

Risks & Rewards

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Actuaries

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PITFALLS OF USING LEVERAGED SHORT ETFs AS "NATURAL HEDGES"

By Yan Peng

In the article titled "*Variable Annuity: Risk Management through Breakthrough Product Innovation*,"¹ which was published in the September 2009 issue number 17 of the "Risk Management" newsletter, the author proposed an innovative product design by introducing additional "inverse funds"

that are negatively correlated with existing funds to achieve "natural hedges" at the product design phase. Intuitively, by allowing investors with different views to long and short the market at the same time, the tail risk to the insurance companies will be mitigated. As an example, the authors proposed to create a synthetic "short fund" by packaging a one-third position in the Financial Bear 3X (FAZ) index and two-thirds in the Russell 1000 Financial index. The underlying assumption is that FAZ can be used as a potential hedge to the Russell 1000 Financial index. Is this really the case?

The purpose of this article is not to explore the practical plausibility (For example, does it create controversy by allowing policyholders to "short" the market? Does it promote market integrity and curb excess volatility?) of the concept of allowing policyholder to short the market, but to point out some of the potential pitfalls by using the leveraged short ETFs (a.k.a. ultrashort) as the "inverse funds" to hedge your portfolio.

An Example Let's start with a simple example. Let's say you were spot-on accurate with your bearish call on the financial sector back in later 2008 and you decided to aggressively capitalize on your call by investing with FAZ, the Direxion Daily Financial Bear 3X Shares. Sounds pretty good, right?

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CHAIRPERSON'S CORNER

Sitting down to write this article, it's hard to believe that we are more than halfway through my term as Chair of the Investment Section Council. Time has certainly passed quickly and a lot has happened in the past six months. When I last updated you on our Section's activities, the financial crisis was still very much on most of our minds, economic recovery was still uncertain, and we were all struggling to find some important lessons to learn from the turmoil of the preceding year. At the time, I noted that I believed the actuarial approach to investment risk and enterprise risk more broadly had been validated. I think the last six months have further proven that point. I am also happy to say that actuaries have been among the first professionals to look beyond the financial crisis and begin to consider risk management in the post-financial crisis world.

The Investment Section Council has been working aggressively to support the forward-looking initiatives of our profession. We have learned a lot over the past six months—both from comments we have received from our membership as well as our general experiences in the marketplace. If we are to be successful (as an organization and as professionals) we need to be agile and nimble; we need to respond quickly and appropriately to changes in the marketplace. To this end, the Investment Section Council has recently undertaken several initiatives:

- 1) We are renewing our focus on delivering timely and informative continuing education programs to our members in the form of webcasts or other "quick-to-market" media. While we continue to find great value in the traditional continuing education formats (e.g., in-person meetings), we have heard your feedback that educational sessions must be quickly designed and delivered to the membership if they are to be timely and valuable. Our experiences over the past couple of years have further confirmed this point of view. Over the coming months, you should expect to see more and more webcasts sponsored by the Investment Section. To that end, we have organized a volunteer committee to oversee the development of webcasts sponsored by this Section. The response to our request for volunteers has been overwhelming and work is already underway. Thank you to those of you who have already volunteered. Of course, we are always looking for more volunteers—in this capacity or another—so please let me hear from you if you are interested.
- 2) We are exploring avenues to bring articles and publications to our membership more quickly. This may involve enhanced use of electronic media (in addition to or in place of our current publications) and/or more frequent publication schedules for our existing media. In this effort, we are using the success of our late-2008 collection of papers on the financial crisis as a guide. And again, we are relying heavily on feedback we have received from you—our members—in setting our course.

Additionally, I am pleased to report that we continue to make progress with the strategic agenda I outlined in my prior article. This involves, among other things, developing quality continuing education sessions, providing networking opportunities for our members, and



Andrew Dalton

sponsoring or funding research projects. By all accounts the 2010 Investment Symposium was a terrific success and the first-ever Life & Annuity Symposium was equally well-received. I have enjoyed meeting many of our members at SOA events throughout the year and have benefitted greatly from the network opportunities that these meetings have provided. I hope you feel the same. Finally, I would note that we again provided sponsorship support to the Actuarial Research Conference—this year’s conference (the 45th Annual) was held in late July at Simon Fraser University in British Columbia. This conference presents pioneering research of interest to our members; some of this research occasionally appears in the pages of Risks & Rewards.

As my term as chair winds down, I leave you with the following thoughts:

I believe that we have accomplished much during my three years on the Investment Section Council. But, much more remains to be done. Our ultimate success will depend upon the extent to which we, the Section Council, are serving your needs as members of this Section. The Section Council wants to hear from you. Please let us know how we are doing. We are always happy to hear about some need that we have satisfied. It is equally (or more) important that you identify for us the needs that we have not yet satisfied. This information will be critical as our strategic agenda evolves.

By the time this edition of Risks & Rewards is published, Section Council elections will have concluded and the new council will soon begin its work. This year’s slate of candidates is extremely strong and the candidates represent diverse professional backgrounds. I know that these candidates will bring a fresh vision to our Section as we move ahead on the initiatives identified above. I would also like to thank the outgoing council members, who have worked long and hard over their terms to advance our collective goals. These individuals have devoted their time and energy to our organization and, I believe, we are well-positioned for the future as a Section and as a profession as a result of their efforts.

Please enjoy the timely and relevant articles in this edition of Risks & Rewards. Happy reading! 🍷

PROSHARES AND DIREXON, THE TWO MAIN PRODUCERS OF THESE INSIDIOUS LEVERAGED ETFS, ACKNOWLEDGED THAT THESE FUNDS ARE AIMED ONLY TO TRACK DAILY CHANGES.

You were right there when FAZ was first introduced on 11/06/2008 and you invested \$1,000 right after the market was open when FAZ was traded at \$60.22 per share. By the end of 2008, the Russell 1000 Financial Services Index returned -12.75 percent since 11/06/08. How did you do? Intuitively, you probably expect a return of approximately 38 percent, or three times 12.75 percent, right? Wrong! You actually lost 41 percent. How did this happen?

Table 1:
Historical Prices/Return of FAZ vs. Russell 1000 Financial Services (RGS) Index

		11/6/08 ²	12/31/08	3/6/09	12/31/09
Price	Direxion Daily Financial Bear 3X Shares (FAZ)	60.22	35.7	104.07	19.43 ³
	Russell 1000 Financial Services (RGS) Index	749.71	654.09	351.45	767.71
Return	Direxion Daily Financial Bear 3X Shares (FAZ)		-40.72%	72.82%	-93.55% ⁴
	Russell 1000 Financial Services (RGS) Index		-12.75%	-53.12%	2.40%

Table 2:
The Four Worst Performing Sectors and Associated Double-Leveraged Short ETFs

Sector	Double-Levered Short ETFs
Real Estate	SRS - ProShares UltraShort Real Estate
Chinese Stock	FXP - ProShares UltraSh FTSE/Xinhua China 25
Oil & Gas	DUG - ProShares UltraShort Oil & Gas
Financial	SKF - ProShares UltraShort Financials

As a patient investor, you shrugged off the confusion and kept invested. On 3/6/2009, the Russell 1000 Financial Services Index closed at its March low of \$351.45 or returned -53.12 percent since 11/6/08. Your position on FAZ returned 72.84 percent. Not bad, but it did not make the kind of killing you had expected—isn't it supposed to triple the return to something like 160 percent? If you are not totally shocked by now, let's see the next one. By 12/31/2009, the Index returned 2.4 percent. How about FAZ? It actually returned -93.55 percent. Yes, you read it right—you lost 93.55 percent of your principal. Your original \$1,000 investment became \$64.53.

If you still have disbelief in the above example, let's take a look at another example of these leveraged short EFTs. In the book "Jim Cramer's getting back to even" by Jim Cramer, the CNBC *Mad Money* host showed a striking example of the following double-leveraged short ETFs associated with the four sectors with the worst performance in 2008: together, the four double-bearish funds marked a 30 percent loss in 2008, instead of a 97 percent positive return if you had truly been able to double-short (this part is confusing).

THE FINE PRINT

ProShares and Direxon, the two main producers of these insidious leveraged ETFs, acknowledged that these funds are aimed only to track daily changes. For exam-

¹ <http://www.soa.org/library/newsletters/risk-management-newsletter/2009/september/jrm-2009-iss17-hu.pdf>

² These are the opening prices. For other dates, the closing prices are demonstrated here.

³ FAS had a 1-for-5 reserve split on July 9, 2009. The listed price in the table is not adjusted to reflect the reverse split.

⁴ Adjusted for the 1-for-5 reserve split on July 9, 2009.

⁵ <http://www.proshares.com/funds/prospectus.html?ticker=skf>

⁶ <http://www.proshares.com/media/documents/ProSharesFactSheetSKF.pdf>

ple, in the prospectus of SKF,⁵ the ProShares UltraShort Financials, states clearly that the objective of the fund is to “seek inverse investment results for a single day only, not for longer periods” and “the Fund does not seek to achieve its stated investment objective over a period of time greater than one day.” Put in another word, it is for day traders who want to place a leveraged bet on a specific sector in a given day and it cannot be used as an inverse fund for hedging purpose for an extended period of time. One of the selling points listed on the factsheet⁶ SKF is “no margin account.” Translation: it is a truly ingenious way to get around the margin rules. In his book, Jim Cramer called it “*weapon of financial mass destruction, aimed directly at whatever poor, misinformed investor buys them and makes the perilous mistake of assuming these products do what most of us expect them to.*”

LOUSY LONG-TERM HEDGES

Apparently, those leveraged short ETFs are lousy long-term hedges. Actually, the inverse and leveraged long ETFs are bad long-term hedges too, but why? Some of you probably already figured out, the answer is simple—mostly because of compound interest and path-dependency. As an over-simplified example, I think most people are familiar with the concept that “if you are down 50 percent, you need a 100 percent return to be back to where you were.”

This is similar to what is happening here with those inversed and leveraged funds. Essentially, the impact of compounding a negative return is more pronounced than compounding a positive return of the same magnitude. The impact is further amplified on a leveraged fund.

Let’s demonstrate this with a more realistic two-day example. Let’s say the basic index return is -5 percent in day 1 and 5.26 percent (or $1/(1-5 \text{ percent}) - 1$) in day 2. By the end of day 2, you are back to where you were in the beginning of day 1. But how about the return on inverse and leveraged funds based on this index? See the following table: the inverse and double-long index lost about 1 percent, the triple-long and double-short indices lost about 2 percent and the triple-short index lost about 3 percent in this two-day “wax and wane” process even though the tracked base index basically did nothing (returned 0 percent).

	Base Index	Double Long	Triple Long	Inverse	Double Short	Triple Short
Leverage Ratio	1	2	3	-1	-2	-3
Day 1 return	-5.00%	-10.00%	-15.00%	5.00%	10.00%	15.00%
Day 2 return	5.26%	10.53%	15.79%	-5.26%	-10.53%	-15.79%
Ending Value	1.00	0.99	0.98	0.99	0.98	0.97

If you were to repeat this process 10, 20, 30 times, the following table summarizes your return in the end.

⁶ <http://www.proshares.com/media/documents/ProSharesFactSheetSKF.pdf>

// WHEN THE VOLATILITY GOES TO EXTREME LEVEL, JUST AS WE HAVE WITNESSED IN THE FINANCIAL MELTDOWN, IT EATS AWAY YOUR RETURNS ... //

Table 4:
Illustration of Returns With Repeated Two-Day "Wax-and-Wane" Scenario

# of Repeats	Base Index	Double Long	Triple Long	Inverse	Double Short	Triple Short
10	0%	-5%	-15%	-5%	-15%	-27%
20	0%	-10%	-27%	-10%	-27%	-47%
30	0%	-15%	-38%	-15%	-38%	-62%

When the volatility goes to extreme level, just as we have witnessed in the financial meltdown, it eats away your returns. With leverage, the pain is compounded. Essentially, you are creating a short-volatility position and even if you are betting on the correct direction, the short-index or long-index position could be outweighed by the short-volatility position. Shorting volatility in a volatile market? It is probably the last thing you want to do.

Interestingly and ironically, research showed that *"these funds, due to their structure, actually contribute to the volatility, thus directly contribute to their own failure as instruments for anything other than a day trade"*!

Remember the great investor Warren Buffet's Rule of Investing? Rule No.1: Never lose money. Rule No. 2: Never forget rule No. 1. It is even worse if you lose money without knowing why and how. 📌

⁷ "Why Short Sector ETFs Aren't So Smart" by Eric Oberg.
<http://www.thestreet.com/story/10454678/1/why-short-sector-etfs-arent-so-smart.html>



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REVIEW OF UNCERTAIN TIMES: A CHIEF INVESTMENT OFFICER'S JOURNEY, BY ALTON R. COGERT, CFA, CPA, CAIA

*By Max J. Rudolph, FSA, CFA, CERA, MAAA, former chair
of the Investment Section*

Actuaries have been active in the risk management field for many years, and recently added the CERA to our international stable of credentials. To manage risk holistically requires a firm to look at risk from many perspectives, both qualitatively and quantitatively. Alton Cogert has used his years of experience as an investment consultant for insurance companies to write a book detailing the levers available to manage investment risks. Using alternating fiction and technical discussions, a Chief Investment Officer at an insurer is fired and uses a teaching gig at the local university to keep himself occupied while he looks for a new job. Of course teaching investment policy requires him to come to grips with his own skill set and he emerges stronger from the experience.

The book is an easy read for someone who works at an insurer, and is especially valuable to someone interested in better understanding the perspective of an investment professional in that setting. It is interesting to see the many tools an investment pro has to work with. While admitting that actuaries can be a key ally to understand risks across the enterprise, the actuarial role is limited to providing liabilities as a single scenario best estimate. Better solutions are not developed. A broadly written book short on formulas and developing solutions focused on the interactions between investment and liability cash flows would be valuable.

The main character, Bob Short (perhaps Alton is a baseball fan who named his character for the owner who moved the Washington Senators to Texas? Or is this a reference to height or stature?), has taken the fall for GAAP income results that do not meet senior management expectations. The Army veteran with a young family now is unemployed. Many professionals have recently had a similar experience and this book will help them to cope and move forward to bigger and better opportunities.

Not surprisingly, the higher ups at Short's firm did not understand the nuances of insurance accounting and were caught by surprise when impairments were taken on the investment portfolio. Much like a political scenario, someone (else) had to take the fall or the CEO might be held accountable. Using book yield returns at purchase and meshing that with GAAP requirements for portfolio reporting led to inconsistency between expectations and results.

As the class develops, Short teaches his students about the investment process. Cogert's experience working with companies leads him to appropriately put emphasis on understanding risk appetite and how it changes based on the current environment. These discussions are highlights of the book. But then he states that alternative names for risk management are Enterprise Risk Management, Asset/Liability Management, or Dynamic Financial Analysis. While ALM and DFA are excellent tools to understand a part of a firm's risks, they do nothing to evaluate operational risk, strategic risks or the culture at an entity. He also assumes that actuaries provide the liability cash flow streams so the investment team can develop the strategic asset allocation when best practices would require an integrated process looking at a combined asset/liability portfolio. A detailed discussion of constraints typical to insurers, beyond how to abuse benchmarks, would add a lot of value.

The book warns of hidden dangers, or unintended consequences, of specific investment strategies. This good advice was shown to be true during the recent global financial crisis.

At one point Cogert shares a distribution of net investment income. As the only lever available to the investment silo this is useful, but better would be the resulting distributable earnings resulting from each

CONTINUED ON PAGE 8

strategy reflecting the interactions between assets and liabilities.

Where *Uncertain Times* is strongest is the book-long development of the process used by an insurance company to build an investment portfolio. By developing one lecture at a time as Short teaches the local class, various concepts are described and build toward the overall process. Especially useful is the discussion that boards and senior managers should feel comfortable challenging the investment manager for the relationship to work well. The portfolio manager should be able to explain what

their actions are and why. This will lead to a successful two-way conversation that helps both groups make better decisions. Of course this is true for each member of the senior management team.

Cogert's book is useful as we try to understand how others think and provides a stepping stone to an ultimate solution. The reader with an actuarial background will find that it helps them to understand how their teammates in the investment department approach a problem. Ultimately this will help the team grow stronger and more productive. **3**



By Max J. Rudolph, FSA CFA CERA MAAA, is the owner of Rudolph Financial Consulting LLC in Omaha, Neb. He can be reached at max.rudolph@rudolphfinancialconsulting.com.

SOA 2010 Elections

Let your voice be heard!

SOA 2010 elections are just around the corner. Online voting will be open 24 hours a day from Aug. 9 through Sept. 3 at 5:00 p.m. Central Daylight Time.

Visit SOA.org/elections to learn more about candidates for SOA president-elect, vice presidents, board of directors and section council positions—and to vote.

Have questions? E-mail elections@soa.org



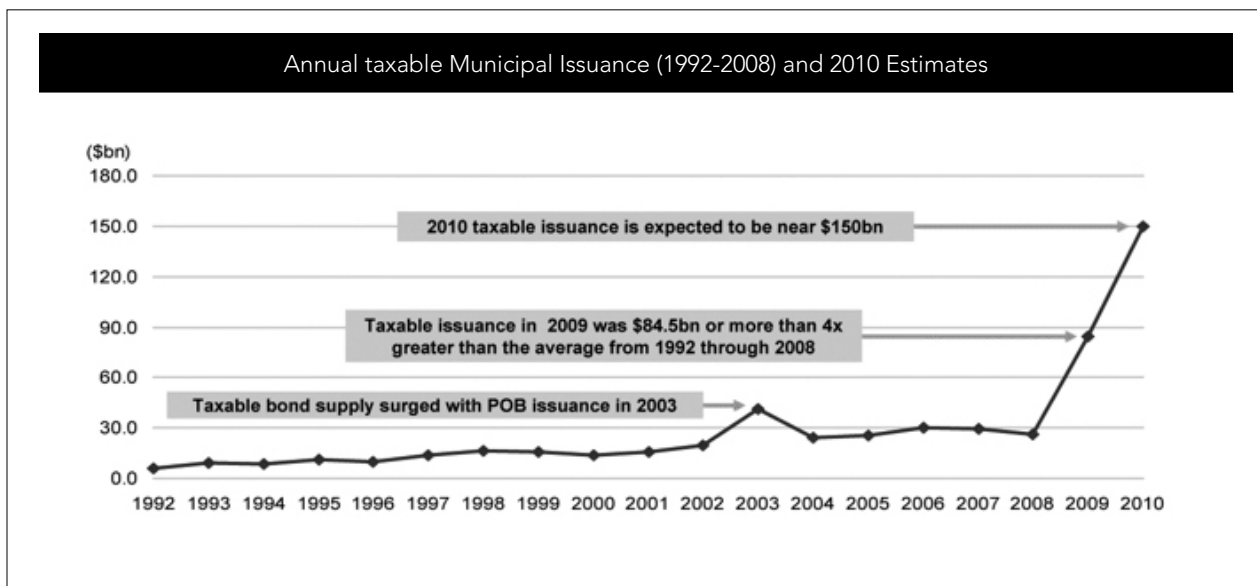
BASICS OF BUILD AMERICA BONDS

By Keith McCarthy

Build America Bonds (BABs) were created by the American Recovery and Reinvestment Act of 2009 (the “Recovery Act”), which was signed into law by President Barack Obama on Feb. 17, 2009. The interest income on municipal bonds has traditionally been exempt from federal income tax. The Recovery Act authorizes state and local governments to issue Build America Bonds, which are municipal bonds whose interest is taxable on a federal income tax basis. In return, the issuers receive a direct subsidy for 35 percent of their interest costs on the bonds. The program was implemented during the credit crisis, when municipal issuers were having trouble accessing the capital markets at reasonable rates. Currently, BABs can be issued by state or local governments for capital projects. Some examples of projects that would qualify for BAB financing include buildings for public schools, colleges and universities; power plants for publically owned utilities; transportation projects; and water and sewer facilities. There is no limitation on the volume of eligible BABs that can be issued by state and local governments.

In 2009, there was approximately \$85 billion in taxable municipal issuance and we expect \$125–\$150 billion in 2010. With approximately \$107 billion in issuance to date, the market for BABs is growing at a rate of \$7 billion per month. Year-to-date, BABs account for 25 percent of total municipal issuance. This is significantly higher than the 16 percent of total municipal issuance BABs tallied in 2009.

Structurally, BABs are quite similar to investment-grade corporate bonds. Historically, the municipal bond market has exhibited very low default rates in comparison to corporate-backed credits. Moody’s-rated municipal issuers have a very limited default experience with only 54 defaults over the period 1970–2009. The majority of these defaults occurred in the health care and housing project finance sectors. The majority of issuance has been long-dated, noncallable bonds, and over 50 percent of issuance has been made up of bonds with benchmark maturities of 250MM+.



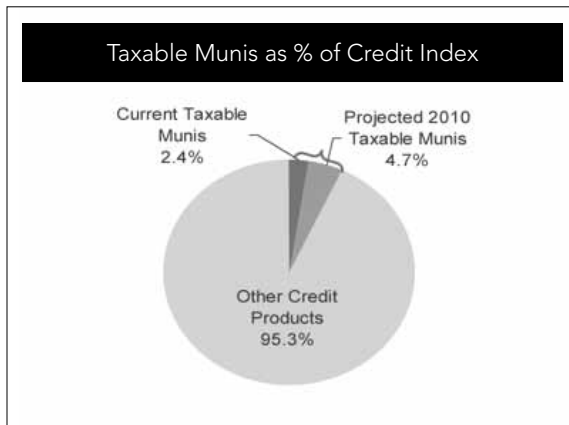
Source: Thomson Financial, Bond Buyer “A Decade of MunicipalBond Finance.”

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// AT THE TIME OF THIS WRITING, THE HOUSE HAS APPROVED LEGISLATION TO EXTEND THE BUILD AMERICA BOND PROGRAM FOR TWO YEARS. //

At the time of this writing, the House has approved legislation to extend the Build America Bond program for two years. The program was due to sunset at the end of 2010. The bill was sent to the Senate where it is awaiting approval following the Memorial Day recess. As had been expected, the subsidy payments will be reduced to 32 percent in 2011 and 30 percent in 2012.

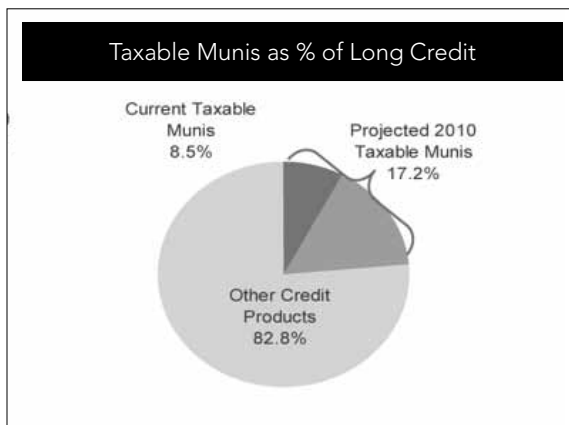
Barclays Capital expects the Build America Bond program to have a very material impact on the composition of its U.S. Credit Indices. Barclays Capital estimates that BABs' share of the U.S. Credit Index will increase from 2.4 percent to approximately 5 percent, and that its representation in the U.S. Long Credit Index will rise from about 8 percent to 17 percent. The Build America Bond program has given municipalities access to a much larger investor base, including pension funds and foreign investors. With the rapid growth in this relatively new asset class, we believe that many investors benchmarked to Barclays Capital U.S. Credit Indices would benefit from including BABs in their portfolios. Otherwise, they risk significant tracking error as a result of their underweight positions in the sector. **Ⓢ**

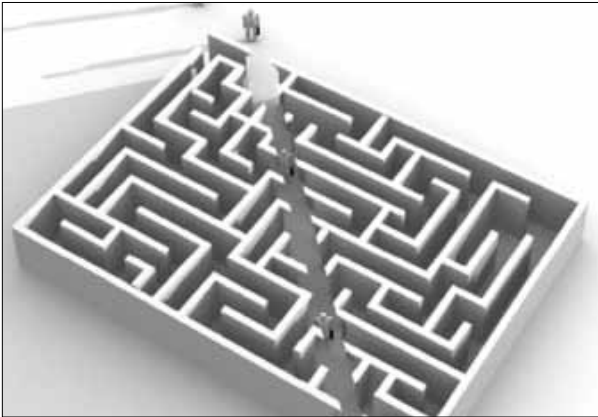


Source: Barclays Capital Municipal Strategies and Index Group.



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SHORT CUTS: EASY YIELD CURVE FIT

By Joe Koltisko

With this edition we would like to kick off a special occasional section of numerical short cuts, rules of thumb, estimators, modeling tips—let’s face it, fudges high and low which, like all great modeling tools are patently wrong but at the same time supremely useful at the right time and place. Please send your contributions to the editors or directly to Sam Phillips (sphillips@soa.org) at the SOA.

The problem is fitting the intermediate points for a real-world stochastic model of interest rates. For example suppose with much care and attention you have generated a range of paths for the 10-year interest rate, and a correlated set of paths for the two-year interest rate. You have worked out mean reversion strength, upper and lower limits, serial correlation, extent of inversion and time spent inverted. With these decided, the 80-20 rule would tell you to put down the pencil. But how do you splice together these pairs of 10s and twos into a set of yield curves?

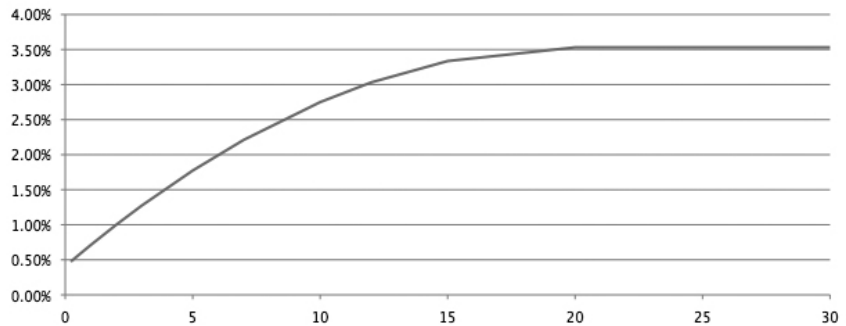
The short cut is to use a parabola $Y = aX^2 + bX + c$, but some further assumptions are needed since the equation has three unknown coefficients, while for each yield curve you have only two points. The extra assumption is that the yield curve is flat, with slope zero, beyond some high point M such as 20 years. This implies interest rates are constant beyond year M . In this case, $dy/dx = 0 = 2aM + b$ so that $b = -2aM$. From there, if we know $(X1, Y1)$ and $(X2, Y2)$ we can substitute into the formula as follows.

The resulting curve connects the dots in a generally reasonable way without creating many discontinuities in the par or forward rate series.

When the curve is inverted, the output also looks like a yield curve. Since the 2nd derivative of a parabola is a constant, the slope always “decelerates” at a constant rate until it hits zero at year M by assumption. A new set of coefficients can be simply computed for each pair of inputs to interpolate and extrapolate. 🧐

Estimate yield curve as		$y = aX^2 + bX + c$
M	20 yr	Maximum x-axis point
X1	2 yr	lower point
Y1	1.00%	data for lower point
X2	10 yr	upper point
Y2	2.75%	data for upper point
a	-0.000078125	$= [Y2 - Y1] / [(X2 - X1)(X2 + X1 - 2M)]$
b	0.003125	$= -2aM$
c	0.00406	$= Y2 - a(X2)^2 - b(X2)$

Yield Curve Fit



X	Y
0.25	0.48%
0.5	0.56%
1	0.71%
2	1.00%
3	1.27%
5	1.77%
7	2.21%
10	2.75%
12	3.03%
15	3.34%
20	3.53%
25	3.53%
30	3.53%



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LIVING WITH ACTUARIAL BLACK SWANS—A DISCUSSION WITH NASSIM NICHOLAS TALEB

Reprinted from *The Forecasting and Futurism Newsletter*, July, 2010 (www.soa.org/library/newsletters/forecasting-futurism/2010/july/ffn-2010-iss2.pdf)

By Ben Wadsley

■ may be killed crossing the street; should I not cross? Taleb's answer is, "Do not cross the street blind-folded!"

At the 2009 SOA Annual Meeting in Boston, Nassim Nicholas Taleb shared some thoughts on Black Swans, operating in the fourth quadrant, and living in the world of Extremistan versus Mediocristan during his keynote speech, all of which can be found in his published work. The follow-up session, summarized here, was our chance to ask the real question: What do we actuaries do about these phenomena?

The panel discussion was jointly sponsored by the Financial Reporting, Investment, and Forecasting and Futurism Sections and featured presenters Steve Conwill, FSA, MAAA, Max Rudolph, FSA, CERA, MAAA, and John Tiller, FSA, CERA, MAAA, respectively. The session was moderated by Alan Mills, FSA, ND. Look for other great sessions from these three sections at the 2010 SOA Annual Meeting in New York. The panelists asked several questions from their respective actuarial fields' point of view, and there were three recurring topics from Mr. Taleb's responses that are summarized below: Disclosure, Stress Testing, and Globalization.

DISCLOSURE

In 2003, Taleb was quoted in *The New York Times* saying that Fannie Mae will go bust. A disgruntled former employee of Fannie Mae had provided a copy of an undisclosed risk management report to a *Times* journalist. The journalist took it to Taleb, who was a professor at NYU, for interpretation, leading to Taleb's prediction. Fannie Mae had this risk report, but without disclosure the investors of the company and the media were not aware of the issues, thus they were not required to act on the results.

Are banks today marking-to-market their loans? No. In derivative trading where mark-to-market is used, every morning you start fresh. This avoids anchoring bias, which is the human tendency to rely too heavily on one piece of information when making decisions. In contrast, banks keep their loans at full value, even when payments are past due—the banks are anchored to the book value of the loan. The solution to this



problem is to use mark-to-market reporting and have volatility instead of having nothing and then experiencing a Black Swan event.

Taleb went as far as to say the banks should stop hounding customers with late payment notices, realize the loss, and renegotiate the loans. This viewpoint may be a bit extreme, but the point he was stressing was that forcing mark-to-market should be extended past where it is being used today.

A natural response to forcing banks to mark-to-market is the concern that it would cause unnecessary panic to shareholders. In the age of the Internet and the 24-hour news cycle, rumors spread quickly. Instead of mitigating rumors, be robust to the rumors. This means that we should have more transparency through risk reporting and valuation so rumors won't have a chance to impact our business. With full disclosure, we can create robustness that will mitigate fragilities inherent in our complex economic systems. Disclosure won't directly make banks robust, but it will force banks to deal with issues immediately and directly which will make them more robust. According to Taleb, mark-to-market in hedge funds may "... make them seem more volatile, because everything is volatile. It's sort of like someone seems sicker because you take their temperature."

STRESS TESTING

To get real risk management value out of stress testing, extreme scenarios must be used. Smaller levels of shocks may not give us the true level of risk in an entity—which doesn't get us to the goal of stress testing—to measure a company's relative fragility and robustness.

Let us consider two portfolios. The first contains 95 percent Treasuries and 5 percent high risk securities. The second portfolio contains senior notes of a fully capitalized synthetic CDO. If only a moderate shock is used—as in early 2009 when banks were forced to stress test their business with an unemployment rate of 10.3 percent, which Taleb claimed was only a blink away from happening—the first portfolio may lose most of the value of the high risk securities, while the value of the second portfolio may hardly move. This would show that the

// PERHAPS THE REASON THAT WE DON'T HAVE A LAND ANIMAL BIGGER THAN AN ELEPHANT IS THE INABILITY OF A LARGE ANIMAL TO SURVIVE BLACK SWANS. //

first portfolio is riskier, when it is clear that it is not. A good stress test would have shown the robustness of the first portfolio (complete loss of the risky securities, but the Treasuries remained untouched) while the second portfolio would show much greater losses, revealing the fragility of the assets, thus filling the tail of the loss distribution.

It may be conceptually difficult to choose a stress test level greater than a historic high, but no largest historical high has a predecessor—World War I and 9/11 were many times larger events than any previous event.

GLOBALIZATION

The world is moving towards the interdependence and connectivity of a globalized world. In just the last year we have been presented with new challenges and have had to deal with terms like “too big to fail.” One large loss that Taleb attributed to the impact of globalization was the 2008 Societe Generale loss of \$7 billion caused by a rogue trader. The single rogue trader was hiding a \$75 billion risk position, and the loss occurred when these contracts were unwound at fire-sale prices. Rogue traders cannot be prevented, but we shouldn't have a bank big enough to be able to take on that big of a risk position because of the nonlinearity in the risk taking ability of banks relative to their size.

Taleb asked us to consider a thought experiment—if instead of one large bank with one rogue trader and a \$75 billion risk position, there were 10 smaller banks with 10 rogue traders and a \$7.5 billion risk position each. While a sales order of \$75 billion caused a market movement of several percent, an order of \$7.5 billion would only take two phone calls and would hardly cost anything on a liquid day. Taleb's prediction was that the loss may have been only \$1 billion if the losses were spread across these 10 smaller banks.

Does Mother Nature already know this phenomenon? Perhaps the reason that we don't have a land animal bigger than an elephant is the inability of a large animal to survive Black Swans. In the case of an extreme drought, large animals requiring a large amount of water per day will die, while some—but

not all—smaller animals requiring less water will survive. This pronounced contagion effect applies to viruses as well. The unnecessary global travel that we do would increase the impact of a flu pandemic. When asked about the possibility of a flu pandemic, Taleb predicted that there is a “95% probability it will happen in my lifetime,” and since there is a high probability that it will kill him, he is going to hurry and finish his next book, *Tinkering*.

Today's use of the Internet also redefines the “run on the bank” scenario. There was a value to the bank of having people stand in line to withdraw their money. In a modern-day equivalent scenario, everyone would have their transactions completed on their Blackberrys in minutes.

The combination of increased flu pandemic contagion effect and our financial interdependence makes it difficult to protect our businesses. Without dividing into smaller financial entities or subcontracting our risk-taking and reducing our global travel, Taleb points out that we are forced into buying “... insurance on the Titanic from a guy on the Titanic.”

CONCLUSION

“There are so many errors we can no longer predict, what you can predict is the effect of the error on you!”
— Nassim Nicholas Taleb 📖



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ECONOMIC CAPITAL: A CASE STUDY TO ANALYZE LONGEVITY RISK

By Stuart Silverman

For some time now, insurers have reflected volatility in asset return assumptions when determining capital requirements, but have largely disregarded the impact of volatility on their liability assumptions when performing stochastic analysis. Considering the acknowledged expertise of insurance companies in managing the liability side of the balance sheet, these disparate approaches raise the question: why?

Factor-based capital models—which ignore the inherent volatility in mortality trends—could potentially understate future economic capital needs. This shortcoming, however, can be overcome with the adoption of a principle-based approach that uses stochastic techniques and dynamic assumptions for mortality among a variety of other variables.

Over the past century, life expectancies increased significantly. But mortality improvements occurred not in a steady upward rise but rather in fits and starts. While life insurers have largely benefited from mortality improvements that were greater than expected, the same is not likely to hold true for insurers in the longevity-protection market, based on past trends. For these companies, understanding the potential volatility embedded in future mortality rates could mean the differences between profit and loss.

Mortality volatility can come from a number of sources. Assumptions about baseline mortality tables may be inconsistent with the actual experience of an insured population. The disparity can be especially problematic in pricing the closeout of a pension plan for which generic industry mortality tables provide the main source of experience.

Lifestyle changes, medical breakthroughs, or the discovery of a blockbuster drug may also contribute to a fundamental shift in basic assumptions. Each could change the mortality curve in unprecedented ways, creating unforeseen volatility in insurers' longevity-based economic liabilities—with longevity risk not accounted for at all in current risk-based capital (RBC) formulas. The question is: how much of a capital



shortfall might an insurer face because of the longevity risk embedded in its portfolio?

ISOLATING LONGEVITY BY EXAMPLE

This issue can be addressed by examining a case study that compares the capital requirement produced by the statutory RBC formula to that generated by a principle-based model using dynamic assumptions for mortality. As part of this analysis, we effectively controlled all risks other than longevity, which enabled us to identify the economic liability arising solely from longevity risk.

For the purpose of this case study, we used a block of single payment immediate annuities (SPIA), described in the table in Figure 1.

Figure 1: Single Payment Immediate Annuity Business

Age	Annual Benefit	Lives
65	50,000	7,000
70	43,600	6,000
75	38,800	5,000
80	34,200	4,000
85	27,700	3,000

An SPIA has two risks—investment and longevity—and provides an ideal tool for a discussion of longevity risk once steps are taken to control the investment risk.

STATUTORY RESERVES AND CAPITAL

We started the comparison by calculating statutory reserves and capital for this block of business.

Statutory reserves are calculated on a deterministic basis with a prescribed mortality assumption, currently the Annuity 2000 mortality table. To build in a level of conservatism, the basic table's mortality rates are reduced by 10 percent. While this approach is well-intended, results will show that the use of a flat discount rate ignores any future improvements in mortality.

// UNLIKE STATUTORY RESERVES AND CAPITAL, WHOSE CALCULATION RELIES ON A FORMULA-BASED APPROACH, ECONOMIC RESERVES AND CAPITAL ARE DETERMINED USING A PRINCIPLE-BASED APPROACH. //

RBC requirements are developed from formula-driven charges for four risk classes: asset default (C1), mortality or insurance (C2), investment mismatch (C3), and general (C4).

Working through the statutory reserves and RBC formulas, the insurer's total asset requirement for the SPIA block is \$11.04 billion (Figure 2). This amount includes a capital charge for asset default and interest rate risk but no capital charge for longevity risk. This is the case even though the level of mortality improvement that occurred in the past clearly indicates that this omission is probably an oversight in the RBC formula.

Figure 2: Statutory Reserves and Capital (\$ in billions)

Total statutory reserve	\$10.40
CAL RBC C-1 risk, asset default	0.11
CAL RBC C-2 risk, insurance risk	0.00
CAL RBC C-3 risk, interest rate mismatch	0.05
Total CAL RBC	0.16
400% CAL RBC	0.64
Total asset requirement	\$11.04

ECONOMIC RESERVES AND CAPITAL

Unlike statutory reserves and capital, whose calculation relies on a formula-based approach, economic reserves and capital are determined using a principle-based approach. For this SPIA block, we defined the economic reserves to be the present value of annuity benefits and economic capital as the additional capital needed to satisfy a predetermined risk level (at CTE 90 or the 99.5th percentile) in excess of the book's economic reserve. Under certain circumstances, margins for adverse deviation are used to determine the book's economic reserve, but this case study instead used a best estimate of valuation.

To maintain continuity with the assumptions of the statutory capital formula, economic reserves and capital assumptions were also based on the Annuity 2000 table, but without the 10 percent discount in mortality rates (i.e., the Annuity 2000 basic

table). Instead of simply multiplying the basic table mortality rates by 90 percent, which may have been conservative in 2000, we reflected both past improvement from 2000 to the valuation date and projected mortality improvement after the valuation date.

To further ensure consistency with the statutory calculations, we assumed that the assets supporting the SPIA block could earn the statutory reserve discount rate. However, to control for the asset risk, for this case study we assumed that the insurer entered into a total return swap to effectively eliminate asset-related risk at a cost of 75 basis points. Other asset-management strategies could have been used to control investment risk. However, this method allowed us to identify the economic capital associated with the longevity risk and the economic capital associated with the asset-related risk.

Unlike the statutory deterministic approach, we calculated economic reserves and capital on a stochastic basis. When performing stochastic calculations, it is important to reflect volatility in all of your underlying assumptions. The graph in Figure 3 illustrates the economic liabilities from a stochastic calculation with static assumptions. Because there are a significant number of lives, the results converge to be the same as a deterministic calculation. That doesn't mean there isn't risk, but merely that the risk isn't reflected in the calculation. In contrast, the graph in Figure 4 illustrates the economic liabilities from a stochastic calculation now reflecting a volatile mortality assumption. The potential dispersion of risk under dynamic assumptions is further illustrated in the graph in Figure 5, which illustrates economic liabilities at various percentiles compared to the average economic liability.

CONTINUED ON PAGE 16

Figure 3:

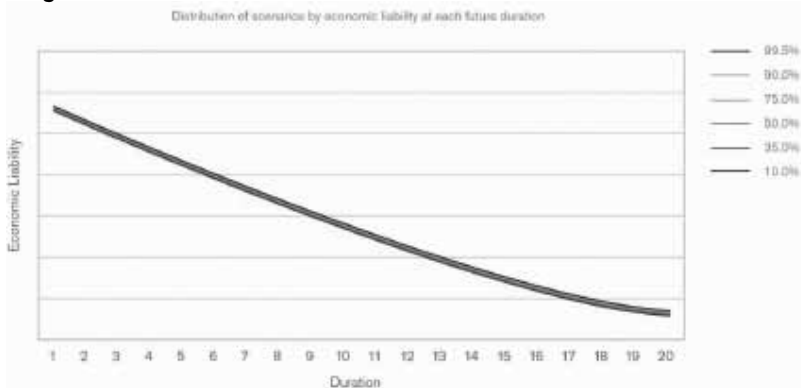


Figure 4:

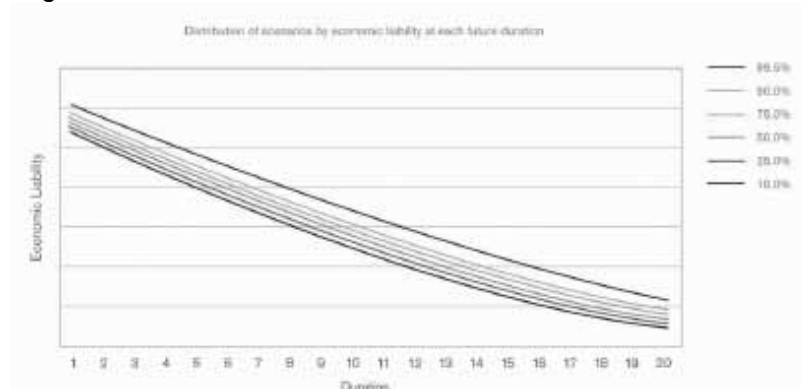
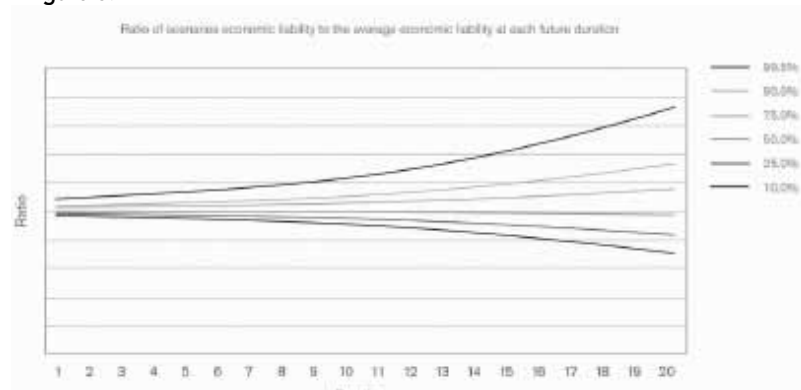


Figure 5:



In this stochastic analysis, mortality volatility was assumed to come from several sources, including:

- A mismatch between the population used to generate the Annuity 2000 mortality table and the population of lives in the SPIA block.
- Volatility in future mortality improvement based on an analysis of historical levels of mortality volatility by age and gender over various time periods. Additionally, we reflected historical levels of correlation by age and genders over time periods. Then we projected volatility in future mortality improvement in manners consistent with how the factors were derived from the historical data.
- Further, our stochastic analysis reflected the possibilities of extreme longevity occurrences, such as a breakthrough in medical research.

Using the above assumptions and methodology, we focused on two economic capital measures (i.e., the 99.5th percentile and CTE 90). We calculated these capital measures at two discount rates:

- 1) the economic liability using the 5.5 percent expected earned rate, which represents the economic capital required because of the longevity risk, and
- 2) the economic liability at the 4.75 percent earned rate after entering into a total return swap rate, which represents the economic capital after reflecting longevity risk and asset risk.

(Note: The economic reserve for this SPIA book is the average of all stochastic scenarios.)

The difference in economic capital values at the two discount rates represents the capital required because of the asset risk.

Figure 6: Economic Reserve and Capital (\$ in billions)

1 Average economic liability value (or economic reserve) discounted at 5.50%	\$10.61	99.5 th percentile	CTE 90
2 Economic liability value discounted at 5.50%	\$11.44		\$11.17
3 Economic liability value discounted at 4.75%	\$12.18		\$11.87
Capital for longevity risk (2) – (1)	0.83		0.55
Capital for asset risk (3) – (2)	0.74		0.70
Total economic capital (3) – (1)	1.57		1.26

The resulting value of \$10.6 billion is fairly similar to the figure produced by the statutory reserve of \$10.4 billion. To some extent this result is coincidental. This is because, at this point in time, the 10 percent reduction in mortality rates used to build conservatism in the Annuity 2000 table happens to be in line with mortality improvements that we applied to the Annuity 2000 basic table. However, if mortality improvement continues, the 10 percent reduction will become increasingly insufficient.

As shown in the table in Figure 7, the economic capital requirement for the asset risk is reasonably similar to the statutory capital requirement. However, the lack of a capital charge for longevity risk is glaringly apparent.

Figure 7: Comparison of Statutory and Economic Approaches (\$ in billion)

	(1) Statutory	(2) Economic 99.5 th percentile	(3) (1)/(2)	(4) Economic CTE 90	(5) (1)/(4)
Reserve	\$10.40	\$10.61	98 %	\$10.61	98 %
Capital for asset risk	\$ 0.64	\$ 0.74	86 %	\$ 0.70	90 %
Capital for longevity risk	\$ 0.00	\$ 0.83	0 %	\$ 0.55	0 %
Total capital	\$ 0.64	\$ 1.57	40 %	\$ 1.25	51 %
Asset (reserve + capital)	\$11.04	\$12.18	91 %	\$11.87	93 %

In fact, the main difference between the two methods can be seen in the \$83 million capital needed for longevity risk under the economic model at the 99.5th percentile (or \$55 million at the CTE 90 level) compared to no capital needed under the statutory formula. This figure is significant in itself, but it also highlights the shortcomings of using static assumptions to assess risk.

When static assumptions are used to calculate economic liabilities, the reserve results tend to converge around the mean, but if dynamic assumptions are used instead, the tail percentile values show a much wider dispersion, which enables us to have a better understanding of the risk profile.

The choice of assumptions has an impact not only on percentile values over time but also on the average economic liability. In this case study, the average economic liability at 4.75 percent rate was calculated to be \$11.235 billion using dynamic assumptions, compared to \$11.169 billion from another stochastic analysis but in this case using static assumptions. The

// REFLECTING VOLATILITY INCREASES THE RANGE OF POSSIBLE VALUES—BOTH INCREASING AND DECREASING VALUES. //

fact that economic liability under the dynamic assumptions is \$66 million more than that under static assumptions is no coincidence but rather reflects the asymmetry in the annuity payout patterns.

This asymmetry stems from the greater likelihood that on average more beneficiaries will live longer than expected than will die sooner than expected. Think about it. Reflecting volatility increases the range of possible values—both increasing and decreasing values. But while people can live to the end of the mortality table, they can't die before the valuation date. This phenomenon therefore increases the possibility that a beneficiary will live longer rather than die earlier, creating the asymmetry. This “cost of volatility” is not reflected in the insurer's liability unless mortality volatility is introduced into the equation.

DEAL OR NO DEAL?

The additional \$66 million is not an insignificant sum. For some investors, it might make or break a deal. But insurers, which have a mandate similar to other investors, often ignore mortality volatility in assessing their products, and thereby make themselves vulnerable to underperforming products.

A far more realistic approach is to recognize longevity risk and identify ways to reduce the capital requirements associated with it. This task is admittedly no easy matter, and options are somewhat limited.

Diversification of risk through issuing life insurance can provide some capital relief, but negatively correlated risks are rarely perfectly matched, as the 1918 pandemic demonstrated with its comparatively higher death rates among young people but lower death rates for older people (relative to expected death rates).

An insurer also may try to reduce its capital charges by demonstrating to its rating agencies its attention to capital management and the steps it is taking to manage its capital needs.

A relatively new but increasingly popular option is the securitization of longevity risk. Markets for longevity derivatives (i.e., longevity swaps or bonds), have started to materialize. These financial instruments make payments based on a survival rate over some period of time.

To see how such an instrument might reduce an insurer's capital requirements, let us consider the case of a hypothetical 10-year longevity bond with principal of \$1 billion. The bond is offered to investors with a 5.5 percent coupon, but the insurer has a 4.75 percent investment assumption, producing an annual cost of 75 basis points to the insurer. After 10 years, the principal is repaid, assuming the economic liability is below the attachment point. However, if the economic liability at the end of 10 years is above the attachment point, the insurer will not need to repay some of the principal, which ultimately offsets the higher-than-expected reserves the insurer is holding. In fact, if the economic liability reaches the exhaustion point, the insurer would not need to repay any principal.

In this hypothetical example, the probability that the insurer will reach the attachment point is 4.0 percent (or 40 out of 1,000 scenarios), while the possibility of reaching the exhaustion point is 0.2 percent (or two out of 1,000 scenarios). Over the 10-year period, investors are likely to lose 1.2 percent of their principal. In 96 percent of the scenarios the result is no loss to the investor. But the average loss of the 40 attachment scenarios is \$308 million.

While this investment is an out-of-the-money risk to the investor, it can immediately reduce an insurer's economic capital. In this hypothetical example, the reduction in economic capital is as much as \$230 million at the 99.5th percentile capital measure, at which point the insurer's economic liability of \$12.18 billion before the hedge drops to \$11.95 billion after the hedge.

Other options may be available, but before an insurer starts down the capital management road, it needs to identify its sources of risk and understand their potential volatility. Without

proper analysis, insurers could find themselves increasingly vulnerable to unexpected changes in mortality. Stochastic models that incorporate volatile mortality assumptions may be a useful tool to analyze this risk. 6



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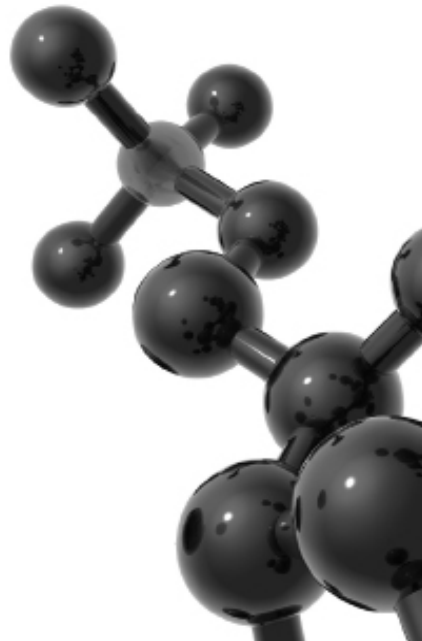
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The deadline for entries announced in the February 2010 edition of Risks & Rewards was June 16, 2010. However, if you missed the deadline, send your article along anyway! Risks & Rewards provides you with a forum to share interesting facts, work products or experiences. Your article can be formal or informal, about any topic that you find informative and interesting related to investment. With the financial crisis still on everyone's mind, this is a great opportunity to express your opinions and showcase your work or analyses.

Here are some topic ideas we'd love to read about:

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- Writing an investment management agreement
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- How to communicate risk and return alternatives to frame a decision from management
- Tips for managing consultants
- Review of Jonathan Wilmot's new book
- Standard option trades: straddles, strangles, calendar spreads
- Economic statistics—what to look for
- Pricing inflation derivatives
- Bond math—beyond duration and convexity, to implied repo, spread duration, krds
- The Lehman debacle
- How does London Clearing House work?
- Dual currency insurance products
- The futures delivery option
- Alternative practices for compensating asset managers
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Please e-mail future submissions to Risks & Rewards to Jill Leprich at jleprich@soa.org, or Sam Phillips at sphillips@soa.org. We look forward to hearing from you.

Sincerely,

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