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Session 6PD
Managing Equity Guarantees

Track: Investment

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Recorder: ELINOR FRIEDMAN

Summary: This session provides an overview of the various methods used to manage the risks from guarantees of equity-based life and annuity products. Discussion includes the use of reinsurance, self-insurance and static/dynamic hedging.

MR. HUBERT B. MUELLER: This is Session 6, a panel discussion on the topic of managing equity guarantees. My name is Hubert Mueller, and I'm with Tillinghast in the Hartford office. I will be your moderator for the session.

We have a very distinguished panel of product experts talking about this topic. We'll start off with Tom Ho from AIG, who will discuss guaranteed minimum death benefit (GMDB) risks in variable annuities. Next will be Darin Zimmerman from Americo, who will look at managing equity risks in an equity-indexed annuity product. And then from a Canadian perspective, we will have Gilbert Lacoste from Sun Life Canada talk about managing equity risks in segregated fund products. Elinor Friedman will be our recorder for the session.

In the session description, you can see that we will be providing an overview of the

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Mr. Thomas S. Y. Ho, not a member of the sponsoring organizations, is president of Thomas Ho Company Inc. in New York, NY.

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

various methods used to manage the risks from guarantees on equity-based life and annuity products. This is quite a hot topic in the marketplace, which is evidenced by the large number of people in the audience today. We hope that there's something in there for all of you.

First, let me introduce Tom Ho. Tom is the president of Thomas Ho Co., and he's also a consultant to AIG at the present time. Before that, he was founder and president of GAT. Prior to that, he was a Professor of Finance at New York University. He frequently publishes articles in journals on valuation and asset/liability management topics.

MR. THOMAS S. Y. HO: Thank you, Hubert, for the introduction. I think managing equity guarantees is a very important topic, and I don't have to remind you, having watched the stock market go down so much over the last two years; but that is not the main issue.

The main issue is that with variable annuity and variable life products, there are three aspects that we have to bear in mind.

First is that the products do have significant exposure to equity risk.

Second is that the exposure to equity risk is not a simple risk exposure like exposing to the S&P stock index—these are more complex. I'll talk about how complex these are in relation to the stock market.

The third part is that after we manage the risk, it has implications for our pricing and for our management of assets, liabilities, and so on.

We want to think about the product design and what we can do about it. So I'll first talk about the product descriptions and will set the stage for us to understand these three issues. Then I'll talk about the guaranteed benefits and some options.

What I will get across today in the discussion is that we have equity risk in our annuity products, but they are in the form of options. Therefore, it leads to the question, ''How should we value these embedded options in these products?''

We have to understand the valuation process before we can really talk about how to manage the risk. And then we can talk about the methodologies; how we should go about managing the equity risk. Then I come to the conclusion that having a procedure in place to manage the equity risk in these guarantees is important.

Variable Annuity Features

Let me very quickly go through some of the major features of variable annuities. First, we can think of it as asset management. So it has an account value: People leave money with us, we manage their money, and we collect the managing fees. As a good money manager, we let them choose the funds they want and take

money out or switch funds, just like an asset management business.

But what distinguishes us from fund managers is that we offer them guarantees.

GMIBs. I will start off with the simplest one, which is the guaranteed minimum death benefit (GMIB) guarantee.

So here we'll say that if the policyholder dies during some period of time, we'll guarantee the principal payment. Or the guarantee can roll up, so that we'll guarantee two percent, three percent annual return, so that when the person dies, we pay not only principal, but all the guaranteed amount rolled up to that level.

And since this is a very long-term investment, we don't want to guarantee just that; in fact, we're willing to guarantee the ratcheting. That means we guarantee every anniversary date the highest watermark of that index of the fund; so the sum might go up and up and then come back down again, and a person dies; that person can get the highest value historically—that is built into his policy.

There are many variations to this basic idea. The only message I want to get across in this point is that we really have offered options to our policyholders in the sense that there's a guarantee built in.

As for the other guarantees, there are many forms. For example, there's a GMIB or a guaranteed account value (GMAB) or guaranteed withdrawal benefits (GMWB).

Having said all this, this whole product still looks like an asset management product, because anyone can just take the money out and withdraw. And when you withdraw, you simply take the account value. So the guarantee only becomes effective when you die.

Finally we have acquisition costs and so on built into the product that you pay for.

Equity Risks of Variable Annuities

Now let's go back to the main topic of what we want to discuss—the equity risk and the variable annuity.

What is the risk? One part of the risk—we very seldom actually think about it—is simply that the way we make money is to take a percentage of the managing fee from the account amount. Therefore, as the account amount grows, our fee goes up.

If the account value comes down, we lose that fee, as we all have become very aware of the past two years; that itself is equity risk. So as soon as we sell this further out, we inherit this equity risk. The present value, of this fee income is highly dependent on the stock index level. You don't think of it as risk, because it's income to you; why should that be risk? I'll come back to this later.

The second part is the guarantee part that we always think about, which is our downside. What if market comes down and people die on us, and now we have to pay all these guarantees? The amount at risk kicks into this whole calculation. To understand all those, we have to look at the simulations and see under what conditions the stock market would come down and then people would cash out the death benefit, and how much money will be lost.

There is an interaction between these two parts. Why? If the stock market goes up, we are very happy, because we're getting fees, and then the death benefit comes down. The present value of death benefits comes down, because the account value is higher than all the guarantees we have. That's good.

The bad news is that if we have the ratcheting effect built in already; then if the stock market comes down, and then people die on us, we have to guarantee at the high watermark. So there's an interaction between this fee and the death benefit with a guarantee. If we separate them and manage them separately, that may not be effective.

Pricing. So how do we price the fees built into the variable annuity? To determine the fees we have to build in, we have to think about all the risks that we have given to our policyholders and whether the fee would cover that.

One approach is the stochastic simulation that I think most of us are familiar with, in that we look at historical behavior of stock market and see what kind of return we expect to get. So typically we would see a risk-free rate of six percent of the market, plus four percent return for risk premium. So let's say 10 percent growth. Then simulate all the possible scenarios and look at the cash flow, and now the question is, what is the discount rate? Yes, we need to know the present value before we can see whether this product's profitable or not.

One approach would be using the cost of capital—how much money it costs us to raise the money so that we use the discount rate. Typically it will be above the risk-free rate, because shareholders will require higher returns than the risk-free rate. So typically you generate all these scenarios and discount and then get a value. Under this value you then ask the same question: Given this value, how much is at risk that we need to manage? And that leads to the risk management aspect of that problem.

The point I'm trying to make is that very often we think of managing risk; but, inseparable is another problem—how to value the product. The two parts can't be separated, because we would just sell the product, and then see how we manage it. I would argue that two parts are the same. But more important, what we just called stochastic simulation methodology would, in fact, be directly contradictory to all the work and the research that's been done on option pricing models.

So if we take all the methodologies we think of as standard and applicable and

apply them, I would argue that we are applying the methodology totally and directly different from all the research done on option pricing. Consequently, if we have not resolved this conflict, how can we manage risk? That would be the question I would pose to you. So let us think about this issue.

Valuing the Product

To begin, we need to talk about how we value the product. Let me then quote an interview that a *New York Times* reporter did with Paul O'Neill. Since Paul O'Neill is our Secretary of the Treasury, how he prices an option surely should carry some weight. This is what happened. Before Paul O'Neil became Secretary of the Treasury, he was offered the post and was very hesitant about it, because he did a very quick calculation and realized that if he did go to Washington, D.C., he would lose $250 million of his options on ALCOA. That is a sizable amount. But he realized that it's not his money, anyway. It's all his children's money, because he would never be able to use all the money he already had before this $250 million.

So he got all his children together in the living room and told them the problem and said, ''I have been offered a position to be Secretary of the Treasury, but you have to give up $250 million of my money that we would pass to you. Would you agree to that?'' And luckily all the children said, ah, we don't care. So it's very good news for the country that the secretary accepted his position in D.C. because his children really don't care about $250 million that they'll be losing.

But the New York Times reporter then went on with his research and found out that Paul O'Neill's options actually are worth only $25 million by standard modeling. Now that's a great discrepancy. How can there be such a big difference? He asked Paul O'Neill, ''How did you do a $250 million calculation then?'' Well, he thinks that ALCOA stock has been growing at a certain rate, and the option will be expiring about 10 or 15 years or whatever. You plug that number in and get $250 million. So what's the problem?

Does this ring a bell for us? When we sell our variable annuity, don't we think about how stock market will perform in 20 years from now? And that is how much money we make. Also the product is very profitable. Unfortunately, if you go to academics and plug in a simple Black-Scholes model, you get a very different number.

Let us now go back to square one. Very often we study the Black-Scholes model or option pricing model in your exams or textbooks and so on. You quickly close the book and say, ''I know all this stuff.'' Usually the important research in finance is stating the obvious; understanding it is the hard part.

So now let's go deeper, understanding what the Black-Scholes model is saying to us, too. What it says is the following: If you think of a call option or put option, it really has to depend on the underlying stock movement. So when the stock goes up, the call option price will go up. If it comes down, we come up. So it's a contingent claim on the stock.

And then you have a strike price so that you're allowed to buy the stock at a fixed price with a certain expiration date, T, and then it very much hinges on the stock volatility. And the conclusion of the Black-Scholes argument is that, look, when you buy a call option, it's no more than buying stock at the margin. The only difference is that you're changing the margin all the time. And listen to me. Follow this formula. The way you change a ratio is just to follow the formula; you get the right answer.

So the implication of that is I don't really care what the projections, or what the forecasts are for stocks. I don't care about anything. All we have to believe is that I can replicate your stock option by changing my hedge ratio of the stock and the margin. I get two identical instruments; and therefore, they should work the same.

So you only have to take me on one belief: It's the Law of One Price. If two identical products have the same distribution of return, they should work the same; and in that case, you get a Black-Scholes price. Now that's so obvious, why would you argue with that? Well, unfortunately, when we sell variable annuities, most of us do argue with that; and these are the arguments I often hear:

The first is that the GMDB is effective only when you die. So what kind of option is it? No one says, ''I want to get the death benefit from the insurance company, therefore I take an excess option, and then I die!'' That's the wrong argument, because the Black-Scholes model says nothing about how you make the decision or having a choice in making that decision. All it says is that it is a contingent claim, as long as the payoff is contingent on the underlying stock. That's it. It has nothing to do with whether you have a choice or you want to make a choice of dying or not dying.

The second argument is that these things are not marketable. That's once again proven to be wrong. Black-Scholes argues that we have to continuously hedge. As long as someone gets back and goes through the thought process of replicating it, the formula is still correct.

The third part is that we have lapsation, and all the things are forgotten. Well, the mortgage market and a lot of financial markets, have forgotten a lot of things, too; but these formulas still remain robust, because you can always develop a model just for these nuances of the product.

Finally, you have things that we don't observe—the volatilities, the interest rate. What are these numbers? Don't worry. The financial market has all those numbers for you. You just don't go around getting those numbers. They're out there, available.

So these arguments, if you look deep down at it, are incorrect. So what is the problem? The problem is not really understanding the embedded options of the product that we are selling. The only thing we really should be concerned with is

how we can replicate these products mentally using stock and bonds. And once you replicate it, the only question we need to ask is, ''How much it's costing us to replicate it?'' And that turns out to be a very hard thing for us to think through.

Why is it so hard? This is the point. This is the problem. The problem is that when we sell a variable annuity, there are really two things going on. One is that there are fees coming in. Think of this like a stock, because every time you're getting a portion of the stock. The guarantee we're giving out is that we have sold a put option to the policyholders. So, the variable annuity has two parts—stocks and a sold put.

And now, what's the problem with that concept? Now let's think what we have done: The put option carries all the downside risk that we will have; and so when the stock market comes down, not only do the fee incomes comes down—that means the stock part comes down in value—but with the put option, we have pay for the guarantees . And thus we are going to lose a lot of money.

And now the question in managing risk is how to protect that part, the put option part. I realize that it is a really hard conceptual part that we have to get through. This is why—think of the process I described earlier, the stochastic simulation method. We think stock will always drift four percent, five percent—some even more aggressive—10 percent above the risk-free rate.

So the stock market is happily growing at 12 percent or more. The guarantee is somewhere lower. The account value, the principal amount, is lower. So when you do the simulation, there are very few scenarios in which we actually can lose a lot of money.

And then when we discount those losses, we discount at a rate higher than the risk-free rate. But what does Black-Scholes tell us? The Black-Scholes model says just the opposite. The Black-Scholes says that your stock return has to grow at a risk-free rate; so four percent less, or more. Then the assumption you make is for the next 20 years—well, that's a lot of money. And then you have to discount at the risk-free rate. That has to be very non-intuitive.

The stock market should have the return higher than the risk-free rate. I guess no one will disagree with me on this one, right? When you are in the stock market, the S&P index, you expect the expected rate to be higher than the risk-free rate. I hope so.

If you believe in that, then the stock return has a positive beta; but a put option has a negative beta. It's a very good hedge against the stock market. So, if something has a positive beta, or a positive risk premium, something that is a good risk hedge against a return should have a return lower than the risk-free rate; otherwise, we have an arbitrage opportunity for the capital markets. So now if we follow the stochastic simulation approach, we would be wrong for two reasons. We

use a growth rate too high to determine the loss and we discount the losses at a higher discount rate back. Therefore, the value is very understated.

When you apply the Black-Scholes model, you drift into a lower discount rate and discount the loss at a much lower discount rate; so your present value is very high. And, therefore, all of the sudden, you realize that you have a lot of risk exposure. How can we possibly say that we have been managing equity risk when we even measure a risk exposure as such a drastically small number? This is something that we really have to think through more carefully, because I think it's so fundamental to the whole analysis.

Therefore, we conclude that put options are expensive, if we follow the traditional way of doing valuation. Therefore, the calculation—what we have been doing is Paul O'Neill's methodology: We think what it's going to be, and rates will still go through his mind and say ''Ah, rate discount.'' Where did you get that number?

But you saw my numbers already. They're off by a factor of 10, and that's only a very simple case. We're selling a lot of money. We're locked on real products here. So it was OK for Paul O'Neill's children to miss a few hundred million dollars; but in the economy as a whole, this is a very big problem.

Therefore, the question now is that we need to do these calculations. Here, I just want to reinforce a concept of how to value a variable annuity that is consistent with 25 years of research in option pricing models. It's really hard for us to argue the very basic point of all the research in the last 25 years.

So now we come to the risk management. The risk management part is that it would be unfortunate if we break up this fee amount and simply go straight or hedge our downside risk, because you can't separate the two. If you manage all your downside risk, what really happens is that whenever the stock market goes up, you come and rejoice, ''Our income is great this year! Our income is great!''

Well, you have not put in enough reserve for all the guarantees you have. If the stock market goes up, you have a higher reserve to put in for the ratcheting feature. So you just can't say, ''I'm going to manage my downside, and when stock market goes up, I just look at my income and be happy about it,'' because you are just looking at one side of the coin. When you do the risk management you have to think of how to do the stable income part and how to truncate the downside risk.

There are basically two methodologies to handle this issue. First is called dynamic hedging, and the other is called static hedging.

I will be very brief about dynamic hedging. The idea is the following: If you have a correct valuation model, and you simulate the computer and shock it—stocks go up, stocks come down, interest rate change, volatilities change—I can buy options such that I match all the sensitivities you want to hedge, and you keep doing it

systematically over time.

One common question I've been asked is, ''Let me apply this dynamic hedging to other stochastic simulation methodology. How wrong can I be?'' That is to say, we simulate all the scenarios, discount at a discount rate that I think is appropriate—I don't care what the market says or what Black-Scholes has to say. I come up with my number, and now I simulate all the sensitivities, I get my traders to buy the options and match up all the sensitivities. What's wrong with this logic?

Since I already match up all the sensitivity—all the resources are all matched up—what's gone wrong? What's gone wrong is that all the dynamic hedging is hedging against an instantaneous move. What's gone wrong is that if you hold it for one month, hold it for any time period, you will find that you're drifting below the Black-Scholes model, because you are using a wrong discount rate. You are under-hedged, and that will be revealed over time; every time there will be a drift below what you expect it to be.

So in the static hedging approach, we don't want to revise our portfolio over time continually. Can we buy options or match up so that we'll be matching all the cash flows? For those who are interested in this topic, I've written several papers on this subject. If you're interested in any of these papers, just leave your business card with me. I'll be delighted to send it to you. For lack of time, just let me conclude.

After having heard all this conceptual part or how you really want to deal with it, the important part is you really need to set a process. There should be a business process built into what I have been talking about. In conclusion, it is important to remember that appropriate pricing will lead to an objective approach. So it would not be anyone guessing what the stock market will do, what discount rate equity holders demand.

Second, pricing and risk management are closely related. You really just can't go out and say I manage my risk, but I have no idea what the value is.

The third part is that you have to do the long-dated options; and therefore, you have to take all the reporting income and all those practical considerations into account.

And finally, the risk management is a business decision. So I'm not advocating that after this you hedge out all the possible risks. We have to take some risk. Therefore, it becomes a business decision.

But valuation approach and good hedging strategies are good tools for your business decisions. So after you make your business decisions, you still have to follow fairly rigidly all the research we have done in this area in valuing options. It's important to think about it—not just managing the risk, but also reserving for the risk.

MR. MUELLER: Thanks very much, Tom, for that vivid and very resourceful introduction. Let me introduce Darin next. Darin is a Fellow of the Society of Actuaries and a Member of the Academy. He's been with Americo Financial for more than three years and during that time has been primarily responsible for their liability modeling and also has been involved with the financial management of Americo's equity-indexed guarantees and equity-indexed annuity products for pretty much the whole time. This is what he's going to talk about today.

Before joining Americo, Darin enjoyed three years working with us at Tillinghast as a consultant in the Atlanta office, and before that he worked for seven years in the individual product division for Minnesota Life.

MR. DARIN ZIMMERMAN: Even before I start, one thing that's not in my presentation that I'm hoping most of you are aware of is the concept of the Greeks. Throughout my presentation I use delta, vega, rho, gamma, things like that, and I'm just going to quickly go through those, so that everybody has an idea what I'm talking about if you haven't been exposed to those concepts before.

If you have a portfolio of either assets or liabilities, look at the first derivative of price with respect to index. If you have an index, say the S&P index, and it goes up, and the price of your total portfolio changes, the instantaneous change is the first derivative, which is delta. So when I say delta, I'm talking about the change in price of assets with respect to the change in my index.

The second derivative, the squared, is gamma. The change in the price of my portfolio with respect to a change in volatility is vega. A change in the price of my portfolio with respect to interest rate is rho. And a change in the price of my portfolio with respect to time is theta. I hope most of you have come across those concepts before, so when I speak of them, you'll know what I'm talking about.

I'm going to talk about the general description of equity-indexed products, what different forms they take. Primarily I'm going to focus on annuities. There's some life out there also.

Next I'm going to talk about functional concerns. And as I went through this section, I tried to think, ''How can you blow up the company?'' If you miss something, and something in the market goes against you, and all of a sudden you're insolvent, that's what I'm talking about. What are the functional concerns of hedging these equity guarantees that you provide in the products?

Finally I'm just going to talk about the experience at my company, the evolution that's gone on from when we started selling these products in late '98, how we've managed them over the last two-and-a-half, three years.

The typical products have a participation rate and a minimum guarantee; but unfortunately, there really isn't a typical equity-indexed annuity design.

There are some that are point-to-point types. They can have an American option, a European option, or a binary option.

The binary option is somewhat obscure. If the underlying index goes up at all, it pays off x percent, maybe seven percent, maybe 10 percent. If it goes down, you get nothing. So if it goes up one percent or 100 percent, you get x. If it goes down, you get nothing.

For the averaging types of options, you can have daily averaging, monthly averaging. Some longer dated contracts say the option sold to the policyholder may be less 10 years. They might do averaging for the first six months and averaging for the last six months so that the consumer doesn't have a big exposure, a daily exposure. It just smoothes out the return for the consumer.

And then there are caps. You can get up to 12 percent, but nothing more. As for floors, some product designs incorporate two percent growth in the fund no matter what. With a spread, you might say you'll get 100 percent of the increase in the underlying index after the first two percent. So the index has to go up two percent before the consumer gets anything.

And all these things do is change the cost of the option. My warning is, be aware of attempts to increase participation rate— because that's what consumers seem to react to—affect the volatility of the returns to the consumer. The most extreme example I could come up with was, assume we gave the consumer an option on a lottery ticket: One out of 10 million times, they get $5 million, and all the rest get nothing. You could have a 1,000 percent participation rate, but their return is pretty much always going to be the guarantee.

Ratchet Features and Constant Index Growth

And then be aware of the interaction between ratchet features and the use of a constant index growth rate in your models (Chart 1). The seven lines here are different paths for the underlying index. So my index goes up 44 percent over four years. I think that's a 10 percent growth rate. And here are seven different ways to get there.

On the right-hand side is the resulting account value for that ending point, and you can see at the top and the bottom, the account value starting at $1,000. Both grow $1,237. The absolute minimum is $1,215.

The reason this is important is because a lot of the modeling actuaries do is something like: ''What's my best guess? I think the underlying index is going to grow 10 Percent, so I put that into my model.'' But what we fail to recognize is that it's growing at 10 percent with zero volatility, and volatility's very important for options.

A corollary here would be for illustration software. If your company chooses to

illustrate these things, and you illustrate a 12 percent growth rate, that will over 20 years give you some amount in some fund. Say the ending fund's $30,000. Well, there are other scenarios in which that fund could be $30,000. There are zero percent growth rates in the underlying index that could get you to $30,000. You would just need a lot of volatility.

What this reduces it to in the mathematics is that the expected value of the ending fund amount is a function of the growth over the period and the volatility experience in that growth period. It took me a couple years to realize what was happening. In our models we had our best estimate, and we were spending $10 for an option that always paid off $8, and we couldn't understand why these didn't make sense. It was because we didn't have any volatility in our growth rate.

Functional Concerns

Statutory Income. If you're in charge of managing these for your company, what do you have to be concerned with? The most important thing is, what is it that you're actually trying to hedge? Are you trying to hedge your statutory income, are you trying to hedge your GAAP income, or are you trying to hedge the economic value added to the organization? All three of these targets would require a different hedging strategy, and obviously you can't employ three different hedging strategies. You have to pick one.

So the bad news is, you can pick one, and the others are going to have volatility in the income, and there's nothing you can do about it, because you've had to pick your most important one. And I guess you could try to combine them—say, in a trending down market pick one, and in a trending up, do the other. But nobody really knows when it's trending.

GAAP Income. For GAAP income, under Financial Accounting Standard (FAS) 133, for those of you who are familiar with it, the intention was to say, ''There's a portion of the contract that's going to return something no matter what the index does, and there's another portion that's going to vary depending on what the index does.'' So that's considered the derivative.

Unfortunately, the way it works out you can't really hedge it, because you've got to fair-value it for part of the contract, for the equity portion. And then you've got a book value accounting method for the rest of it. It's almost impossible to hedge that derivative piece.

A consultant we worked with to implement this says he gives it two years. He thinks the analysts are just going to hate what this does, because nobody can hedge it. People are going to get big swings in their GAAP income, and they'll never be able to explain it other than by saying, ''Well, it's just FAS 133. It's the way it works.'' So, I hope he's right.

Internal Rates of Return

Depending on whether you pick your stat-hedging strategy or whether you pick your fund-hedging strategy, you're going to get different internal rates of return (Chart 2). On the left side of the graph the consumer's getting guarantees no matter what. On the right side the consumer is getting his or her account value, depending on the growth in the underlying index. And in that middle region is where it switches over from a three percent underlying guarantee on the minimum contract and growth. So, just ignore that hump.

But what it says is that from a stat hedging perspective or even from an economic hedging perspective, if you use the fund-hedging strategy—just hedge the total amount of the fund, which is as close as you're going to get for hedging GAAP—your returns are going to be tied to the S&P. And depending on your level of expenses, the decision may be, ''Well, why don't we just buy the S&P and stop selling this? If we're making a bet on the growth of the S&P, why do it through selling insurance? Why not just buy the options ourselves or buy the index ourselves?'' So that's something to keep in the back of your mind when you're designing these and trying to decide what's most important to your company's bottom line when you design a hedge strategy.

Shape of the Option

Most people have seen the picture of Black-Scholes. The option payoff is a straight line. Then it goes up. And then the option smoothes it when you add the time value on top of the intrinsic value.

But if you're really going to hedge this yourself, if you're hedging statutory income, you need to be concerned about the immediate cash surrender value. It says they have an American put on the call option you've sold them. They can put the entire contract back to you at any time for the surrender value, and if you have a lot of money tied up in a call option as part of your hedging strategy that has lost a lot of money, you may not have sufficient assets to fund the surrender.

The other point I wanted to make about this is that when you say I've got this minimum floor, it creates a disjointed delta and gamma. What that says is that you're in the market whenever they're above their strike price, and you're out of the market whenever they're below the strike price. So if you look at the first derivative, your delta is zero below the strike and one above the strike, and that can be very difficult to hedge, because you've got to buy and sell options every time the index goes back and forth or you've got to buy and sell futures every time the index goes back and forth. So that can be very difficult to hedge if this is what you choose to hedge.

GAAP income is a little bit smoother because it's going to incorporate lapses and mortality, and that will smooth out. And it doesn't require that you hold that stat income or the cash surrender value floor, because if it does go down, the option isn't a stand-alone option or a stand-alone instrument that will get exercised

perfectly rationally.

Since it's part of the whole contract, and you either have to keep the whole contract or sell the whole contract, it will not get exercised perfectly rationally, and so that's why you don't need that cash surrender value floor.

If you're going to do economic value, it's closer to GAAP; but you reduce the notional amount by the surrender charges, like you do with stat income. And this is a picture of it (Chart 3). In two dimensions, this is what the value of the call option looks like as a percentage of fund amount. This is a long call option. It's a 10-year option. So on the right side it goes from zero to 10, and on the left side is the index, from 200 to 2,450.

That's the cash surrender value floor, and this isn't even really the option. This is kind of the option over here, plus the intrinsic value of the put on the right. If the consumer surrendered the contract, that's how much value you would need in the option to fully fund the benefits.

Lapse Function

To figure out what the time value of the option is to put on top of the intrinsic value, you really need to know what the lapse function is, and I just pulled this out of thin air, because this is what I think a lapse function should look like (Chart 4). On the front edge, when there's a lot of time before they surrender, or a lot of time before the option expires, the behavior isn't as predictable, and they're less likely to surrender, because they'll gamble that it'll come back.

On the far end, the behavior is very rational. If they're six months from surrender, and they need the S&P to go up 50 percent before they get anything, there's a very good chance that in six months, they're going to get the account value. Well, they can surrender today for the account value and put it in a CD. So, the person who understands this—the rational consumer—would obviously surrender the closer you get to maturity, if you're still significantly below the strike.

And, again, this assumes no vesting. If you have a long-dated option—say, 10-12 years—if you wait eight years, you might get 50 percent of any growth. If you wait nine years, you might get 75 percent. Some annuities will incorporate a vesting schedule. This would assume no vesting schedule.

Volatility Skew

Volatility skew is another issue the actuary needs to be aware of when trying to manage these guarantees.

Here's what the volatilities actually look like in two dimensions (Chart 5). If you go out onto Bloomberg's and look at a host of different options with different maturity dates and different strikes, and you back into the implied volatility, this is what the graph of that implied volatility looks like.

A lot of people just think, ''Well, my two-year volatility is x.'' Well, it depends on what your strike is two years from now. So you determine it empirically, but that's just saying you go to Bloomberg, and you look at market prices, and you back into it.

If you've got a lot of liabilities that are spread out all over that universe of maturity dates and strike prices, but you're only choosing a handful of options to hedge it—you know, large, $10 million, over-the-counter options—you're going to be at risk that you're not going to be closely matched. The value of your liabilities could go up substantially if the tails go up.

If it gets even more concave, when your few assets are just kind of in the middle and don't move, your assets won't go up as much as your liabilities do. And that's going to cause certainly an earnings hit; it might even cause insolvency. So this is something that you need to be aware of when you're looking at trying to hedge your liabilities.

Further Concerns

Operational concerns deal with how good your reporting system is.

We had some problems with this. When we were hedging, we would gather up our sales weekly, and we would see some in there that were six months old and just never got processed. We were fortunate the market had generally gone down in that time, but it could have been a real hit. And so the person managing this risk for the company needs to be aware that you can't just trust that the systems people are getting it right. You need to verify that they're getting it right.

And then there's the issue of system integrity—I include this because for the first couple of years, our system was an Excel spreadsheet that had links to Bloomberg. And we thought it worked—we hoped it worked, and it should work—but we were never really sure, because we didn't have an independent auditor to say, ''Yes, I've looked at it; it works.''

And the other thing is, can new products be dropped in? If you've only written averaging options, and now you want to issue point-to-point options, that'll probably work; but if you're point-to-point, and you want to go to a more complex averaging option, your system may not be able to value averaging options, because you don't have a closed-form solution for it. So that's another thing to be concerned with.

Looking down the road as you expand, what could your hedging system need to be a really robust system?

Getting Into and Hedging Equities Market

Now I'm jumping into our experience getting into the equity-indexed market and how we hedged it.

At first we started out using reinsurance to hedge the equity portion, and this allowed us to get into the market. We never could have gotten into the market if we didn't have someone a lot bigger than us buying our options, because the cost of buying options would have been prohibitively expensive.

But this had some drawbacks: The first drawback was when we started this back in '98, even before I was there—I always think of when I was on my honeymoon. We went to Barbados, and everywhere you went you saw T-shirts that said, ''Hey, Mon, No Problem.'' And so we're designing our annuity product, and we're saying, ''Should the deposits price daily? If we get the money on the 1st, do they get the S&P on the 1st? Or should we only do it weekly—7th, 14th, 21st?''

The reinsurer said, ''Hey mon, no problem; we'll take that daily risk. Go ahead and price daily.'' So we designed the policy form that way. We filed it. We executed the deal. And within like a couple of days they said, ''We changed our mind. We don't want to do this anymore.''

And so we had to find a new reinsurer. We went out and we found a new reinsurer, and we said one of the features of our annuity is that it prices daily, and they said, ''Hey mon, that's your problem.'' So, that stung us a little bit, but there was nothing we could do. We just had to accept the risk.

We reported to them once a week, and then they bought the options the next day or the next afternoon. Or, if they were on vacation, the day after that. And our price was whatever price they bought at, plus a fee. So they didn't really have any incentive for efficiency. So we got out of this within a couple of years.

Fortunately, sales grew, and we reached critical mass, and we were able to get on the right pricing buying over-the-counter options. And so we became a Wednesday afternoon shop. We rolled up our new sales every Tuesday night, gave them to the investment people Wednesday morning, and they went out and bought options. And that's how a lot of people managed this. We had two brokers that were willing to do business with us. But we didn't stick with this very long, because we decided we could do better going to dynamic hedging. And that was our third step.

We used futures to manage delta until we liked the price of volatility. What happened when we started selling this, when we were designing the product, volatility was at 12 percent. And when we first started selling the product, it was at 17 percent, and within months it was at 27 percent. Well, our owners were privately held. They were comfortable accepting the risk of betting that volatility was going to come down. A lot of companies wouldn't do that. Since we're privately held, we had the ability to do that, so we used futures to hedge the change in price due to the change in index. But we were just naked on change in volatility, change in price due to change in volatility and the changed price due to change in interest.

We won those bets, but we might not have. It was a calculated risk our owners were willing to take.

So then we decided we needed to get more sophisticated. Finally we purchased professionally developed commercial software. It was written by Annuity Systems Inc. in Toronto. It's called the Risk System. It's got an economic manager, and it graphically displays data—that's one thing I like about it.

This is our value at risk due to changes (Chart 6). Well, it's the inverse of the cumulative distribution function. The distribution function goes from zero to one over the total universe. Well, we're going from zero percent to 100 percent. There's a 100 percent chance our value at risk is below $2 million, and there's a 50 percent chance that we'll break even, and there's a .01 percent chance that we'll lose $2.5 million. So, think of it as the inverse of the cumulative distribution function.

This shows our value at risk, but what the bar graphs at the bottom show are the probabilities of that happening (Chart 7). The light blue thick bars use historical, and the thin dark blue bars show what the market predicts. It's like when you have bonds, they create your future assumptions—your future interest rates. That volatility skew projects the market's opinion as to what the probability is that it'll wind up down at 900, what the probability is that it'll be at 1,000, what the probability is that it'll be at 1,150.

So we can look at our risk that way. And this has a hedge optimizer (Chart 8). It's connected into Bloomberg; so it knows what assets are available for sale over the counter. What the green line is: It went out and it used some algorithm to optimize what the cheapest hedge was. And it hedges to within some tolerance. It said, ''Buy two one-year calls and short a 90-day call,'' or whatever it did. It smoothed out our value at risk pretty well. And then this just shows us the Greeks at the bottom there. You've got mark to market, delta, gamma, vega, rho and theta.

The one thing I want to say is that this has what we didn't have before—an economic manager. And it was able to look at the difference between hedging the fund, what our Greeks were, and hedging the statutory income, or the surrender value. It's a world of difference.

Our liabilities had a delta of $30,000 per point for the fund and only $5,000 per point for hedging stat income, and that's because the market's depressed. But that was a real eye-opener for us and probably paid for the software just by telling us that.

Before I conclude, the one thing I wanted to say is that, again, this was developed by Annuity Systems Inc. in Toronto.

MR. MUELLER: Thank you, Darin. Next and last we have Gilbert Lacoste from Sun Life Financial, and Gilbert will talk to us about segregated fund products.

Gilbert graduated from the University of Montreal in 1988 with a bachelor's degree in mathematics and started his career thereafter with a pension consulting firm until 1992, when he joined a Canadian insurance company, where he worked in the retirement and investment products department. Also, the last year or so he was the director of risk management for this company. In November of 2000 Gilbert joined Sun Life of Canada as a senior investment officer where he's now entrusted with day-to-day responsibility for the asset and liability management. Gilbert is both a member of the Society and of the Canadian Institute of Actuaries, I guess qualified under both, as well as a chartered financial analyst.

MR. GILBERT LACOSTE: I'm very excited to be with you and just to share with you some of the strategies that we have to mitigate some of our equity risk. What I'm going to talk about mainly is the equity risk that we have from our segregated fund guarantees, which are part of our individual and variable annuity contracts.

So, what I would suggest as a menu is, first of all, a quick description of the product features, just to make sure that everybody talks the same language, because this is a Canadian product. Then I'm going to talk about the hedging program itself. I'm going to spend more time on the process itself. I'm going to talk about the issues going forward, and this is something that we don't do but obviously we want to do.

The Office of Superintendent of Financial Institution (OSFI), is the regulatory body that regulates federal insurance companies. They just came up with a new paper that describes the requirements that you have to meet if you want to have some capital offset. So I would like to discuss that a bit.

The product features include two levels of guarantees. There's one that is at the maturity of the deposit, because all our guarantees are at the deposit level. So once you make a deposit, 10 years down the road, if the market value that is associated with this deposit is less than a certain percentage of the deposit itself, then the company will pay you back some money.

And there's a guarantee at death, as well. Say you die, and the market value that is associated with the deposit is less than a certain percentage, then you're going to get some money back.

We have 28 available segregated funds that the policyholder can invest in. The product has two resets allowed. What it means is that twice a year the policyholder can elect—if the market value is greater than the guarantee—to switch and then have the guarantee being equal to the current market value. Each time that they do that, though, the maturity date of the deposit is extended to 10 years from the time that you reset.

As well, the management expense ratios (MER), will defer depending on the type of segregated funds you have and the level of guarantee that you have elected. You

have fund transfers allowed, and there's nothing really that will penalize the policyholder if he transfers the funds.

Quick Hedging Program Overview

When we came up with this product, senior management made it very clear that there was no way that they would go with such a product if we didn't have a hedging program to avoid any catastrophic risk. They were willing to lose a bit of money, but they didn't want to bet the whole company.

All my discussion will be based on an economic basis. All the programs and techniques and so on have been created in-house. We had some review from internal and external peer reviews, but all the codes have been created by us. We use interest rate and equity derivatives. Mainly we have interest rate swaps, put options and we use futures as well. So basically what we're doing is dynamic hedging.

The program was implemented in June 2000. So it's going to be two years very soon. And I wouldn't say that everything is working 100 percent. We still need to improve some of the aspects of the program.

The data on the liability side is updated on a monthly basis, but we can come up with estimates of the liability on a daily basis. And like I said earlier, this is a process that we still feel is evolving.

Hedging Program Risks

Unfortunately, we cannot buy hedges or put options or futures or short futures on our own segregated funds. So what we have to do is to come up with proxies that will mimic our segregated funds; and by doing that, then you introduce a basis risk.

The basis risk is compounded by the fact that you have the policyholders that will behave in such a way that sometimes is not very rational. Depending how the fund managers manage their segregated funds, fund manager behavior will create some additional basis risk.

Some future uncertainties: You have realized volatility. This is mainly if you use short futures, due to the fact that you have asset returns that are not normal.

You also have implied volatility—if you use short-dated options, then you don't know what the implied volatility will be when you roll over.

Then you have interest rates, correlation and liquidity risk, and you have more on the transactional side as well, bid-ask spreads, and transactional costs.

Hedging Program Process

Onto the process itself: You'll see that it's very, very logical and commonsense. First of all, we look at the data. Then we regress our segregated funds on relevant

indices, indices with which we can go and buy put options or short futures. – Now that the segregated funds are a function of our indices, we value our liabilities. Then we determine our hedge ratios. And from there we come up with what would be the optimal hedge position. And what we do, as well, we evaluate on a monthly basis our hedge performance.

Collect Some History: So, the first step is that we collect historical trading values for our segregated funds and the underlying indices. And what we do is that for all the indices that we have collected information on, we calculate the returns, the volatilities and the correlations between the indices.

To come up with all those values, we use a decay factor; so it will put more value—more weight—on the most current information. All this collection of data is done through Bloomberg, so everything is pretty well automated.

Regression: So once you have all this information, then what we do is a short-term regression, and you'll find out later on why it's important to say the word short-term. We just regress on the daily returns and use commercial software that is pretty powerful. You'll see throughout the whole process that this is software that we use intensively. It's named Mathematica.

We take our 28 segregated funds, and we regress based on the indices that you can see here (Table 1). So at the end of the day you can say that Segregated Fund 1 is approximated by x percent of the standard index 1 and y percent of the other index 2 and so on.

Table 1

Hedging Program Process - Regression

- **Short Term Regression**
  - **Daily Returns**
  - **Mathematica (Pseudoinverse of Equation Matrix)**
  - **Regress 28 Segregated Funds on**
    - **RBC DS Canadian bond fund index**
    - **TSE 35 Index**
    - **TSE 60 Index**
    - **S&P 500 Index**
    - **MSCI EAFE Index**

So, at this point I think it's important to find out what type of information we have for each segregated fund. So for each segregated fund we have the estimated long-term and short-term regression coefficients and total volatility. The long-term is used to come up with the value of your liabilities, and the value of the liabilities is based on the put options that you have embedded in your product. The regression coefficients in the long-term don't change much. We monitor them. But this is not something that we change very frequently.

And then the short-term information is used to come up with the hedge ratios, because the hedges that you're going to purchase are more short-term.

It's important to talk about the total volatility, as well. Or it's probably more important to talk about the residual volatility, because you have to realize that the segregated funds have their own volatility. But when you use a regression, then the volatility that is coming up from the new portfolio of indices is not equal to the actual volatility of the segregated fund itself. So it creates a risk, a residual volatility, that we'll recognize and that we use when we apply the information at the deposit level.

Value Liabilities: For each deposit we have to come up with a lapse rate, a mortality rate, management fees, guarantee fees, and the total volatility of each deposit. So at the end of the day if you take one deposit, then you know that this deposit has been invested in different segregated funds. For each segregated fund, through regression, you can define it as the function of different indices.
From there you can come up with the volatility associated for each deposit. And this is where you recognize the residual volatility that we were talking about earlier.

So now you have is the volatility for each deposit. You have the strike value because you know the guarantee. You have the market value associated with the deposit. You have your risk-free returns. So you have everything to come up with the value of your liability.

The Trinomial Tree: What we use is just a risk-neutral trinomial tree. To come up with the value of the liability, like I said earlier, we use the long-term volatility. The information about the trinomial tree is in a book by John Hall called *Option Futures and Other Derivatives*. I'm sure you can find it as well in other books, but a lot of the techniques from our hedging program come directly from that book, so I would recommend it.

So now for the trinomial tree: You have to come up with different nodes. For each node, you have to do some calculation. You have to recognize the resets, and we assume that only 25 percent of the people will elect if the reset is optimal.

And how do we define that a reset is optimal? We take the present value of what we charge compared to the value of it; and if what we charge is greater than what it's worth, then the policyholder would have advantage to reset. For each node we

have to recognize the survivorship and the lapsation, as well.

Hedge Ratios: So now that you have your tree, then coming up with the deltas, gammas, rho, vegas and thetas that Darin was talking about is pretty simple. You just go from first principles. The only thing that we do a bit differently is that to come up with the theta, we use the Black-Scholes-Merton differential equation. So if you have your delta and gamma, then you can solve for your theta.

So now, what we have is a tree. You have all your deltas, gammas, and all your Greeks. From there you can calculate your dollar Greeks. So what you have is for each deposit, you have your dollar Greeks; but it's not good enough, because you need to translate those dollar Greeks into a function of your indices so that you can go and buy hedges in the market.

So we use the short-term regression that I was talking about earlier to break down the dollar Greeks of the deposit into dollar Greeks as a function of the indices.

So you do this for all your deposits. You have the sum of all your deposits for all the business you have. Now the last step is just to come up with what hedges you should buy.

Optimal Hedge Position: What we do is a bit different. The reason we're doing it is that we have some indices that don't really have any hedges, or buying the hedge in the market would be very, very expensive. Or maybe we don't have enough exposure to justify the purchase. So we come up with the optimal hedge position by minimizing the variance of the change in net portfolio.

So if we take it one by one, the net portfolio is just the difference between your assets and your liabilities. We try to come up with an equation that shows the change in your net portfolio as a function of these dollar deltas and gammas. So we have a very nice equation. And then from there we can calculate your first moment and second moment, and by definition come up with your variance.

The variance is defined as a very long equation. Then what we do is take the partial derivatives on what we are trying to optimize, and then we make it equal to zero. And then we resolve the system of equation. I wouldn't suggest that you try it by hand. It's very, very difficult manually. We use Mathematica to come up with the answer, and some of the answers are three or four pages long. So, unless you don't know what to do on your Saturday nights, I would really suggest that you use Mathematica.

So from that process we find out, let's say, the amount of dollar deltas and dollar gammas that you should have in your index 1 for example. That would be the optimal portfolio and you look at what you have and then transact based on that.

Performance Evaluation: We just do a breakdown of gain/loss, and you can look at how it's broken down (Chart 9).

Capital Offset Overview
I will talk about the paper that came out from OSFI. They just came up with a paper saying that if you want to have any capital relief from your hedging program, this is what you need to file, and these are the requirements.

I've been to a presentation from OSFI, and they want you to prove that your hedging program is really an integral part of your risk management framework and that the company itself has a very strong risk management culture. You cannot go and say, ''This is what we're planning to do.'' They want to see that you have your hedging program in place, implemented, and proven to be effective for at least three months. And OSFI would be the first one to agree with me that it's still an evolving area. So everybody is kind of learning at the same time.

Documentation: The OSFI paper defines the type of documentation that you need to send. First, you're going to have to send an application. You have to document the principal techniques and processes of your hedging program, things like what is the rationale of your hedging program? Why are you doing this? What kind of products? What are the limitations? And so on.

I picked one that I thought was a bit unusual, because one of the requirements that you need to document is the kinds of expertise or skill sets of the employees or persons that will be involved in your hedging program. And they go even further by saying that you have to send the resumes of these people.

Reporting: The paper says that you have to send some reporting to the senior management at least monthly. The board has to be involved, and they have to receive reporting on the quarterly basis.

You have to verify your actual model results on a periodic basis. And you have to report, as well, on the effectiveness of your hedges and the residual risk.

Part of the reporting as well would be stress testing. You have to do stress testing at least monthly. They say that you should use deterministic scenarios, but stochastic is acceptable as well. And they have very different points that you have to include in your stress testing.

One thing they want is an independent review and validation of your hedging program and models; and it has to be done by qualified resources. This could be internal or external, but if you use someone internal, it has to be someone that obviously was not involved in the creation, modeling, and implementation of the current model hedging program.

And they don't want to leave the actuaries out of the loop. They're going to need to

receive a letter from the chief actuary documenting the appropriateness of the hedging program, the models, the stress testing, the results and the whole shebang.

After doing all this work, it's a bit sad to find out that there's a maximum offset that will be allowed by OSFI. This is defined as being 50 percent of the reduction. If you do your financial projections and you come up with the required capital without the hedging program, then you have an amount; and if you do the same exercise with your hedging program, then hopefully the amount will be less. What you're going to have as a credit will be only 50 percent of the difference between the two.

Conclusion

Our hedging program has been done in-house. It's performed monthly. We use Mathematica very heavily, and the hedging program is still evolving. You can receive some capital offset from OSFI, but you have to make sure that it's an integral part of your risk management. They have very, very specific requirements. The paper is on their Web site. So if you're interested, you can go and look; however, there's a maximum of 50 percent reduction.

MR. DANIEL PATTERSON: I have two comments, maybe one for Darin. When you're talking about FAS 133, there may be some problems with it. We write a fair amount of equity indexed, and I feel like FAS 133 is actually a very positive step forward, because it does isolate what Tom was talking about, in the sense that if a company can really replicate the future outcomes with two assets that have market values, then they essentially have established the market value of the liability. We have very little GAAP income effect due to market movements or volatility movements. I just wondered what your comments were on that.

MR. ZIMMERMAN: I guess my biggest complaint with FAS 133 is that it's trying to pull us toward fair value accounting. And if all of the assets and all of the liabilities were done at fair value accounting, you could hedge rather adequately. The problem is that the most simplistic hedge is you own some bonds and an option. The option is accounted for at market; the bond is accounted for at book.

The bifurcation under 133 says the host contract, which is a portion of the bond, is at book. The derivative, which is the current option and a portion of the bond, is held at market. And so you've got mixing of book and fair value; and if we just went straight to fair value, that would work great. If everything was at book, that would work great. My problem with it is that it's mixing apples and oranges, and it can look like there's income volatility, when if you bought bonds and the right call options, you're hedged.

MR. PATTERSON: I don't have such a big issue with the mixing of book and market in the sense that if a person really is truly buying a bond portfolio that matches well with their liability cash flows, book value and market value accounting are just whatever. And the fact is that with equity indexed, the real risk that people

need to get a handle on is: Is a company hedged properly?

So the book value of the so-called host really is not that big of a deal to me. If I were an analyst, and if I were really looking over somebody's books, I would want to know, ''How are you hedging?'' And the best way that I could understand if you're hedging properly is if you independently value your liability and then see how your asset is moving.

For example, let's say a company is perfectly hedged with an option, but they are not going to hedge withdrawal risk. Persistency is going to dramatically improve in up markets. None of the industry is hedging that—maybe some. I'd say most of us are not. And so part of the FAS 133 framework is going to identify that. OK. Embedded in your liability option valuation is a factor for persistency. It identifies the risk better, I think. OK.

MR. ZIMMERMAN: I agree with that.

MR. PATTERSON: OK. And one quick one for Gilbert: What's your feeling about the basis risk? How much is it month to month, and is it really truly a zero sum game in the sense that it's just going to average out over time?

MR. LACOSTE: Well, we did a lot of work, because at one point, it was becoming a real issue. The two were going haywire. So we're getting better and better. But you still have some exposure, because obviously the portfolio of the proxies that you have behaves differently from your own seg funds. It's something that we have recognized and that we're still working on—we don't feel that we have a good handle on it.

MR. MUELLER: OK. We'll take one more question, please. Anybody else?

MR. WILLIAM MITCHELL: This is a question for any of you who are working on the product development side. What kind of recent product innovations or demands from your field force have you seen?

MR. LACOSTE: I can give you a Canadian flavor of it. The latest that we heard, and I'm not too sure if you have it here, but it's basically to come up with what they call the EEB. So I'm not too sure if it's something that is in the U.S. market. In the Canadian market -it's something that is getting very popular.

MR. MUELLER: And maybe from a U.S. perspective what's interesting is that some companies actually use the EEB feature to offset some of the GMDB risk, because EEB essentially pays off the tax that the heirs have to pay on the death benefit. If, in fact, the amount paid out was above the fund value, there is a tax on that; and so the EEB kind of pays a flat percentage of that. I think it was introduced by Sun Life into the market, and in some ways can be an internal hedge on the GMDB risk.

I think one more thing that I've seen in the U.S. marketplace is that—and I think Allstate introduced this and maybe some others—there is this spousal death benefit rider: If the person dies with an annuity contract, the spouse can then take over the contract with that same GMDB-type position and continue the contract rather than getting the money paid out. That would be another option that's sort of relevant here I think in this context.

Maybe also one comment on Gilbert and the segregated fund product that he introduced. I think it's relevant for the United States also from two perspectives:

(1) It talks about guaranteed minimum accumulation benefits, which some companies have introduced in the market.

(2) Second , the developments that he's talked about with OSFI are also on the horizon for the United States. As most of you I think are aware, the Academy's Life Risk-Based Capital Adequacy Task Force actually is working on a similar model that will be introduced into the U.S. market and will be effective most likely by 2003. It is already being discussed at the NAIC level and will have similar formulas, similar requirements, and maybe also a partial hedging credit. So, stay tuned for that.

Chart 1

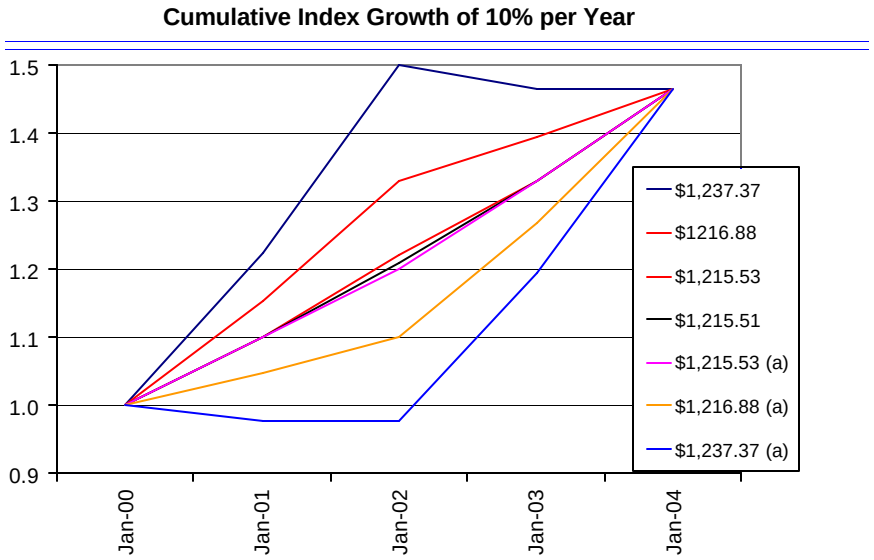

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Chart 2

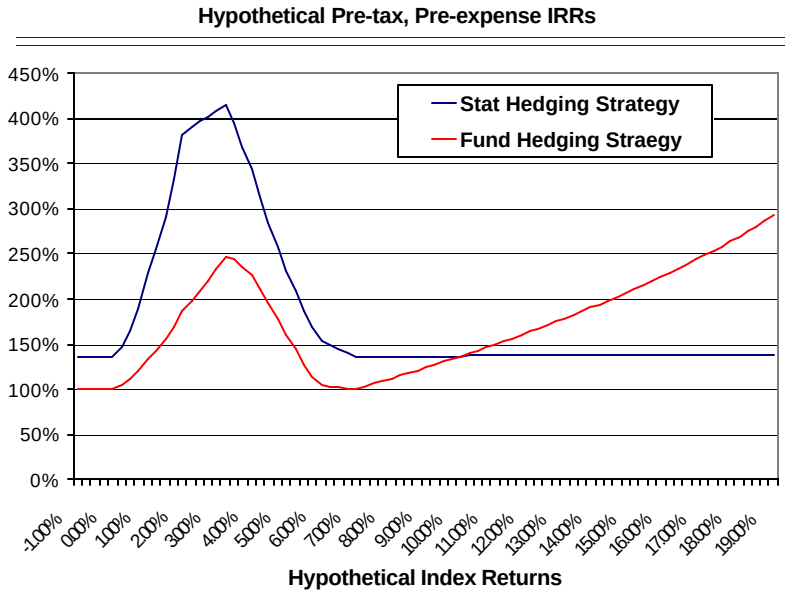

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Chart 3

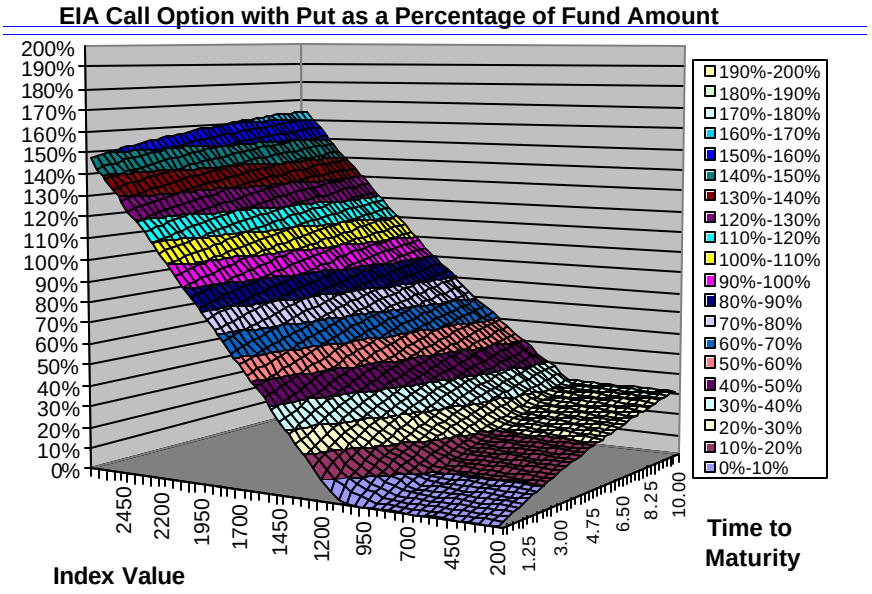

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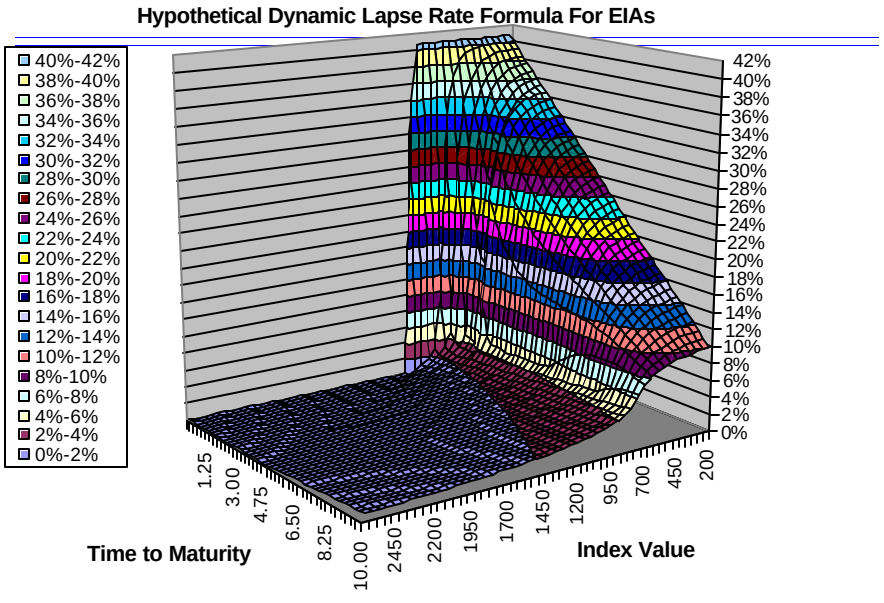
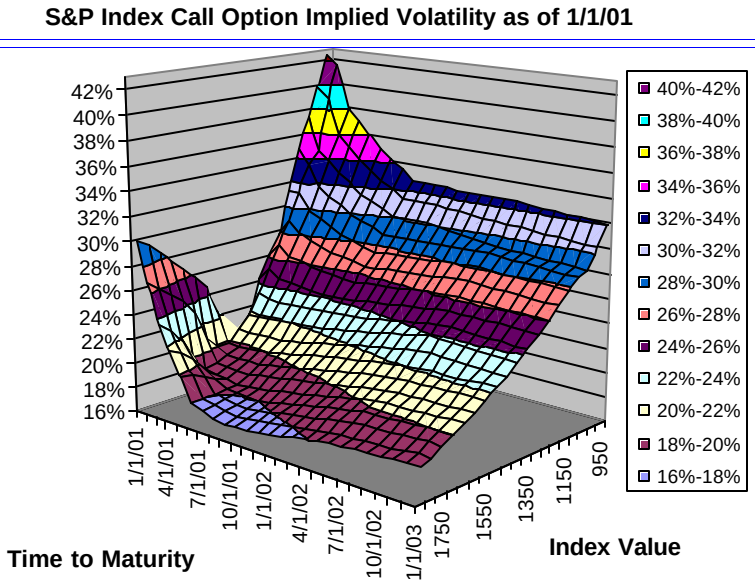
Chart 4



30

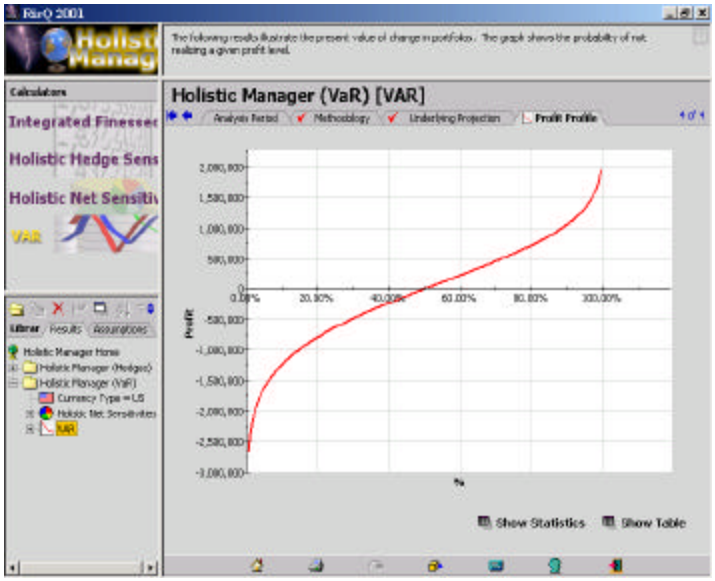
Chart 5



32

Chart 6

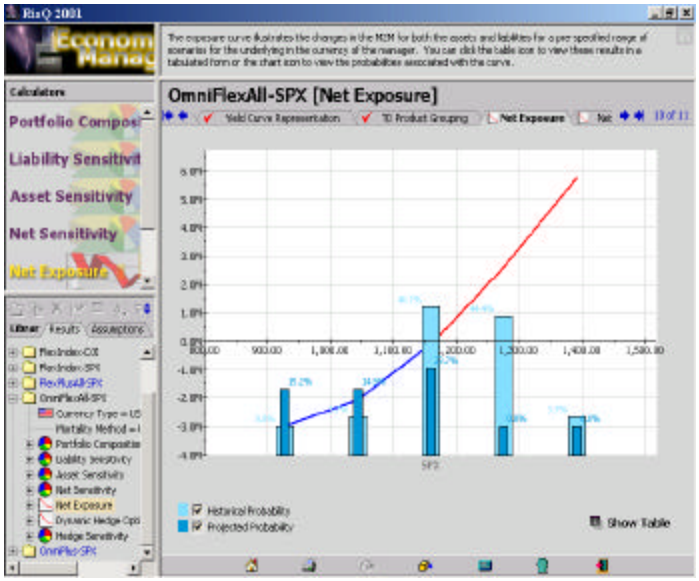
Value-At-Risk



38

Chart 7

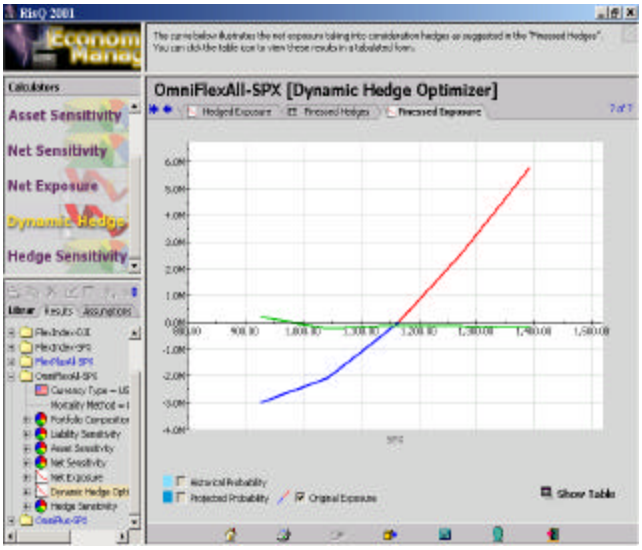
Unhedged Exposure



39

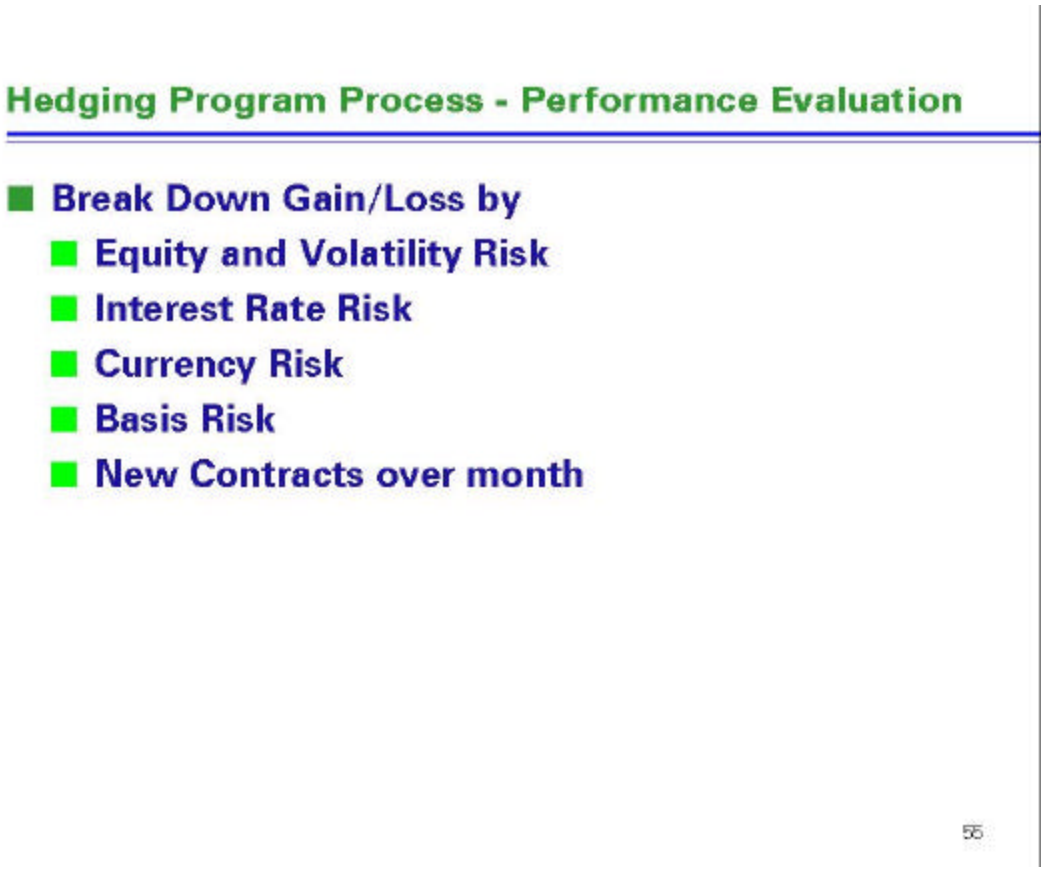
Chart 8

Hedged Exposure



40

Chart 9


Hedging Program Process - Performance Evaluation
Break Down Gain/Loss by
Equity and Volatility Risk
Interest Rate Risk
Currency Risk
Basis Risk
New Contracts over month
55