

# Risk management

ISSUE 29 ■ MARCH 2014



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# Risk management

Issue Number 29 • MARCH 2014

Published by the Joint Risk Management Section  
Council of Canadian Institute of Actuaries,  
Casualty Actuarial Society and Society of  
Actuaries.

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## JOINT RISK MANAGEMENT SECTION

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## ARTICLES NEEDED FOR RISK MANAGEMENT

Your help and participation is needed and  
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will be published:

### PUBLICATION DATES

August 2014  
December 2014

### SUBMISSION DEADLINES

May 1, 2014  
September 1, 2014

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In order to efficiently handle articles, please use  
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answers for everyone's benefit.

# Chairperson's Corner

By Barry Franklin

## AS WE FLIP THE CALENDAR PAGE FROM 2013

to 2014 I cannot help but wonder what the coming year will bring. I suppose this curiosity is fairly common, as there are numerous lists of predictions published every year spanning multiple disciplines. I have to admit to some personal fascination with self-described prognosticators and the predictions they make, particularly those in the financial and economic realm. While I don't place much stock in the actual predictions, I do find the practice itself interesting—particularly when we can look at how well these predictions fare in retrospect. Perhaps unsurprisingly, it turns out predictions made by experts are not all that accurate.

Each January, Blackstone Vice Chairman Bryon Wien makes predictions of what he expects to be the top 10 big surprises of the coming year. According to *Business Insider*, Wien scored a 2.9 of possible 10 points for his 2013 predictions (with fairly generous partial credit awarded). Among the predictions he missed completely were: (1) Gold prices reaching \$1,900 per ounce (prices tumbled from about \$1,700 to just over \$1,200); (2) dramatic increases in commodity prices, with corn reaching \$8.00 per bushel (\$4.18) and wheat \$9.00 (\$6.62); and, (3) S&P 500 index falling below \$1,300 (it rose from around \$1,400 to over \$1,800). To be fair to Mr. Wien, *Business Insider* points out that he has been right about half of the time in the past, which is not too bad considering the specificity of some of his predictions. Still, it is no better than a coin toss from a probabilistic view.

*Forbes* contributor Andrew Klausner publishes a similar list each year and he self-scored his 2013 predictions, twelve in all, at 50 percent. His major misses were: (1) a 10 percent drop in the stock market for the year; (2) a major deal being announced involving major wire houses Merrill Lynch, B of A, UBS, Morgan Stanley and Wells Fargo; and, (3) continued consolidation in the asset management arena.

As actuaries, we make our own forecasts and predictions, even if we don't publish them for all the world to see. Importantly, we have standards of practice to guide us in our work so that we hopefully achieve better outcomes than one could realize from simply tossing a

coin. This edition of *Risk Management* includes some topics that bear directly on the discipline of making actuarial predictions. This discipline of challenging and testing assumptions is part of what defines the actuarial profession—and sets us apart from crystal ball gazers.

While not a prediction per se, I am excited to share some of the 2014 plans and priorities identified by the JRMS Council. Of course, we will continue to sponsor practical research and educational events and webinars for the benefit of section members.

An increased area of focus will be ensuring relevant risk management content is provided at all major meetings of our sponsoring organizations, and networking opportunities are offered for JRMS members at those events as well. Most exciting, though, is the launch of a free e-library for JRMS members enabling them to access and electronically “check out” selections from hundreds of relevant business and risk management titles on a temporary basis. Please be sure to renew your JRMS membership so you can take advantage of this important member benefit, and also help us further increase the value to members by recommending additional titles to include on our library “shelves.”

In closing, I will venture to make one prediction for the year. I believe that 2014 will provide significant opportunities for actuaries to demonstrate our value as risk management practitioners, and that the JRMS will play an important role in establishing the actuary as a recognized leadership “brand” in the discipline of risk management. ■



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# Letter from the Editors

By Heather Adams and Jared Forman

**AS THE REGULATORY FOCUS** on risk management increases, so does our opportunity for professional growth. Whether your company is adjusting to the federal oversight that comes with a SIFI designation or preparing for ORSA, risk management professionals are getting the “seat at the table” we have been looking for. The Joint Risk Management Section newsletter strives to deliver content that will help you take advantage of this opportunity to advance the risk management capabilities at your organization.

This edition includes articles covering a wide variety of topics. Starting off with the “Negative Consequences of Pension Risk,” David Cantor and Brett Dutton outline a framework that provides guidance on how to holistically manage pension risk.

On the life insurance side, in “A Principle-Based Approach to Mortality Guarantees for Life Insurance Products,” Carol Marler considers options to share poor experience from mortality shock events with policyholders in products with and without built-in mortality guarantees.

In “Enterprise Risk Quantification,” economic capital and stress testing are reviewed as methods to quantify risk. Authors David Wicklund and Chad Runchey outline key considerations for each of these methods in areas of methodology and implementation.

Focusing again on pensions, in “Rising PBGC Premiums: Assessing Pension Risk Management Decisions with a Shareholder Value Framework,” David Jaffe and Michael Moloney discuss the implications of a changing PBGC premium structure and its implications for both plan funding and risk in light of the Bipartisan Budget Act of 2013.

The next two articles discuss the current trends in two very different hedging programs. “A New Normal in Equity Repo” by Anand Omprakash and Phillippe Combescot points out a changing environment in the equity derivatives market for equity repo rates and the impact on hedging programs. Moosa Aziz and Greg Slawsky suggest that now is the time for companies to review their hedging programs for surrender risk in “Hedging Surrender Risk.”

In the final article of this edition, we continue our series, “Talk with a Risk Management Guru,” that was introduced in the December issue. This time we hear from Mike Smith, Chief Risk Officer of ING US. Through this interview Mike shares his insights into the current state of risk management in the industry as well as provides some advice to young actuaries. We want to thank Mike for taking the time to interview with Josh Rundle and share his knowledge with our readers.

We would also like to thank David Schraub, Kathryn Baker and Robert He for their support with pulling this newsletter together.

Enjoy! ■



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# A Framework for Pension Risk Management

By David R. Cantor and Brett B. Dutton

**OVER THE PAST DECADE**, sponsors of corporate defined benefit pension plans in the United States have been taking meaningful steps to reduce financial risk in these plans. Plummeting plan funded ratios, resulting from the 2008 stock market collapse and the corresponding decline in interest rates, have helped drive this recent spur in risk reduction. Changes to federal funding requirements and accounting standards over the past decade have generally also served to increase plan sponsors' interest in mitigating financial risk associated with their plans.

For such plan sponsors, low funding ratios and asset-liability mismatches have a number of potentially significant negative consequences, including increased pressure on corporate cash (due to higher and more volatile funding requirements) as well as elevated balance sheet and income statement volatility. As a result, pension risk can have a significant impact on key corporate items such as credit rating, cost of capital, and valuation (Bader 2003).



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Plan sponsors recognize the problems pension plans can cause and are taking action to manage the risk in these programs. Thanks to improving balance sheets (e.g., via corporate deleveraging) and improving cash ratios, more and more companies now have the latitude to tackle pension issues head-on. Even for

companies that have already embarked on de-risking strategies, continual monitoring and consideration of new tactics is necessary for prudent ongoing plan management.

## A FRAMEWORK FOR PENSION RISK MANAGEMENT

The following Pension Risk Management Framework

can help companies evaluate, manage, and monitor pension risk in a holistic manner. Because pension risk manifests itself differently in every organization, the framework is intended to provide broad guidance rather than be overly prescriptive.

### 1. Diagnose and inventory pension risk factors

From a corporation's perspective, pension risk can be defined as the risk of a change (up or down) in the plan's funding deficit or surplus and the resulting change in the plan's funding ratio. Pension risk management does not simply mean removing or reducing risk exposures but rather more holistically focusing on areas where it makes strategic and tactical sense to hedge or exploit risks.

A number of common risk factors impact a plan's funding status; the two most important of these in terms of their influence are movements in interest rates and equity markets. Other risks, such as credit risk and longevity risk, could have a direct and meaningful impact on a plan's current funding status and long-term total cost. Additional plan risks exist beyond those whose direct impact is primarily financial, including those related to operational and fiduciary matters of the plan.

Listing and identifying a plan's risks is an important first step in understanding and managing the overall level of risk associated with the plan. A company must seek to understand its exposure to each risk and the likelihood of adverse outcomes related to each risk. Importantly, the risk impact must be understood at both the plan level and at the company level in terms of how the exposure may offset or amplify risks in other parts of the business. By conducting a pension risk diagnostic, measuring risk exposure, and creating a pension risk profile, a company can increase its understanding of its plan's current health as well as potential risk areas.

### 2. Decide which risk factors to address

Depending on a company's objectives, risk tolerances, the costs and benefits (both implicit and explicit) of mitigating risks, and other considerations, each pension risk factor can be analyzed in terms of how it should best be managed.

For example, if management's objective is to increase company value, risk management of the pension plan

“The risk impact must be understood at both the plan level and at the company level in terms of how the exposure may offset or amplify risks in other parts of the business”

has to positively affect one or more of the inputs that drives firm value in the first place; for example, cash flows, growth rates, and the discount rate used to value cash flows to investors. Some risks are best to hedge, reduce, or remove, while others are best left to pass through to the individual risk management function of investors (who can shift their own portfolios to counter decisions made by the company). Furthermore, some risks may be best for a company to simply ignore if not material, while yet other risk exposures can potentially be increased and intentionally exploited.

### 3. Utilize the pension risk management toolkit

After cataloguing the risk factors and selecting an approach to manage each one, a company can utilize different approaches to effectuate changes. Common approaches utilized to mitigate pension financial risk are often described as ‘levers’: for instance, one can think of a benefit lever, an investment lever, a funding lever and an insurance solutions lever.

These levers are not mutually exclusive and independent of one another; ideally, they will function together, like a machine, to support the primary objective of managing the risks in the pension plan. For example, a company that has decided that interest rate risk is worth hedging (perhaps because cash flows will increase and the discount rate the market used to value those cash flows will decline and thus increase firm value) can explore which lever or levers might best achieve the desired result.

#### *Benefit Lever*

This lever addresses changes that can be made to the terms of the pension plan to alter the risk profile. For example, freezing the pension plan to new entrants and/or new accruals, changing the plan design, or offering participants a lump sum option, are all ways to manage risk exposures.

For U.S. corporate plans, pension benefit reductions can only be implemented with respect to benefits not yet earned (accrued) by participants. Short of the drastic step of filing for a distress termination with the Pension Benefit Guaranty Corporation, benefits already earned by participants’ past service cannot be modified to reduce cost or risk to the company. For this reason, while the benefit lever

can often lower a pension plan’s risk trajectory over the long term, most types of benefit changes will do little in terms of immediate risk reduction. One exception is the addition of a lump sum option for plan participants, which (to the extent exercised) results in immediate settlement of pension risk.<sup>1</sup>

#### *Investment Lever*

Risk management strategies using the investment lever generally seek to align the expected performance of the plan’s assets with the expected behavior in the plan’s liabilities. Core to such strategies is that pension liabilities behave like bonds given they are, at heart, a contractually defined stream of cash flows.

There are numerous ways to match expected asset and liability returns. For example, matching the duration of the plan’s assets to the plan’s liabilities is commonly employed as a first step in this process. Such an investment strategy is usually implemented via a greater allocation of the portfolio to bonds and perhaps the inclusion of interest rate derivatives. More complicated approaches include key-rate duration matching and cash flow matching.

Consistent with a theme of this article, any shift in investment allocation should be viewed not only from a plan perspective but also from a corporate perspective. Merton (2006) discusses conducting asset-liability modeling for the entire company and claims full immunization of pension liabilities may not be the value-maximizing strategy for an entire enterprise. A change in investment strategy impacts the company’s overall risk posture and ultimately impacts capital budgeting decisions and company value.

#### *Contribution Lever*

Another way to manage risk in the pension plan is through increased contributions. This lever does not change a plan’s sensitivity to the different risk factors but by making a cash infusion beyond minimum requirements and improving plan health, a plan is better protected against adverse scenarios. Note, a pension contribution simply shifts from the corporate balance sheet to the pension balance

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sheet—the overall enterprise is still virtually in the same position before and after the infusion. Nevertheless, a firm may decide the optimal use of cash is in improving the plan’s health rather than deploying the funds in some other manner.

A company can also issue debt to fund its pension plan. In the current low interest rate environment, some companies may be inclined to make such a transaction. In essence, this amounts to trading one piece of debt for another; the pension plan is debt to participants.<sup>2</sup>

#### **Insurance Lever**

Purchasing annuities, either on a partial basis or as part of a full blown pension termination process, can shrink the size of the pension plan or eliminate risk entirely. Longevity swaps are an alternative to annuity purchases that allow a sponsor to hedge a plan’s longevity risk while retaining investment and other risks. Longevity swap transactions have gained popularity among pension sponsors in the United Kingdom, but have not yet significantly impacted the pension landscape in the United States.

#### **4. Select a Strategy**

A plan sponsor’s choice of a strategy depends on short- and long-term implications in terms of key metrics like earnings per share, stock price, credit rating, enterprise risk and valuation. As conditions change, the best strategy may also change and the plan sponsor should be flexible enough to adapt to this reality. Strategy decisions also depend critically on achieving buy-in from a myriad of stakeholders including company management, shareholders, regulators, participants, etc. Proper governance is also critical.

#### **5. Monitor the Strategy**

Just like a person may get a physical health exam every year or few years, the plan’s exposure to risk factors should also be frequently monitored and adjustments might be warranted as conditions change. Moreover, any strategy that is implemented should be evaluated over time to determine if the intended effects are materializing and whether modifications need to be made.

Reducing and eliminating pension risk is not a foregone conclusion. Careful analysis needs to be performed to determine if this is the best decision for a company. Plan funded level, plan size relative to the company, company risk tolerance and objectives, company borrowing capacity and credit rating, time horizon, and a host of other factors play a determining role in how to best manage the pension plan.

The Chinese symbol for risk is a combination of danger and opportunity. Strategically managing risk by following a Pension Risk Management framework should help companies balance this danger and opportunity and enable good decision making that increases the odds of achieving stated objectives.

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#### **ENDNOTES**

<sup>1</sup> This article examines risk primarily from the company/ shareholder perspective. Freezing the pension plan (and perhaps concurrently moving employees to a defined contribution plan) or offering lump sum cash outs to employees may create additional risk for those individuals. The other levers discussed in this article may also alter the risk profile of plan participants and other stakeholders in ways not addressed herein.

<sup>2</sup> The determination of whether to borrow and fund the plan or to fund the plan according to statutory rules generally involves a comparison between the liability discount rate and the borrowing rate. Other factors do complicate matters including, but not limited to, insurance premiums, the actual structuring of the corporate bond offering, corporate tax rates and tax deductibility of pension contributions and debt interest payments (Gannon 2013). Additionally, other types of assets can be contributed to the pension plan like company stock and property.



# A Principle-Based Approach to Mortality Guarantees for Life Insurance Products

By Carol Marler

## HOW DOES A RISK MANAGER APPROACH THE QUESTION OF MORTALITY RISK?

What are the implications for risk management of product designs which guarantee a maximum mortality charge? This article begins by describing how mortality assumptions are developed. With that as background, the impact of guarantees is considered. This article will focus on life insurance policies.

## MORTALITY ASSUMPTIONS

The probability of death is 100 percent. The question is in the timing. The traditional approach to mortality assumptions for life insurance business is tied to a published table of mortality rates by age. That table, in turn, is developed from intercompany mortality studies. Other parameters may also drive the table, including (among other things) gender, tobacco use, duration since policy underwriting, time frame of the study data, and the purpose of the table. For example, in the United States, tables used for regulatory reporting are very different from the tables used for pricing or for reporting under Generally Accepted Accounting Principles.

The process of creating a mortality table is as much art as science. Often the ratios of claims to exposure are calculated for groups of ages, in order to increase the credibility of the results. Then, for practical reasons, the data is smoothed and interpolated to give results at individual ages. For most ages, much of the emphasis is placed on fitting the experience data. At the oldest ages, where insurance experience is relatively sparse, different approaches have been used, such as incorporating experience from general population and/or choosing some analytical formula that relates age to mortality rate.

Actuaries often modify the published tables to reflect features of a particular block. In considering the mortality outlook for a specific block of business, the published tables may be modified to reflect the recent mortality experience of the company in question and the underwriting approach to be used for that business. The adjustment is typically in the form of a schedule of multiples to the published table. With respect to the resulting adjusted table, there are a number of risk factors that should be considered.

## STATISTICAL VARIANCE AND BASIS RISK

If the mortality rate is correctly specified for each policy, the binomial distribution may be assumed, producing a well specified metric for variance. Because of the large number of policies, it is possible to simplify the calculation by assuming either Poisson or normal distribution. In any case, the variance can be calculated directly on a seriatim basis. Determining the variance by amount requires a somewhat more complex calculation than variance by count, but in either case an exact overall variance can be computed without recourse to any simulations. The range of possible claims per period can be specified to any desired confidence level.

One issue that arises in considering variance by amount is whether to use total face amount or face amount net of reinsurance. From a risk perspective, retention limits are a form of risk mitigation, and thus the net face amount seems the correct metric to use. Mortality in excess of retention has been transformed into a different sort of risk, namely credit risk involving the reinsurer.

Another element of risk is basis risk, i.e., whether the table used to set the mortality is a correct measure for the block of business. The basis risk can be broken into two parts, first whether the mortality for the current period is properly specified, and second, whether the future trend of mortality is appropriate. Basis risk is always difficult to quantify. There is no formula for estimating the error range, and an ongoing program of monitoring the emerging experience is necessary. Actuarial judgment comes into play in deciding whether any divergence between actual and expected is merely a temporary aberration or an indication of an ongoing trend away from the previously selected assumptions.

## MORTALITY IMPROVEMENT

Many companies incorporate some degree of projected mortality improvement into their schedule of mortality adjustment multiples. The larger the assumed increase, the greater the risk that actual experience will be less favorable than projected. A conservative assumption of

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little or no improvement provides an implicit margin for this risk.

The mortality assumption by duration is intended to represent the normal effect of aging, with possible allowance for further progress in medical science to extend lifespans. Since the trajectory of advances in health care may not match these assumptions, emerging experience may vary. In addition, there is a risk of an extreme mortality shock not anticipated by historic trends.

### MORTALITY SHOCKS

Commonly considered risk scenarios include pandemic disease and other catastrophic events such as terrorism or natural disasters.

Pandemic disease is considered to have a greater impact than any of the other possible events. It has been nearly 100 years since the last major influenza pandemic. In that time, medical science has made significant strides in treatment of contagious disease. Nevertheless, although the details of any future pandemic may differ from this experience, it gives a worthwhile starting point for considering how bad a pandemic might be. Also, although HIV/AIDS proved not to be catastrophic for the life insurance industry, the projections made in the early days of that epidemic can also be a useful guide to building disaster scenarios.

Whether adverse mortality comes from a gradual trend or from a catastrophic shock, how can a company respond to adverse experience?

### PRODUCT DESIGN

In the case of departure from expected trend, the company may re-price new business and/or adjust its underwriting. These choices will not be helpful, however, in the case of a catastrophic shock which has already occurred.

For inforce business, it may be possible to pass along some or all of the excess mortality cost to policyholders. Product design determines the range of possible adjustments. Such actions to pass along adverse mortality experience will be undertaken with caution due to the reputation risk involved. If the excess mortality is

an industry-wide issue, it seems more likely that companies will choose to pass along the experience.

A great many traditional life products, whether permanent, renewable term, or decreasing term, do not permit the insurer to change premium rates. On participating business, companies may choose to reduce dividends to reflect adverse mortality experience. Dividends, of course, cannot be reduced below zero. So the gross premium becomes, in effect, the maximum guaranteed premium.

### NON-PAR PLANS

Universal life product design allows the company to increase the current mortality charges, subject to contractual guarantees. Some term plans also provide for adjustment to current premiums, particularly in the YRT “tail” that follows the initial level premium period. Thus, we see that mortality guarantees within non-par product designs do not, in fact, increase an insurance company’s mortality risk. Rather, they are an element of the feature which allows the company to decrease its risk in certain scenarios, and only act to limit the degree to which the increased risk can be passed back to policyholders.

When looked at from this perspective, the presence of an explicit mortality guarantee is associated with an option for the company to pass along adverse experience. Products without an explicit guarantee are actually more risky in that there is no provision for adjusting premiums either upward or downward. ■

# Enterprise Risk Quantification

By David Wicklund and Chad Runchey

## OVERVIEW

Insurance is a risk-taking business. As risk managers, we must ensure that the risks taken are intentional and understood, as well as aligned to the organization's objectives. This can be achieved only through a well-designed risk management framework, with effective governance and high-quality risk information. To provide management with the information it needs, risks should be quantified through various lenses, at aggregate and more granular levels. This article focuses on risk quantification at an enterprise level.

We will discuss two important risk quantification topics: economic capital and stress testing. Each provides management with different information needed to influence capital management, investment and other business decisions, and require coordinating information across the enterprise.

We will provide background on some of the factors driving risk management enhancements across the industry and the limitations of common industry approaches. Then we will discuss the purpose, key methodology decisions and practical challenges for economic capital and stress testing.

## DRIVERS

Across the insurance industry, companies are enhancing risk management practices as they recognize both risk management's importance and increased regulatory focus. As the 2008 financial crisis unfolded, financial institution losses emerged in ways companies had not anticipated. Two risk quantification realities quickly became apparent to management and regulators alike. First, many companies did not have a framework in place to evaluate enterprise-level risk exposure to adverse environments. And second, many did not have the infrastructure in place to perform timely risk analysis.

Regulation of insurance companies with a U.S. presence varies based on the size and complexity of an organization and location of the parent company. With the emerging regulatory developments, most companies will soon fit into one of the following categories:

1. U.S. parent, not systemically important, no bank ownership — Legal entities are regulated by state regulators or local foreign regulators; group disclosures to state regulators
2. U.S. parent, systemically important or bank ownership — Group is regulated by the Federal Reserve; legal entities are regulated by state regulators or local foreign regulators; group disclosures to state regulators
3. European parent — Group is regulated per Solvency II; legal entities are regulated by state regulators or local foreign regulators; group disclosures to state regulators

Companies in each category are experiencing an increased regulatory emphasis on risk management, with different regulators introducing various requirements, some of which are similar. For instance, the U.S. insurance regulators will soon require that companies produce an Own Risk and Solvency Assessment (ORSA) report. To comply, U.S. companies must provide their internal

view on group-required capital and a prospective view of required and available capital in normal and stressed environments. Companies deemed systemically important financial institutions (SIFIs) by the Financial Stability Oversight Council (FSOC) or that own a bank will be subject to the Federal Reserve's Internal Capital Analysis and Assessment Process (ICAAP), for which a robust enterprise stress-testing framework is a key component. Finally, companies with European parents are preparing for Solvency II enterprise risk reporting,



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including economic capital, stress testing and capital projections.

Companies in the first group are subject to less rigorous and prescriptive requirements than those in the others, though additional factors may influence them. The U.S. ORSA will provide insurance regulators with a new window into risk management practices and quantification methods, and ensure that risk management topics are on board of directors' agendas. What boards or U.S. regulators will do with this information is not yet known, but it's preferable for companies to show regulators that they are on the leading side of industry risk management practices. Companies with more rigorous regulatory requirements—SIFIs and European subsidiaries—will redefine leading practices and place pressure on the rest of the industry.

#### LIMITATIONS OF EXISTING APPROACHES

Measuring risk exposure is hardly a new concept for insurers, though common industry approaches have limitations. Insurers often manage capital needs with frameworks based on U.S. risk-based capital (RBC) or rating agency benchmarks, quantify individual risks in silos with widely varying techniques, and lack the ability to aggregate risks across businesses or project full future balance sheets in adverse conditions.

State regulators designed RBC to provide early warning of financial trouble, but companies have often relied on it beyond its intended use, employing it as a primary capital adequacy measure. A company's position on RBC—and rating agency capital, which aligns closely to RBC—is a very real constraint, but it does not necessarily lend itself to understanding the company's specific risks. RBC is built on a U.S. statutory balance sheet, which is book-value-based and may show losses slowly over time. It also has known missing risks (e.g., longevity, operational) and is not tailored to the risks facing specific organizations. Finally, since it is applied at the insurance legal-entity level, risks taken by non-insurance entities (including the holding company) are not captured.

Additional, more economic risk exposure measurement techniques are also utilized but are often considered in risk silos (e.g., credit risk exposure), resulting in varying quantification approaches and levels of rigor. Limits are often applied for some risks and not others, and the individual risk quantification approaches are not linked to the overall company risk appetite.

An emerging leading practice is to produce a forward-looking projection of a company's balance sheet for various adverse scenarios under various accounting lenses (statutory, GAAP/IFRS, and/or economic). Although the value in the exercise is appreciated, few companies have robust stress-testing frameworks, and current capabilities have shortcomings. Projecting stochastically calculated balances, determining assumptions under stressed conditions and aggregating for the enterprise are some current challenges, resulting in slow turnaround times and use of shortcut methods that compromise accuracy.

#### EMERGING ENTERPRISE RISK QUANTIFICATION APPROACHES

##### *Economic capital*

Management must understand the organization's overall risk and whether taking that risk provides an adequate return. Capital frameworks measure exposure across quantifiable risks. Economic capital models can align with the organization's specific risks and objectives, provide a consistent view on the capital required to support those risks, and help inform management about risk and return trade-offs.

Economic capital is commonly understood to utilize a value-at-risk measure on the potential loss of market value balance sheet surplus. While a popular application—and the Solvency II definition—economic capital need not be constrained to this interpretation. Regardless of the precise methodology, any economic capital framework seeks to determine how much capital should be held to support the actual risks the company faces. The capital definition should be aligned to a company's risk appetite definition and its unique objectives.



“The capital definition should be aligned to a company’s risk appetite definition and its unique objectives.”

statutory-based framework may be utilized with a long-term run-off approach.

- *Risk measure and confidence level:* Regardless of the balance sheet and time horizon, a company must decide to what part of the tail it plans to measure exposure. While 99.5 percent value at risk is common, different confidence levels and risk measures (e.g., CTE98) could also be considered, depending on the valuation framework. Ultimately, the risk metric and confidence level should align to the unique objectives of each organization.

Once a methodology is agreed upon, implementing the approach presents challenges:

- *Management buy-in:* Building senior management understanding and buy-in is often the greatest challenge with economic capital. An economic capital model is only as useful as the management actions it influences. To make it more than a theoretical exercise, economic capital’s value must be demonstrated to management, and sometimes theoretical purity must be sacrificed for ease of understanding.
- *Risk distributions and aggregation:* Capital calculations, by definition, seek to measure potential losses in risk distribution tails. Unfortunately, limited data exists to understand and illustrate the actual shapes of the tails and how risks are correlated within them. These assumptions typically require significant judgment and have greater uncertainty. It is instructive to perform calculations for a range of assumptions to understand the sensitivity of the results and where significant model risk may be present.
- *Coordinating across the organization:* Insurance companies are generally organized around multiple business units and corporate functions, each with responsibility for balances that feed the enterprise results. To produce meaningful and timely results, the capital modeling approach must be consistently applied across the organization and be efficiently aggregated.

Some key, and interrelated, methodology decisions are as follows:

- *Valuation framework:* Commonly economic capital frameworks utilize observable market variables to value assets and liabilities. Alternatively, an economic balance sheet can be defined with a discounted cash flow approach using current, but not necessarily market-consistent, assumptions. Because of their book value principles, GAAP and statutory balance sheets do not capture risk if required capital is quantified in terms of short-term losses.
- *Time horizon:* Most commonly economic capital is defined by the potential loss over a one-year horizon, where the market value at each point in time reflects the full tail of the liabilities and the applicable risk margins. A run-off approach is sometimes used that could focus on how cash flow or surplus emerges over a long-term projection, but companies typically prefer the simplicity of a short-term approach. The time horizon should be linked to the valuation framework. For example, a market-consistent valuation framework is commonly used with a short-term horizon, where a

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### ***Stress testing***

Stress testing is a powerful tool to supplement a company's internal capital model due to its conceptual simplicity. Stress-testing results are easy to explain to senior management and can drive home an understanding of a company's most material risk exposures. The approach does not attempt to capture all quantifiable risks, but instead illustrates the future financial impact over several periods of adverse, yet plausible, scenarios involving one or more risk factors. Executives hesitate to act on measures they do not fully comprehend—like a diversified 99.5 percent value-at-risk measure on an economic balance sheet, for example. Conversely, “If this economic scenario unfolds over the next several years, here's how our balance sheet will look” can be powerful enough to drive management actions.

A forward-looking stress test projects a balance sheet for a given adverse deterministic scenario. Consider the following in such an approach:

- *Balance sheet:* Any balance sheet definition that is important to the organization (e.g., GAAP, statutory, economic) should be considered. The Federal Reserve's Comprehensive Capital Analysis and Review (CCAR) framework is built around a GAAP balance sheet, but for some organizations statutory and/or economic balance sheets may take priority.
- *Income statement:* For companies utilizing a GAAP-based stress-testing approach, the balance sheet and income statement respond differently to market changes (e.g., unrealized gains flow through other comprehensive income rather than net income). Typically a projected balance sheet is the test's focal point, but management also values understanding the income impacts.
- *Scenario types:* The risk materiality should drive the scenarios selected. This will vary by company, though commonly market risk is the most material and scenarios are hence focused on market events.
- *Scenario quantity:* No absolute rules exist for the number of scenarios. Companies should use

enough scenarios to cover the most material risks, but not so many that the message gets lost.

- *Projection length:* The emerging consensus is to project the balance sheet for the business planning period (typically three to five years) since the purpose of the exercise is to inform management decisions.

Stress testing, while simple in concept, can be a challenging to implement. An insurance company balance sheet is complicated enough to calculate at a point in time; calculating it several years in the future in severe market conditions is even more difficult. Some particular challenges are:

- *Forecasting complicated balances:* Stochastic balances are particularly difficult to project, because they require stochastic-on-deterministic calculations. Additionally, the complicated and non-continuous rules in GAAP and statutory reporting (e.g., asset-adequacy reserves, Actuarial Guideline 43, Actuarial Guideline 38, GAAP loss recognition) present significant challenges. Well-designed processes and sufficient computing power are essential.
- *Setting assumptions for adverse scenarios:* Secondary effects of the scenario tested must be considered. For example, policyholder behavior will respond to adverse market environments. Assumptions for this are required for the models, but experience needed to set the assumptions probably does not exist. As a result, significant actuarial judgment is required, and a range of assumptions should be tested.
- *Precision level:* As noted above, precise calculations of future balances are not trivial, leading companies to rely on simplifications and rules of thumb. However, overdependence on such techniques can lead to answers that are less meaningful and can draw ire from regulators.
- *Coordinating across the organization:* The same coordination challenges noted for economic capital are present for stress testing as well.


“Stress testing is a powerful tool to supplement a company’s internal capital model due to its conceptual simplicity.”

## CONCLUSION

Both internal and external risk management drivers vary from company to company, but enhancing risk management is a common goal across the insurance industry. Producing high-quality risk information to inform management decisions is critical to an organization’s success. Risk management information must provide management perspective through various lenses and at various levels of detail.

Economic capital and stress testing both require coordination across the organization to provide management with vital risk information. There is no single correct approach and careful consideration is required both in setting up the right approach for the organization and the plan to implement. As the external environment and strategic objectives differ from organization to organization, so too should risk quantification.

*This material has been prepared for general informational purposes only and is not intended to be relied upon as accounting, tax, or other professional advice. Please refer to your advisors for specific advice. ■*



100 Years of Expertise,  
Insight & Solutions

# SAVE THE DATE

2014 Centennial Celebration  
and Annual Meeting

New York City, NY – Hilton Midtown  
November 9 – 12, 2014

The graphic features a blue background with a yellow rectangular area containing the CAS logo, the text "100 Years of Expertise, Insight & Solutions", and the large text "SAVE THE DATE". Below this, a black silhouette of a city skyline is shown. At the bottom, the event details "2014 Centennial Celebration and Annual Meeting" and "New York City, NY – Hilton Midtown November 9 – 12, 2014" are displayed in white and yellow text.

# Rising PBGC Premiums: Assessing Pension Risk Management Decisions with a Shareholder Value Framework

Michael Moloney & David Jaffe

**ON DEC. 26, 2013, PRESIDENT OBAMA** signed into law the Bipartisan Budget Act of 2013, which increases Pension Benefit Guaranty Corporation (PBGC) premiums, above and beyond the increased PBGC levels coded into law as part of 2012's Moving Ahead for Progress in the 21st Century Act (MAP-21). Under the new law, effective Jan. 1, 2014, PBGC variable rate premiums (VRP) increased from their current level of 0.9 percent of unfunded liability to 1.4 percent of unfunded liability. In 2015, they will increase again to 2.4 percent plus an additional inflationary increase. In 2016, they would increase yet again to 2.9 percent plus an additional inflationary increase. They would continue to increase with inflation in years 2017+.

## PART I: PENSION RISK MANAGEMENT SHAREHOLDER VALUE FRAMEWORK

We present a shareholder value framework to help sponsors with pension risk management decisions, building on prior work from Sharpe, Tepper, and others.<sup>1</sup> This framework is just one of many lenses sponsors must use to make pension risk management decisions. Importantly, the sponsor must weigh the shareholder perspective against the fiduciary obligation to invest plan assets solely for the benefit of plan participants.

We imagine a simplified defined benefit pension with a single deterministic liability payment  $L$  due in exactly one year. The plan has asset  $A_t$  which can fluctuate with time. The risk-free discount rate  $r$  is assumed to be constant and yields a discount factor  $V$ . The corporate tax rate is  $T$  and is assumed to be constant. The plan's funded status at time zero is as follows

$$\text{Funded status} = A_0 - L * V \quad (1)$$

Since the plan duration is one year, any plan surplus at the end of the year will revert to shareholders. As such,  $(A_1 - L * V) * (1 - T)$  can be thought of as a shareholder asset. Shareholder value in the pension must account for three additional elements:

1. The plan will need to fund the VRP on any shortfall. Thus, shareholders have an additional liability in the amount of  $\max((L * V - A_0) * \text{VRP}, 0) * V * (1 - T)$  where VRP is the variable rate premium percentage<sup>2</sup>.
2. If the plan ends the year with a surplus, the sponsor might be forced to share some of that surplus with the government in the form of taxes on plan reversions or with participants in the form of benefit increases. If we assume that the sponsor would share  $\phi$  percent of the surplus with participants and the government, then the surplus pay-out to the government and participants would be  $\phi * \max\{A_1 - L, 0\}$ . This is equivalent to  $\phi$  percent of the payoff on a call option on the plan asset with strike price  $L$ . We call this option  $C_A$  and say there is a shareholder liability in the amount of  $\phi * C_A$ .

The rising premiums create an incentive for plan sponsors to fully fund their plans to avoid paying the premium. On the other hand, funding the plan increases the risk that the plan will develop a surplus. This may concern sponsors of frozen plans who could owe an excise tax on any plan surplus at the plan's termination date. How, then,

should a sponsor weigh the benefit of reduced PBGC premiums against the increased surplus risk?

In this paper, we attempt to answer this question in three parts:

1. In part I, we provide a framework for making pension risk management decisions from a shareholder value perspective
2. In part II, we show how the framework can be used to make pension funding decisions in light of changing PBGC VRP
3. In part III, we quantify this impact



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3. Suppose the company will go bankrupt during the year with probability  $\lambda$ .<sup>3</sup> In that scenario, the sponsor could default on any unfunded liability at year's end. The benefit to the sponsor of this default would be equal to  $\max\{L - A_1, 0\}$ . This is equivalent to the payoff of a put option on the plan asset with strike price  $L$ . We will denote this put option as  $P_A$  and say there is a shareholder asset of  $\lambda * P_A$ .

Folding in these three elements, the shareholder value can be expressed as follows:

$$\text{Shareholder value} = \frac{[(A_0 - L * V - \phi * C_A + \lambda * P_A - \max((L * V - A_0) * VRP, 0) * V] * (1 - T)}{(2)}$$

We will refer to this quantity as  $SV_0$  to denote that it is the shareholder value assuming the sponsor funds 0 to the plan at the beginning of the year. If the plan is currently underfunded so the VRP is positive, we can remove the maximum from equation (2) and reorganize as follows:

$$SV_0 = [(A_0 - L * V) * (1 + VRP * V) - \phi * C_A + \lambda * P_A] * (1 - T) \quad (3)$$

Next, put-call parity gives us the following:

$$C_A + L * V = P_A + A_0 \quad (4)$$

Substituting equation (4) into equation (3) gives us:

$$SV_0 = [(A_0 - L * V) * (1 + VRP * V - \phi) + (\lambda - \phi) * P_A] * (1 - T) \quad (5)$$

Equation (5) is intuitive and has important implications for pension risk management and pension plan investment decisions. In cases where  $\lambda > \phi$ ,  $SV_0$  increases with  $P_A$ . This suggests the sponsor should want to maximize the value of the put option which can be accomplished by increasing the riskiness of plan assets. Conversely, if  $\lambda < \phi$ , the sponsor should want to minimize the value of the put option which can be accomplished by derisking plan assets or purchasing annuities. This result is intuitive: if a sponsor bankruptcy is more likely than surplus sharing ( $\lambda > \phi$ ), this means that the downside risk sharing with plan participants is greater than the upside risk sharing with participants so the sponsor is incentivized to increase risk. The opposite is true if  $\lambda < \phi$ .

## PART IIA: ASSESSING PLAN FUNDING USING THE SHAREHOLDER VALUE FRAMEWORK

Suppose the sponsor wishes to fund the plan. This can be accomplished without changing the sponsor's cash on hand by issuing debt in the capital market to fund the pension. Suppose the sponsor issued debt  $D * (1 - T)$  to the capital markets and used the debt to fund the pension in the amount  $D$ . Equation (5) would now change in four ways:

1. The unfunded pension liability is reduced by  $D$ .
2. The sponsor is now required to repay the loan to the debt holders with interest at the end of the year. Assuming the sponsor does not default on this obligation, the sponsor has assumed a liability equal to  $(1 - T) * D * (1 + (1 - T) * r_c) * V$  where  $r_c$  is the sponsor's borrowing rate in the capital markets.
3. The underlying asset of the put option in equation (5) is now  $A + D$ .
4. The sponsor has probability of default of  $\lambda$  on the capital market debt. This can be expressed as a shareholder asset of  $(1 - T) * D * (1 + (1 - T) * r_c) * V * (\lambda)$  which can be approximated as  $(1 - T) * \lambda * D$ .

Thus, we can rewrite equation (5) as follows

$$SV_D = [(A_0 + D - L * V) * (1 + VRP * V - \phi) + (\lambda - \phi) * P_{A+D} - D * (1 + (1 - T) * r_c) * V + \lambda * D] * (1 - T) \quad (6)$$

If we define the quantity  $CS = r_c * (1 - T) - r$  for corporate credit spread, we can reorganize equation (6) as follows:

$$SV_D = SV_0 + [D * V * (VRP - CS) + (\lambda - \phi) * (D + P_{A+D} - P_A)] * (1 - T) \quad (7)$$

We can simplify equation (7) by again invoking put-call parity (equation (4)):

$$SV_D = SV_0 + [D * V * (VRP - CS) + (\lambda - \phi) * (C_{A+D} - C_A)] * (1 - T) \quad (8)$$

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Similar to equation (5), equation (8) is both intuitive and important. It tells us that borrowing to fund the pension changes (pre-tax) shareholder value in two ways:

1. Shareholder value is increased by  $D*V*(VRP-CS)$ . On the one hand, shareholders benefit by no longer being required to pay PBGC premiums on the piece of the unfunded liability that has been funded. On the other hand, the sponsor must pay a credit spread on the money borrowed.
2. Shareholder value is increased by  $(\lambda-\phi)*(C_{A+D}-C_A)$ . On the one hand, borrowing increases shareholders debt which increases the payoff of the default option in a default scenario (represented here by  $\lambda$ ). On the other hand, funding increases the cost of surplus sharing (represented here by  $\phi$ ). The term  $(\lambda-\phi)$  is multiplied by the change in the value of the call option since both of these aspects only apply if the plan ends the year in a surplus position<sup>4</sup>.

**Annual Increase in pre-tax shareholder value in 2016 (PBGC VRP=2.9%)**

Increase in SV (\$MM)	Risk-free rate					
	0.00%	1.00%	2.00%	3.00%	4.00%	5.00%
0.00%	\$29	\$32	\$35	\$38	\$41	\$44
1.00%	\$23	\$26	\$29	\$32	\$35	\$38
2.00%	\$16	\$19	\$23	\$26	\$29	\$32
3.00%	\$10	\$13	\$16	\$19	\$23	\$26
4.00%	\$3	\$6	\$10	\$13	\$16	\$20
5.00%	(\$4)	(\$0)	\$3	\$7	\$10	\$13

Credit spread (pre-tax)

## PART IIB – IMPLICATIONS OF PBGC VRP FOR PLAN FUNDING

Using the nomenclature and results developed in Part IIA, we can now say the following:

Plan sponsors should borrow to fund unfunded pension liabilities if the sponsor's after tax credit spread is less than the variable rate premium

We can see this result in equation (8). It would make sense for the sponsor to borrow to fund the pension whenever  $SV_D - SV_0 > 0$  or whenever

$$SV_D - SV_0 = [D*V*(VRP-CS) + (\lambda-\phi)*(C_{A+D} - C_A)]*(1-T) > 0 \tag{9}$$

Based on the logic we developed in Part IIA, the term  $(\lambda-\phi)*(C_{A+D} - C_A)$  is always nonnegative. This can be reasoned as follows:

- If  $\lambda > \phi$ , the term is nonnegative because  $C_{A+D} \geq C_A$ .
- If  $\phi > \lambda$ , this implies the case of the risk averse sponsor. In that case, we reasoned above that the sponsor should seek to minimize the risk in the plan by investing the plan assets in risk-free securities. In that case,  $C_{A+D} = C_A = 0$  so the term is zero.

Thus we have that

$$SV_D - SV_0 \geq (D*V*(VRP-CS))*(1-T) \tag{10}$$

$VRP > CS$  is a sufficient (though not necessary) condition for the sponsor to borrow money to fund the plan. Plugging in our definition of  $CS$ , we arrive at our conclusion: whenever the following equation holds, the sponsor should borrow money and fully fund the plan to avoid paying PBGC premiums:

$$VRP > r_c * (1-T) - r \tag{11}$$

## PART III: QUANTIFICATION

We quantify the annual pre-tax shareholder value created by the sponsor's borrowing \$1 billion to fund a pension plan in 2016, assuming 0 percent inflation and a 35 percent corporate tax rate. We use equation (8) assuming  $\lambda = \phi$ .



## CONCLUSION

In conclusion, we find that a shareholder value framework supports borrowing to fund the pension for almost all tax-paying sponsors, in spite of concerns about surplus sharing risk. We showed this result mathematically in section II above. Intuitively, we can think about two different types of pension plans:

1. For sponsors where surplus sharing is a significant concern ( $\phi > \lambda$ ), we showed in section I that derisking the plan increases shareholder value. After derisking is complete, surplus sharing is a minor issue so does not have a material impact on the funding decision. In that case, we showed in section II that borrowing to fund increases shareholder value for almost all tax-paying sponsors by reducing PBGC premiums and providing a tax deduction on the corporate debt interest payments.
2. For pension plans where surplus sharing is not a significant issue ( $\lambda > \phi$ ), the shareholder value framework may support increased risk taking as a method to maximize the value of the sponsor's put option on plan assets.

As noted in the introduction, this shareholder value framework can often conflict with the views of other stakeholders. Although these conflicts are beyond the

scope of this paper, the shareholder value model can also be used to highlight potential conflicts between different stakeholders, most notably plan participants whose interests can sometimes conflict with shareholders. ■

## ENDNOTES

<sup>1</sup> See for example W. Sharpe, 'Corporate Pension Funding Policy,' Stanford University, January 1976,

F. Black, 'The tax consequences of long-run pension policy,' Financial Analysts Journal, 1980

I. Tepper, 'Taxation and Corporate Pension Policy,' The Journal of Finance, March 1981,

B. Alexander, 'Gentlemen Prefer Bonds,' London Business School 2002.

<sup>2</sup> Technically, the PBGC premium is calculated off of the liability discounted at the PBGC interest rate but we use the risk-free rate here for simplicity. Reflecting the correct PBGC discount rate would not change equation (8) which is the article's key conclusion

<sup>3</sup> More precisely,  $\lambda$  is the probability of default adjusted for (1) the expected settlement rate on debt in bankruptcy and (2) the market credit risk premium

<sup>4</sup> If the plan ends the year in a deficit, there is no change to the sponsor's debt (and therefore default payoff) because the borrowing increases debt to debt holders but the funding reduces debt to plan participants

## On the Research Front

### PAPER SUMMARIZES NATURAL RESOURCE SUSTAINABILITY SUMMIT

The SOA's Research Department announces the release of a paper summarizing its December 2012 Natural Resource Sustainability Summit. The paper contains a synopsis of presentations and discussions and outlines many considerations for the SOA on natural resources sustainability and how actuaries might get involved in this area.

<http://www.soa.org/Research/Research-Projects/Risk-Management/research-2013-nat-resource-sustain.aspx>

### APPLYING FUZZY LOGIC TO RISK ASSESSMENT AND DECISION-MAKING

The CAS/CIA/SOA Joint Risk Management Section's new report explores areas where fuzzy logic models may be applied to improve risk assessment and risk decision-making. The report, authored by Kailan Shang and Zakir Hossen, discusses the methodology, framework and process of using fuzzy logic systems for risk management. An Excel tool showing examples of some simple fuzzy logic modeling is included.

<http://www.soa.org/Research/Research-Projects/Risk-Management/research-2013-fuzzy-logic.aspx>

# A New Normal in Equity Repo

By Anand Omprakash

**THE EQUITY DERIVATIVES MARKET**, on the surface, had a fairly uneventful year in 2013. In spite of concerns about the government's debt ceiling being breached and worries over potential Fed "tapering" of QE3, the VIX (the market's de facto "fear index") failed to significantly breach the 20-point handle at any point during the year. The historically low levels of volatility were largely the result of buoyancy in the equity markets, where the S&P 500 experienced its best return (30 percent) since 1997.



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Yet, there was one aspect of the equity derivatives space that was marked by watershed changes—the Delta-One market, particularly in *equity repo*. A confluence of balance sheet and

liquidity constraints (Basel III), coupled with unusual supply/demand dynamics in equity forwards, lead to equity repo rates breaching extreme levels. In fact, equity repo rates implied from total return swap (TRS) markets and listed futures reached record highs. The most significant moves have occurred on the EuroStoxx50E (SX5E), S&P500 (SPX) and Nikkei (NKY) indices across the whole term structure (from three months to 10 years).

## WHAT IS EQUITY REPO?

Before discussing the details of what happened in equity repo in 2013, it's useful to first start with a few reminders. For those familiar with repo markets outside of the equity market (particularly bond repo), it may be useful to think of equity repo in the context of secured funding rates.

In the equity derivatives world, the repo rate is defined as the spread, expressed as an annualized rate, charged over the borrowing rate to go *short*.

$$\text{FinancingCost} = \text{Interest rate} - \text{RepoRate}$$

By definition, the repo rate becomes negative when long synthetic equity financing is expensive. The interest rate benchmark is the overnight rate for daily

financing and LIBOR 3M for longer dated. Note that by this definition, the spread charged over 3M LIBOR to go long in a TRS is  $-\text{RepoRate}$ .

To fully understand how the repo rate fit into the delta-one market, it is useful to analyze repo in the context of forward pricing. Note that the traditional forward pricing equation, broken down into its three primary components (spot, financing cost and dividends)

$$\text{Forward} = \text{Spot} \times (1 + \text{FinancingCost} - \text{DividendRate})^T$$

reflects the fact that a forward seller can hedge his position by borrowing funds to buy the underlying security (or index).

While in derivatives textbooks the cost of financing is usually given as the risk free rate, in the real world a forward's implied financing cost can deviate from the market's risk free rate (as seen in the aforementioned equation).

If we adjust for this discrepancy, we can modify the forward price equation as follows

$$\text{Forward} = \text{Spot} \times (1 + \text{Libor} - \text{RepoRate} - \text{DividendRate})^T$$

Thus, in a sense, the repo rate, as defined above, is a correction term to the risk-free rate in the traditional forward pricing equation.

An equity forward's repo rate is heavily influenced by the fees earned from lending the underlying security in the securities lending market. The repo rate tends to be positive for specific stocks the market is looking to short (due, for example, to corporate events or bearish sentiment) and close to zero for stocks commonly owned by a large number of investors (like index components). The repo on an index is the average repo rate of the components. For SPX it used to be close to zero since most of the 500 components are not in high demand to be shorted.

When the repo rate is very negative on an index, as it currently is on major global indices (Chart 1), it reflects that demand to finance long positions in an underlying via derivatives outstrips the market's desire to provide such financing.

## THE GREAT REPO DISLOCATION OF 2013—A BALANCE SHEET PHENOMENON

As noted earlier, repo rates reached historical extreme levels across the major equity indices in 2013 (Chart 1).

While different regions have some unique drivers of repo, there are several global drivers responsible for the bulk of the moves.

Arguably the most important of these drivers are the *balance sheet* constraints (Basel III) that are currently being implemented by banks. The increased capital holding rules required by these regulations have hurt the banks' collective ability to facilitate Delta-One trades. The new requirements have constrained this facilitative ability because Delta-One products (on the long side) are, ultimately, *financing* trades that allow an end user to take a long position without using the end user's balance sheet (synthetic exposure).

To see why this is the case, consider what happens when a bank facilitates a simple Delta-One product, such as an Equity Forward. If Investor X buys a 1Y forward on SPX from Bank A, and there are no other market participants willing to take a short position on the forward, Bank A must hedge the position by buying the SPX's underlying constituents and holding this position on its own balance sheet. Because the stocks now on Bank A's balance sheet are not considered risk-free assets (such as cash), from a regulatory perspective, Bank A has increased its leverage, and must *deleverage its balance sheet* elsewhere to compensate.

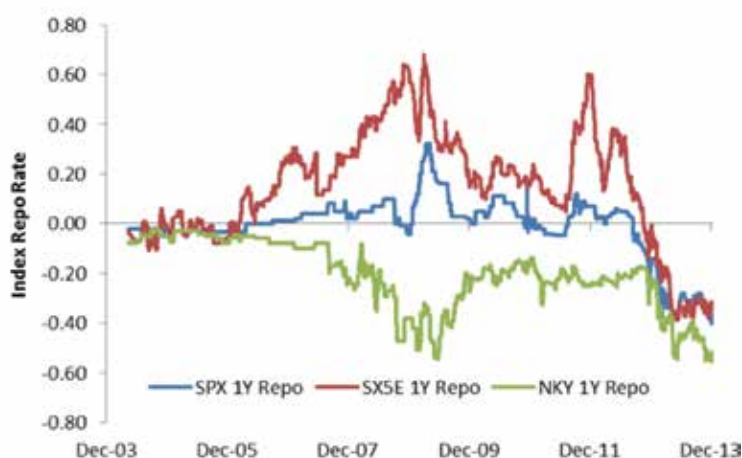
While the aim of regulators is for a well-capitalized banking system that can support the economy and the efficient flow of credit to consumers and companies, the initial effects of such regulations can lead to significantly disruption.

### ANCILLARY REPO DISRUPTING FACTORS

In addition to the constraints on banks' balance sheets, there are several ancillary factors that contributed to the repo dislocation.

In both Europe and Japan, 2013 witnessed a marked increase in demand for upside exposure via long-dated call options, which indirectly influence the repo market

Chart 1: 1Y Repo Rates Across Major Indices



Source: BNP Paribas

(via a call option's inherent long forward exposure). The increase in demand for call options was the result of a confluence of both macro and technical drivers.

With regards to Europe, note that prior to 2013, investors had become historically underweight European equities due to the recession in peripheral countries and concerns/uncertainty stemming from the sovereign debt crisis. Additionally, SX5E long-dated call option prices reached historic lows in 2013 (as a percentage of spot) due to ultra-low bond yields (which depressed SX5E forwards), low implied volatility and rising implied dividend yields. As a result, investors, looking to position on Europe's depressed equity valuation relative to global peers, began to buy long-dated call options to position for a European equities catch-up. This demand has pressured forwards up and, consequently, put downward pressure on repo rates.

In Japan, the introduction of "Abenomics" caused significant demand for short to mid-term forwards. Japanese equities have long suffered from low price-to-book multiples and depressed returns on equity given on-going deflation and the strength of the yen—a consequence of the "lost decade." However, the implementation of Shinzo Abe's policies by the new BOJ

CONTINUED ON PAGE 22

governor, Kuroda, through an unprecedented asset purchase program, has triggered a significant rally in the USDJPY. The weaker yen has had a dramatically positive impact on earnings for Japanese companies. Consequently, foreign hedge funds and asset managers have positioned on this development by purchasing tens of billions of dollars of notional upside exposure on the Nikkei via call option structures, creating substantial demand for Nikkei forwards.

Banks, due to constrained balance sheets, were not prepared to handle this increased forward demand, and repo rates consequently fell sharply.

While we highlighted Europe and Japan specifically, due to the macro and technical drivers influencing those markets, the increased demand for forwards was, in fact, a global phenomenon, albeit expressed differently in the United States. While in the United States, the dislocation in repo rates began with the short-term futures roll at the end of 2012, long-term repo rates truly collapsed after several asset managers, looking to be long SPTR and short duration (benefit if interest rates rise), bought substantial amounts of SPTR long-term forwards at the beginning of 2013 (instead of their usual positioning via TRS). With banks unable to provide the balance sheet required of such trades, SPX repo rates plummeted to historic lows.

Outside of the supply/demand dynamics, repo rates continue to be driven by other concerns, most notably a pronounced fear of further regulations and taxes (*Financial Transaction Tax or FTT*). The current draft of the FTT, as it stands, would dramatically impair credit markets and financing costs for both banks and non-financial institutions according to many reports (e.g., ICMA/European Repo Council report). Moreover, several high ranking officials including officials at the Bundesbank have voiced concerns about the current plans.

### EQUITY REPO STARTLING IN CONTEXT OF MACRO DRIVERS

The collapse of equity repo rates appears startling in

an environment of ample liquidity and unprecedented monetary easing by global central banks.

The “Hunt for Yield”<sup>1</sup> and collateral scarcity resulting from central bank actions (QE/LTRO), political decisions (austerity reducing EGB supply) and regulations (increasing capital requirements, CCPs, etc.) caused fixed income secured funding rates to fall. BNP Paribas rates strategists estimate a US \$2 trillion shortage of AAA/AA collateral, which is creating a “collateral squeeze.”

However, the repo dynamic witnessed in fixed-income conflicts starkly with what we have observed in the equity repo space, where the cost of funding for high quality equity has skyrocketed. In fact, some structured credit secured funding costs are now lower than those in equity: high yield, MBS and CLO collateral funding rates have fallen below equity funding rates. This is a result of the imbalance in supply and demand for quality collateral.

### THE GOOD, THE BAD AND THE UGLY

The dynamic between equity repo rates varies across regions and the magnitude of the dislocation corresponds largely to 1) the degree of uncertainty; 2) concerns of market participants. Consequently, the repo markets that offer the greatest opportunity also present the most risks.

**The Good:** We believe that the dislocation in long-term repo (due to the imbalance in long-dated forward demand) is likely to be absorbed over time by structural forward selling flows by U.S. insurance companies (who hedge their variable annuity exposure).

**The bad:** The Nikkei repo rate dislocation is mostly the result of demand for short to mid-term upside exposure from global macro funds, the result of ongoing currency debasement by the Bank of Japan. Domestic investors and pension funds are still under pressure to increase their equity allocation to equities over time.

**The Ugly:** SX5E repo markets are facing a wide range of issues, including regulation/taxation concerns, bal-

ance sheet deleveraging and dis-intermediation. The complexity of these issues can explain the steepness of the TRS spread term structure.

## IMPACT ON DELTA HEDGING PROGRAMS.

**Lock-in long-term SPX repo rate:** For investors who are generally short the SPX, the most straightforward way to take advantage of the dislocation is simply going short SPX via a long-term TRS to lock-in the elevated financing spread. By locking in such rates, an investor can also avoid the volatility present in short-term repo (Chart 2).

The SPX TRS is bid indicatively at 3mL + 36bps from three up to 10 years maturity.

**OTC combos instead of rolling futures:** While we have spent much of this piece discussing the changing dynamics of long-term repo, we note that short-term maturities have not been spared from the turmoil. As illustrated in Chart 2, short-term equity repo has been significantly volatile over the last year. We expect this elevated level volatility to persist for the foreseeable future, largely due to our aforementioned concerns, many of which remain ongoing.

The volatility in short-term repo represents a concern for a large segment of equity investors. Note that the volatility of short-term repo can make rolling long futures position through the screen difficult, especially when rolling large notional sizes. To help alleviate these potential difficulties, we suggest that investors consider using OTC combos as an alternative “synthetic long”. Combos, due to their OTC nature, often allow investors to roll larger size more easily, and oftentimes with a tighter bid/ask spread.

For those not familiar with the Combo structure, it basically entails being long an index call and short an index put of the same strike and maturity (a long combo). Note that because of the “put-call parity” concept in options pricing, a Combo effectively provides an exposure to the index forward of that maturity. To wrap up, an OTC combo provides OTC synthetic long exposure

Chart 2: SPX Short and Long-Term Repo Rates



Source: BNP Paribas

while futures provide a listed synthetic long exposure.

## CONCLUSION

It's important to realize that while distortions in equity repo market might only appear to interest funds that solely trade distorted parameters, the implications of repo market volatility stretch far beyond such “fast money” investors. Distortions in the repo parameter make their way into the pricing of virtually any derivative structure, across both Delta-One and volatility-oriented products. While ongoing regulatory uncertainty suggests that repo could continue experiencing turmoil for the foreseeable future, strategies exist to mitigate the deleterious effect of volatile repo on derivatives end-users. We hope to have shed some light on the developments in equity repo, and some ways to position in response to such developments. ■

## ENDNOTES

<sup>1</sup> A phenomenon in which investor demand for safe yields across government and corporate bonds is generally driving the cost of funding lower.



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# Hedging Insurance Company Surrender Risk

By Moosa Aziz, Gregory Slawsky and Aurelien Villac

**INTEREST RATES HAVE BEEN IN A SECULAR DECLINE OVER THE PAST SEVERAL YEARS** and have remained below their long-term averages as central banks across the globe have embarked on asset purchase programs to jump start economic growth. While supportive to risky assets and the economy as a whole, this extended period of low rates poses significant challenges to the Insurance Industry. There is the immediate impact of spread compression as General Account portfolio yields approach statutory minimum crediting rates, but there is also the potential longer-term risk of policyholder surrender (or disintermediation) if rates sell off sharply.

In this article we will review the dynamics of surrender risk, briefly discuss current valuations in the Interest Rate option markets and present some tailored structured hedging instruments that can be used to manage this risk.

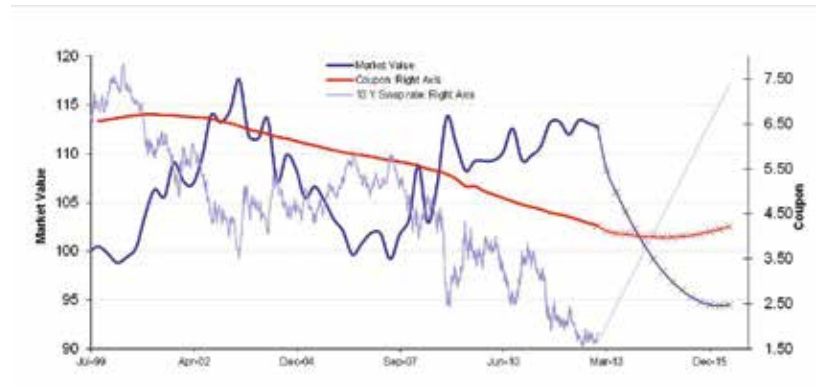
## SURRENDER RISK DYNAMICS

In *Chart 1* we demonstrate the dynamics of an insurance company general account by simulating the average coupon and market value of a synthetic general account (GA) portfolio<sup>1</sup>.

As market rates (light blue line) move lower, the average coupon of the general account (red line) also moves lower as maturing assets are invested at lower yields. In the event of a future selloff, the average coupon cannot keep up with market yields and policyholders ultimately have an incentive to surrender their policies. This forces the insurance company to sell assets when their market value (dark blue line) is trading below par.

Insurers have traditionally hedged surrender risk in the interest rate options market and current options valuations suggest that it is still a good time, on a historical basis, to consider adding protection.

**Chart 1: Impact of Rising Rates on a Synthetic General Account Portfolio**



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## INTEREST RATE OPTION VALUATIONS

In *Chart 2* below we show the history of 1Y maturity options on 5Y, 10Y, and 30Y swaps. Implied volatilities are currently quite low in relative terms and have been lower on just two occasions since 2000. The first was during the pre-Lehman crisis period when liquidity was abundant and there was little risk premium in the market. The second was during the second quarter of 2013 when rates were at multi-year lows and the market was convinced that the Fed was going to be purchasing assets over the long term. While past performance is not indicative of future behavior, a review of historical record suggests meaningfully lower levels in 1y volatility are not likely.

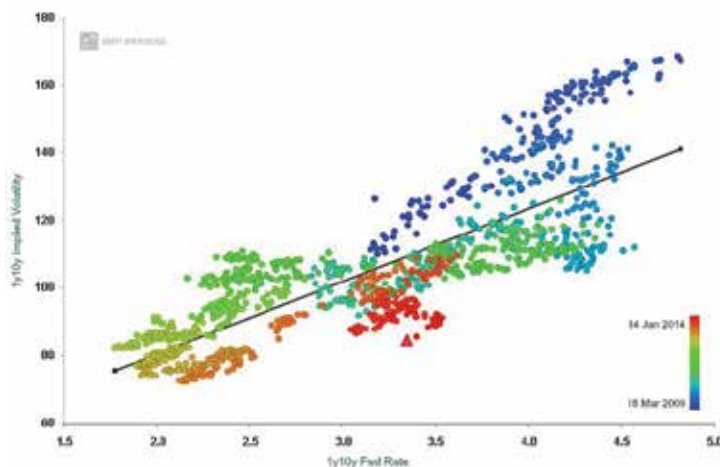
**Chart 2: Swaption Implied Volatilities (1Y Expiry)**



Source: BNP Paribas Global Markets

An alternative way to gauge the fair value of option pricing is to look at the relationship between forward rates and implied volatility. We specifically look at 1y10y forward rate versus 1y10y implied volatility in *Chart 3*. This chart suggests that implied volatility is cheap relative to the current level of rates since the Fed committed to Quantitative Easing in 2009.

**Chart 3: 1y10y Fwd Rate vs 1y10y Implied Volatility**

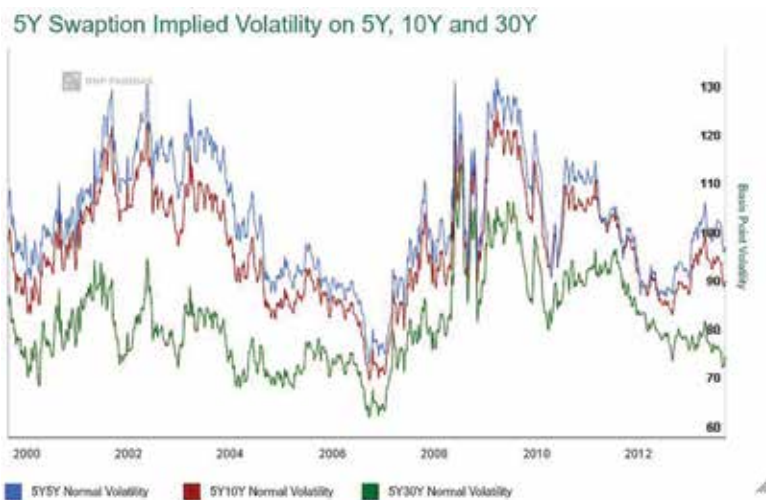


Source: BNP Paribas Global Markets

“ Insurers have traditionally hedged surrender risk in the interest rate options market and current options valuations suggest that it is still a good time, on a historical basis, to consider adding protection. ”

The history of longer-dated volatility, specifically 5Y options on 5Y, 10Y and 30Y swaps, is shown in *Chart 4*. Here the picture is somewhat more mixed as longer-dated volatility is low relative to levels observed over the last five years BUT is still higher than pre-crisis levels. This owes largely to the absence of Structured Note issuance which has historically provided supply of longer-dated volatility into the market.

**Chart 4: Swaption Implied Volatilities (5Y Expiry)**



Source: BNP Paribas Global Markets

However, while longer dated volatility does not exhibit the same relative cheapness that we see on the short end of the volatility surface, it is still well below post-crisis levels. Furthermore, given the FOMC’s tapering of their asset purchase program, one could certainly argue that implied volatilities could richen in the near term. This brings us back to our fundamental point—it is (still) a good time to hedge.

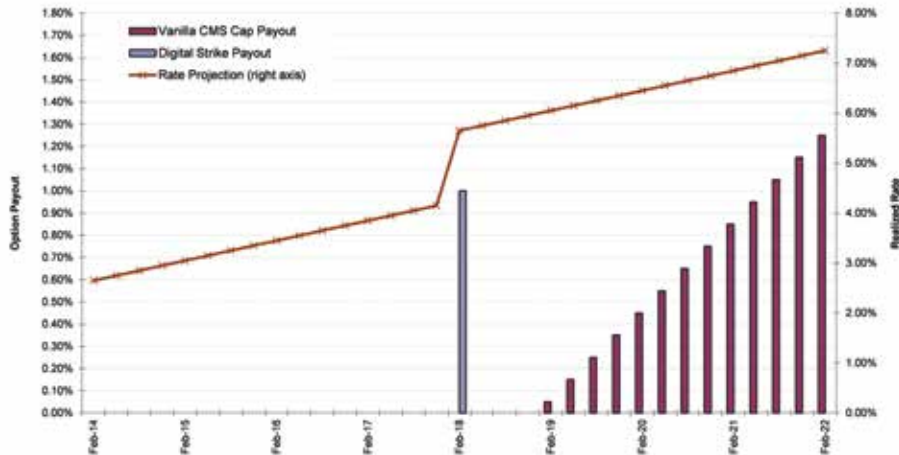
## SURRENDER RISK HEDGING SOLUTIONS

As we alluded to earlier, surrender risk is well understood by the industry and many Insurance Companies do continue to buy high strike interest rate options (payer swaptions and CMS Caps) to protect against a move higher in rates. However, as one analyzes the available hedging alternatives, it is worth considering structured solutions that could provide more tailored protection at a lower cost. After all, while Constant Maturity Swap (CMS) Caps will protect against higher rates, given the path dependency<sup>2</sup> of the underlying surrender risk, they may be a fairly blunt and costly instrument.

An ideal alternative to hedge such a path dependent risk would be a digital option that paid the option buyer a lump sum (1.0 percent of notional in our example) in the event that market rates moved significantly higher in a single three month period. The payout diagrams in *Chart 5* highlight the difference between the standard CMS Cap hedge and the “ideal” Digital Option hedge under a stylized interest rate scenario. Both the CMS and Digital Caps start 3Y forward and end 5Y after their start date with 20 quarterly observations. The strike of both the vanilla and CMS caps is 6 percent. The CMS cap has a standard linear payout while the Digital Cap pays 1 percent of the notional amount if rates move up by 1 percent in a single quarterly observation period. In this example, the insurance company receives the option payout precisely when they expect to experience surrender

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**Chart 5: Payout of Digital Cap versus Vanilla CMS Cap under a Stylized Rate Scenario**



Source: BNP Paribas

on their general account portfolio. However, while this solution may be ideal for the insurance company, in practice it is extremely difficult for option desks to risk manage this type of digital, forward volatility product and therefore most desks are unwilling to offer this structure in any meaningful size.

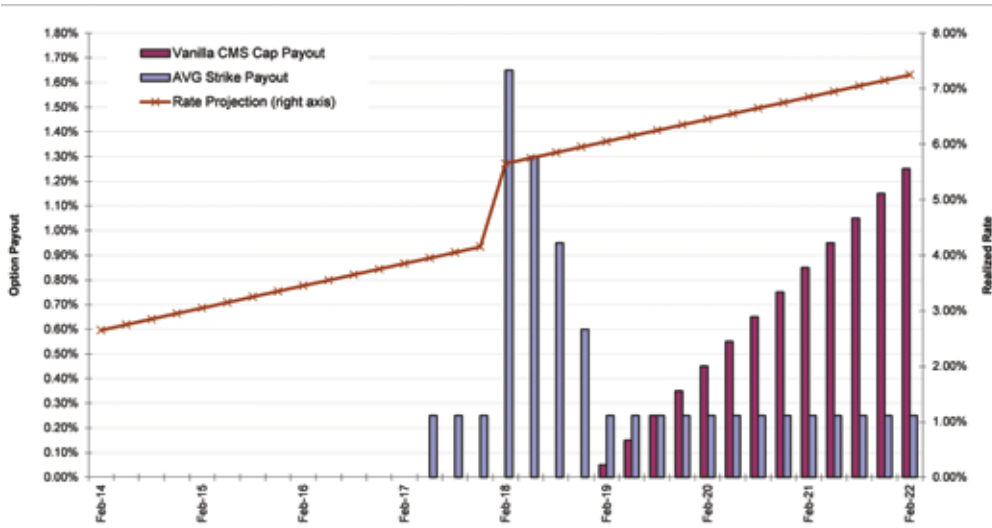
The goal then is to find a hedging structure that addresses both considerations. A structure that contains some path dependency to match the underlying surrender risk but does not leave option desks exposed to large digital risk on forward volatility. One possible alternative is an averaging strike cap. The averaging cap pays out if the rate in the current period is higher than the average rate over the past four observation periods. As shown in *Chart 6*, this structure provides a larger payout to the option buyer when there is a significant jump in rates in comparison to a vanilla cap. However, the averaging rate cap will have a lower payout than a vanilla cap if rates are high but are increasing gradually. Importantly, the averaging feature smoothes out the path dependency making the structure easier to risk manage and, consequently, easier to offer in larger size.

Another alternative structure that insurers can consider is a knock out cap. As shown in *Chart 7*, this structure has the same payout as a vanilla CMS cap so long as the underlying interest rate



“ The goal then is to find ... a structure that contains some path dependency to match the underlying surrender risk but does not leave option desks exposed to large digital risk on forward volatility. ”

Chart 6: Payout of Averaging Strike CMS Cap versus Vanilla CMS Cap under a Stylized Rate Scenario



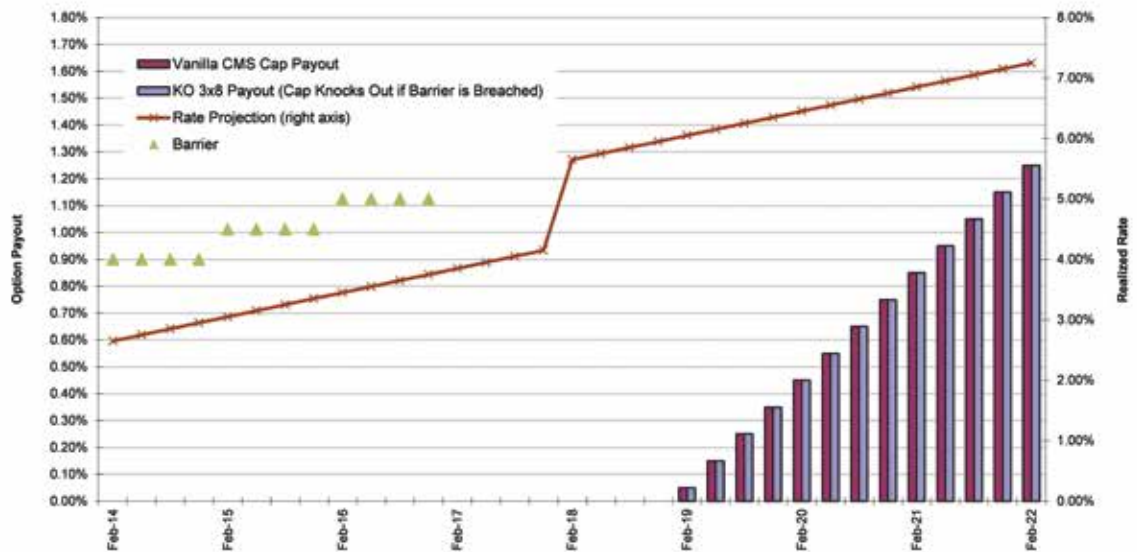
Source: BNP Paribas

does not break the “barrier” in the first three years. In this case, the insurance company is effectively selling the scenarios in which rates move higher in the near term in order to cheapen the protection in the medium and longer term. The knock out cap with barriers set at 4 percent, 4.5 percent and 5 percent for Years one through three respectively costs roughly 25 percent of the cost of a vanilla cap with the same strike. This structure may appeal to those who are of the view that the economic recovery will be tepid for the next few years and rates will remain low in accordance with the forward guidance being provided by the FOMC.

These structured products represent just two examples of how hedging solutions can be tailored to meet the specific needs of an insurance company. However, as we have highlighted, the important consideration when selecting a hedging instrument is to balance the dynamics of the underlying risk that is being hedged with the ability of the market participants to provide liquidity in the necessary size.

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**Chart 7: Payout of Knock Out CMS Cap versus Vanilla CMS Cap under a Stylized Rate Scenario**



In conclusion, valuations in the interest rate options markets are currently attractive relative to recent history. With the Federal Reserve initiating the unwind of its extraordinary quantitative easing program, there is potential for volatility markets to reprice higher. Given this backdrop, insurers should review their hedging programs to ensure they have sufficient coverage. In addition to vanilla instruments, insurers should also consider tailored solutions, such as the ones presented here, that more closely hedge the path-dependent risk that drives policy surrender.

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#### ENDNOTES

- <sup>1</sup> The synthetic portfolio replicates the performance of a laddered bond portfolio invested equally across the USD swap curve with a weighted average maturity of five years
- <sup>2</sup> The path dependency of the liability implies that there is an increased likelihood of surrender when rates rise rapidly as the GA portfolio crediting rate cannot keep up with market rates.

# Talk with a Risk Management Guru—Interview with Mike Smith

By Josh Rundle and Winnie Chen

**Josh:** It's a pretty exciting time for you and your company this year. This year will be the year that your company is transitioning from ING to Voya after quite a bit of anticipation. I really like the new name as it seems to capture what the industry is all about. Whether it is insurance, investments, or retirement savings, it really highlights the fact that as we roll along on this journey, you want to feel secure. Tell me a little bit more about why you are excited for this year's transition and what the name Voya means to you?

**Mike:** Well, I think for me, having joined what was then ING 5 years ago and seeing the transformation from where we were, which was a company that has just accepted substantial amount of aid from the Dutch State and was going through a challenging process to determine what it was going to be in the future. Now, we've had a successful IPO. We've gone to the capital market for a number of very successful capital races. I think the world understands our story and our employees do, too. Now that the preparation work is done, we are shifting our focus to executing and delivering on the things we told the outside world we were going to do. That's the exciting part now.

**Josh:** ING has a few different campaigns that I particularly enjoyed, being part of the industry and as an actuary. One of the campaigns I really like is the Orange Money campaign. Not only is it humorous, but it does a good job of getting people thinking about where their money is going and how it impacts their retirement outlook. But the one I want to briefly hit on is ING for Life. Maybe it's partially a generation thing, but I really enjoyed the experience on the website. It feels as though you are almost catering a product specifically for me. Can you tell me a little more about where you see technology like this taking us in the years ahead and how it might change the landscape of the industry?

**Mike:** Last week I changed roles to become CEO of ING U.S.' Insurance Solutions unit, so the ING for Life is directly within my new responsibilities. Stepping back for a minute, life insurance ownership is at the lowest level since World War II. Some estimates of the protection gap range into the trillions of dollars. While



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as an industry this is clearly an opportunity, there is also a societal problem here. We have tens of millions of individuals who are not protected and are not taking advantage of some of the other opportunities that come from a solid life insurance and financial plan. I think there's a great opportunity for us as an industry and Voya particularly to build on tools like ING for Life to reach more of the millennials, if you will. To younger people and people who don't think they can afford it or have children not to afford it, ING for Life can help them understand and demystify life insurance and also help get their heads around retirement savings through the use of Orange money. I think that's a primary challenge for us as a company and one that we are focused on.

The thing about ING for Life that I like is that it does capture the audience really well. The thing we need to continue to improve on is that it doesn't necessarily lead to a place that is fully satisfying for the person. It is the great tool to build awareness. We will continue to do that. We just need to take it to the next step.

**Josh:** Is the goal to make a direct-to-consumer sales channel more prominent by means of technology?

**Mike:** Well I think we need to recognize that we have an important relationship with our distribution partners that we need to continue to honor and work with. But there are also parts of the population that just aren't adequately served. We need to find ways to make sure they are getting served, either by helping the distribu-

CONTINUED ON PAGE 32

tion partners reach them or finding another means. I am not saying we are going direct. We have a lot of customers that need our product. And they are not finding their way here so we need to collectively find the way to get them there.

**Josh:** If you don't mind, let me take a step back. You came to ING in the heart of the financial crisis. What attracted you to ING at this point in your career?

**Mike:** Well, I would say it was a combination of things. Primarily, out of chaos comes opportunity. I thought I could add something to the organization that it needed. From a professional level, it was a great chance to go somewhere and bring my experience to bear.

**Josh:** We mentioned that you entered ING in the middle of the financial crisis. How did entering ING at that particular moment change your thoughts about risk? How did it make you a better CRO as you later took on that role?

**Mike:** First of all, my prior company, which I have nothing but admiration for, didn't have a distinctly articulated risk function. It was instead embedded throughout the business. I was impressed by how the risk function in ING was fully separated from the rest of the business and how that was envisioned to work. I was also intrigued by the three lines of defense model. Also, my prior experience of having risk deeply embedded into business helped me find what I would call a middle ground, which is a risk function that is independent, can raise objections and isn't fully ruled by the business. But at the same time, a big part of our mission is to make sure the business is thinking about risk themselves and are not looking to us as merely a gatekeeper. We are not the people that say yes or no. We advise—what the risks are and what are the best ways to navigate them. We work with the business to find a balanced solution to achieve the goals of the overall organization. I feel we have created a very effective Risk team that is a key member of every business unit. We get listened to. We have a strong influence over where the organization is going. We are not just an aggregator of risk data. We are a partner. I think that's really critical.

**Josh:** This is a good transition to my next question. We know that ING will be transitioning from a Dutch subsidiary to an independent U.S. based company. Can you tell us about how coming from a Dutch subsidiary better positioned the company from a risk standpoint and how it will change your thinking going forward?

**Mike:** I would say this is not so much about being Dutch than it is about European. The heritage of a fully articulated risk function with a lot of emphasis on economic measures has put us ahead of the game in some aspect. I think there are some things we need to modify and will have the freedom to do so. We will also be able keep the things we find really useful. We will spend less time focused pure market value measures, which showed some weaknesses during the financial crisis. In other words, I think we have a chance to use the best of both worlds. I think the other transition for us is from a European parent that had ample capital, and had given us a very clear mandate to grow to one where capital is limited and we now access the capital markets directly. As a result, we have a whole different set of external stakeholders to get used to. It is a very different set of communications both in terms of style and content to the outside world versus talking to a European parent. The questions that we're asked are very different. The focus is very different.

**Josh:** How much do you see yourself using the market consistence methodology going forward?

**Mike:** I think we will use it in spots. We find it helpful in pricing. It helps us filter out potentially unpriced options that we have sold to policyholders. We can make better economic decisions that way. I think we will use some of those elements in our capital assessment.

**Josh:** You spoke at the annual meeting on ERM. There are a couple of thoughts that I want to touch on. Actuaries like to use large complex models and very sophisticated metrics that some may say are difficult to understand. From your experience on both sides of the table, how does a young actuary go about tackling complex risks while still maintaining the simplicity needed

to help senior level management quickly grasp concepts and make decisions accordingly?

**Mike:** A couple of things. Align the things you are measuring with those things that management views as important. And there are two ways to do that. One is to define the risk measure and embed that into management objectives. That's an approach I've seen done. We chose a different approach, which is to understand the exposure to things that management already cares about, like capital and earnings and show what can happen under various conditions. Use scenarios feel real, I think it's very hard to relate to events that we present as 1 in 200 or 1 in 500. It's just too easy for management to say that will never happen. If you start with the 1 in 5 or 1 in 10, then go to 1 in 20, and build momentum that way. The way to really be accepted is start by building risk metrics that management relates to and lead the organization to make decisions in light of those matrix.

**Josh:** I think that is some great insight for younger actuaries. Let's dig just a bit deeper on that. How would you recommend relating to management and gaining credibility in an often limited amount of time?

**Mike:** This is another thing I mentioned in my presentation. Know your audience. You can't make an effective presentation if you don't know where they are coming from. You can't be influential if you don't understand what is important to them. Once you know that, you can find ways to help them understand risk in the context of the things that are important to them, what they need to be worried about and how we can collectively try to solve the problems.

**Josh:** I really appreciate you taking the time, especially during quarter-end, to talk to us about risk. One last question relating to your success in the industry coming from an actuarial background; What is a key piece of advice that you would give a young actuary, early in their career, that will help them gain a "Big Picture" mentality that will ultimately help them progress throughout their career?

**Mike:** First of all, you have to want to do that. For many in our profession, it's very comfortable to stay in the details and there is nothing wrong with that. But if you are aspired to be a business leader, your actuarial training is an enabler. Also seek out other learning opportunities as you go through the career. Focus on expanding your knowledge more than about progression up through the ranks.

One mistake a few people make is when they have the opportunity to move into a new business, maybe move from finance to a product area, but at the same level they ask "Why would I take this if it's not a promotion?" The better way to get to a position where you can get the bigger promotion is to have a broad skillset. The way I have approached career decisions is to focus on whether there is an opportunity for me to continue to learn. If I felt I was in role where my pace of learning had slowed, I would start watching for new positions and talking about other opportunities. I would look for opportunities that would be new and different, either in terms of subject matter, function, and then if there's a management opportunity, then what can I learn from the management perspective?

**Josh:** Thank you very much for your insight today. It is certainly appreciated.

**Mike:** I wish you the best of luck. ■

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