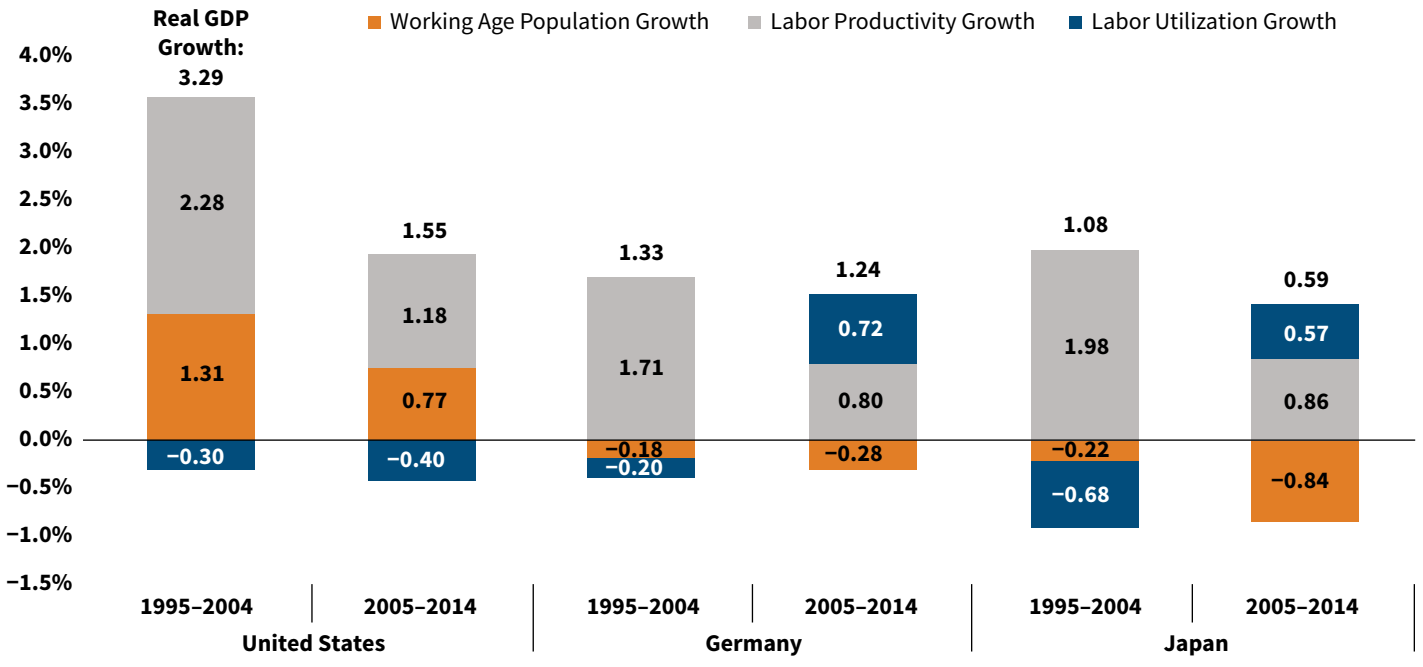
Women are increasingly becoming better educated and wealthier, making them attractive as potential decision-making customers. As they live longer than men, too, and are nearly half the total population, they should equitably be

FIGURE 2 POPULATION GROWTH OF DIFFERENT AGE GROUPS: 1970–2015

	World	Germany	Japan	United States
Total population	100%	3%	22%	54%
60+ years	199%	43%	281%	126%
80+ years	394%	201%	945%	217%

Source: UN, Credit Suisse Demographics Research

FIGURE 3 REAL GDP GROWTH DECOMPOSITION



Source: UN, GGDC, Credit Suisse Demographics Research

allowed the same access to the labor market and the same wages as men. This will in turn boost the aggregate expenditures leading to higher GDP levels and higher growth. A similar argument is made for increased youth labor force participation leading to higher labor productivity growth.

IMMIGRATION AND LABOR GROWTH

As populations age and decrease (e.g., Germany and Japan), immigration becomes a factor that can mitigate aging and labor force pressures. Today, the highest life expectancy country, Hong Kong, has a lower fiscal burden than the second-highest life expectancy country, Japan, as more than half of its population change is due to younger immigrants. We contrast Germany and the United States (**FIGURE 5**) to show that negative natural population change is offset by net migration in Germany but is complemented and added to by net migration in the United States.

FISCAL UNSUSTAINABILITY OF PENSIONS, HEALTH CARE AND LONG-TERM PROMISES

Higher old-age dependency ratios across aging countries lead to increasing age-related expenditures. Age-related expenditures (health, pensions and long-term care) represent more than 20 percent of GDP in both Japan and Germany, and in the EU 78 percent of total benefits get spent on them. No country can afford these long-term promises based on current growth and revenue collections. It is vital that people be made aware of these unsustainable promises, especially in a lower growth and lower interest rate environment. Citizens need to increase their savings as governments have made unsustainable promises that they will not be able to deliver.[4]

FIGURE 4 GDP, GDP PER CAPITA, POPULATION GROWTH

		GDP Growth	Population Growth	GDP per Capita Growth
Germany	1980–1985	1.19%	−0.18%	1.4%
	2010–2015	1.96%	−0.03%	2.0%
Japan	1980–1985	4.28%	0.68%	3.6%
	2010–2015	1.35%	−0.17%	1.5%
United States	1980–1985	3.36%	0.92%	2.4%
	2010–2015	2.14%	0.70%	1.4%

Source: UN, Credit Suisse Demographics Research

FIGURE 5 POPULATION CHANGES: NATURAL (BIRTHS LESS DEATHS) AND NET MIGRATION (IN THOUSANDS)

	Germany			United States		
	Population Change Components					
	Natural Population	Net Migration	Population	Natural Population	Net Migration	Population
1990–1995	–578	3,233	2,655	8,859	4,569	13,428
2010–2015	–997	1,250	253	6,890	5,008	11,897

Source: UN, Credit Suisse Demographics Research

More holistic and robust approaches to modeling longevity are needed, as highlighted by Haberman & Renshaw (2011) and Booth and Tickle (2008), and these should extend beyond Carter-Lee variants of modeling longevity. Also, governments and societies must address existing longevity challenges. This will require: flexible e-enabled retirement with no mandatory retirement age, increased female labor force participation with technology, selective (skilled and unskilled) migration, and outsourcing.[5] As argued to global governments and financial investors in "Why Increasing Longevity Affects Us All" (2012), this will require promotion of new financial services—especially pensions and insurance products—for not just the old but also the young in keeping with changes in life cycle, longevity, growth, interest rates, inflation, asset returns and regulation.

OLDER CONSUMERS AND WORKERS—WHY WE GOT THEM WRONG

I present something that collectively has been missed by academics, investors and researchers as we were guided by past data to make decisions. The 65–74 age group now is one of the richest age groups, in contrast to the 1970s when they were the poorest. (See **FIGURES 6** and **7**.) Ignoring this age group as consumers, savers and investors based on past trends is a common error that we need to reverse. Fortunately, the largest consumer companies, investors, insurance companies and central banks in Japan and Germany have recently started adapting to this.

Not only are the older age groups richer than they have ever been, they consume very differently than when they were young and than the young age groups today, as shown

FIGURE 6 MEDIAN INCOME BY AGE GROUP, CONSTANT 2014 USD

Age Group	1990	2014	% Change
15–24	$9,780	$10,420	7%
25–34	$30,033	$31,219	4%
35–44	$37,511	$38,680	3%
45–54	$37,759	$40,000	6%
55–64	$27,629	$34,498	25%
65+	$17,880	$22,248	24%
65–74	$19,733	$25,143	27%
75+	$16,035	$19,209	20%

Source: U.S. Census Bureau, BLS, Credit Suisse Demographics Research

FIGURE 7 MEDIAN HOUSEHOLD NET WORTH BY AGE GROUP, CONSTANT 2011 USD

Age Group	2000	2011
Younger than 35	$9,765	$6,676
35–44	$59,689	$35,000
45–54	$111,867	$84,542
55–64	$150,866	$143,964
65+	$146,205	$170,516
65–69	$154,226	$194,226
70–74	$161,027	$181,078
75+	$134,535	$155,714

Source: U.S. Census Bureau, BLS, Credit Suisse Demographics Research

in **FIGURES 8** and **9**. Our research shows that the young today are also very different than the older age groups when they were young, demonstrating differences in behavior between the millennial generation and the baby boomers. Consumer changes by way of age structure, GDP per capita and household structure affect aggregate consumer expenditures, savings, capital flows and inflation as shown in published macroeconomic and financial research. The financial services industry needs to pay greater attention to this just like the pharmaceutical and consumer industries have.

FIGURE 8 U.S. HOUSEHOLD COMPOSITION NUMBERS BY HOUSEHOLD SIZE (IN THOUSANDS)

Household Size	1990	2015
1	22,925.9	34,650.0
2	29,901.8	40,470.9
3	16,213.0	19,313.7
4	14,070.7	15,852.7
5+	10,235.7	13,272.9

Source: Euromonitor, Consumer Expenditure Survey BLS, Credit Suisse Demographics Research

FIGURE 9 HOUSEHOLD CONSUMPTION BREAKDOWN, BY AGE GROUP AND MAIN CATEGORIES, 2014

Share (%)	25–34 Years	65+ Years	75+ Years
Food	13.4	12.5	11.9
Housing	35.1	33.9	36.5
Transportation	18.0	15.9	13.9
Health care	5.4	13.4	15.6
Personal insurance	11.0	5.2	2.8

Source: Euromonitor, Consumer Expenditure Survey BLS, Credit Suisse Demographics Research

CONCLUSION

Demographics is not all about age or counting the number of people. It is about consumers and workers of all ages, who affect macro fundamentals—debt, growth, consumption, savings, investments, capital flows and asset prices. A holistic understanding of demographic influence on macro variables is essential for the actuarial profession, which plays a key and relevant role in managing risk associated with both assets and liabilities. These developments affect both the asset and liability sides, necessitating newer approaches to product development, risk management and asset allocation. ■

References

[1] See "Uncertain Approaches to Longevity: Towers Watson Public Lecture on Longevity" (2005); R. Fogel (2005), "Changes in Physiology of Ageing in the Twentieth Century," NBER; H. Booth and L. Tickle (2008), "Mortality Modeling & Forecasting: A Review of Methods," AAS: 3, 1/11. 3–43; Haberman & Renshaw (2011), "A Comparative Study of Parametric Mortality Projection Models," *Insurance: Mathematics and Economics*, 48(1), 35–55.

[2] A framework developed by ECB and used by main central banks, academics and financial institutions globally.

[3] We advised governments facing labor shortages to take policy actions to close the gender participation gaps.

[4] *Age of Responsibility*, a cross-institutional report to U.K. government on savings, pensions, education and health.

[5] Credit Suisse Demographic's Research (2000), *Demographic Manifesto: New Jobs, New People*.

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Special thanks to Anaïs Boussié and Mengyuan Yuan for their collaborative input while writing this article.

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Q&A

RACING TO THE TOP

Q&A WITH MILLIMAN CONSULTANT SARAH KONRAD HINCHEY

Q: Tell us a little about your background. How did you make the decision to become an actuary?

A: Like many actuaries, I was always strong in mathematics, taking the most advanced courses my high school offered. During my junior year of high school, I attended Northwestern Mutual's one-day program, "A Day in the Life of an Actuary." The speakers presented a variety of possible career paths for actuaries, outlined the exam process and discussed the typical daily activities that could be expected for an actuary. Knowing that I wanted to pursue a career in which I could utilize my math skills, but not wanting to be a math teacher or pure mathematician, the actuarial career path seemed like a potentially good fit.

I applied for and won an actuarial science scholarship from the University of Wisconsin–Madison, where I met professor Margie Rosenberg, who mentored me throughout my four years at UW and encouraged me early on to participate in all of the Actuarial Science Club activities. I believe her personal coaching and support played a key role in helping me to graduate UW with three actuarial exams passed and two summer internships under my belt. This positioned me very well to start my career.

Sarah Konrad Hinchey, FSA, CERA, is a consultant at Milliman in San Francisco. She has extensive experience in applying predictive analytics within the insurance marketing and distribution domain, as well as pricing VA and i-CPPI products.

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Q: Would you provide some work history and how it segued into your interest in predictive analytics?

A: My first job out of college was as an actuarial analyst in Connecticut, as part of The Hartford's leadership and development actuarial training program. This exceptional program allowed me to rotate through a variety of actuarial roles and departments. It also provided extensive exam support and study time, which enabled me to earn my FSA within three years of graduating from college. In 2011 I had the opportunity to take a six-month assignment in Ireland, where I led the local actuarial team in implementing Solvency II recommendations from the European regulator. This was a pivotal point in my career in which I was challenged to step outside of my comfort zone, ultimately giving me the confidence to take on more non-traditional roles.

While in Dublin, I was recruited by the Amsterdam-based insurer ING for a variable annuity (VA) product development and pricing role. This was a dream job for me at the time, allowing me to live and work in Europe indefinitely while developing new VA products for European business units. Because VA products were very new in these markets, my expertise was needed in all stages of the product life cycle: from design, pricing and risk management, to marketing, legal and board approval. This involvement gave me high visibility throughout the company, and soon I found myself in discussions with one of the top female executives of the company, Chief Innovation Officer Mariken Tannemaat.

Tannemaat asked me to join her marketing and distribution team as the sole actuary and product expert. I started by working with our strategic marketing partner on data-driven pilot projects such as cross-sell campaigns based on propensity-to-buy models. It was very motivating to see the positive and significant business impact of these low-cost projects; for example, we saw an increase in cross-sell conversion rate of 50 percent in Romania, 90 percent in Poland and 100 percent in Turkey.

I quickly recognized the modeling techniques being used and realized there was a lot of overlap with concepts I had previously learned in my regression and loss models studies for the actuarial exams. But instead of predicting frequency and severity of claims, we were predicting likelihood of customer sales and lapses. This was a true "light-bulb" moment for me, when I realized that I had found the career path where I could apply my quantitative skill set and actuarial expertise together to drive customer-focused, front-end business impact.

Q: What skills positioned you for work in predictive analytics?

A: First, strong communication skills and an understanding of underlying profit drivers helped me to better lead multiple cross-functional projects and obtain buy-in from executive board members across different countries. By showing them how these initiatives would add value to their bottom line, they were more willing to invest time and resources in data analytics projects.

Second, the ability to understand the big picture and make the connection between the analytics and the human behavioral element helped me turn insights into actions. For example, in one of the marketing pilots we discovered that one of strongest predictors of lapse was the action of a customer contacting the call center. (We joked that in order to reduce lapses, the agents should simply not answer the phone.) The better approach was to dig deeper in order to determine specifically which types of inquiries most often led to lapse. Knowing this information, the company could proactively respond by directing similar future inquiries to more experienced call center agents who could potentially influence the customer behavior at this critical moment.

Finally, having an open mind and a willingness to learn in an unfamiliar

environment. Because this is such a new and growing field in the life insurance industry, there is no rule book for how to do things. There will always be new targets to predict and new data sources stemming from the latest technology developments. It's a lot of learning as you go.

Q: What skills do actuaries bring to analytics that other professionals may not?

A: Marketing analysts, data scientists and actuaries all bring valuable insights to the table. What sets actuaries apart is their combined understanding of the theory behind statistical models, the profit drivers, the risks, the product mechanics and the balance sheet impact. In other words, actuaries understand the big picture and see how all the moving pieces work together; they understand the content and can see more than just the numbers. This positions the actuary to design an analysis around the right questions and interpret how the results fit within the larger scope.

Q: What advice do you have for people who may be interested in predictive analytics positions?

A: Predictive analytics is a full-circle field that touches all areas of a company, so it's important to develop good relationships across departments. IT architects can help unlock the company's data sources and infrastructure. Legal can advise which data sources can and cannot be used for different purposes. Product managers and actuaries can provide insights on specific product features and profit drivers. Marketing and sales will ultimately be responsible for customer-facing campaign execution and collection of response data to complete the feedback loop. A good business case for any predictive analytics project takes all of these aspects into account.

On the technical side, the Johns Hopkins Data Science Specialization offered online through Coursera is an excellent starting point. The 10-course program will lead you through all the steps of a data analysis, from data preparation to machine learning, all while learning the R statistical programming language in an active and supportive environment.

For real-life examples, Kaggle is an online platform for predictive modeling competitions on which companies and researchers can post their data, and data scientists from all over the world compete to produce the best models for cash prizes.

Finally, join the SOA Predictive Analytics and Futurism Section in order to stay up-to-date with section-sponsored news, webcasts, meetings and research in predictive analytics.

Q: Where do you see opportunities for actuaries in the predictive analytics arena?

A: As a profession, we need to more visibly take ownership in this space before losing it to competition coming from non-actuaries. Within the life insurance industry, there are tons of opportunities for actuaries to use predictive analytics in marketing (segmentation, sales and retention efforts), distribution (optimization of customer contact strategies), underwriting (simpler processes, better risk assessments), claims (fraud detection) and pricing (assumption-setting), just to name a few.

Outside of the insurance industry, there are more career opportunities. Companies like Google, Facebook and Amazon are light-years ahead when it comes to predictive analytics. In addition to these powerhouses, there are also interesting opportunities in biotechnology (Genentech), genetics (23andMe), nonprofits (Bayes Impact) and even in fashion (Feetz)!

Q: What are some of your best professional memories/ experiences as an actuary that may inspire others to explore different actuarial paths?

A: Stepping outside of my comfort zone to take on new challenges has taken me on a rewarding path across both international and professional boundaries. I've enjoyed learning about the commercial side of the business from the "fun marketing guys," leveraging our complementary skill sets along the way. During my time in Europe, I learned a lot from advising CEOs and management teams of 13 different countries and hearing about their unique business challenges (always coupled with local cuisine and culture). Of course, I will never forget riding my bicycle to work every day like the locals in Amsterdam, in a business suit and heels, rain or shine. Lastly, I've enjoyed doing my part to bring visibility to the actuarial profession. Now that I'm back in the United States, my ambition is to continue to build the reputation of actuaries as predictive analytics leaders across the insurance industry. ■

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GOOD TO KNOW

Working to become a better professional is vital to your success. Here are some resources to help you advance your career.

BOOK

LIFE PRODUCT TAXATION

The Society of Actuaries (SOA) has published a new edition of *Life Insurance and Modified Endowments Under Internal Revenue Code Sections 7702 and 7702A*. This textbook for actuaries and tax attorneys focuses on federal income tax treatment of life insurance contracts in the United States. This second edition takes into account Internal Revenue Service guidance released after the original edition and incorporates changes with life product taxation.

bit.ly/modifiedendowments
$145

APP

RECENT UPDATE TO THE SOA CPD TRACKER

The SOA CPD Tracker now includes a new crowdsourcing feature, which allows actuaries to submit an activity for others to easily search and add from the continuing professional development (CPD) catalog. Actuaries have entered more than 43,000 CPD hours into the tracker during the past few months. The SOA CPD Tracker is a free Web tool and downloadable application for actuaries to manage their CPD.

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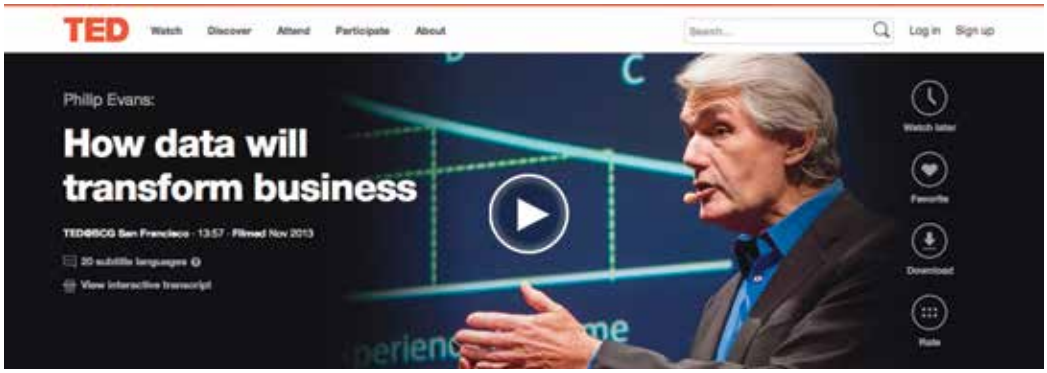
VIDEO



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TED TALK WITH PHILIP EVANS

What does the future of business look like? Philip Evans gives a quick primer on two long-standing theories in strategy—and explains why he thinks they are essentially invalid.
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If you know of a tool that might be beneficial to other actuaries, please let us know by sending an email to ***theactuary@soa.org***.

SURVIVAL OF THE FITTEST

BY STEPHEN A. EADIE

A LOOK AT THE EVOLVING SOA EDUCATION SYSTEM

The last major redesign of the Society of Actuaries' (SOA's) Education system occurred between 2001 and 2004, more than 10 years ago now. Implementation of the new system began in 2005. Since then there has been no major redesign of the Education system, but there has been continuous improvement. As set out in this article, the landscape has changed dramatically.

CANDIDATES

A candidate's experience in completing the SOA's requirements has changed continuously since 2005. The candidate must now complete a Validation by Educational Experience (VEE) requirement to become a member. The VEE component requires the candidate to successfully complete courses in topics that are important to actuaries and best provided in a classroom environment. The current topics included in the VEE program are Applied Statistics, Economics and Corporate Finance.

In addition, e-Learning was introduced with the Fundamentals of Actuarial Practice Course (FAP) in 2006. This method of delivery allows candidates to work at their own pace and provides opportunities to practice on real-life problems. The exercises and assessments that have been developed for FAP provide the candidate the opportunity to demonstrate many critical skills that are not easily included in formal "pen and paper" examinations. The FAP assessments are available on demand.

Online e-Learning modules also are used to supplement a candidate's education in each fellowship track, which began in 2007. New material that was not easily included in the formal examinations is now an integral part of each candidate's experience. The techniques used also require a candidate to work on communication and other business-related skills.

The candidate now completes four of the preliminary exams through a Computer-Based Testing (CBT) program that was introduced in 2007. Providing exams through CBT allows for instantaneous results, more sittings throughout the year and more exam centers.

The Fellowship Admissions Course (FAC) was expanded in 2008 to include additional requirements through the introduction of the Decision Making and Communication Course (DMAC). Candidates now complete the DMAC prior to enrolling in the FAC and present a project at the FAC. We now are actively training candidates in decision-making and communication.

A candidate may now complete the Chartered Enterprise Risk Analyst (CERA) credential on the way to achieving fellowship in any practice area. The additional learning provided in the CERA-specific courses is of tremendous value to all candidates. The CERA was introduced in 2007 and then integrated into all practice areas in 2013.

The fellowship examinations became available twice a year beginning in 2011. Candidates can now continue to focus on a particular exam until they are successful. Gone are the days of waiting a full year to "try again," and it is no longer necessary to put one exam aside while you attempt a completely different topic because of exam scheduling.

In addition, the SOA introduced expanded candidate support in 2014. For example, seminars were delivered and are now online to help candidates prepare for written

exams, online practice exams for Probability (P) and Financial Mathematics (FM) are now available, and performance feedback is a standard part of CBT results.

Finally, with the addition of the General Insurance track in 2013, our candidates can obtain learning in all actuarial disciplines. The SOA now provides a complete actuarial curriculum.

Of course, there are still a number of proctored, high-stakes pen-and-paper examinations. These examinations appropriately cover the core learning objectives in each of our practice areas.

> "The SOA continues to strengthen our profession using its world-class education system."

PARTNERS IN EDUCATION

Prior to 2005, staff and volunteers working together supported the SOA Education system almost entirely. This work was managed by an Education executive committee of five volunteers (the general chair, the vice general chair, the examination chair, the Education chair and an at-large member) who worked with senior staff at the SOA. A board partner provided Board oversight.

In 2007, the Education executive committee was expanded to include the board partner, an e-Learning chair, an academic partner, a staff partner and the executive director of the SOA. This larger group was necessary given the expanded nature of the redesigned Education system. There was a need to build a structure for both staff and volunteers to support the new e-Learning system, hence the e-Learning chair. Additional staff were required to support the IT processes, plagiarism protocols and content development necessary for e-Learning. An academic partner was added to make sure that we had clear representation from the academic community. This was especially critical with the introduction of the VEE program and the redesigned preliminary examinations.

Many of the initiatives described in this article would likely not have occurred without the expanded Education executive committee. In addition, there are many other initiatives with new partners in education that have been introduced since 2005.

1. A solid partnership with the academic community is now in place. Following the introduction of a university outreach program in 2007 and the launch of the Centers of Actuarial Excellence program in 2009, the SOA has continued to add university-focused programs.

2. The global CERA treaty was signed and the SOA now partners with many of the major actuarial associations in providing education and accreditation in the area of Enterprise Risk Management.

3. The SOA works with other actuarial organizations to benchmark our methods and to ensure our Education system continues to use best practices.

4. The SOA works with professional educators to improve our Education system. Independent syllabus reviews have been completed—or are scheduled for—all of our practice areas. The curriculum committees take these recommendations seriously, and many changes have already been made.

5. Our e-Learning system has been reviewed by professionals in that field. A lot of what we do is first class, but there are areas being improved now as a result of this independent review.

Finally, the Board established a Learning Strategy Task Force last year that included representatives of many of our education partners. This task force made a number of recommendations that will lead to continued improvement in the future. ■

Stephen A. Eadie, FSA, FCIA, is the past general chair of the SOA's Education Committee and co–vice chair of the International Actuarial Association's Education Committee. In these roles, he has worked to improve educational opportunities for actuaries worldwide.

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EXPLORING NEW ACTUARIAL IDEAS AND APPLICATIONS THROUGH RESEARCH

BY R. DALE HALL

The Society of Actuaries (SOA) continues to maintain and build upon its body of actuarial research to support our members and the profession. We would like to share with you the research efforts currently in development by our member volunteers and staff research resources.

Here's a sample of the types of projects ahead:

1. The SOA recently established the Committee on Climate and Environmental Sustainability Research. One of its first projects will examine the use of discount rates in modeling the economic impact of a changing climate and environmental sustainability. The SOA is also pursuing research on quantifying the financial implications of extreme climate, and research on mitigating risk associated with environmental sustainability.

2. As we focus on future experience studies, we have formed an Experience Studies Executive Committee that reports to the SOA Board. The committee supports the volunteers who are reviewing and exploring new opportunities on vital experience study projects on behalf of our profession. The committee helps plan future studies and reviews the annual assessment process.

RELATED LINKS

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action

3 | We've mentioned big data topics before, and this year is no different. We will have new collections of essays on predictive modeling and analytics, as well as essays on data visualization. We continue to support new ideas and practical applications within this growing area of data analysis.

4 | The SOA continues to invest in necessary health care, long-term care and retirement research, from longevity risks and retirement income to aging and genetic testing.

5 | In addition to research by sector and industry, our organization is hosting a research case study challenge for college and university students. This student case study brings together actuaries from both education and research standpoints. It provides a way to tap into the students' new ideas and perspectives as part of the overall efforts supporting the actuarial profession. We urge you to take a look at the case studies that are developed through this project. ■

GOOD RESEARCH READS

GUIDE ON INVESTMENT AND RETIREMENT ADVICE

The SOA Committee on Post-Retirement Needs and Risks has developed a guide for employers to use when considering advice options for a company retirement plan. The guide covers how investment and retirement advice differ, why plan design matters when choosing investment advice services, insights on automated advice systems, and other perspectives involving investment and retirement advice.

bit.ly/retirementinvest

HEALTH PROVIDER PAYER ARRANGEMENTS

The SOA report, *Provider Payment Arrangements, Provider Risk, and Their Relationship with the Cost of Health Care*, serves as a resource used by health actuaries and others to explain various types of provider payment and risk arrangements. The report outlines the general steps and considerations for designing, implementing and measuring results of existing payment reform models, and it also offers case studies for reference.

bit.ly/providerrisk

EMERGING RISKS SURVEY FINDINGS

The SOA, the Casualty Actuarial Society and the Canadian Institute of Actuaries' Joint Risk Management Section released the latest emerging risks survey report. Cybersecurity was the leading risk of this risk manager survey. Read the report for the full findings.

bit.ly/emergingrisk

R. Dale Hall, FSA, CERA, MAAA, is managing director of Research at the Society of Actuaries.

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Notice of Disciplinary Determination

ON OCT. 26, 2015, a Discipline Review Committee of the Society of Actuaries (SOA) was convened to review the disciplinary determination of the Joint Disciplinary Council's (JDC) Disciplinary Panel in the matter involving Steven J. Rubenstein, ASA. The JDC Disciplinary Panel determined that Mr. Rubenstein should be expelled from the SOA due to material violations of the *Code of Professional Conduct* (*Code*). Based on the determinations of the JDC Disciplinary Panel, and pursuant to the SOA's Bylaws, the SOA expelled Mr. Rubenstein, effective as of Aug. 11, 2015.

Mr. Rubenstein materially violated Precept 1 of the *Code*, particularly with respect to Annotation 1–4,[1] when he sent numerous inappropriate email transmissions of a harassing, threatening and intimidating nature to actuaries and others. Some of the emails were sent in disregard of a court order that he cease sending such emails. Mr. Rubenstein's conduct reflected adversely on the actuarial profession.

All members of the SOA are reminded of their responsibility to follow the *Code of Professional Conduct*.

[1] Precept 1. An actuary shall act honestly, with integrity and competence, and in a manner to fulfill the profession's responsibility to the public and to uphold the reputation of the actuarial profession.

Annotation 1–4. An actuary shall not engage in any professional conduct involving dishonesty, fraud, deceit or misrepresentation, or commit any act that reflects adversely on the actuarial profession.

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