

# **RECORD, Volume 27, No. 1\***

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Colorado Springs Spring Meeting  
May 30-31, 2002

## **Session 51TS Using Risk Management to Optimize Value**

**Track:** Investment

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*Summary: Attendees learn about tools used to manage enterprise risk and optimize firm value. Potential topics include economic surplus, earnings at risk, and law of one price. Attendees learn how various risk-management tools can complement each other.*

**MR. MAX J. RUDOLPH:** We're going to discuss using risk management to optimize value. We'll talk about some of the tools. I'm going to focus on some things that we've used at Mutual of Omaha in order to share quantifiable information with senior management and with people who are not necessarily numbers oriented. We are also going to get into the guts of the numbers. From a risk management standpoint, I want to make sure that we're not forgetting about the health lines. We talk a lot about annuity, life and pension products, but the health lines seem to fall through the cracks. When you're looking at enterprise value and enterprise risk, the health lines are very important.

I'm a vice president and actuary at Mutual of Omaha. I work in the corporate actuarial unit with enterprise risk management. I'm currently a member of the Investment Section Council. Frank Sabatini is a partner with Ernst & Young out of Hartford. He's also a past member of the Investment Section Council.

I'm going to talk about what we look at when we're talking about risk management in a general discussion with senior management. I'm going to share a couple of really neat graphics with you. We show some of them to the rating agencies, and I

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**Note:** The chart(s) referred to in the text can be found at the end of the manuscript.

think they're pretty powerful. I'm also going to discuss risk-return profiles. If you only take one thing with you from my presentation, I'm hoping you'll take a better understanding of economic surplus and how you can build off your duration work to do economic surplus for the firm. We'll talk about duration for both a specific product and the firm. We'll talk about how there is no free lunch. Finally, I'll share some of the tools that people are using.

Don't reinvent the wheel. The first article that I wrote after I got my FSA (*Financial Reporter* August 1995) was about how you could take your existing model, which at the time for us was the cash-flow testing model, and how you could use it to do a lot of different projects. This would include embedded value, duration and business line projections. I got a lot of pushback on that concept, because if you take your cash-flow testing model and you're using it, it's very robust and takes a long time to run. That is not as much of an issue today as it was 10 years ago. I still believe that if you use the existing model, you save a lot of time trying to explain what the differences between your models are, but each company has to weigh these issues. A single model can save time in recurring projects, but each division has to weigh run time versus time spent to explain differences in the models. It's a balancing act.

One comment I would like to focus on is that overcontrolled opportunity losses are just as costly as undercontrolled accidents. As risk managers, our job is to encourage our companies to take risk. Our job is not to say no. While some projects should be slowed down, we need to focus on how risk can be taken and managed effectively.

Knowing your audience is extremely important. Maybe your senior corporate managers came up on the marketing side. You're going to present a totally different presentation to someone with a marketing degree than you would to a president who came up from actuarial, accounting or investments. You have to tailor what you're doing to that specific group. The same thing is true with external audiences. Your securities analysts, rating agencies and regulators all have different backgrounds. You have to think about what they are going to understand. You have to consider how you can help them to take that iterative step to the next level and if you're doing more than they expect. You have to ask yourself, "If I'm doing less than they expect, how do I get my presentation up to a level that will pass muster with them?"

One thing that can be a problem is that different professions call the same thing by different names. I've been on a number of task forces within my own company, with accountants especially, and we'll spend hours debating. Afterward we discover we were talking about the exact same thing and we just wasted that time. Of course, the next day we do the exact same thing again. We don't seem to learn, but at least we're aware of this risk. Knowing that somebody's education, perspectives and goals are going to be different is important. A regulator is going

to have much different goals in terms of what you're presenting to them, perhaps, than a rating agency.

Almost always, graphics are the key with presentations. I have one example in which that's not the case. I had a boss for a number of years and every time I'd show him my really cool graphics, he'd ask to look at the numbers. You want to go in with graphics, but you also want to have the numbers in your pocket so that if somebody asks that question you can back up what you've done

Our cash-flow testing team put together Chart 1. It's very powerful. You can see that it shows each of the 20 years of a cash flow testing model. It looks at what the statutory surplus is at the end of each year. These are the C-3 Phase 1 scenarios from risk-based capital (RBC). They are interest rate scenarios. There are 50 scenarios that are built under that. A lot of companies, when this project was going in, were saying this is really going to be hard to do and we don't really need to do this additional work. Once we set this up, though, it was very easy to run each year and we made it part of our regular cash-flow testing process. It shows your mean by year, your quartiles, and your maximum and minimum by year. It's another tool and it's one that is taking results that you already have. I can go into a rating agency and show them this, and they know exactly what I'm talking about. They know what this means and I can show it to them in 30 seconds and move on to something else.

You can do the exact same thing for other projects besides cash flow testing. You can do that for cash flow at risk, earnings at risk, even embedded value at risk, if you get into an option-adjusted value of distributable earnings (OAVDE) environment.

The risk-return profile is something we've done for several years now, and I've noticed a number of other people have been presenting it, too. I think it was developed by a number of people all at the same time that were saying, "We're doing these interest rate scenarios, and instead of just looking at the mean, let's try to look at the distribution." A good way to look at it is to look at the present value of distributable earnings and then measure our risk by the dispersion of that result for each scenario. The average of all those is, of course, the OAVDE. So far in our shop we've done the interest rate risk, but I think eventually, as we move more towards unified valuation systems (UVS), we'll be adding the other risks and the correlations and it will become much more powerful even than it is today.

I think there's a good story in the risk-return profile in Chart 2 as to why we're doing this. As we've done a lot of duration work by product, we've found that the universal life duration is very susceptible to interest rate movements and that your duration can change from 10 to zero very quickly. It did change very quickly back in late 1998 when long-term capital management (LTCM) and Russia and all that was going on. We wondered if we should be duration matched. We started off with that as our goal. At the same time, we recognized that there was enough

movement that you didn't want to force the investment department to put on a new hedge every month—it just didn't seem to be very worthwhile. We ran through our scenarios using OAVDE, and found the mean to be about \$41 million. The duration of our liabilities was very short, about half a year. Investing that short didn't seem to make sense, so we decided to test the short investment strategy.

Chart 3 shows the results of investing to match the duration of the liabilities at that point in time. Would you want the set of cash flows in Chart 2 that are almost always higher, or the one that has very low dispersion? I'd much rather see just a little bit more diverse group of cash flows than one that's stable, but very low. It doesn't mean I'm not worried about what these lower scenarios are and trying to figure out what I can do to improve them. You can use risk/return profiles for crediting strategies, investment strategies or just about anything.

I want to focus on economic surplus and on the duration of the firm because those are, I think, very important and they're not getting the attention that they should get. When I first started to put together this presentation, my goal was to get this back on the industry table so that we utilize the work that we're doing for durations. You've got all the work done. If you're calculating durations, you've got all the values at all the different points. Don't throw them away. Economic surplus is the difference between the market value of existing asset, premium and liability cash flows. We look at source of funds, so we roll together the existing assets and the existing present value of future premiums, and then compare that against the uses of cash from the liability cash flows. You're going to use best estimates. If you're going to come up with the distribution of results, I think you're just kidding yourself if you include provisions for adverse deviation (PAD). I don't think we really know in every case whether a PAD is conservative or if it might be liberal. We just don't know. It might have a different impact than we expect. If you run your scenarios so your dispersion uses best estimate assumptions, that is a better way to do it. It doesn't mean that you don't also look at a stress test where you include your PADs that you might have for GAAP or statutory purposes.

The results are going to be more volatile. Any time interest rates move, this number is going to change. One downside to our methodology so far is that it assumes parallel interest rate shifts. It is in the spirit of fair value accounting. There are a number of initiatives going on right now, both internationally and within the NAIC. At the June 2002 NAIC meeting, some of the variable-annuity distribution results and their impact on both capital and statutory reserving will be presented. That is a huge step towards UVS. You can really get ahead of the game by trying to follow what's going on.

Duration, also known as option-adjusted duration, measures the embedded options within both liabilities and assets and looks at the amount and timing of cash flows as they vary across a range of interest rate scenarios. As I said before, matching duration may not be optimal and I'm not going to get into the specifics of that, but you can put together a number of different strategies and run it through your tool

and see for yourself what your risk is. Convexity risk is where the durations diverge as interest rates move—the smile and frown of your price behavior curves.

There is one thing I do want to point out, because over the last couple of years there have been a number of presentations and papers put together that are inconsistent with what we did here. We split out the cash inflows against the cash outflows. We don't net the premiums and liabilities. We include premiums with the assets. The groups that have done that show a result in which they have an infinite duration. They don't have an infinite duration. It's a reflection of their measure. If they include the premiums with their assets, they won't show an infinite duration and it makes a lot more sense.

Chart 4 is a generic product. It's similar to what an annuity would look like. The zero point reflects your extract date. You look at your assets and your premiums combined, running them through a whole bunch of interest rate scenarios from that point. You then spike up your interest rates 100 basis points and run it through a whole bunch of interest rate scenarios. Then you spike it up 200 basis points, and so on.

Do the same thing for the liabilities. As rates decrease, the impact of the interest rate guarantee kicks in, so you see the convexity there. That shouldn't surprise anyone.

A lot of times when we do this at the enterprise level, the numbers are big enough that they look parallel, but they're not, and so that's why we've incorporated the bottom graph that is the economic surplus. It's the difference between the two top lines. One thing that I can't stress enough is that all of these numbers are based on cash flows. There's no GAAP, there's no STAT, and it's strictly cash flow. It's like an asset would be valued in the market.

You can see that there's some concern if interest rates go down. There's a little bit of concern if interest rates go up, but these scenarios were pretty well matched to start out with, both for duration and convexity across a pretty wide variety of scenarios. You can use this tool to compare alternatives. You can compare your investment strategy or different product features. It will let you see what the difference is between a 3 percent guarantee and a 3-1/2 or a 4 percent guarantee. Maybe, for those of you who have a lot more guts than me, maybe you want to see a 5 or 6 percent guarantee. This tool works very well for things like comparing your crediting strategies.

I have a little saying that I came up with. I gave a very similar talk to the Investment Committee of our board about a week ago. I'm really pleased that our board is interested in this kind of stuff, but I was trying to come up with things to help them remember. I was trying to talk about convexity risk. The graph that I showed as an example actually had some convexity on the asset side, too. I said, "When your assets are frowning (meaning when your curve in the top graph looks

like a frown), your policyholders are smiling." That's where the economic surplus comes in. If these two lines cross, you've got a problem in that scenario. That product line isn't worth anything.

One of the things that you need to decide as you're going through this process is whether to include your target surplus assets or not. We have not included target surplus assets and manage all of our surplus assets as a block, but your company may do something different. You need to be clear when you show this to the rating agencies or to other external parties. I don't really think one method is better than another.

Chart 5 is a graph that we did a couple of years ago that is very powerful to me. The top line that goes up very high is looking at a fixed premium deferred annuity with a four percent guarantee modeled right when LTCM capital went under and interest rates went down quite a bit. This is a subset of our in-force block. Now, spreads at the same time went up, so there are some other things happening here too, but just as an illustrative example, I think it's pretty useful. Looking at this as of September 30, 1998, the scenarios are much worse than as of year-end 1998 and then we came back to it at the end of June 1999. At that point I wasn't as worried as I had been. Something interesting appears in this analysis. When the scenario was bad, the cost of the options that would have helped me was the most expensive. You have to put yourself through a stress test. You have to question, "If I'm where I'm at today and interest rates go down two percent, do I potentially have a risk-of-solvency problem?" Options were cheap right before the LTCM fiasco. A day later, they were a lot more expensive. I don't want to be too strong here, but in my opinion that reflects on the value-at-risk models that banks tend to use. They only use history that's fairly recent and so you would have held almost no capital right before all of the LTCM stuff happened.

If you're going to be a risk manager, it pays to be a contrarian. Try to think against the curve. I know on September 11 it was really hard to do, but I went into my office and I closed the door. I tried to think of anything that I could do to help mitigate any of the risks that we had potentially just incurred. Luckily we didn't incur a lot of losses at that time, but the time to think about that was earlier. So I guess the thing that I would encourage people to do now is to sit back and think of what could go wrong, and what could go right. You have to ask yourself, "Could something going right cause something else to go wrong?" I think we all need to do a lot more of that.

Looking at Chart 6, we found that the risk was primarily in the top five or so scenarios. If I can figure out what's the same between those worst scenarios, maybe I can hedge that.

We looked at which interest rate scenarios produced the worst results and found that there were some similarities. Again, we're talking about a deferred annuity with an interest rate guarantee. If interest rates stay down for a while and go below the guarantees where you can't support them, you lose some money. Then if interest rates spike up, all those people leave. So you've lost money, everyone left, and you've locked in your losses. If it goes down slowly and comes back up slowly and you still have quite a few people left at the end, then you can end up just holding on and doing okay. It's that scenario in which interest rates go down, stay down for a while, and then pop back up that seems to cause the biggest problems. Obviously, you need confidence in your dynamic lapse formula.

Another comment I would make on dynamic lapses is that we need to do a better job of stealing models from other industries. The mortgage-prepayment models are pretty well developed. We need to use the S-curves that they've developed and see how they can work for us. I know we've done some work with that. For a home mortgage, if rates have come down by about 60 basis points, that's a point of inflection for that market. Now, are our policyholders as sensitive as somebody that has a mortgage is? I don't think so, because if it's in somebody's interest to go and refinance her mortgage, it's going to be plastered all over *U.S.A. Today* and within a week all the refinances are going to be done. With insurance, with annuities, you haven't seen that yet. I don't think it's beyond the realm of possibility, though. I think that if interest rates were to go up, you'd see the big article saying you should roll it into something else. If interest rates go down, I think we're kidding ourselves if we think that policyholders won't figure out at some point that they've got a pretty good deal and stick around.

I think there's enormous value calculating the enterprise duration ( $D_S = D_L + (D_A - D_L) \times MV_A / MV_S$ , where  $D_S$  is the duration of surplus). This formula lets you see the sensitivity of your company to movements in interest rates. It covers the whole firm, not just one product line. If you have a mismatch or large leverage, it's amazing how quickly the duration will change for the firm. Even if you feel like you're not mismanaged or mismatched, if you're highly leveraged, meaning you've got a small amount of surplus relative to your total block, it can really take off.

There are a number of different forms of this formula. This is the one that I prefer, but certainly the others are just as good. This one looks at duration of the liabilities ( $D_L$ ) then you add to that the mismatch, the difference of the duration of assets ( $D_A$ ) and  $D_L$ . This reflects whether you're invested longer or shorter than your liabilities. When I'm talking about assets here, I'm talking about all the assets including the surplus assets. Then you multiple that by the leverage term, the market value of your assets ( $MV_A$ ) divided by the market value of your surplus ( $MV_S$ ).  $MV_S$  can be obtained by subtracting the market value of your liabilities ( $MV_L$ ) from the  $MV_A$ .

We recently made this risk measure a part of the balanced scorecard for our firm. I think it's really well suited to balanced scorecard where you're looking at a red,

yellow, green kind of stoplight mentality. Let's look at an example with fictional numbers. Let's say I'm very comfortable with any duration less than 20. If I'm comfortable with that duration of 20, maybe I'll say if the duration gets up to 15, then I will change my dashboard to the yellow light. That way it gets on the radar of senior management. I'll say, "We've been taking a little bit more risk here; let's be aware of it." Let's not do an acquisition that's going to cause us more problems. Let's try to manage through that and decide what we want to do. Then if you get to 20, then it turns to red and then you have the sirens going off and all that.

Table 1 shows that your liability duration really doesn't drive the surplus duration. It's driven by a combination of your mismatch and your leverage. In the top line I have a liability duration of four and a mismatch of four, meaning I'm invested four years longer than my liabilities. That's quite a bit. I have leverage of five, which means I've got five times as many total assets as I have surplus, which isn't really huge. All of a sudden I've got a surplus duration of 24. That's a big bet. But in the line with the same liability duration, the same mismatch and a leverage of 10, the surplus duration is 44. If interest rates go up by 2 percent, I'm in big trouble. At the same time, if you're short it has a similar type of impact. You can get down close to a 20 duration very quickly if you have the leverage at 10. This is one of those tools that I think it's important to be aware of. It's not an end-all. No tool is an end-all, but it's important to know what your risk is because we just never know when interest rates might change by 3 or 4 percent, especially in today's environment.

Table 1

*Mismatch / Leverage Examples*

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Liability Duration	Mismatch	Leverage	Surplus Duration
4	4	5	24
4	2	5	14
4	0	5	4
4	-2	5	-6
4	4	10	44
4	2	10	24
4	0	10	4
4	-2	10	-16

• Surplus duration =  $D_L + \text{Mismatch} * \text{Leverage}$

There's no free lunch. You have to take risk to get return. If anybody's come up with a way to get return without taking risk, then let me know. Most of the balanced scorecards that I've seen have been very return-oriented. I haven't seen many scorecards that have included constraints. Their balanced scorecard is based on GAAP returns or a similar measure. There are very few that say something is okay, but only within a particular constraint. I think qualitatively that's there, but that's where companies need to think on both sides a little bit better. A current issue is the number of bond downgrades. A lot of companies impaired assets and generally had a bad year credit risk-wise. Of course, that's part of the cycle. It's something to be expected. What happened, though, at a lot of companies was that the board all of a sudden said, "We'd better back off on our credit risk or the rating agencies will be mad at us." But we still need to support these commodity-type products. One way to get extra yield is to buy mortgage-backed securities and take convexity risk.

Chart 7 maps the difference between a sequential collateralized mortgage obligation (CMO) and a non-callable bond. Obviously, this doesn't show credit risk at all. If I map the liability against this, I've got negative economic surplus in down scenarios if I'm backing it totally with mortgage-backed securities. If interest rates go down 300 basis points, not only am I in the guarantee for my annuities, but I've just been handed all the cash in my portfolio to reinvest because all the sophisticated homeowners just refinanced. So that can be a good teaching tool as well for people within your firm.

You can't give a talk on risk management without talking about the efficient frontier. I think there are different levels of models. There are some models out there that do a very good job of creating an efficient frontier. If you look at your different product types and map them out, and then map combinations of the different product types, you can create an efficient frontier. Be very careful because you don't want to fall in love with your models at the risk of common sense. If your models are working right in today's environment, that doesn't mean they will work right in tomorrow's environment. Each time you use it, you want to make sure you look at it for reasonableness, both on the inputs and on the outputs. With that in mind, it still can be a good way to develop an optimal mix of products for your firm based on where you're at today. You can look at where you can move up and increase your return with the same amount of risk or reduce your risk for the same amount of return. Either one of those adds value to your stakeholders, but the smell test is important. Again, be a contrarian. As you're doing risk management holistically, meaning looking at the whole enterprise, it's very important to avoid the silo mentality. That's something that's very hard to do the way most companies are set up. I know it's true at my company. We have strategic business units (SBUs) that are very focused on the risks involved in their own products. We really don't spend a lot of time thinking about how the risk of, say, a single premium deferred annuity (SPDA) might offset the risk of group life. Somebody needs to be doing that work and generally that's going to fall back to the corporate area.

Some other projects that I'll mention include doing some product design optimization using the efficient frontier. Also, in the last year we've spent time graphing the trends as we get a better feel for what the S&P tests are doing for capital, liquidity and earnings. It's helping us to understand what they're looking at and to help guide them where maybe we're misunderstanding what they ask for or are sending them the wrong information. We're getting past that and now we're trying to understand the reasoning behind the factors. It starts some really good discussions and the rating agencies are very interested in having that discussion if you think something doesn't look right for your product line.

Trending duration is another topic I'll touch on briefly. Since this presentation was due, we put together a graph that measures the duration for a product line and maps that duration month by month based on the current interest rate scenario. It made sense to do it against the five-year Treasury and it was really interesting to look at. For this product line, as interest rates went up, the duration went down. I knew there would be a trend there, but it was one of those things where I just wasn't sure what the trend was going to be. It's helping us to understand the risks within our own product line and the limitations of some of the tools.

In the last couple of years, before this year, we had seen fairly parallel shifts, so key rate durations fell on the back burner while we worked on some other things. That didn't happen this year. This year we went from an inverted curve to a pretty steep curve and the partial durations were much more material than they had been. If you have got that process set up to where you just push a button and it runs, they're already set up and you recognize that risk.

We also show a graph to the rating agencies that uses work already done for cash flow testing. We take the cash flows, rather than the earnings, and focus on the level scenario, the pop-up scenario, and the pop-down scenario. We look at it in terms of the sources of funds versus the uses of funds. I can show that and in 30 seconds the rating agency has a good idea that we're in pretty good shape.

Showing the impact of model improvements is another area I want to touch on. One of the things that I'd like to spend some time working on in the next couple of years is trying to project both duration and embedded value under certain scenarios. I would like to include new business and look at it from the dynamic financial analysis (DFA) side of things.

Trending RBC, or looking at your capital diversification, is another topic I want to quickly cover. One of the graphs we started showing the rating agencies shows our C-1, C-2, C-3 and C-4 as a pie chart. We show the most recent two years. Showing that, in addition to some of the other tools, backs up some of the presentations done by our SBUs and our investment department. It shows that we took less risk in this, or we took more risk in that and it helps that discussion go forward. I'm not an expert on either risk adjusted embedded value or risk-adjusted

return on capital (RAROC), but it seems like those would fit in pretty well with some of these same models.

I'll finish up by repeating what has become my mantra. The key is to use multiple tools. Don't live and die with one tool, because eventually you're going to die with it. Leverage off what you're already doing and know your audience. With most audiences, graphics is going to be the way to go, but with some audiences it's not, and it's important to know which group is which.

One of the shortcomings in the tools we've been using is that they don't include taxes very well in the modeling. That's something to be aware of as you're doing your duration. As long as you assume that taxes are a certain percent of your cash flow, it doesn't matter, but if that's not the case throughout your product lines, then it does matter.

**MR. FRANCIS P. SABATINI:** We're in interesting times. It's getting harder and harder to do business. We're all looking for ways to gain an advantage, and as actuaries we're going through a transition. You may not feel it or experience it on a daily basis, but it's up to us and we're the ones that have the skills to help our management make good, fact-based, decisions and gain that competitive advantage. We're spending too much time as an industry making a lot of the seat-of-the-pants decisions. The risk-management framework, in my opinion, is the best way to create better value. I'm going to talk about some techniques and show you examples, but I really want to focus on the message.

You need to look for that last place to go to gain an edge, and I think risk management is one of those places to go. It's a hell of a lot better to be good than to be lucky. I've been lucky, but I wasn't always lucky and I decided somewhere along the way that being good helped, too.

The main things that drive value are quality and volatility of earnings, the level of earnings relative to the risk assumed, and how much perceived risk is on the balance sheet. Lots of analysts today look at perceived risk on a balance sheet that may not even be there. In contrast, analysts may look at the balance sheet and the perceived risk is a lot less than what's really there, and then they get surprised. It's important to have the ability to respond to the perceptions about risk.

What you want to try and do with risk management is create the highest value for the risks that are assumed. At the end of the day, the analysts or whoever is looking at your organization is going to figure it out. If you realize that balance, then your organization will realize the right value. Ultimately, those organizations that have the right balance between risk and reward are the organizations that are going to win. The organizations that win are the ones that make the right choices based on the right information. Today, information can't be developed without the use of technology. The information around risk management, particularly as it

relates to the financial issues, but also as it relates to the non-financial issues, can't be addressed without the use of good models and good information.

I'm going to suggest a new paradigm. The old one was that risk management was focused on mitigating risk. The value that risk management has brought historically is based on how much mitigation it has been able to produce. Sometimes it's hard to measure. A lot of times it's hard to get management to really understand the value that risk management brings. And the other paradigm, particularly for the multi-line companies, has been the focus on each business line independently. I've been talking about this for a while, and people are actually starting to do it. Look at the company as a whole, so the new paradigm is the entire enterprise. That means knocking down silos or going across silos. The other new piece of the paradigm is to look at risk management not as a defensive, but as an offensive weapon. We're in the business of taking risk; let's just make sure we take the right risks and we get compensated for the risks that we're taking. The value that we bring to the organization is our ability to help the organization achieve the right balance of risk and reward.

We've all seen the efficient frontier picture in Chart 8. I think X represents where a lot of the organizations are. In part it's because of lack of information; it's partly due to inadequate technology. It's awfully hard to get to the line, but moving up or moving left are things that can be achieved. Getting close to the line is what you want to try and do.

So how do you transition to the new paradigm? The old paradigm was to look at the risks of your business line and not worry about what the other business lines are doing. Under the old paradigm, we would develop our risk-mitigation strategy, determine tolerances, such as saying we don't want to be mismatched by so much or we don't want so much credit exposure beyond a certain level, and then implement our mitigation program. Then we would monitor the program. That served us well. There's nothing wrong with the old paradigm; it's just the new one is a little bit better because it's looking to identify opportunities and synergies and ways that we can optimize value.

We evaluate and plan in terms of looking at risk-reward alternatives across the entire organization. We look to see what could go wrong, and ultimately we set a strategy. Looking at the entire organization develops the strategy, and we're going to make that point throughout the talk. Act, implement, and then re-evaluate the whole process.

What are the key elements? You have to look at the entire organization. You need good, strong modeling capabilities, and the key is not to spend 80 percent of your time building the models. You need to spend 20 percent of your time building the models and 80 percent of the time using them. It's not rocket science to make that shift. It's pretty easy. It's investing the time. There are organizations that are able to have all their models built, validated, and running within days of getting the end-

of-quarter information. It can be done. It's called automating the process. You just have to spend the time to do it.

I don't know that every company has to have a chief risk officer, but you have to have somebody that worries about risk management on a full-time basis. It's not a part-time job, particularly if you want it to be an offensive weapon and if you want it to be holistic across the entire organization. It needs to be a responsive function. What I mean by that is if you're running a risk-management organization, you want the users of that information to notice that it's there and it can be used. If it's a report that sits on somebody's desk and that person goes to a meeting and looks at it, but does not act on it, then it's not adding the value that needs to be added. The process needs to be focused on supporting real-time decisions. Ultimately, if you do it right, you change the culture. The decision-makers will consider the opportunities and look to the people that are involved in the risk-management process to ask, "What if we did this? What do you think of this idea?"

What kind of information is required? It is important to provide metrics that they can relate to. Don't talk to them in a language that they can't understand. If all they worry about is GAAP earnings, then give them GAAP earnings. If you sneak in an embedded value, that's fine, too—and make them pay attention. But if all you give them is embedded value and they don't understand it, you're not going to get them to pay attention. Give them a little mix of what they like and what they don't like. Graphics are good as well, but put it in their terms and give them information that allows them to make decisions and then ask them to make them and you'll be surprised. If they think that the quality of what you've given them is good and the information that you've provided them is actionable, they'll make those decisions.

I'm going to give you a couple of examples. Consider that a lot of people are walking around a company saying they don't know how these people can write this product, and that it's the riskiest thing known to mankind. They think they are the only company that thinks rationally and knows how to do it right. But did you ever think that there is a possibility that somebody figured out something new? Maybe they looked at the whole problem from a much different perspective than you might have, or they took an offensive rather than a defensive view of the risk? Look at how much risk there is, rather than how this risk plays into the organization as a whole. Ask how we can go to market with this and still tolerate the level of risk this product brings?

And that gets to the second point—growing without increasing the overall risk by exploiting natural hedges between different parts of the business. That's the theme that you're going to get in the next section. We're going to look at a risk management and attribution methodology case study. Again, don't focus on the metrics; there are pieces missing. The point is more the process and the mindset that's involved.

We're going to look at financial risks. We're going to look at financial risk across the entire company. We're going to determine attribution for each risk element and we're going to define risk in a statistical way that reflects historical experience or expectations for the future. We're going to recognize to what extent different risks are correlated with each other, or whether or not they're correlated at all.

There are new metrics that have some value. Among these are earnings at risk, present value of distributable earnings, GAAP earnings at risk, RAROC, and return on risk adjusted capital (RORAC). Another point relates to horizon. Risk is not 30 years from now, particularly if you're a senior executive in a company. Risk is next week. Risk is one year from now. Risk is five years or 30 years from now. The goal in all of this is to get management's attention and make sound, risk-adjusted, decisions.

Let's go back to our case study. I'm going to look at these five risk elements: interest rate, equity markets, credit, mortality and lapse. We're going to look at "earnings at risk," and using horizons of one, five and 10 years. Earnings at risk is a rank ordering of outcomes.

In the case of Chart 9, it's earnings and you have a distribution of results, worst to best. The amount of earnings at risk could be planned versus a point in the distribution, such as the fifth percentile or tenth percentile.

We've used an interest rate generator in the modeling that we've done here. It's fairly robust. For example, we have a variable annuity product in this example, so we actually generate the subaccount level returns using a CAPM methodology and correlations between the different asset classes. We also have included credit. We have done a wonderful job over the years of modeling credit as an X-basis point event per year. How many people believe that credit events occur on a constant annual basis point rate? There are some more sophisticated techniques that we use, particularly as they relate to the correlation of different credit events. We fit historical experience at the rating level and treated credit as an independent event. Mortality is mean variance, so each  $q_x$  has a mean and variance. Here, we actually modeled both systematic and non-systematic risk, so we assumed a long-term deterioration in mortality. We assumed non-systematic variation in terms of lapse. We establish lapse formulas, including the dynamic lapse, and assume their validity as if someone came down from the mountain with a pair of tablets. Well, reality may be entirely different. What if you're wrong? So why shouldn't you capture the risk that you're wrong on the lapse assumption?

In the case study, we have \$1.8 billion in liabilities, with \$400 million in universal life (UL), \$1.3 billion in variable annuities (VA), and \$100 million in bank CDs. The assets invested for UL are corporate bonds and mortgage pass-throughs, and bank CDs are backed by mortgage pass-throughs. Let's look at the results.

We've done stochastic processing and Table 2 shows the cumulative value of earnings over five years. If we run a scenario and we had \$5 million a year in earnings, then \$25 million would be the result. We do that for each of the scenarios. We're not discounting and we're not accumulating, we're just adding them together. We run the model and all stochastic processes are active. There are credit events happening randomly, mortality events happening randomly and interest rates moving randomly. We produce a result and we end up with a distribution. The first percentile, which is the worst result, is -\$9.7 million. The mean value is \$9.7 million, which is slightly skewed because you see the 50<sup>th</sup> percentile is a little higher. The earnings at risk, using the fifth percentile, is the difference between the mean of \$9.7 million and the fifth percentile of \$1.3 million, or \$8.4 million.

Table 2

FRM Case Study – UL Results (5 year earnings)

Percentile	Total	Lapse	Credit	Mortality	Interest
1 <sup>st</sup>	(\$9.7)	\$16.6	\$11.0	\$7.6	(\$0.4)
5 <sup>th</sup>	1.3	16.9	13.0	11.1	4.4
25 <sup>th</sup>	7.2	17.1	14.4	14.9	10.3
50 <sup>th</sup>	11.2	17.3	15.1	17.3	15.0
75 <sup>th</sup>	14.9	17.4	15.8	18.7	18.0
100 <sup>th</sup>	23.9	18.0	17.1	27.2	22.8
Mean	\$9.7	\$17.3	\$14.7	\$17.4	\$12.9
EaR	8.4	0.4	1.7	6.2	8.5

OPTIMIZING Value

Now let's look at the interest rate column. We did the same projection except the only thing that was stochastic was interest rates. So, we used base lapses, base credit, and base mortality without any stochastic variation on those items. It produced these results. The same is true with mortality. With mortality we had a single interest rate scenario and kept everything else constant.

Table 3 uses the same numbers that that were on the bottom of Table 2, except they've changed their orientation. The cumulative value of independent earnings—at-risk amounts is \$16.8 million. But, if you run them all together, the result is \$8.4 million. The difference of \$8.4 million is referred to as the correlation effect or impact of diversification. But the point here is, what's causing the diversification?

The worst interest rate event doesn't occur at the same time as the worst credit event occurs, and it doesn't occur when the worst mortality event occurs. A lot of these risk elements aren't really correlated with each other. When you evaluate them in that context, the sum of the worst-case scenarios, or the sum of the tail events is not going to be the same as when you look at them in total. If you're managing a company looking at each of these independently, it's going to cause you to make underwriting, credit and reinsurance decisions differently than if you're looking at it in a broader context.

This technique also permits the earnings-at-risk attribution. I've done it on an uncorrelated basis, but the results will be close to the same if you did the math on correlated results. Fifty percent of the results are coming from interest rate risk and a much smaller percentage from credit. Remember, we're looking at credit over a five-year time horizon. Mortality is 38 percent and that's being driven by the fact that it is a life insurance product and that we have some assumptions about mortality deterioration.

Table 3

FRM Case Study – UL Results (5 year EaR)

Risk Element Contribution	EaR	Percent
Interest Rate	\$8.5	50%
Credit	1.7	10%
Lapse	0.4	2%
Mortality	<u>6.2</u>	<u>38%</u>
Uncorrelated Total	16.8	100%
Correlation Effect	<u>(8.4)</u>	
Correlated Total	8.4	

OPTIMIZING Value

Table 4 presents the same information, but looks at it across product and risk elements. This chart displays three products. For the variable annuity line, you have \$21.3 million of equity earnings at risk exposure. This is not surprising. About 70 percent of the liability was invested in equity-related assets. The bank CDs are all pretty much interest rate risk.

Table 4

## FRM Case Study (Base = VA emphasis)

Risk Element Contribution	UL	VA	CD	UnCor.	Cor. Effect	Holistic
Interest Rate	\$8.5	\$2.1	\$1.2	\$11.8	(\$0.4)	\$11.4
Equity		21.3		21.3		21.3
Credit	1.7			1.7		1.7
Lapse	0.4	1.0		1.4	(0.2)	1.2
Mortality	6.2	0.3		6.6		6.7
Uncorrelated Total	16.8	24.7	1.2	42.7	(0.4)	42.3
Correlation Effect	<u>(8.4)</u>	<u>(4.2)</u>	<u>(0.0)</u>	<u>(12.6)</u>		<u>(24.4)</u>
Correlated Total	8.4	20.5	1.2	30.1		17.9

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An important thing to note is that \$42.7 million is the sum of all the uncorrelated earnings-at-risk amounts across the different products and risk elements. The fully correlated result is \$17.9 million. The \$24.1 million difference in earnings at risk is huge. The results illustrate that even for interest rate risk there's a correlation effect because the worse event for UL isn't necessarily the worse event for the bank CDs. Of course the proportions of the business relative to each other will impact the results.

Table 5 looks at the same metrics across one-year, five-year and 10-year time horizons. Over the one-year horizon, the one thing to note is that credit, on a proportional basis, is a much higher percentage of the total earnings-at-risk amount. That is not surprising, but at the same time from an attribution point of view, it's still not as big as interest rate risk, even on a one-year horizon, which surprises a lot of people. It depends on your organization and how much credit risk you take relative to interest rate risk how this is going to come out. Equity risk is still a big piece of the total.

Table 5

## FRM Case Study – All Products

Risk Element	EaR <sup>1</sup>	EaR <sup>5</sup>	EaR <sup>10</sup>
Interest Rate	\$1.1	\$11.4	\$27.4
Equity	5.9	21.3	50.4
Credit	0.9	1.7	1.9
Lapse	0.0	1.2	7.6
Mortality	1.3	6.7	14.7
Uncorrelated Total	9.1	42.3	102.1
Correlation Effect	(5.2)	(24.4)	(64.2)
Correlated Total	3.9	17.9	37.9

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The interesting thing is that interest rate risk plays a much greater proportion of the total over time relative to credit. One of the things that you might ask when looking at this result is, "Is there any way I can protect against the one-year credit risk, while still taking the long-term credit exposure?"

The other interesting thing to note is that on a per-unit basis, the earnings-at-risk amount is about the same regardless of whether or not you're looking at a one-year, five-year or 10-year horizon. It's about \$3.8 million a year. But you can start telling management that you're taking twice as much equity risk as you are interest rate risk. As you recall, this company had a lot of variable-annuity exposure. What if we could change the balance sheet of this company to reflect a little more universal life (\$500 million), a lot more bank CDs (\$500 million), and a bit less in the way of variable annuities (\$800 million), leaving everything else the same? What does that do to the result?

Table 6 shows all the new numbers. Of course we have much more interest rate risk because we have fewer variable annuities, more bank CDs and more UL product. We have less equity risk, but now it's a little more balanced. It shows a little more credit risk. Lapse is about the same. And there is a little more mortality because you're writing a little more UL.

Table 6

### FRM Case Study – All Products (Balanced mix)

Risk Element Contribution	UL	VA	CD	UnCor.	Cor. Effect	New	Original
Interest Rate	\$10.6	\$1.3	\$6.1	\$18.0	(\$1.9)	\$16.1	\$11.4
Equity		13.1		13.1		13.1	21.3
Credit	2.1			2.1		2.1	1.7
Lapse	0.5	0.6	0.1	1.2	(0.3)	0.9	1.2
Mortality	<u>7.8</u>	<u>0.2</u>		<u>8.0</u>		<u>8.0</u>	<u>6.7</u>
Uncorrelated Total	21.0	15.2	6.2	42.4	(2.2)	40.2	42.3
Correlation Effect	<u>(10.5)</u>	<u>(2.6)</u>	<u>(0.1)</u>	<u>(13.2)</u>		<u>(22.9)</u>	<u>(24.4)</u>
Correlated Total	10.5	12.6	6.1	29.2		17.3	17.9

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Interestingly enough, the uncorrelated totals are pretty much the same and the correlated earnings-at-risk amount hasn't changed all that much. We've shifted around a product mix and we have a higher expected value. The mean goes from \$26 million up to \$35 million, so we've increased the dollar value of the earnings and have maintained a same amount of risk. This is a great illustration of using the risk management process as an effective management tool. We just improved our earnings over a five-year horizon by shifting the product mix and keeping risk the same.

In Table 7 we took the UL line and kept everything constant except we increased the mismatch of the assets to the liabilities. The distribution doesn't look as good as it did before, but we've improved the mean and we've had a corresponding increase in the risk metric or the earnings-at-risk metric. This one is a little bit harder to interpret in terms of its relevant value.

Table 7

### FRM Case Study – Investment Variation (5 year earnings)

#### Percentile Distribution

<u>Percentile</u>	<u>VA Emphasis Value</u>	<u>Balanced Value</u>	<u>Increase Mismatch Value</u>
0 <sup>th</sup>	(\$20.4)	\$1.1	(\$2.1)
5 <sup>th</sup>	7.7	17.4	19.5
25 <sup>th</sup>	20.8	29.7	33.3
50 <sup>th</sup>	28.7	36.9	41.7
75 <sup>th</sup>	37.5	44.3	49.3
95 <sup>th</sup>	46.5	51.8	56.9
100 <sup>th</sup>	58.2	62.1	67.2
Mean	25.6	34.7	39.4
Mean – 5 <sup>th</sup>	17.9	17.3	19.9

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What have we done? We took a more balanced portfolio and we certainly moved a little bit closer to being more efficient. We improved earnings and we didn't hurt risk all that much. When we mismatched the UL portfolio, we took on some more risk, but we improved value as well. You can now imagine how a proactive risk management process focused on producing management information allows management to make quality, fact-based decisions. In my view, it's the job of the risk manager to constantly present options about what the organization can do to improve value and improve their position in terms of optimizing the quality and level of their earnings as well as to the risks that they're taking and the resulting value. We do this all the time with the embedded value-at-risk context, which is pretty powerful for organizations that are comfortable with an embedded value as a measure.

**MR. GEORGE SILOS:** I'm George Silos from New York Life. I've been working in this field for a few years. I have some observations and perhaps you'd like to respond to them. First, Max mentioned the concept of firm life duration. Do you think it's useful? I think it's useful. My boss thinks it's useful. There's a small section of actuaries in our company that also think it's useful. It's something that we've been doing for a number of years and it really hasn't gotten too much play at the top levels of senior management. In some respects, I'm glad it has not because there are some aspects of this concept of firm life duration that have been difficult for me to really get a handle on. For one thing, in practice, I notice that it changes a lot and you get a lot of questions when you talk to the investment folks. They say, "Last year you told me the duration of this particular product was four and now

you're telling me it's three." It changes a lot. Because interest rates change, the duration doesn't encompass the whole picture; there is convexity as well. It changes a lot with the slope of the yield curve. You mentioned the whole partial duration concept. I tend not to go into partial durations because it's even more time consuming to get than regular duration. On the other hand, if you stick with regular duration you'll have trouble explaining things from one year to the next as the yield curve slope changes. Also, another reason why duration tends to change is the credit spread. If you focus on duration with respect to Treasury rates and spreads are 50 basis points one year and 150 the next year, perhaps the best target for duration might be single-A spreads over Treasuries as opposed to just Treasury rates. You also mentioned the algebra about the premium cash flows versus the liability cash flows. At the risk of sounding naïve, we do net the two. We also show them individually, but we net the two when we talk to our investment folks. I guess our view is that the investment folks have their assets. They don't really know that the premium is an asset, if you want to look at it that way, so we generally focus on the net of the two and I think algebraically it works out to the same thing when you get to the duration of surplus.

You mentioned buying derivatives and giving management what they want. In our own firm we've talked about buying derivatives and that might solve the duration problem, but then you've got a big GAAP earnings problem, so that's another one that's been difficult to get our hands around. Like I said, in some respects I'm glad senior management hasn't been acting on this information. In October 1998, in my view the duration of surplus was a big number and the investment folks weren't worried about it. I was losing sleep over it and they weren't worried about it. They believe in mean reversion and if you act on the stuff too much, you're going to end up buying low and selling high.

One last point is with respect to Frank's presentation on the credit risk and the mortality risk. We've done a little bit in that area as well. We've separated both credit and mortality and even lapse into two different kinds—the uncertainty risks and the risks. In other words, our products may have 15 basis points for credit risk. Should it really be 15 or 20 or 10? We don't know. Besides that, from year to year, you don't know when another Enron or WorldCom is going to happen, so one is risk and one is a long-term trend and you have the same thing with mortality. Over the long term, we don't know how much mortality improvement there will be and then that will be the uncertainty. In terms of risk, you don't know in one year if a single \$20-million policy will go under or a few \$20-million policies.

**MR. RUDOLPH:** I'll make a couple of comments. New York Life is one of the companies that really does a lot of this type of work. They go beyond some of the things that we do. One comment that I'll make with the duration changing from period-to-period and year-to-year, is that with focusing on the graph of the value, the value for us didn't change as much. At certain times we were close to the overall maximum value. As you move to the left on the curve, you'll be moving toward the zero duration. We actually had one point where our duration was zero

for the firm, which scared me a little bit, too, because I want to take some risk. But by using the value and the graph instead of just saying I went from a duration of X to a duration of zero, which would have scared people, we helped to focus the discussion on the picture and said the value of the firm really didn't change that much. We're just at a point on the curve where the convexity is really driving things. At that point we say if interest rates continue to go down we've got some problems, but try to deal with that qualitatively. I agree with you on the duration with the assets versus premiums in terms of when you're doing a present value, but there are some presentations where the net is zero for one year. They are dividing by zero and that's where you're getting the infinite duration.

**MS. MARSHA WALLACE:** I just want to say that you've mentioned that a lot of companies are below the efficient frontier curve. Do you think they might be under the curve because of focusing too much on things like earnings as opposed to value? By focusing on earnings they're not getting to the points on the curve where the value would be better.

**MR. SABATINI:** I agree 100 percent. One of the things that's been difficult in my career is I've always wanted to measure that. I don't think value gets destroyed as much as it doesn't get created, if that makes sense. My view on that is that the first step is to get them to pay attention, but if you try to get them to pay attention by focusing on value, you might not otherwise be successful. So you focus on the things that are important to them and help them understand how to manage them. At the same time, tell them if they make this particular decision, it will have this impact on value and go from there. We've done that in some of the work that I've done and have been fairly successful. Sometimes the best decisions are the ones that are consciously competent. Even if they may not be the most optimal decisions, at least they can understand that they made a decision that is going to reduce earnings volatility, but over the long-term maybe not create as much value as we may have otherwise gotten. But at least it's a conscious, fact-based decision, which is what it's all about.

**MR. RUDOLPH:** I want to make one last comment on that. I would include time horizon. If decisions are made entirely based on a 3-month or 1-year time horizon you will never maximize the value of the firm.

Chart 1

*Result Distributions*

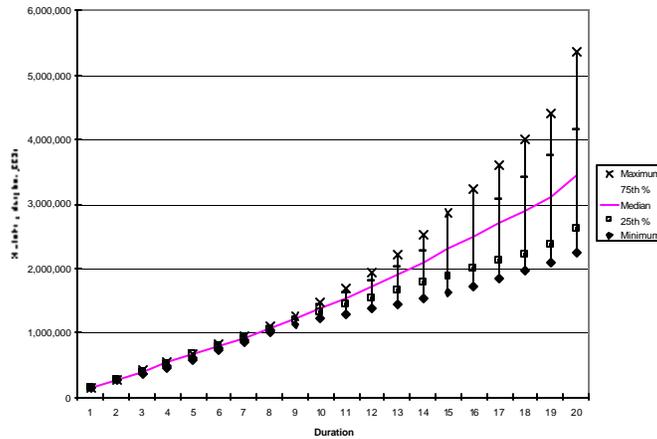


Chart 2

*Risk/Return Profile*

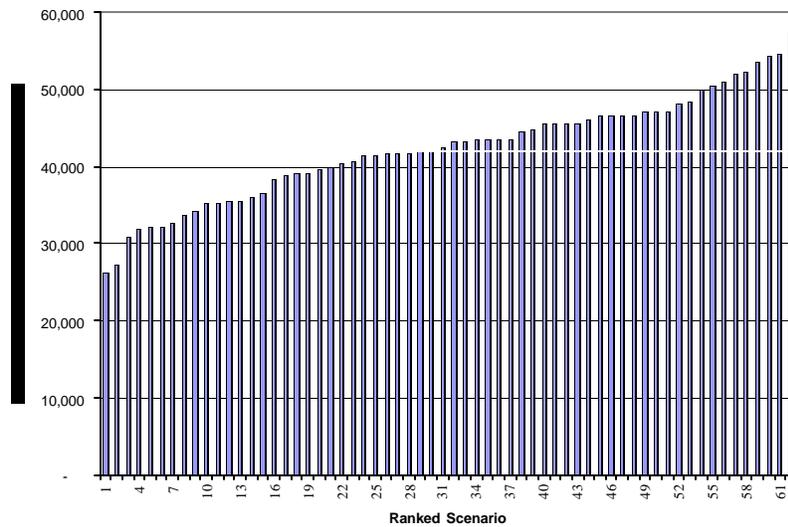


Chart 3

*Risk/Return Profile - Alternative*

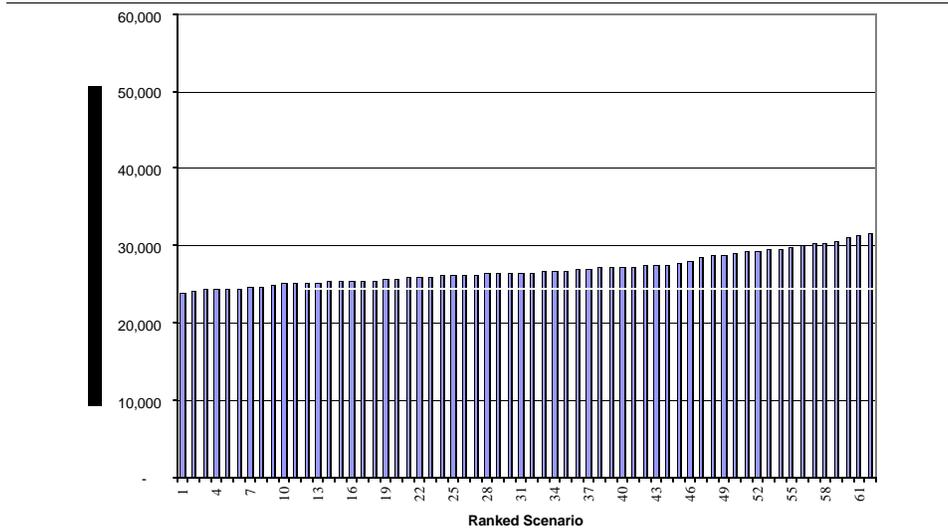


Chart 4

*Price Behavior Curves*

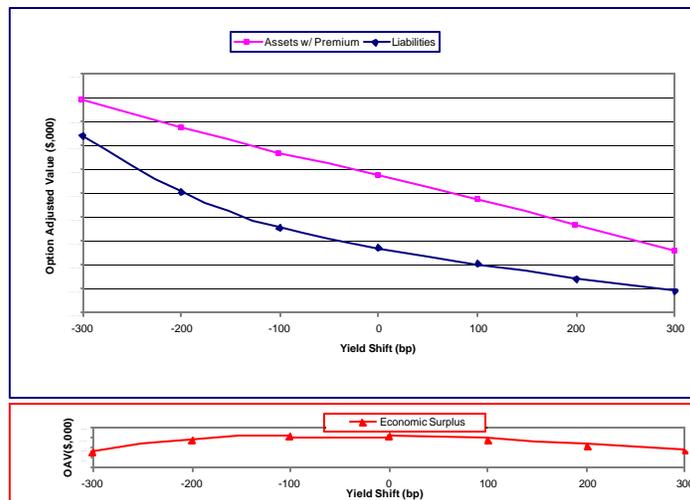


Chart 5

*Deferred Annuity Option Adjusted Value of X% Guaranteed Credited Rate*

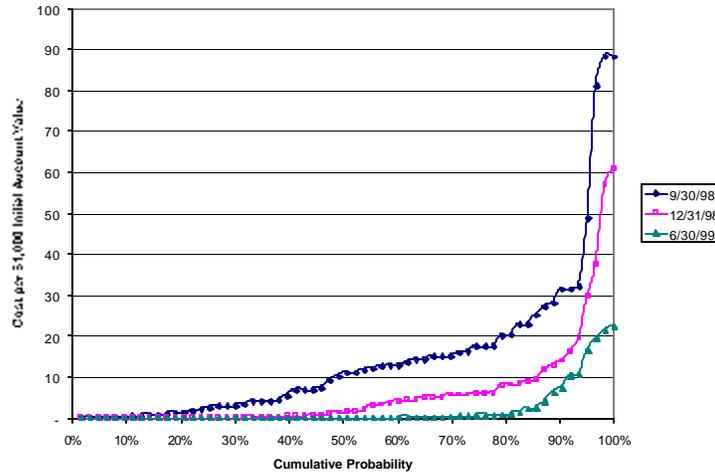


Chart 6

*Deferred Annuity (5 Highest Cost Scenarios)*

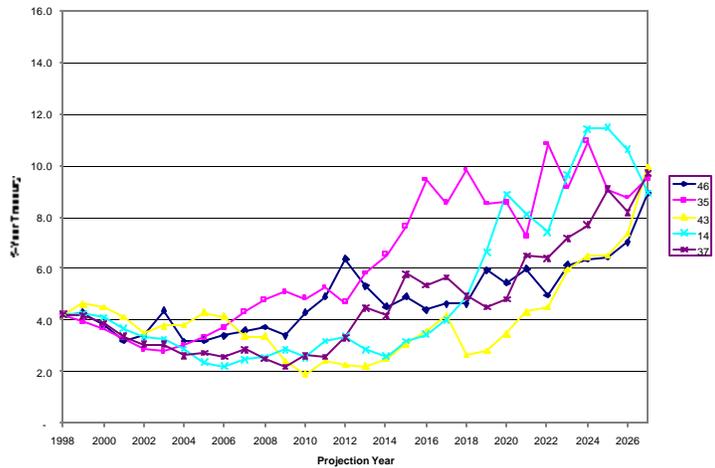


Chart 7

*Credit quality vs. convexity risk*

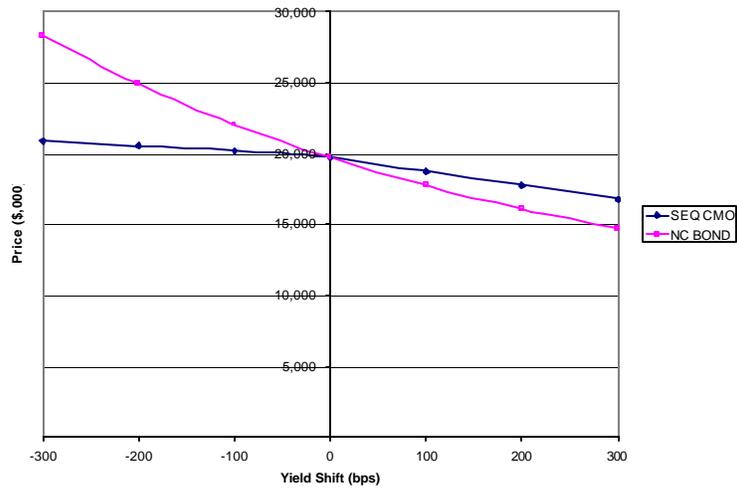


Chart 8

Optimizing Shareholder Value

OPTIMIZING  
Value

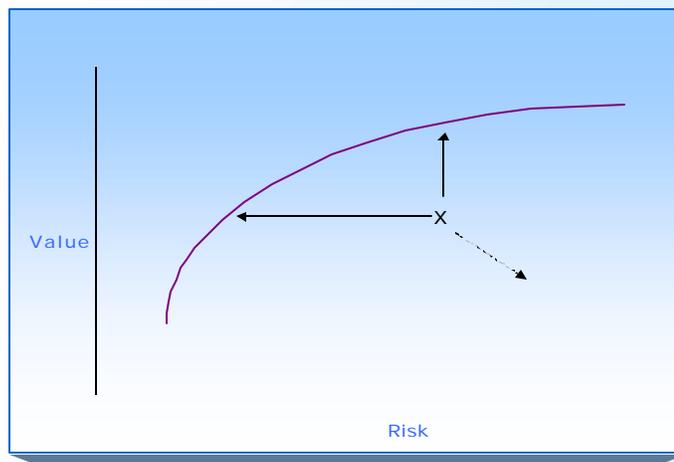
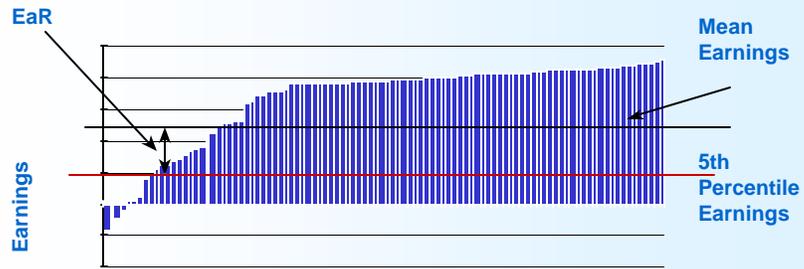


Chart 9

### Earnings at Risk (EaR)



OPTIMIZING  
Value