

Risk management



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Risk management

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ARTICLES NEEDED FOR RISK MANAGEMENT

Your help and participation is needed and welcomed. All articles will include a byline to give you full credit for your effort. If you would like to submit an article, please contact Ross Bowen, editor, at Ross.Bowen@allianzlife.com

The next issues of *Risk Management* will be published:

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PREFERRED FORMAT

In order to efficiently handle articles, please use the following format when submitting articles:

- Word document
- Article length 500-2,000 words
- Author photo (quality must be 300 DPI)
- Name, title, company, city, state and email
- One pull quote (sentence/fragment) for every 500 words
- Times New Roman, 10-point
- Original PowerPoint or Excel files for complex exhibits

If you must submit articles in another manner, please call Kathryn Baker, 847.706.3501, at the Society of Actuaries for help.

Please send an electronic copy of the article to:

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Letter from the Editor

By Ross Bowen

WELCOME TO THE JUNE ISSUE OF RISK MANAGEMENT!

Barely a week passes without a news story breaking that affects the insurance industry and the world in a new and unexpected way. Our newsletter intends to collect the best ideas we have in our profession for recognizing, anticipating, and reacting to these surprising events.

The Joint Risk Management Section is a collaborative effort of the SOA, CAS, and CIA. The *Risk Management* publication is well positioned to support the four main objectives of the section:

- To increase the level of communication and interaction with section members;
- To expand ERM educational opportunities for section and SOA members;
- To continue to foster risk management research; and
- To support the SOA's initiatives in promoting the actuarial profession as risk managers.

In this issue, Jeremy Waite and Andy White have written a useful article summarizing a risk management project undertaken by a working party of the International Actuarial Association. The resulting article is intended to be a platform for analyzing and responding to risk through a Comprehensive Actuarial Risk Evaluation (CARE). One day it may lead to a standard for risk assessment.

Larry Rubin and Victor Shi have written an article encouraging us to rethink our risk management strategies while the dust is still settling from the global financial crisis (if it is over!) One recommendation they make is to avoid short term-ism and take a long term view of the markets.

Effective risk management isn't about predicting the future; it is about preparing for what is possible.

Dr. Stephen Hiemstra has contributed an article, "Putting the System Back in Systemic Risk." He suggests management approaches for dealing with systemic risk and gives us a logical way to break down the analysis of risk in a step by step fashion. Efficient organizational learning is the key to survival.

Victor Shi partnered with Yungui Hu to produce a second article for this edition. "Risk Surface—Chart Your Risk Profiles," describes a tool for risk communication that can help practitioners illustrate the tail exposures we face when our sources of risk come from many places. Their approach can be much more illustrative than the more common deterministic scenario approach of showing optimistic, best guess, and pessimistic futures.

With this June issue of *Risk Management* I'll be taking over as editor. Sim Segal has done a great job managing this publication and I'll look to carry on his good work. Please help by submitting articles to the newsletter in the future. Besides general risk management articles, we are looking for articles related to Risk Identification, Risk Quantification, Risk Response, and Risk Culture and Disclosures.

Enjoy this issue of *Risk Management*!



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Being Active In the Risk Space

By Matthew Clark

I AM SITTING IN O'HARE AIRPORT ON MY WAY HOME FROM THE ERM SYMPOSIUM with the deadline for my "Chairperson's Corner" submission looming. Between the JRMS face-to-face meeting and the symposium, I realized how the people in front of me have had an impact on the actuarial risk space. The advancement of the profession is in our hands and I often take that for granted. In this column I will talk about how you can make a difference and leave your mark.

PARTICIPATION

Participation is the first and most important step. The ERM Symposium is the crown jewel of the actuarial risk space. The talent that converges on Chicago every spring

is second to none. This event provides insight into cutting edge techniques and thinking in risk across the life, banking, and property and casualty industries. The sessions are just half the fun. The social inter-

action is unlike other actuarial functions. Just walking between sessions the conversations are filled with energy and information. If you have missed this event in the past, I encourage you to add it to your calendar for 2011.

By the time this issue is published, another exciting risk event will have passed. In May the Systemic Risk Summit will take place in Atlanta. What makes this an event worth mentioning is the collection of speakers as well as the format. This event is aimed at the serious practitioner with an even balance between speakers and discussion. The interaction and thought provoking conversation make this event another can't miss on my calendar. If you miss these events, the Joint Risk Management Section is also sponsoring several sessions at each of the SOA/CAS/CIA meetings throughout the year.

On a daily basis, there is still the INARM list serve. Seldom does a day go by without a thought provoking conversation in the risk space. This group covers a wide

range of risks by a variety of practitioners. If you are not already a member, I encourage you to join and participate in this group.

EDUCATION & RESEARCH

I may be preaching to the choir, but I cannot address the development of the risk space without focusing on the Chartered Enterprise Risk Analyst (CERA) credential. Over the past several years this credential has evolved and received global attention. I encourage both students and experienced actuaries to consider the CERA credential. It is important to keep up to date on the evolution in risk techniques and methodologies. The ERM Symposium and related meetings are key forums to continue that educational process.

The SOA sponsors numerous research opportunities through each of the sections. The JRMS has several research projects in different stages in process. Keep your eye open for future projects that may be of interest to you.

VOLUNTEER

By the time this issue is released, the SOA section elections will be upon us. I encourage each of you to exercise your right to vote. For those of you who are running for a position on a section council, I commend and thank you for your contribution to the profession. It takes the dedication of many people to support the many activities and initiatives of the section. While the elections are held once per year, there are still many opportunities for you to give back to the profession. Some suggestions include:

- Join a project oversight group for a research opportunity
- Contribute an article to this newsletter
- Join the ERM Symposium planning committee
- Volunteer to speak at an industry event

While volunteering is a personal decision and requires a personal sacrifice, I can say that I have found the experience very rewarding.

As usual, we have another great issue that I hope you enjoy! ■



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Commuting and ERM

By Steven Craighead

ANALOGIES, I love analogies. I use them to understand, discover interrelationships and explain complex topics, especially now in ERM.

The most fruitful that I have found is to compare ERM issues, strategies and scenarios to the process of driving to work on a four-lane highway. Every day, I try to arrive at work as quickly and as safely as possible and I must be aware of my surroundings to be able to do this.

When driving, there is a dynamic interplay between capacity, conditions and behavior. For instance, capacity is related to the number of lanes available and the traffic volume. Obviously you can get to work faster if there are fewer cars where there are wide stretches of clear pavement, but then suddenly pockets of congestion appear because of the behavior of other drivers. Realize that it only takes four drivers going the same speed in the four separate lanes to completely block traffic flow.

Varying road conditions are influenced by the weather, the quality of the tarmac, accidents and police patrols. When the weather is bad, the commute time will go up. If the far right lanes are filled with potholes, more drivers will drive in the left lanes. An accident will bring everything to a halt and police presence slows everything down, which can be both good and bad.

Individual behavior could range anywhere from extreme fear to testosterone fueled road rage. Add cell phone use and text messaging to this and things can really get bad. Remember that the driver's behavior is also influenced by road capacity and the conditions. The juxtaposition of all of the separate individual's behavior then leads to both the wisdom and the madness of crowds.

Bringing all of this together you have a rich, dynamic and frustrating system. Over time, if you observe the mob, the traffic patterns, varying conditions and your own reactions, you are able to create strategies that improve your drive time on average (or at least you think so).

For instance, finding the fastest route while avoiding traffic is like developing a strategy to enter a new market or issue an IPO—requiring an understanding of the current economic conditions, regulatory control and your competitors' behavior.

How do you handle slow and extremely cautious drivers in every lane of the highway? Does your strategy address the competitors that don't understand the business or the greedy and testosterone fueled ones who cut corners and take advantages of the system? How does your strategy address accidents that arise from a confluence of unfortunate events? Horrible things happen just from the bad actions of just one individual. Are you prepared for this? The one in one hundred year events seem to happen more and more frequently. Also, the police are out in numbers and are watching. What do you do?

What type of vehicle do you drive? Is it a slow lumbering semi that takes 40 acres to turn around? Are you restricted by the all of the inertia, so you can barely go uphill and are out of control going down? Even though you have a greater vantage point being perched up high in the cab, does it really do you any good? Or do you drive a Viper? You are able to weave in and out of traffic, but end of being short sighted.

How do you drive? Are you aware of your surroundings or do you turn on your music, get in the far left lane and proceed to miss your exit? Or are you distracted with cell phone calls and text messages?

I could go on describing various strategies such as when at certain times and locations you want to be driving in the far left lane to avoid other drivers that are entering or exiting the highway. Or avoiding the lane where traffic always mysteriously slows at a certain time each day. Also, you don't want to get behind a slow lumbering school bus that has a governor on the engine. Each of these circumstances can easily be related to ERM issues, with a little thought.

I regret to say that I don't think quickly, but I do try to think deep. For instance, I didn't realize the value of the interplay between capacity, conditions and behavior in ERM until I discovered it from my daily commute.

Why don't you try this if you can and develop your own ERM thought experiments from what you learn? ■



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Putting the System Back in Systemic Risk¹

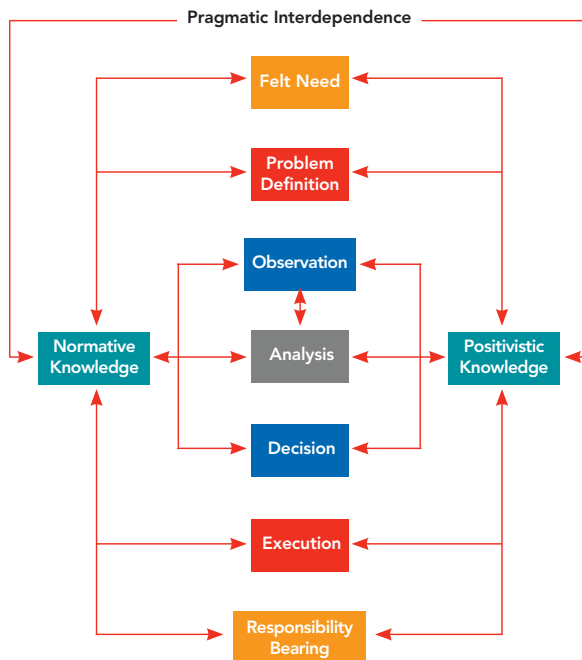
By Stephen W. Hiemstra

THE RECENT INTEREST IN ESTABLISHING A SYSTEMIC RISK REGULATOR BEGS THE QUESTION:

exactly what is systemic risk? The usual answer to this question is something close to “big, unanticipated loss.” Unfortunately, this is neither descriptive of a systemic crisis nor a statement of risk as a future loss requiring management response. This article discusses the system in systemic risk and suggests management approaches for dealing with systemic events. A key result is the question: How efficiently does your organization learn?

One approach to problem solving is to break a problem down into various steps: felt needs, problem definition, observations, analysis, decisions, execution, and responsibility bearing (see chart). I will take this approach as my outline in discussing systemic risk.

Steps in Problem Solving and the Knowledge Used



Sources: 1. Glen L. Johnson. 1986. *Research Methodology for Economists*. MacMillan Publishing Company, New York. P. 15. 2. John Dewey. 1997. *How We Think*. Dover Publications, Inc. Mineola, NY. P. 72.

FELT NEEDS

A felt need is an ill-defined problem. Over the past two years we have observed:

- The numerous losses seen across world markets suggest a continuing systemic crisis.
- This crisis is characterized by continuing economic under-performance with excessive debt, housing inventory buildup, and unemployment.
- The policy innovation has been unreflective with deadlock on substantive issues like healthcare, immigration reform, energy, war & peace, education, and pension reform.
- Many of the current issues have demographic roots as baby-boomers approach retirement.

A felt need leads to anxiety among observers and real losses in a business that does not have a strategy for dealing with the changes observed.

PROBLEM STATEMENT

The first step in moving towards a strategy for dealing with chaos is to define the problem. A problem statement should be interpreted as a tentative business strategy.

Linsky and Heifetz (2002) make an interesting distinction between problems that require no change in the fundamental approach to business (technical problems) and those that require adaption (adaptive problems). Generally speaking, organizations prefer dealing with technical problems and have trouble coming to terms with adaptive problems. This is, in part, true because adaptive problems are more disruptive and, in part, because they are more costly.

The recent crisis has these components.

- World economy is transitioning from closed national economies to open international economy. Theme: Law-of-one-price dynamics¹.

FOOTNOTES:

¹ This article summarizes comments given at Georgia State University at a workshop on Aug. 18 and 19, 2009 sponsored by the Enterprise Risk Management Institute International entitled: *Systemic Risks: Regulatory and Policy Responses*.

“Stability through change demands clarity about who you are and what you are trying to do.
—William Bridges (2003)”

- Likewise, participation in world leadership is transitioning from Cold-War dualism to Group of 8 (G8) to Group of 30 (G30). Theme: More people means more complex decisions.
- This financial crisis reflects, but is not the cause of problems. Theme: Philosophic transition from modern to post-modern era accompanies generational handoff.
- Change is evolving and dynamic. Theme: Learning to learn efficiently.

Systemic risks are inherently adaptive problems because the system—however defined—is changing and causing large losses to market participants. Organizations defining the problem in technical terms are essentially denying that the problem created is large enough to warrant the costs implied in organizational adaptation.

OBSERVATIONS AND ANALYSIS

Once a problem statement has been adopted, information needs to be gathered and analyzed in developing

an adequate response. In the current crisis, a number of observations are pertinent, including:

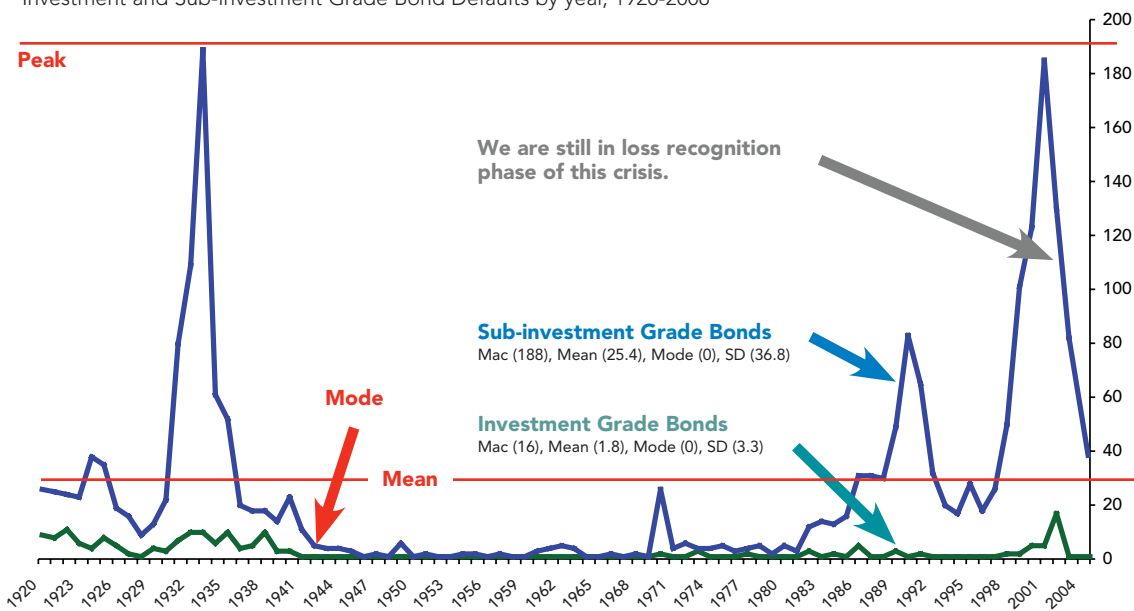
- Risk management has evolved into change management.
 - Qualitative processes are more important now than quantitative modeling because existing data are poorly suited to the current reality.
 - Dynamic models are harder to develop and maintain than static-equilibrium models.
- Systemic risk is no longer a 30-year flood problem and is subject to what engineers refer to as a peak load problem (see chart).

FOOTNOTES:

² International trade theory observes that only one price can exist in the world market for a given commodity, adjusting for transportation costs, uncertainty, and government interventions. This is referred to as the law of one price. The implication of this law is that as international markets are opened to trade, structural adjustments need to occur as countries become more specialized in taking advantage of open access to world markets.

Annual Corporate Bond Issuer Default Counts

Investment and Sub-investment Grade Bond Defaults by year, 1920-2008



Sources: Moody's Investor Services, Default and Recover Rates of Corporate Bond Issuers, 1920-2008. February 2009. Exhibit 22.

CONTINUED ON PAGE 8

PUTTING THE SYSTEM BACK IN SYSTEMIC RISK | from Page 7



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From the chart on bond defaults, we can make some significant observations, including:

- Investment and sub-investment grade loss distributions differ fundamentally.
 - Still, spillover (contagion) exists. Poor risk analysis, fraud, and dynamic factors can lead to a jump from investment to sub-investment grade.
- Mean is poorly matched with mode of loss distributions.
 - Losses in peak are clearly a large portion of total losses.
 - Mean/maximum ratio is roughly 1:8.
 - Distributional analysis may not be as helpful as seeing the loss distributions as having two-states.
- Systemic losses are no longer rare—suggesting, perhaps, a moral hazard problem associated with policy interventions since the 1980s.
 - 100-year floods should not occur every 10 years.

So, what is the “system” in systemic risk?

Financial markets are no longer legally separated and independent. We can infer this because:

- Barriers of entry in banking and insurance markets were eliminated in the 1990s.
- Regulation assumes distinct charters for thrifts, state, and national banks which are no longer distinct.
- Capital policy is still done on charter basis which leads to policy struggles.

Large firms can influence legislators, regulators, and professional groups domestically and internationally to pursue their interests.

- Optimization of firm interests had converted stable markets into dynamically changing markets.
- Market information is costly and individual investors cannot assume transparency.
- Financial statements are inadequate to monitor firm risk taking.

Competition in the political and economic realms has been undermined.

- We have returned to a political economy similar to the days of Adam Smith where the distinction between the state and corporations has blurred.
- Outsourcing of governmental functions can be innocent (food service/IT/HR) or troubling (military/policing/decision support) depending on the mix.
- Many assumptions of the Enlightenment (competitive markets, personal discipline and integrity, education as an ideal, political participation as civic duty, belief in objectivity) assumed by Adam Smith have been violated.

In a nutshell, we live in interesting times.

RECOMMENDATIONS

In a dynamic situation, efficient organizational learning and adaptation is the key to survival.

- In the evolving environment, leadership needs to articulate a fresh vision and identify what is new that we need to learn about.
- Study history to find patterns and review previous studies.
- Develop new information and data systems that track losses.
- Promote team approaches to aid organizational learning and give people bridges from the old to the new environment.

Managers can respond in various ways, including:

- Leaders should both learn (especially from losses) and lead striving to develop consensus around decisions and esprit de corps.
- A well-thought out risk appetite is especially important right now.
- Caveat decisions with sunset clauses as they are crafted—when is this decision obsolete? (risk management caveat)
- Build new information and incentive systems, such as risk based pricing, around new activities.
- Actively work to improve organizational decision culture and pick projects to learn (real hedge). ■

References

1. Bridges, William. *Managing Transitions: Making the Most of Change*. Cambridge: Da Capo Press, 2003.
2. Linsky, Martin and Ronald A. Heifetz. *Leadership on the Line: Staying Alive Through the Dangers of Leading*. Cambridge: Harvard Business Press, 2002.



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Risk Surface: Chart Your Risk Profiles¹

By Xiaokai Shi and Yungui Hu

A KEY CHALLENGE in Enterprise Risk Management (ERM) is how to effectively increase risk transparency and improve risk communication within an insurance organization. Risks in the insurance industry are often managed by various cohorts of people with distinct backgrounds. Risk management in insurance organiza-



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tions has become more sophisticated and quantitative, because risks in the real world have become more complex than before. Therefore, a consistent view and clear communication of a corporation's risk profiles are more in demand than ever before. Executives should be given a clear picture of the risks on the balance sheet when judging the external environment and forming their strategies.

Stress testing is certainly a powerful tool for an organization to understand its risk profiles under various scenarios. However, this can be like seeing the most astonishing previews of a horror movie without understanding the full context. In this article, we propose a new term called the "risk surface" to enhance risk communications.

IDEA OF RISK SURFACE

The risk surface is a surface of insurance liabilities or surplus values under nearly continuous changes of factors such as equity performance, equity volatility, interest rate curves, and credit spreads. We demonstrate an insurance company's surplus under alternative scenarios and provide three dimensional charts that assist in visualizing this surface.

It is difficult to show the full picture of a company's risk profile with a limited number of scenario or sensitivity

tests, which usually demonstrates just optimistic, moderate, pessimistic, or extremely bad scenarios. It is particularly helpful to management if the overall liabilities or surplus values are displayed within three dimensions by various equity performance and interest rate (or spread) levels. This allows the executives to have live views of both the tail events and the risk factors' correlations within the tails. For instance, an insurance carrier with extensive variable annuity GMxBs, the executives appreciate a simple chart showing the capital positions with respect to the S&P 500 and interest rate levels.

Depending on the asset and liability mix, many insurance companies' performance and financial strength are largely driven by the following list of external risk factors:

- Interest rate curve
- Credit spread curve and credit events
- Equity performance and volatility

At the corporate level, assets, liabilities, and their relationship to external risk factors frequently are not straightforward when assets/liabilities are consolidated. This additional complication makes it difficult for management to understand the impact on the balance sheet from various economic shocks. As a tool for risk communication, a risk surface can help visualize the tails and the relationship of surplus/liability to key risk factors made evident from the shapes of the surface. Below is a simplified example of a risk surface.

RISK SURFACE OF A HYPOTHETICAL INSURER

We assume that a mono-line insurer writes a simple variable annuity (VA) product for our illustration example. It is assumed that the VA product has rich embedded GMxB guarantees that are not hedged. Suppose that there are \$108 billion assets invested in zero coupon bonds and the liability totals \$98 billion which are proxied by a replicating portfolio to facilitate extensive liability valuations. In our example, the replicating portfolio consists of only zero coupon bonds and vanilla put options (assuming the VA only has GMDB or GMAB types of living benefits). Though it provides only a rough approximation to the behavior of the VA liability, this simplified replicating portfolio works well to demonstrate the risk surface concept.

We consider three market risks: interest rate curve shifts, equity level changes, and equity volatility movements.

FOOTNOTES:

- ¹ The views in this article only represent the authors' personal opinions. This article does not represent any statements from the organizations where the authors are employed.

- The yield curve starts from 5.5 percent at the short end (1-year maturity) to 7.25 percent at the long end (30-year maturity). Parallel shifts of the yield curve from the base case range from -5 percent ($i=0.5$ percent for the short end and 2.25 percent for the long end) to 9 percent ($i=14.5$ percent for the short end and 16.25 percent for the long end).
- The Equity (S&P 500) level starts at 1100 in the base case. The percentage changes of the level of the S&P 500 range from -60 percent (S&P 500 = 440) to 55 percent (S&P 500 = 1705).
- The base case of equity volatility (S&P 500 vol) is 20 percent and the variations range from 8 percent to 95 percent.

The specified full range of each risk factor is discretized to 30 points. Therefore, there are 27,000 scenarios in our simulation.

After the valuation of assets and liabilities, the risk surface of the VA writer is easily produced. The graphical representation is in terms of surplus (capital) positions with regard to the evolution of the underlying risk factors. **Figure 1** shows the risk surface with respect to interest rate curve shifts and the percentage change in the level of the S&P 500 with the S&P 500 volatility fixed at 20 percent. It is presented in both a three dimensional plot and a two dimensional contour plot. The color surface in the left plot represents the surplus values under all possible combinations of interest rate curve shifts and the percentage changes in the level of the S&P 500. From this surface, observe how the two risk factors affect the insurer's surplus position, where upward (downward) shifts in both the interest rate curve and the S&P 500 profits (harms) the insurer. The tail of the surplus is located at the left front corner marked by blue where the interest rate shifts down by 5.5 percent and the S&P 500 drops by 60 percent. The contour plot also reveals how the surplus changes relative to interest rate and S&P 500 changes. The color of the graph shows the surplus level for various combinations of these two risk factors. For example, a shift of -5 percent from the base interest rate curve and no change in the S&P 500 base level of 1100 represents the current market condition at the time of writing, with a surplus level

Figure 1: S&P 500 volatility = 20 percent

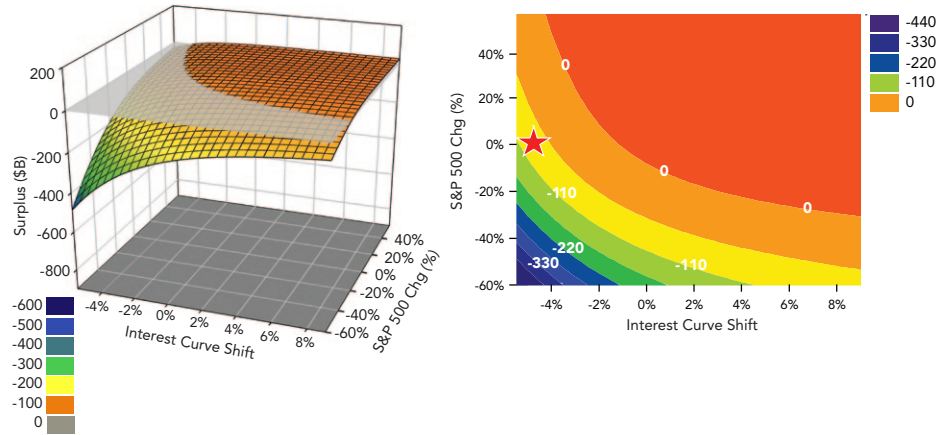
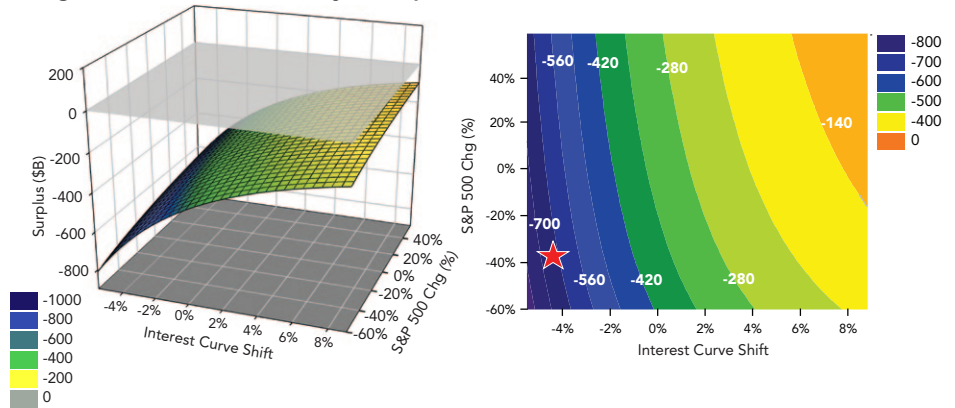


Figure 2: S&P 500 volatility = 95 percent



of -\$110 billion denoted by the red star. Considering the initial asset position of \$108 billion, we conclude that this business is extremely risky, due mainly to the fact that this business has very rich unhedged GMxBs.

In **Figure 2**, to demonstrate the impact of volatility, we assume that the S&P 500 volatility jumps to 95 percent. Observe how the insurer is insolvent in all scenarios. Recall how during the recent market turmoil, the S&P 500 dropped to 680 (-40 percent down from the base level of 1100), and interest rates were historically low (-5 percent shift from the base level). The red star in the contour plot below identifies the state of this company under similarly stressed situation (though the equity volatility is even higher here).

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Figure 3: S&P 500 volatility = 8 percent

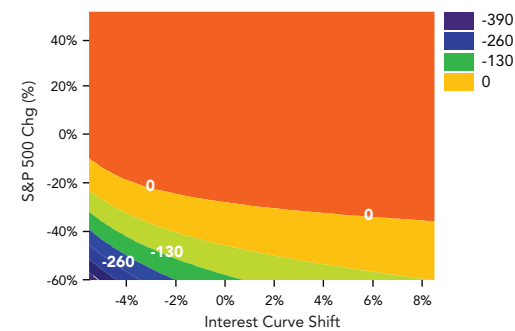
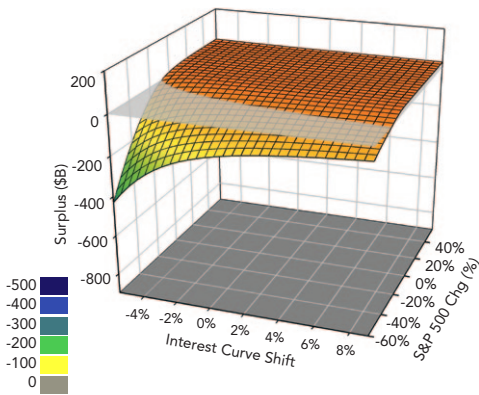


Figure 4: S&P 500 index jumps 50 percent / drops 60 percent

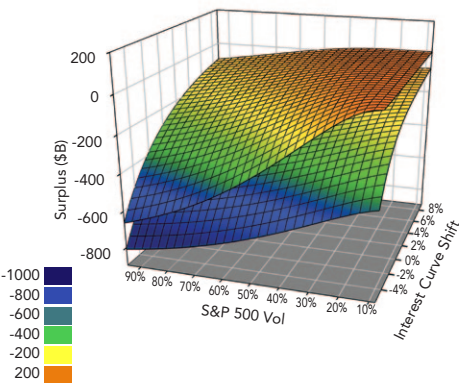


Figure 3 shows the risk surface when a favorable S&P 500 volatility of 8 percent occurs. Observe in the 3-d plot that most of the surface is above the zero-surplus plane (the gray transparent plane). Note this as well in the contour plot where the majority of the plot consists of red and orange. However, tail risk does not disappear as shown in blue.

We have illustrated the risk surface with respect to interest rate curve shifts and the percentage changes in the level of the S&P 500 for only three volatilities. By discretizing the range of volatility by 30 points, we obtain 30 risk surfaces. Separately, we have plotted the three surfaces, however, all of the risk surfaces could be plotted in the same plot, which a risk manager can use to visualize surplus movement with all three risk factor changes occurring simultaneously. See how Figure 4 displays two risk surfaces plotted in one graph with respect to volatility level and interest rate shift. The upper surface is for the 55 percent jump of S&P 500 index (=1705) and the lower one shows a 60 percent drop (=440).

The characteristics of the risk surface are uniquely determined by an insurer's business and risk management strategies. In this example, we show the surplus surface when the embedded derivatives are unhedged. In the case of liability options being hedged, the hedging asset surface, liability surface, and the net hedging surface (asset surface minus liability surface) is a great aid to the risk manager. The hedging effectiveness in the tails can be easily visualized and examined. Furthermore, by plotting surplus surfaces of both hedged and unhedged positions, we are in a good position to assess the value added from hedging.

Ideally, the insurer should maintain risk surfaces that are above the zero-plane for most of the cases and whose tails below the zero-plane are narrow and short. In our simplified case, only interest rate curve shift, S&P 500 level and volatility are considered. Nevertheless, other risk factors affecting the business can be included too.

Companies can plot their insurance liabilities in the same manner. Liability surfaces would be a valuable tool for pricing actuaries, ALM practitioners and insurance asset managers to understand the underlying dynamics of insurance liabilities.

PROS AND CONS OF RISK SURFACE

The risk surface has clear advantages as a risk communication tool:

- Develops a common language to demonstrate alternative scenarios
- Increases risk transparency by visualizing tail events
- Facilitates risk communications to understand risk correlations
- Adds value allowing asset managers to gain deeper understanding of insurance liabilities when developing investment strategies and establishing investment constraints
- Visualizes the business' sensitivities to risk factors evident from the shape of the liability or surplus surface

“As a tool for risk communication, a risk surface can help visualize the tails and the relationship of surplus/liability to key risk factors made evident from the shapes of the surface.”

There are also challenges in constructing the risk surface. Under current liability valuation systems, it is extremely time-consuming to develop a liability or surplus surface illustrated in this article, as actuaries from every business line need to re-process their liability models possibly hundreds of times to consider all of the combinations of risk factors. It is especially true for complex liabilities such as UL with secondary guarantees and variable annuities with GMxBs. Therefore, it makes this nearly impossible as a frequent reporting process. However, this challenge can be overcome by using replicating portfolio techniques (although some basis risks cannot be captured by the tool).

The idea of a risk surface is to demonstrate how an insurance company's surplus or liabilities react to external market factors such as equity performance and volatility or interest rates. This concept can be expanded to include other actuarial risks such as mortality, lapse, morbidity or other actuarial risk factors; however, it may be difficult to include these additional risk factors using portfolio replication.

POSSIBLE IMPLEMENTATION

Even though the implementation of the risk surface may not be an easy exercise, companies may want to integrate this into existing processes such as capital forecasting or stress testing. We propose the following key implementation steps:

- Select the key risk factors. An insurance company has to first understand the key underlying drivers of their business values / risks. This could be challenging for multiline companies that write business with distinctive product economics / risk profiles.
- Define the granularity of the shocks to each risk factor and the tails (e.g., 20 percent interest rate level is in the extreme tail). History can be a source to determine how tails should be modeled. Care should be taken in selecting the range of risk factor movements for modeling runtime considerations.
- Implement a portfolio replicating tool and use it to construct a replicating portfolio used as a liability benchmark.
- Once the replicating portfolio is constructed, set the selected risk factors according to the specified granularity assumptions and then value both the asset portfolio and the liability benchmark.

- Import these series of market values into any standard plotting software which allows the generation of the risk surface.
- Assess the reasonableness (magnitude and shape) of the surface (e.g., by comparing with capital forecasting results).

CONCLUSIONS

Strategists who steer the ship may not always have a clear picture of the depth of the water underneath. But by using a risk surface, which facilitates risk communication and risk transparency within insurance organizations and other financial institutions, they will have the knowledge that will prevent them from running aground.

Actuaries should make their models match reality as closely as possible. Our models are complex because the world is even more complex. But as financial modelers who handle extensive levels of complexities, we often struggle to find simple rules of thumb to explain our findings to the people who steer the ship. However, graphics have always served as a common language throughout history of mankind. When executives are provided with risk surface charts that convey this complexity and if they are properly educated on the use of the charts, they will have a much greater understanding of the company's risk profile. ■

Insurance Risk Management at Life Insurers: Dynamically Managing Economic Cycles

By Larry Rubin and Xiaokai (Victor) Shi

ALTHOUGH NEAR-TERM SURVIVAL IS STILL A PRESSING ISSUE for many insurers, it is currently the right time for the industry as a whole to revisit its risk management strategies in the wake of the most severe financial crisis in eighty years.

As the crisis unwinds, it is almost certain that there will be a more deleveraged financial system and a substantially different regulatory environment. In the near- to mid-term, it is likely that the global economy will remain volatile, with accompanying uncertainty in the equity and credit markets. With all of this in mind, what should insurers focus on in this changing environment? Which changes to Asset/Liability Management (ALM) and Enterprise Risk Management (ERM) can help companies ride out the current crisis and even come out of it even stronger?

RETHINKING PORTFOLIOS

First and foremost, insurers need to take a longer term view of their business and investment portfolios. If they establish a more top-down view of balance sheet risks and develop risk management approaches that allow them to more successfully withstand volatile markets, then they should be able to effectively manage their risks in changing economic cycles.

The life industry’s portfolios in particular have changed significantly in the past few decades. As the chart below shows, they are much more complicated than they used to be. Assets include structured classes and both callable and embedded options. Liabilities include some embedded options that policyholders have an economic incentive to exercise, and others (e.g., contingent on mortality/longevity events) which they cannot.

Historically, life insurance used a simple, protection-oriented business model. Liabilities were valued with traditional actuarial approaches and insurers generally allocated their assets conservatively in simple fixed income classes. In recent years, however, wealth accumulation products such as variable and fixed deferred annuities have gained popularity as baby boomers plan for retirement. More and more insurers are offering guarantees (which represent short positions) on top of more dynamic wealth accumulation or life protection products. In addition, more and more companies have allocated assets to structured classes such as CDOs or CMBS. Furthermore, some large variable annuity writers’ hedging programs have totally re-shaped their balance sheets.

Life Insurers Balance Sheets Historically		Life Insurers Balance Sheets Today	
Bonds	Whole Life	Bonds	Whole Life
Money Market Funds	Term Life	Money Market Funds	Term Life
	Fixed Annuity	CMO	Fixed Annuity
	Long-term Care	CDO	Long-term Care
	Long-term Disability	CLO	Long-term Disability
		ABS	UL with Guarantees
		CMBS	VUL
		S&P 500 Futures	Equity-indexed Annuity
		Other Options	GMDB
		Equity	GMIB
		Alternatives	GMAB
			GMWB
			GLWB
			Securitized Liabilities
	Surplus		Surplus

Generally speaking, there are three categories of insurers:

- General account carriers (e.g., whole life, universal life, term life or fixed annuity carriers), such as New York Life and Northwestern Mutual. These companies are traditional life insurers that primarily offer protection-oriented and fixed accumulation/income products. They tend to have sound distribution channels, competitive life products, and loyal customers. Since their liabilities are in the traditional life and annuity business, they are not fully exposed to equity market risks. However, they are exposed to large mortality/longevity risk and disintermediation risk (i.e., ALM mismatch risk).
- Separate account carriers (without material guarantees), such as TIAA-CREF. These companies generally offer variable products without material guarantees. Their business are more like mutual funds, although some are life contingent and thus more exposed to equity performance risk than general account carriers.
- Embedded option carriers (e.g., GMxBs), such as The Hartford, AXA, Ameriprise, and Lincoln National. These companies offer guarantees on their variable products or universal life, which exposes them to equity performance and volatility risk, interest rate risk (e.g., GMIB), and policyholder behavior risk. These carriers generally run sophisticated hedging programs, such as entering derivative transactions in the financial markets, to offset some of their positions on the guarantees embedded in liabilities.

Some large insurers, such as Metlife and Prudential Financial, have diversified business portfolios that are a combination of the categories described above.

The distinctive nature of individual companies puts them at different competitive advantage/disadvantage depending on market cycles. Clearly, the extreme bear market in late 2008—which was characterized by a plunging stock market, sky-rocketing equity volatility, and low interest rates (as well as credit crunch)—has substantially hurt embedded option carriers. GMxBs of variable annuities often have roll-up, ratchet or step-up features, which made these exotic options extremely difficult to move out of money and negatively affect insurers when equity markets fall.

Separate account carriers also suffered, though to a lesser extent than embedded option carriers, because their incomes declined as a result of lower account values. Other than suffering declines in the value of their investment portfolios, most general account carriers have weathered the crisis reasonably well thanks to their relative isolation from the volatility of the financial market. In contrast, many embedded options carriers are de-risking their products and some are even considering exiting their current business (e.g., variable annuities).

It is increasingly clear that insurers will continue to significantly restructure both the assets and liabilities on their balance sheets. It also is likely that there will be industry consolidation once a recovery begins apace. However, insurers cannot afford to misinterpret the current situation as a solely temporary one or the result of a market over-reaction. Management needs to think broadly about how the industry is changing and develop clear strategies to ride out future economic cycles.

PREPARING FOR THE INEVITABLE SUNNY DAY—AS WELL AS MORE RAINY ONES

How can insurers ensure they will be adequately capitalized in a less leveraged financial world? If high inflation and interest rates return, how should insurers mitigate the disintermediation risk and how will policyholder behavior change?

History can teach us a great deal about managing economic cycles. As the graphic below shows, the U.S. economy has experienced seven recessions in the past 40 years. Although circumstances have varied leading up to each recession, downturns generally correspond to distortions in:



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- Interest rate levels (which generally correspond to the level of inflation), and credit supplies/events, and
- Equity market performance and volatility.

Declining yet already low interest rates have been the rule since 90s. However, this has been an aberration—albeit a fairly lengthy one—that has corresponded to unusually low rates of inflation (other than in equities and real estate).

The converse of the past decade was the inflationary mid-1970s to mid-1980s, which saw interest rates top 15 percent, and substantially affected the insurance industry. Life policy surrenders and policy loans increased to higher than anticipated levels, which resulted in disintermediation risks for insurers. Many of them had to liquidate their assets in order to pay off cash withdrawals from the general accounts. As noted in one recent report published by Bridgewater Associates,¹ in the early 1980s, policy lending had reached 9.3 percent. In the same period, policy surrenders had reached 12.3 percent (compared with 6.7 percent in 2007). When interest rates fell in late 1980s and guaranteed crediting interest rates on policies were higher than what companies made on investments, cash inflows

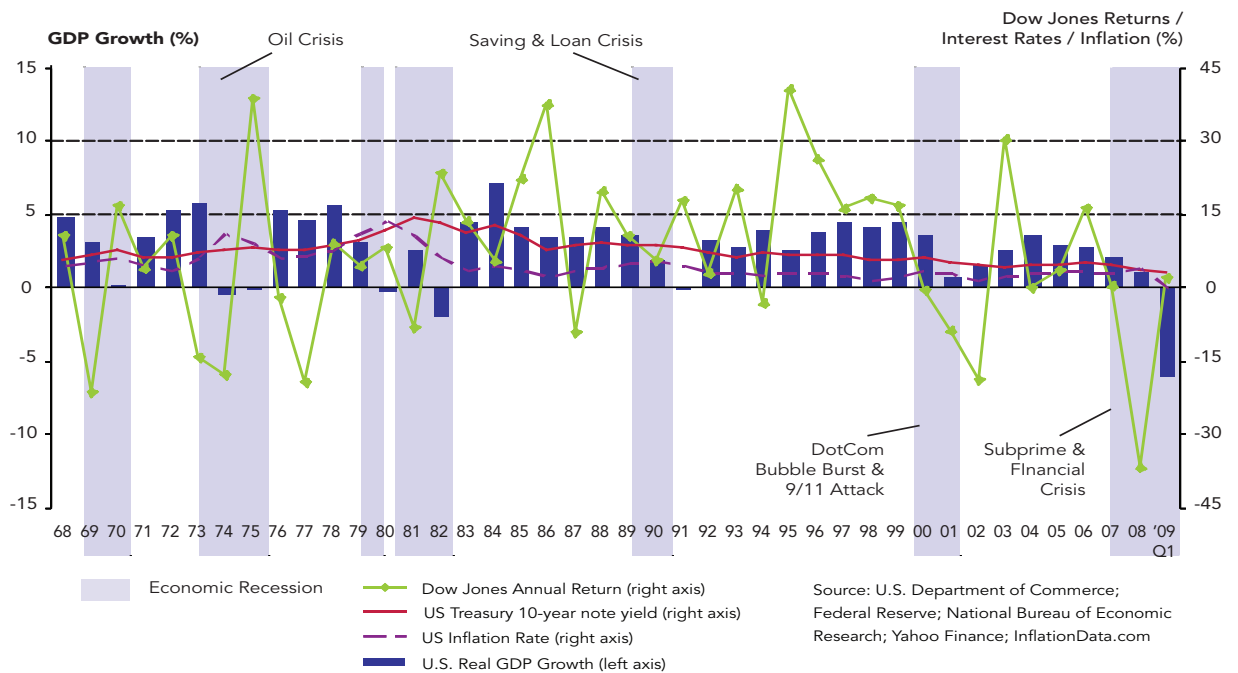
into insurance companies immediately caused solvency problems and rating downgrades.

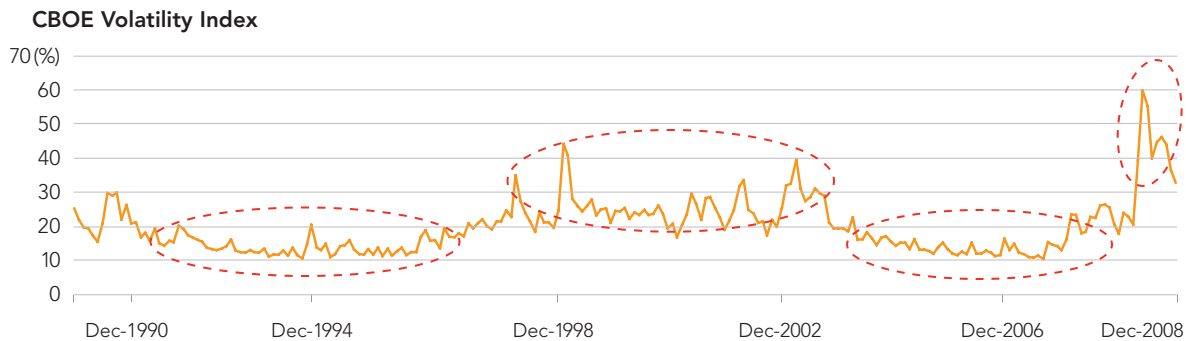
What relevance does this have to current conditions? Many economists believe that there is a good chance high inflation and interest rates will return in the near- to medium-term. They base their views in large part on the Federal Reserve’s aggressive policy of increasing the U.S. dollar supply. For example, in March 2009, the Fed announced a plan to buy \$1 trillion in debt (including up to \$300 billion in longer-term Treasury securities and an additional \$750 billion of mortgage-backed securities) in order to unfreeze the credit markets in the midst of financial crisis. This aggressive policy could undermine dollar values, which in turn could drive up interest rates—although no one can predict with certainty if and when this will occur. In addition, substantially increasing government spending (and the deficit), as well as the United States’ international

FOOTNOTES:

¹ “The Coming Insurance Industry Crisis,” Bridgewater Associates, Inc, March 2009

Economic Cycles (1963-2009 Q1)





trade deficit, might further shake investor confidence in the dollar's long-term value—all of which compounds the risk of inflation and rising interest rates. Conversely, if high unemployment and lower wages persist, and both consumers and business continue to cut expenditures, then a deflationary spiral might be possible. The latter scenario would be especially pernicious because, in light of the fact money market rates are already close to zero, policymakers do not have the flexibility to lower rates to stimulate demand.

The authors cannot predict the future, but effective risk management is not about predicting the future as much as it is about preparing for what is possible. Insurers, especially general account carriers, have to be aware of and prepare for uncertainty about inflation, deflation, and interest rate movements.

EQUITY MARKET CYCLES

The equity market has gone through many cycles in the past 40 years. In general, equity cycles switch more

frequently than credit cycles, are more seriously affected by crises (especially crises of confidence), and often bottom out swiftly. As shown in the chart, the U.S. stock market—thanks in large part to technological developments—experienced unprecedented growth starting in the mid-1990s. However, this growth was interrupted by three serious crashes resulting from the Asian financial crisis of 1998, the bursting of the internet bubble in 2001, and the bursting of the credit bubble last year.

Embedded in these market cycles has been a number of volatility cycles (see chart below). Between 2004 and late 2007, volatility was relatively low, but it soared to an extraordinarily high level in the middle of last year's financial panic. For embedded option carriers who offered short positions such as GMxBs on variable annuities, increased volatility substantially hurt their bottom line and capital strength. In light of ongoing volatility, the GMxB business faces an uncertain future as guarantees have created extreme stress on insurers' balance sheets.

CONTINUED ON **PAGE 18**

In order to avoid or at least better manage future volatility, insurers need to give serious thought to the following questions:

- How will the industry evolve after the crisis, taking into account different economic scenarios?
- Will current volatility revert to a more normal level, or has there been a paradigm shift?
- What are the right strategies for dealing with uncertain equity performance and volatility, especially in light of the direct relationship between revenues and equity performance for separate account carriers and embedded option carriers?
- What are the right strategies if the market recovers, stag-nates, or declines further?

DYNAMIC RISK MANAGEMENT ACROSS ECONOMIC CYCLES

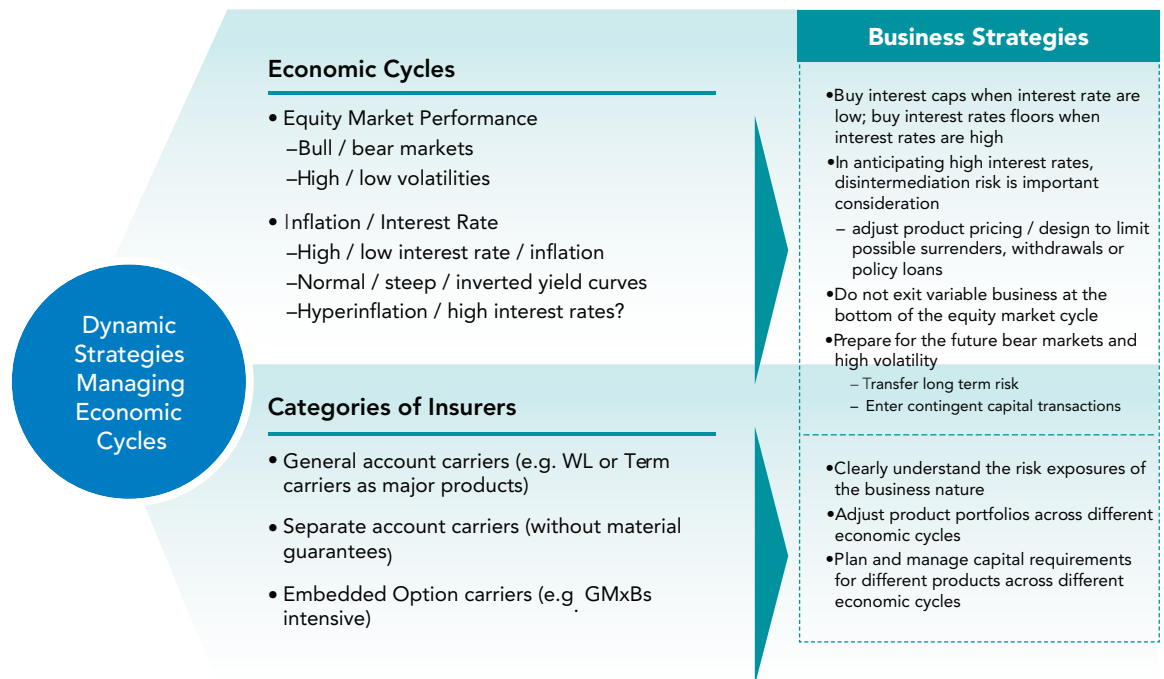
Life insurance companies, which by their nature are supposed to endure, will inevitably face many severe economic shocks such as the inflation of the 1970s and the systemic shock of 2008. Insurers' risk appetites are generally high when the economy peaks, and are much

lower when the economy contracts. However, this tends to result in a reactive rather than proactive approach to managing economic cycles. As the graphic below shows, management would be better served by taking a long-term perspective and dynamically managing the business throughout economic cycles.

Initially, it is good practice to anticipate the scenarios that could unfold in the next cycle and what action is needed to both protect the company's balance sheet and ease future earning volatility. For example, when interest rates are low, management should consider what may happen if they rise. Purchasing interest rate caps when interest rates are low is economically advantageous and is clearly a strategically sound way to protect a company. Furthermore, when interest rates are high, companies could purchase interest floors when their market price is low. Interest rate floors would have offered inexpensive protection 20 years ago, and it is possible that interest rate caps offer inexpensive protection today.

Dynamic risk management also can include adjusting risk and product design pricing. At the bottom of an economic

Risk Management: Dynamically Managed Economic Cycles



cycle, when policyholders' risk aversion is high and there is increased demand for guarantees, insurers that maintain high ratings have the ability to charge higher prices for the long-term risks (e.g., long-term disability) they offer. Management should have a clear understanding of policyholders' economic incentives and how they may exercise guarantees. For example, in anticipation of higher future interest rates, companies may offer products with higher or longer surrender charges on their UL products. Furthermore, some existing variable annuity guarantees, such as roll-ups, step-ups and ratchets, are clearly at odds with dynamic cycle management; accordingly insurers should determine if they can continue to offer them.

Another way for individual companies to manage economic cycles is by purchasing contingent capital as a supplement to economic capital. As one example, in the midst of the financial crisis, many variable annuity writers started macro-hedging programs to avoid further losses and protect their balance sheets from equity market declines. As another example, in the middle of the 2008 financial crisis, Prudential Financial benefited from one put option they entered into with Wachovia some years before; Prudential's resulting capital access has helped them retain the investor confidence.

Finally, management should have a clear view of and strategies for determining which risks on their balance sheets it needs to transfer or exit, and when to do so. For example, at the bottom of an equity market cycle, it is probably unwise to exit the variable business and expand the general account business. As another example, when they face considerable equity or credit market uncertainty, companies should consider expanding into less capital intensive businesses and take on risk (e.g., mortality) that is less correlated to the markets.

CONCLUSION: MANAGE FOR THE LONG-TERM

In conclusion, insurers need to take a long-term view of their business and investment portfolios. If they establish a more top-down view of balance sheet risks and develop risk management approaches that allow them to more

successfully withstand volatile markets, then they should be able to effectively manage their risks in changing economic cycles.

As importantly, effective risk management is not about predicting the future as much as it is about preparing for what is possible. Because very few things in this world are certain, a wide range of plausible "what ifs" and potential responses to them deserve careful consideration. In his book *The Black Swan*, Nassim Taleb talked about two different worlds, Mediocrastran and Extremistan. Risk management typically operates under the assumption that we live in Mediocrastran, where investment returns and deviations are based on the standard normal distribution. Managing for the long-term requires us manage as if we are in Extremistan. When market interest rates were 10 percent, the interest rate scenario of sustained rates below one percent was in Extremistan, not Mediocrastran. In today's environment rates above 10 percent are in Extremistan.

Accordingly, while history never repeats itself exactly, it is prudent to examine long-term investment trends—as well as micro-trends inside them—when considering what may happen in the future. While such an approach will not immediately reverse the damage the recent financial crisis has caused to many insurers' balance sheets, it can help strengthen ALM practices and prevent similar stresses from recurring in the future. ■

Risk Evaluation: What do you CARE?

By Jeremy G.T. Waite and Andy White

THE GLOBAL FINANCIAL CRISIS REVEALED SOME SIGNIFICANT GAPS IN RISK MANAGEMENT.

One of the contributory factors often singled out as a root cause is the reliance the banking industry placed on sophisticated mathematical models. There are two elements to this issue, firstly the extent and use of the models to make informed decisions, and secondly the models themselves. Mathematical models are deductive by nature, and simplifications of real life. The problems with models can be the premise, the use or the validity/accuracy of the underlying thing it tries to represent. There is scope for fundamental misunderstandings between model creators (and their models) and management who make decisions based upon the outputs.

The failure of management to understand the nature of the models and any associated overconfidence in their decision making ability can be addressed, at least in part, by having a Comprehensive Actuarial Risk Evaluation (CARE) performed by an actuary.

One of the core competencies of actuaries is understanding risk. Actuaries are competent at building models to represent risk. It is crucial however to have a healthy respect for the limi-

tations of any model, and to be able to place the risks in context. Models don't predict the future and don't replace judgment, they merely help gain better insights and understandings as to what can go wrong given the inputs used. As the designers and owners of many risk models, actuaries are well positioned to understand precisely how much reliance should be placed on models and where additional judgment is needed.

The Committee of Sponsoring Organisations of the Treadway Commission (COSO) is a private sector initiative that has a well established ERM framework, as shown in figure 1. The framework is useful as it clearly lays out the multi-dimensional nature of risk and places strategy as the first step of this framework. The CARE can play a role in being objective and independent in the assessment of the risks for the firm, given their context, history, culture and strategic positioning, and works within this framework.

RISK ASSESSMENTS

Within this article and the CARE paper the definition of risk used is the potential for an outcome with negative consequences. A negative consequence can be the failure to meet objectives, fulfill realistic expectations or take advantage of a positive (profitable) opportunity. To fully evaluate risk we must look at all potential negative outcomes. Narrowly defining risk can make evaluation more convenient, but wrong (e.g., looking for your lost keys under the nearest lamppost).

Many companies mismanage risk using some or all of the below methods:

- Relying on historical data (e.g., house prices will continue to rise)
- Focusing on narrow measures
- Overlooking knowable risks
- Overlooking concealed risks
- Failing to communicate (risk managers/actuaries not communicating the model error well enough)
- Not managing quickly enough—"When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to get up and dance. We're still dancing."—Charles Prince, CEO, Citigroup

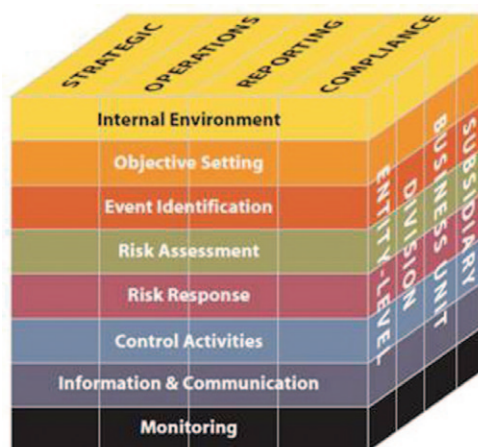


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Figure 1: The COSO ERM framework



“Narrowly defining risk can make evaluation more convenient—but incorrect, like looking for your lost keys under the nearest lamp post as that’s where the light is.”

The CARE report would provide for a platform to discuss the issues of risk in a company specific context, it can make recommendations and would be a useful read for auditors and shareholders alike.

THE CARE PAPER

A working party of the International Actuarial Association undertook a project to understand what dimensions of risk should be considered in an ERM risk assessment. The working group consisted of 15 actuaries and non-actuaries from five countries. The resulting report is a working paper not a standard of practice. It is intended to start up a discussion that might someday lead to the establishment of a standard for actuarial risk assessment.

A key component of the CARE paper is the multidimensionality of risk, the dimensions selected in the paper are not intended to be exhaustive, and the key dimensions to consider include:

- Market consistent value vs. fundamental value
- Accounting basis vs. economic basis
- Regulatory measure of risks
- Short-term vs. long-term risks
- Known risks vs. emerging risks
- Frequency risk (earnings volatility) vs. severity risk (solvency)
- Viewed stand-alone vs. full risk portfolio
- Liquidity risk

There is more detail in the paper but the chart below considers briefly the core considered risks. Of course not every single aspect of risk can be considered in every evaluation so the communication of the limitations of any analysis is crucial. This includes avoiding over-reliance on any particular model and abandonment of judgment. Any situations of deficient data should be identified along with any significant assumptions (implicit or explicit) and any areas where models used diverge from reality. It is just as important to consider what is not covered by a model or analysis as it is to understand what is.

COMPONENT	CORE CONSIDERED RISKS
Market consistent value vs. fundamental value	All businesses use fundamental analysis to make decisions, without it there would be no trading and no market. Market consistent analysis substitutes the analyst’s own judgment for that of the market. Where a company has sufficient expertise to refine models and assumptions to reflect a risk to a company’s individual profile better than using market assumptions these should be documented and the difference between this and market assumptions should be identified. Market assumptions can also help to identify the view external stakeholders may take to a company’s actions.
Accounting basis vs. economic basis	Accounting rules can never reflect all of the specifics of a company’s performance. The economic view attempts to do this, reflecting the true value creation within the company and reflecting the interplay between risk taken and reward achieved. The accounting basis is however the view of the company seen by shareholders (and other stakeholders) and ignoring this dimension could be at the cost of deviations the cost of capital and business opportunities.
Regulatory measures of risk	Regulatory measures of risk and capital are crucial to the ongoing operation of the company. If the firm’s view of risk is less than that of the regulator and the firm follows what it believes to be the ‘true’ value and cost of risk this could lead to problems meeting regulatory standards. If the firm’s view of risk is higher than that of the regulator then focusing only on regulatory requirements could miss any risks specific to the institution which are not covered in the regulator’s approach.
Short-term vs. long-term risks	True value creation requires a view of the ultimate value (i.e., the long term). In reality though companies which become insolvent can rarely trade out of that insolvency. In less extreme circumstances short term volatility in share price & financing costs can have a material impact on a company’s performance and cannot be ignored.

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COMPONENT	CORE CONSIDERED RISKS
Known risks vs. emerging risks	There is a degree of Knightian Uncertainty in all risks, rather than binary delineation of known and unknown. Allowing for risks that are unknown can not be an exact science by definition. Consideration should however be given to risks which may fall outside of experience to date and may be toward the unknown end of the continuum of degrees of uncertainty.
Frequency risk (earnings volatility) vs. severity risk (solvency)	Statistical techniques work well for high frequency risks which are the risks which will be the most important to the shorter-term time horizons. They do not work as well for low frequency / high severity risks which sit toward the emerging risk end of the spectrum. For these risks other techniques are available such as scenario analysis. The use of judgement is essential for severity and / or unknown risks and the analyst needs to be appropriately sceptical towards model quantification.
Viewed stand-alone vs. full risk portfolio	For risk controlling it is usually more practical to set a limit for each risk on a stand-alone basis. For risk pricing stand alone risk levels are often indicative of market pricing. The interaction between risks is also crucial to a company, the difference between the sum of the individual risks and the portfolio view being the diversification benefit. Risk steering is primarily concerned with effective utilization and allocation of any diversification benefit. The diversified view allows management to direct the risk taking of the firm.
Liquidity risk	Liquidity risk is different from the accounting, economic or regulatory views of risk, and can be of critical importance (as recent history shows). It involves access to cash or cash equivalents when needed and may differ for different time frames.

Figure 2: Description of a CARE Report

- Purpose of the report
- Qualifications of the actuary preparing the report
- Expected users and usage of the report as well as limitations of the report
- Statement of adherence to actuarial standards
- Discussion of data used for the analysis:
 - Description of methods and assumptions used for the analysis
- Reasons for choosing these methods and assumptions
- Presentation of results of evaluations:
 - Risk types of various risks by risk measures
 - Ranking of various risks by risks measures
 - Comparisons of different risk measures
- Conclusions and recommendations

FURTHER DETAIL

The view put forward here is of the actuary as the professional who can and will deal with the multi dimensional characteristics of risk evaluation utilizing a combination of complex models, stress tests and professional judgment with appropriate consideration of the limitations of each approach.

The full paper produced by the working party is available online at http://www.actuaries.org/CTTEES_FINRISKS/Documents/CARE_EN.pdf.

This report is intended to be the start of a discussion of what would encompass the unique role of the actuary in the area of risk evaluation. The report has just been issued by the International Actuarial Association. The working group looks forward to the reactions to this vision from those within and outside of the actuarial profession. ■

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Competency FRAMEWORK

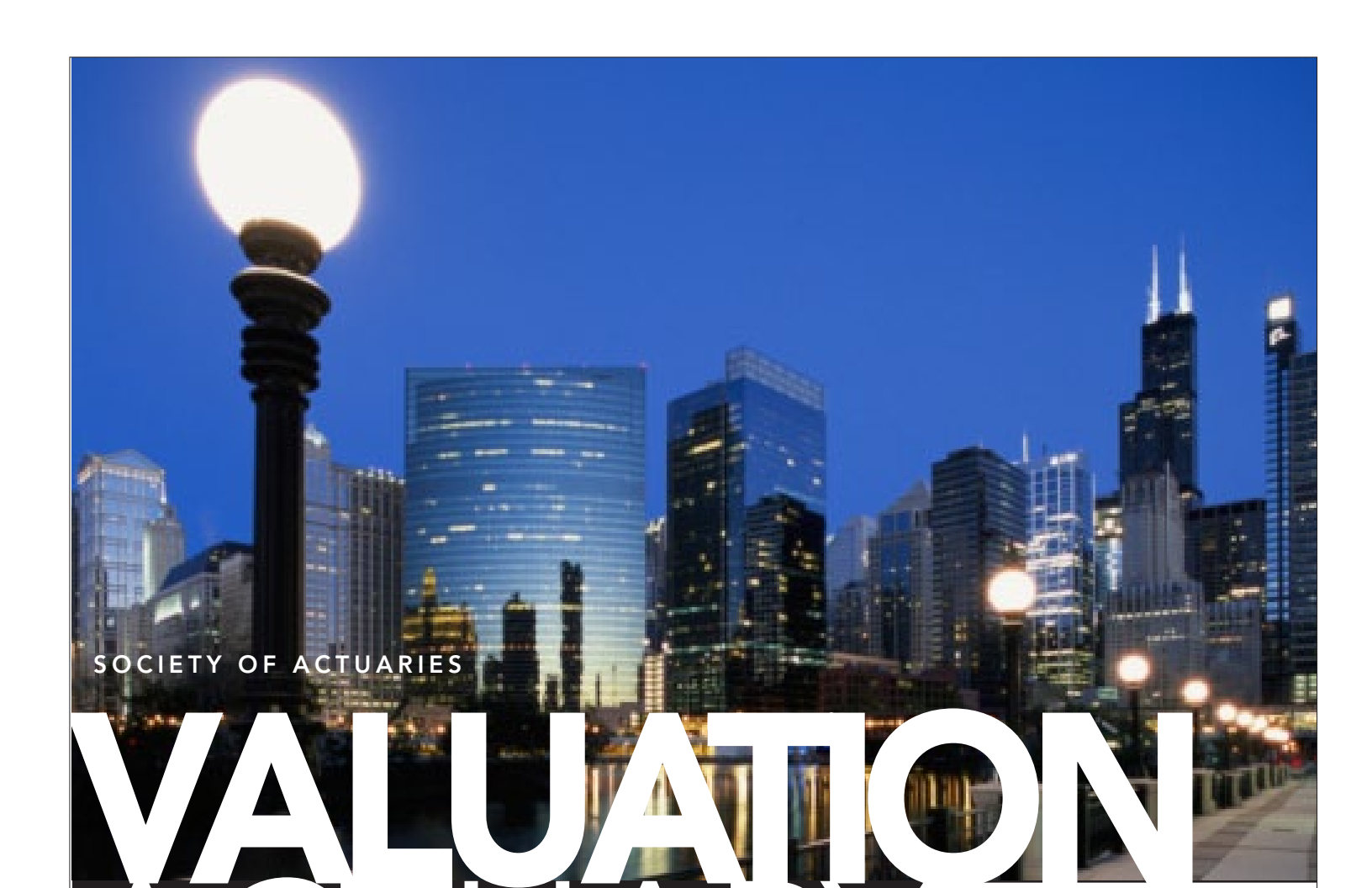
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