

# RECORD OF SOCIETY OF ACTUARIES 1992 VOL. 18 NO. 3

## CASE STUDIES

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Panelists: SHANE A. CHALKE  
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STANLEY B. TULIN  
Recorder: GREGORY D. JACOBS

- Past solvency problems
- Adequacy testing
  - Cash flow
  - Gross premium valuation
- How to report/translate to management
- A different view of solvency
  - Regulation versus utility
  - "Option adjusted" balance sheet
  - "Option adjusted" valuation
- Report on single premium deferred annuities (SPDAs) and Credit Risk Project Oversight Groups (POGs)

MR. GREGORY D. JACOBS: We have four esteemed panelists, three of whom will actually do case study discussions. Before the case studies are presented, Mark Doherty, Director of Research for the Society of Actuaries, will speak on some of the Society research that's being done with regard to the currently released report on SPDA lapsation and the soon-to-be-released report on the credit risk analysis on bonds, mortgages and such. The case studies will be presented by Shane Chalke, president of his own firm, Chalke, Incorporated; Trish Guinn, who is with Tillinghast in New York; and Stan Tulin, who is with Coopers & Lybrand in Philadelphia.

MR. MARK G. DOHERTY: Several years ago the Society of Actuaries renewed its commitment to research. I'd like to talk to you about some of the projects that are case studies. They're of truly massive proportions as you'll begin to see. I think that you'll begin to understand that the Society of Actuaries itself, through its volunteer system, some research we've paid for, and some cooperative ventures with other organizations, has come a long way in the past several years.

A good place to start is to consider the motto of the Society of Actuaries: "The work of science is to substitute facts for appearances and demonstrations for impressions." I hope that the studies we will talk about will give you some insight and prove that, in fact, we are substituting facts for appearances.

The first study is an SPDA persistency study. This was a joint effort done with the Life Insurance Marketing & Research Association (LIMRA). Interestingly enough, all the researchers on this project were actuaries. Basically we took a 10% sample of the data collected. This sample consisted of 350,000 contracts. Obviously you can assume that we have about 3.5 million contracts in the total database. We had \$8.3

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billion in cash value. That is out of a total of \$83 billion. The experience results really are for calendar years 1984-89. We had limited data on issue years going back to 1978. The data are concentrated, however, in the early years of the studies. We had 24 companies contributing data to this study.

We began by breaking the data into two, distinct pieces: interest guarantee periods of one year or less and interest guarantee periods greater than one year. The characteristics we studied were surrender charges, tax status (qualified, nonqualified), free partial withdrawal provisions, contract size, age, interest credited, distribution systems, and the expiration of the interest guarantee period. Also we had some information by sex.

What are the results? Well, we got some interesting outcomes. Some people found them surprising, but they are actually very logical. Those products with a one-year interest guarantee and no surrender charges were four times more likely for full surrender than the ones with surrender charges. A multiyear interest guarantee period, with surrender charges having expired, had a 36% withdrawal rate. The expiration of a multiyear interest guarantee period is the primary factor, though, for full withdrawal. When we looked again at a multiyear interest guarantee contract period that had expired and had no surrender charge, the withdrawal rate exceeded 50%.

Now, in factors for the partial withdrawals, we were able to correlate those with age of the annuitant. That is, the older the annuitant, the more we saw in partial withdrawals. With regard to contract size, the larger the contract size, the more withdrawals. A free partial withdrawal provision, obviously, was one that allowed for the partial withdrawals.

The analysis by interest rate spread during this period showed no significant results. It's important to remember that this is a declining period of interest rates. If you need some further information and details, this report is available from the Society office.

The next study is another study of truly massive proportions. This study, which has been underway for a couple years, is a credit risk study. We analyzed what was going on in terms of private and placement bonds and commercial mortgages because we noted that the publicly traded bonds had a lot of information already available. You can refer to the Vanderhoof et al. paper published in the 1989 *Transactions*, Vol. XLI, pp. 547-591, "The Risk of Asset Default, Report of the Society of Actuaries C-1 Risk Task Force of the Committee on Valuation and Related Areas," on C-1 risk in publicly traded bonds.

We decided that it was important to take a look at the area of commercial mortgages and private placements. This became a joint Society/ACLI study. The ACLI had information on defaults, delinquencies and foreclosures, but not of a greatly detailed nature that would allow us to analyze these assets in depth. We did get broad participation by small companies, middle-size companies and large companies. The proportion of large companies tend to weight toward the larger amounts. The initial study was done on a pilot basis.

The 1985-89 pilot study was done to find out if we could do this or not. This study had never been done before in terms of commercial mortgages on an aggregate basis.

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We have gotten to a point where we believe we can continue this study. So, for 1990 data onwards, this is going to be, we hope, an annual study. We should catch up in the next couple years. The important thing to remember is that commercial mortgages and private placements are about 45% of the assets of the insurance industry. In addition, what we are doing is applicable to pension funds and banks.

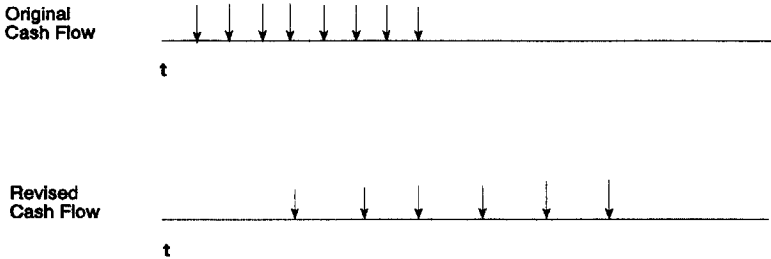
The credit risk study is divided into a number of pieces. To begin with, we have an exposure base. Perhaps the best comparison for this exposure base is a disability model. If you look at it in terms of underwriting, loans are underwritten as are people. You may or may not have an incident of disability at some point in time. We would call that a credit event in terms of the investment area. Another thing that's not been done typically, other than counting the incidents, is to determine the severity. We're trying to take a look at this in economic terms. So, in an exposure base, we're looking at all the portfolios of a company, aggregated and totaled by all the companies. Then we look at the credit events. These are simply any changes in the originally contracted-to cash flows. A credit event is not a default, per se, and it's not a foreclosure, per se. It's any change from the originally contracted-to cash flows. Thus, it could be positive or negative. It also gets away from the onerous sound of default or foreclosure, the ultimate end. If you think about it in terms of the disability model, when you have a foreclosure or even a credit, an incident has occurred. All we're trying to do is determine whether that person, that investment, becomes active and healthy again, stays impaired, or dies off (foreclosed or defaulted). We're trying to look at all this and determine the true economic loss based on present value. We then hope to get the basis point loss across the entire portfolio. Of course, we do special analysis. In terms of mortgages, we look at geographic location and property types. You can take a look at amortization schedules, balloon payments, things of that nature. In terms of bonds, we track the ratings, looking at how the ratings have changed over time. We look at the SIC codes and see how that impairs or impacts the bonds themselves as well as leveraged buyouts (LBOs).

The basis for our work is essentially for year-end 1989 with an exposure of \$111 billion in commercial mortgages. This represents over 20,000 individual mortgages and \$67 billion in private placements or roughly 10,000 private placements. The exposure base, because of its massive amount of information, is typically done on a mainframe.

When you look at the investments, you'll see that investments are not really monitored as we would like to see them done. What we found typically is that the investment was monitored only when there was a problem. No one worried about it until a payment was missed or a payment was late, then suddenly mechanisms were triggered. What we have in Chart 1 is just an example. Looking at an original cash-flow pattern, going out through a period of payments, and in this case, let's assume a balloon payment, something's occurred. There at time,  $t$ , we have some problems, some reworking, some modification to the contract, and we have a revised cash-flow pattern. What we want to do then is to take those cash flows and compare them. The difference in the present value of those cash flows then will be the economic loss or gain.

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CHART 1  
Credit Risk Study Credit Event



Basically, we look at a very simplistic way of doing the choice of interest rates. In terms of commercial mortgages we look at spot rates. We use a Levy Barron's index. This is basically three-, five-, seven-, ten-year interest rates that are spot rates. We find the term left on the original cash flow and the new term on the revised cash flow, then match the duration of each of the payments up that yield curve. That is the discounting rate we use. In terms of private placements, a similar approach is done, but now we're concerned about the use of quality. Private placements typically do have quality ratings, so we're attempting to take a look at spreads based on quality ratings in addition to the date of the credit event.

Each exposure base has about 30 data elements. If you multiply that by 20,000 for one year, you can see that the record lengths do get long. In terms of the credit events, the variable length record we're using is now based on a Lotus spreadsheet template. We're able to somewhat quantify it. Fifteen companies contributed data in 15 different formats for the credit events. So, it makes it a little difficult to try to standardize things, and, as a result, we now have the Lotus template.

We have been working on data validation. Because of the nature of this study, in order to be credible, it's very important that we validate the data. We think of this investment research as a very sensitive area. We want the data as clean as possible so that we can explain any of the subtle changes. For example, in year-end 1989 the private placements went from a CUSIP numbering system to a private placement number, a PPN. That change was not reflected in the companies by saying this asset has now become this number; the data were just given. In going back, it's not always easy to match a CUSIP number with a PPN number. However, we've now developed a way of doing that.

The calculation procedures and computer systems have to be verified. At this point we are doing the analysis looking at incidence and severity. We're looking at matrix changes in quality for private placements. What happened to the quality rating of bonds over time? In terms of the commercial mortgages, we're also looking at a matrix of change. What happens to those mortgages that have had credit events? How many go back to become healthy, active loans? How many go into foreclosure? How many are in a modification or a reworking situation? Now that the data

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have been validated, soon we'll be able to state some results. We will present our results to the individual companies first, and then the aggregate will be released, we hope by August 1992 for private placements and September 1992 for commercial mortgages. We are seeking new participants for these studies, and we have some new companies signed up for 1990. Our timetable is to be current within the next two years.

What is it we're really trying to do? When a loan goes out, the money goes out the door. We want to trace that money until it comes back in the door. That is the cradle-to-grave approach, cash to cash, if you will. One of the things we're concerned about is what happens in rollovers. Credit events do not occur because a loan comes due and a balloon payment is made allowing the company to reinvest money as a new loan. But rollover, or refinancing, is very important to us. Extensions are another area we have to be concerned about. A new phenomenon on the horizon is something known as a vendor take-back loan or a money purchase mortgage. For commercial mortgages, when a property has been foreclosed upon, the lender takes back the property and perhaps another borrower offers to buy the property but wants the company to make a loan. Here we have a position where cash went out the door, the property came back, and now it's going back out the door in terms of a loan to this individual or to the company. We want to track it back to cash.

The credit risk study is very quantitative. We view it as a tracking mechanism. We hope on the assets we're tracking that we'll be able to understand their patterns. The quality question is answered in terms of what's going on in private placements, but it is not answered for commercial mortgages because commercial mortgages do not have a quality rating system as of yet. We believe that any rating system should be done based on empirical evidence. Now, we have an adjunct effort dealing with qualitative factors. We don't believe we have a system yet, but we're hoping to collect sufficient data to put one into effect over time.

The credit risk study is a key component in working with the industry and NAIC advisory committees. We think we are here to help them establish valuation reserve methods and work in the area of risk-based capital. We hope our studies can work in monitoring these investments and provide some industry norms. Foremost in our mind is to be able to establish adequate reserves for valuation purposes and the solvency of insurers.

To give you an idea of the scope of this project for the Society of Actuaries, the cost for the credit risk study is in excess of \$500,000 at this point. That includes computer time, systems development work, staff time and expenses. In addition, thousands of volunteer hours have gone into this project. If we add the qualitative factor to this, we have a study of enormous proportions – not only in terms of what it's going to cost but also in terms of what it's going to accomplish.

Quality is something that is very difficult when you put it in the context of a commercial mortgage. What appears to be good today could be bad tomorrow. We're attempting to take a look at and capture what we believe is the essence of quality. We hope to be able to collect data on a number of variables, determine what are the important factors here, and then develop a rating system that will be useful. I know that a number of companies have begun to utilize our system. Right now it's a

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straightforward system to collect data to help people rate mortgages in the future. It has 13 factors, plus one overall assessment or judgment. Three of the factors are quantitative, and 11 of them are ranked from one to five with one through four being of different degradations of investment quality and five being simply noninvestment.

When you have a loan-to-value that's high, you have more risk. When you're refinancing risk, you're looking at a balloon payment that is often 100%. You're looking at fairly high risk. The lesser the refinancing risk, the greater the opportunity for having that repaid.

Other things we're looking at in terms of these quality factors are leasing status and tenancy credit. We look at how much is leased and the quality of the tenants leasing it. Metro area market outlook takes a look at the standard metropolitan statistical area (SMSA), and the economic picture of that geographic area with regard to job growth, construction, absorption, vacancy, terms, and concessions in that market. The micromarket outlook is a very small locale within the SMSA. The Chicago area, for example, would be the metro area. If we looked at the Society office in Schaumburg we would be homing in more in terms of the micromarket.

The appropriateness of the building location basically is looking for the highest and best use of the property. Classically, we're looking at what's physically possible, legally permissible, financially feasible, and maximally productive.

In terms of the building function and style, we want to determine if it's being used for the purpose it was intended to. When looking at the economic use we need to know the style, the aesthetics and the materials used. With respect to lien position and title, we look at our legal interest, for example, fee simple, first lien, second lien. In terms of borrower strength, we look at how the borrower is leveraged: liquidity, net worth, overall cash-flow position. This person or company may be involved in more than one property. The asset management ability is taking a look at the borrower's ability, incentive, experience, track record, and knowledge of the marketplace. Income enhancement and credit supports are basically a master lease with high credit tenant or a letter of credit. Owner occupancy is another area that we think is important.

Seasoning is the payment experience. Obviously, new loans do not have any seasoning, and therefore, they would be rated low while those that have been paid for 15-20 years in a long-term mortgage may be looking at a payment history that's very good. Finally, we look at the overall assessment. Some things cannot be captured by itemizing them into factors, so we think the overall assessment done by the underwriter is extremely important.

What are we trying to do? Well, we're starting with 1990 new commitments. We're looking to do any reevaluated loans, rollovers and any updates. We're dealing with 20,000 mortgages as it is, and more companies are participating. That number will grow. We're trying to integrate this into our credit risk study.

I think the important aspect of this whole approach is that a quality rating system needs to be empirically based. We hope in the near future to present a full set of data for you in terms of the credit risk study, private placements, and commercial

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mortgages, as well as a continuation of the study on an annual basis. In addition, we will integrate the quality rating system by determining the factors that are important and presenting to the members the whole package so they'll know what's going on in terms of the major investment of the insurance industry. We hope what we're doing is substituting facts for appearances and demonstrations for impressions.

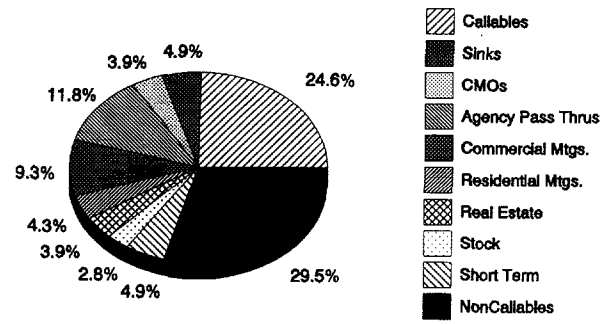
MR. SHANE A. CHALKE: I'd like to discuss the concept of solvency from the company perspective and within that context discuss how to make risk decisions because solvency decisions really are risk management decisions. There are literally no ways to eliminate risk. Every business enterprise assumes some element of risk, and the fundamental questions are how to make decisions in this environment and how to assess the trade-offs between business venture returns and assumed risk. In doing this, I will use three different tools. Two tools will be used to measure risk, and one tool is used for decision making. For the decision making tool, I'm going to go back to about 1750 because I think most of the good work in decision making was done back then.

The two tools for solvency measurement are the option-adjusted balance sheet and the option-adjusted corporate valuation. The tool I will use for decision making is based on utility theory. That's why I'm going to pull you back 250 years or so to discuss option pricing models that are fundamental to much of what's going on in risk management today, especially with respect to economic risk and interest rate risk. These models are widely adaptable to various contingent events and various independent variables. Pricing models purport to accomplish two things: (1) to explain market prices of assets and (2) to price assets without an observable market price by relating them back to assets that have observable market prices. Essentially what we're trying to do is explain the prices of assets in relation to each other. The company I will use is entirely contrived. Even the products that the company sells have been invented just for this presentation.

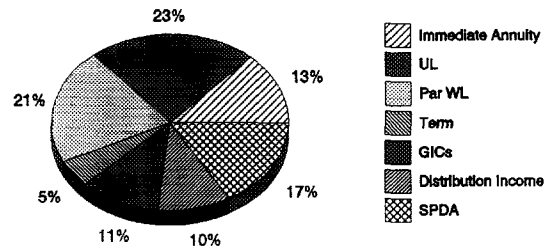
I will start with this concept of the option-adjusted balance sheet (Chart 2). Essentially we divide the balance sheet into assets and liabilities and develop a portrayal of the market value of assets in relation to book value of assets. On the other side, we're looking at the "market value of liabilities in relation to book value of liabilities." Let's take a closer look at the bottom left-hand corner. We are comparing the book value of liabilities, the statutory reserve and the option-adjusted value of liability streams. The intuitive way to interpret this is that, when we say option-adjusted value of liabilities, we don't really mean market value of liabilities. As any of you who have bought and sold blocks of business or companies know, the market is quite illiquid and tumultuous with no clearly definable pattern of prices. However, we can price the value of a basket of assets that matches the cash flows of the liabilities in various economic environments, both in terms of price of those cash flows and timing of those cash flows, and that's essentially what we do through an option pricing model when we price liabilities. We can calculate the value of this basket of assets in several different ways. We can calculate the value of a basket of Treasuries and Treasury derivatives that correspond to the liabilities, or we can calibrate to some other credit quality of assets, the most conservative, of course, being the Treasury representation.

### Asset and Liability Portfolio Allocation

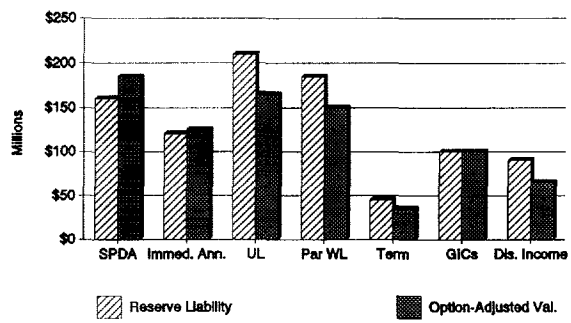
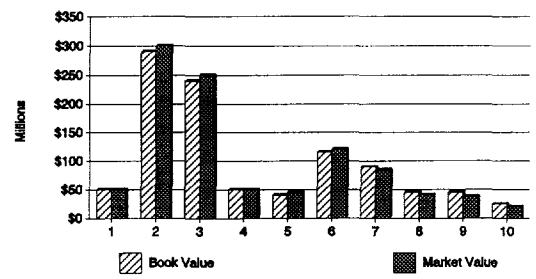
Distribution of Book Value



Distribution of Statutory Reserve Liability



### Comparison of Book to Market



- 1 Short Term
- 2 NonCallables
- 3 Callables
- 4 Sinks
- 5 CMOs
- 6 Agency Pass Thrus
- 7 Commercial Mtgs.
- 8 Residential Mtgs.
- 9 Real Estate
- 10 Stock



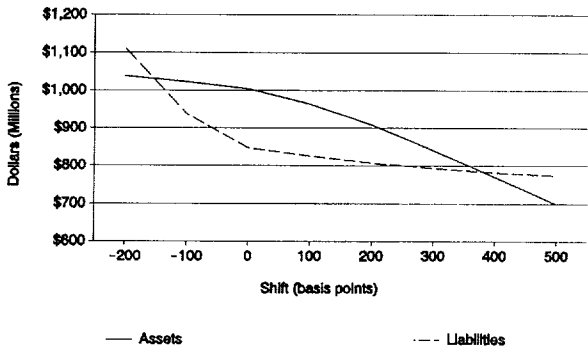
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Now, for the products. We have an SPDA. For this, we get an interest rate somewhere around five-year Treasuries, tax deferred, and take out money whenever we want it, at book. That's completely implausible, but just for illustration, I'll work with that. After calculation, we find that the option-adjusted value of the annuity block exceeds the statutory liability, the statutory reserve. This is an indicator that we would use to assess whether or not there's likely a problem. This is really only half the story because, if you look at market-to-book ratios on the asset side, there's no reason to panic if you have a market-to-book ratio of .92 or .88 or 1.08, without looking at what's happening on the other side of the balance sheet because we are leveraged institutions. If we were to look at the comparison on the liability side and put right next to it the comparison on the asset side, we may or may not have cause for concern. In this particular case, we find that we've passed this first measurement test. Our option-adjusted value of liabilities is exceeded by the market value of assets. This may or may not occur, but the basic point here is that you need to look at both sides before you begin to assess the meaning of this kind of a measurement mechanism. That's our first tool, the option-adjusted balance sheet. It is quite revealing at times. There are many reasons why, for certain products, the option-adjusted value might exceed the statutory valuation and vice versa.

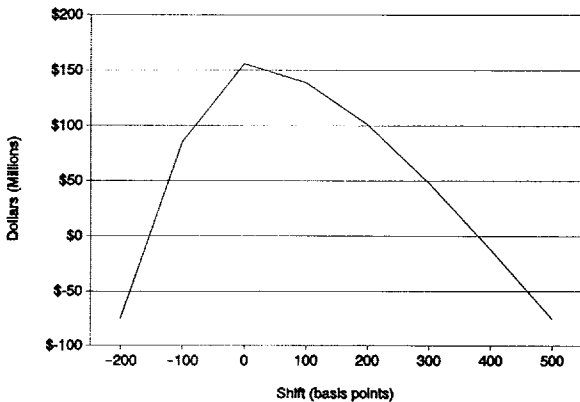
The second tool is really an extension of the concept of option-adjusted value on the liability side and market value generally calculated with option pricing models on the asset side. If we take these values, and plot them over changes in interest rates, we derive what's known as price behavior curves (Chart 3). We map or plot, on the asset side, the market value of assets today. As we move interest rates upward and downward in the model, we recalculate the hypothetical market value of assets and plot this on the graph. We do a similar exercise for liabilities. Again, using an option pricing model, we calculate option-adjusted value of liabilities. Above the zero is the level of interest rates, or term structure on the day that we did the analysis. Then we move interest rates upward, in hundred basis point increments, and downward, at hundred basis point increments, and look at the pattern of value.

This is a very revealing analysis. It explains a few difficult concepts of option-adjusted duration and convexity. Option-adjusted duration is really nothing more than the slope of those curves, unfortunately, with a negative sign in the front of it. Because tradition has it that bonds can't have a negative duration, we reversed the slope. Convexity is just the second derivative of that curve or the concavity. It's a very useful tool because we can begin to look at the pattern of risk we're dealing with, and this concept can be extended to literally any independent variable interest rates, mortality levels, or lapse models, which is an important aspect for the risk-bearing profile of the company. The main use of this kind of a representation is that we can most readily use this to design insurance postures against risk bearing with which we are uncomfortable. For example, if we were to look at Chart 3 and say we're a bit uncomfortable with the fact that the market value of surplus embedded within this line of business disappears with the 350 basis point increase in interest rates, we could certainly do something about that. Of course, there are always trade-offs involved, but we can sculpt the form of insurance that we could use in order to rectify the situation. This may involve changes in asset allocation or direct interest rate insurance in the capital markets in the form of interest rate derivatives, caps, floors, swaps, swaptions, or changes in product features over time. Chart 3 is often used to graph the difference between these lines or the price behavior curve for

Option-Adjusted Value of Assets and Liabilities



Option-Adjusted Value of Economic Surplus



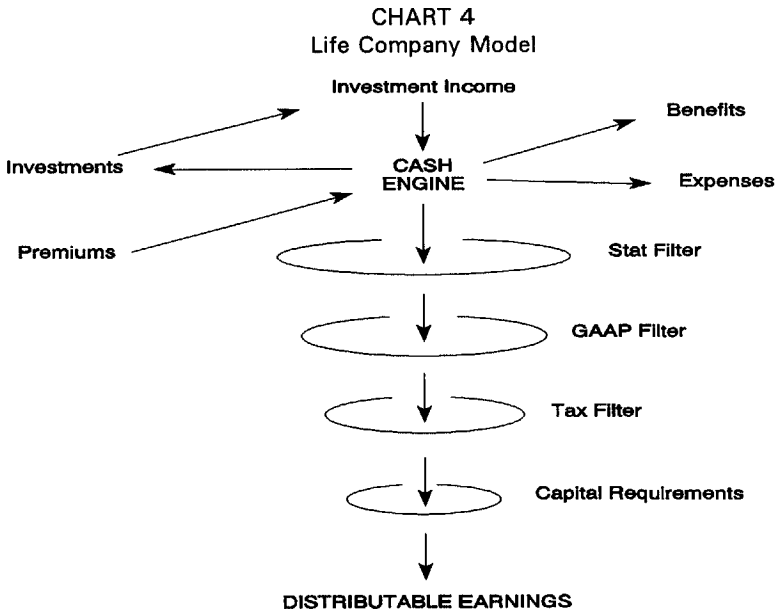
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Shift (b.p.)	Assets			Liabilities			Economic Surplus		
	OAV	Duration	Convexity	OAV	Duration	Convexity	OAV	Duration	Convexity
-200	1,038	1.47	N/A	1,113	18.66	N/A	-75	-188.24	N/A
-100	1,023	1.89	-39.10	938	10.61	906.18	85	-45.51	-10,470.59
0	1,004	4.04	-199.20	848	2.66	801.89	156	12.23	-5,641.03
+100	965	6.16	-176.17	826	2.23	48.43	139	37.62	-1,510.79
+200	909	7.96	-121.01	808	1.76	49.50	101	110.42	-1,485.15
+300	842	9.21	-47.51	794	1.40	37.78	48	-500.00	-1,458.33
+400	771	10.14	0.00	783	1.06	35.12	-12	-83.95	2,291.67
+500	700	N/A	N/A	775	N/A	N/A	-75	N/A	N/A

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economic value of surplus. Then we can more keenly look at the pattern of risk that we face in terms of interest rates. We find this to be a very effective building block tool. Now, there's a lot of talk in interest rate risk management about the duration of surplus. It's currently the hottest topic in asset/liability management. That is, again, a useful representation of risk but perhaps not a holistic representation. For example, the duration and convexity numbers that go with this graph are shown at the bottom. Now, if you just concentrate on the third line down, you'll see what people most often talk about in terms of leveraging within our institutions. Here we have an asset duration of about 4, liability duration of under 3, 2.66, but a duration of surplus in excess of 12. If you look at how fast that duration of surplus drifts as interest rates rise, it goes from 12 to 37 to 110. That's quite dramatic. However, there's nothing in this whole grid of numbers that you can't understand much more readily, simply by looking at this picture. That's one reason why we like the graphical representation.

Extending this once more, to move from the measurement realm to the decision making realm, I'm going to describe one more concept. We can think of the life company as looking something like Chart 4.



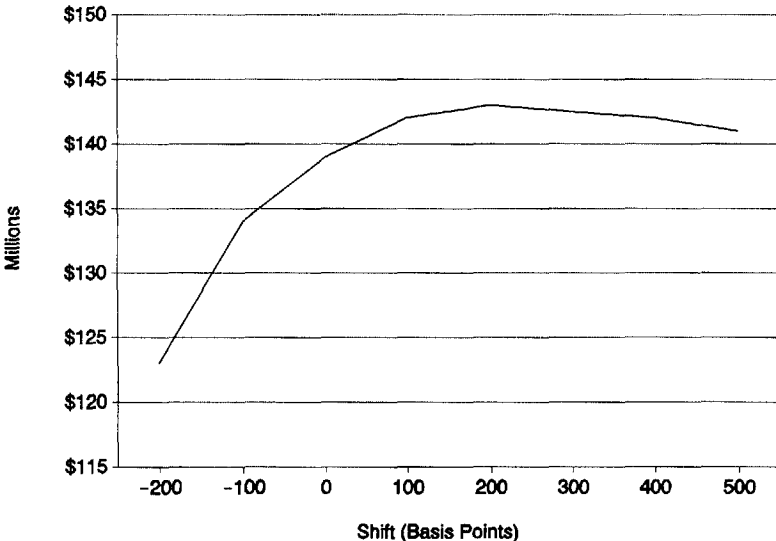
Essentially, we have fundamental economics that exist with an insurance company. A company is cash based, sells products, collects premiums, makes investments, pays out benefits, and has expenses. Some of the institutional things that go on with our companies are not entirely represented by the fundamental economics, but they are constructs that exist within the business world. We call these filters, and they interpret the workings of the cash. We have a statutory accounting mechanism that many of us believe works poorly, yet it exists as a business constraint. Many of us are faced with GAAP accounting. Certainly all of us have to run tax books, and we

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have various institutional capital requirements that vary considerably: the yet to be promulgated, but now in wide use risk-based capital, various views by the rating agencies, required capital, and statemandated required capital requirements. The actual ownership benefit that's derived from the insurance company is the cash that passes through all of these filters. Cash is not distributable (free to leave the company to be deployed for other projects or investments) until it passes through all of these filters.

So, looking at this as our fundamental company model, we can concentrate on that distributable earnings stream, the piece that falls out of the bottom of this very complex filtering mechanism, and treat this as a financial instrument in and of itself. In other words, we can look at a different way of valuing companies, a different way of looking at profitability of insurance company ventures, and we can analyze this distributable earnings stream through an option pricing model. We developed option-adjusted value of distributable earnings (OAVDE), a measurement concept with which we can actually graph that in price behavior curve format as well (Chart 5).

CHART 5  
FPM<sup>sm</sup> Life Insurance Company  
1st Quarter 1992  
Option-Adjusted Value of Distributable Earnings as of 12/31/91



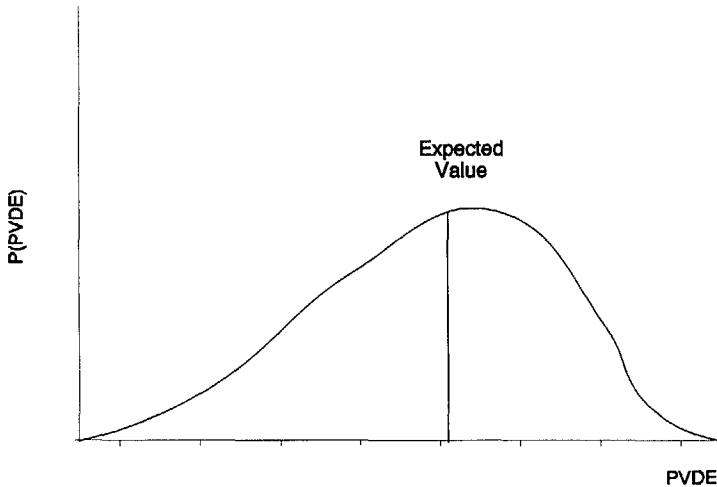
This curve is useful both in terms of its shape and in terms of its magnitude. In fact, the fundamental question of the risk-bearing interest exercise, the risk decision making exercise, is the trade-off between the shape and the height of the company valuation, the actual value of the distributable earnings stream calibrated to capital markets in contrast to the fundamental hedge position of the underlying economics, the underlying cash. This is a fundamental decision with which we're faced.

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In order to address this problem and to make decisions in this environment, it is necessary to have a decision tool. I believe this is currently where much of the industry stands, at the threshold of making the decision but without the decision tool. The measurement tools are starting to get very good, and the decision tools are quite lacking.

The next step is to develop the value of this company because the distributable earnings stream is a stochastic event. We can take the central value above the zero point and represent it in a probability distribution form. Many of you have done this kind of work with measurements like present value book profits. We're simply extending it one additional dimension. We can represent the present value of distributable earnings as a probability distribution, and of course, probability distribution has an expected value (Chart 6).

CHART 6  
Capital Value pdf



We all know the expected value is not a particularly good measurement from which to make decisions because it ignores the character and the nature of the risk that's involved. So, in order to evaluate from a decision maker's standpoint, it's necessary for us to move to a more robust decision making mechanism. We propose that the best way to make decisions in this environment is with the concept of utility. Essentially, expected value is very basic, but we can look at the utility of a distribution as well by substituting for each observation of the random variable the utility of that random variable.

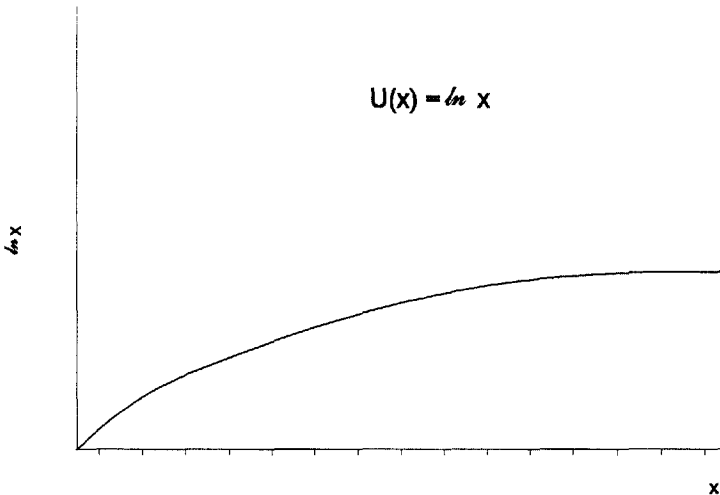
What is utility? This is where I have to go back a few hundred years. Prior to the mid-1700s, it was largely thought that the fair price for an insurance company was expected value. That changed as a result of what was known as the St. Petersburg Paradox.

$$E(x) = \sum_{i=1}^n P(x_i) \cdot x_i$$

$$U(x) = \sum_{i=1}^n P(x_i) \cdot U(x_i)$$

There was described a game where the expected value was infinite, but nobody was stepping up to the plate to pay infinity to play this game. So, essentially, it was a game where you toss a coin until it comes up heads. Whenever it does, the payoff is two to the  $N$ , where  $N$  is the observation where it comes up heads. So, you calculate the expected value, and it's infinity. If I said we're all going to play this game, I don't think I could collect infinity to have someone play. So, the solution to the St. Petersburg Paradox was the concept of decreasing margin utility. The first indication that I've read about a logical solution to this was known as Bernoulli's Principle. Bernoulli said that utility does decline at the margin with each additional unit. He postulated that utility was equal to the log of the observation (Chart 7).

CHART 7  
Bernoulli's Principle



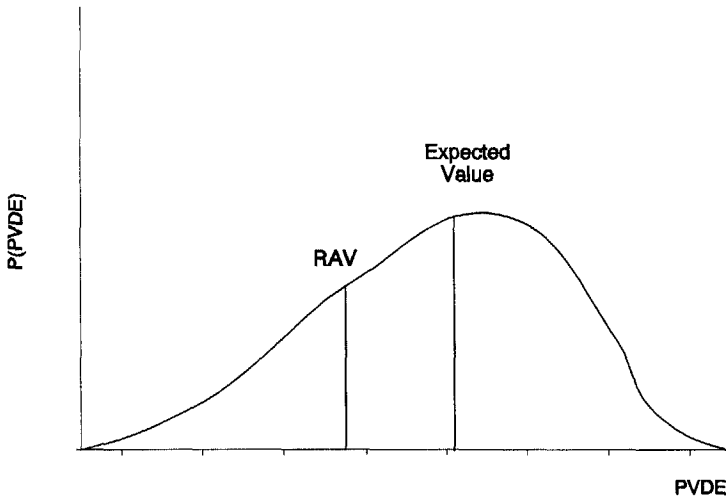
Bernoulli offered that any function with declining margin utility made plausible sense. He also talked about utility of  $x$  being the square root of  $x$ . Now what do we do with that theory? We use utility models in our analysis to help strike a balance between this trade-off of the value of your company and the degree of risk borne by the company. However, we don't use Bernoulli's Principle. It's rather crude for a number of reasons. It doesn't pass some very basic tests that cause some quite intuitive problems. In modern times the exponential utility model has gained favor for a number of reasons related to the properties of the model itself.

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$$U(x) = \frac{1}{r} [1 - e^{-rx}]$$

The formula doesn't assume that everyone has the same utility posture or same risk aversion profile. The  $r$  in the formula is really a calibration factor, where you calibrate the formula to your posture toward risk. There are a number of empirical ways of doing this. The upshot is that we can use a utility model to calculate, for each distribution, measures of standard deviation, in addition to expected value or other measures about that distribution. We can also calculate a risk-certain equivalent value for the distribution based on any risk aversion level. This is called risk-adjusted value. Essentially, it involves calculating the utility of the distribution and then, on the same scale, calculating the constant or certain dollar amount that falls at the same place on the utility scale. We can represent it graphically (Chart 8).

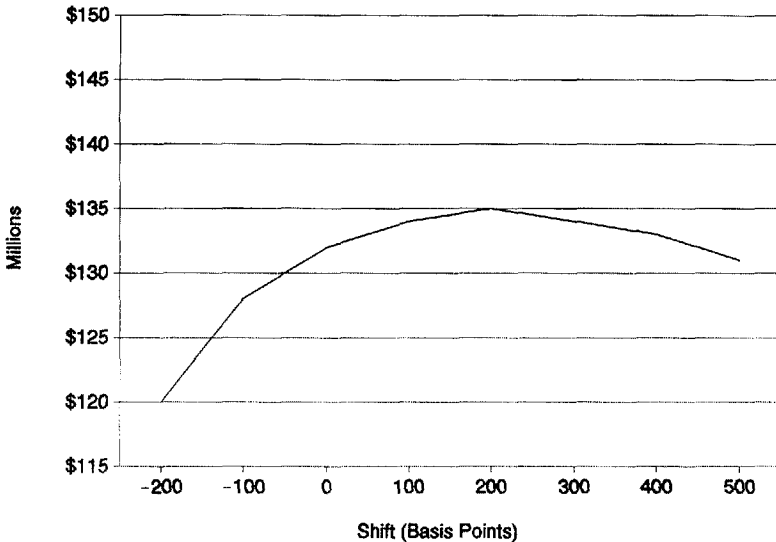
CHART 8  
Capital Value pdf



For a rational corporate decision maker, the utility will always fall below the expected value, and this will be true with any utility function with declining margin utility by unit. What I like about this is that, although we cannot ordinarily very effectively rank other parameters of a distribution and expect to make good decisions, we can ordinarily rank the risk-certain equivalent, or the risk-adjusted values, to make pretty good decisions.

I'll give a quick example of how we use this. Just as I showed a price behavior curve for distributable earnings, the value of the company with changes in interest rates, we can also present the curve that is the utility of this earnings stream over changing interest rates, utility of distributable earnings (Chart 9).

CHART 9  
Utility of Distributable Earnings



This is done, by calculating "expected values" through the option pricing model, by calculating utilities based on a certain risk aversion profile. This is not particularly revealing until we plot this on the same graph as the option-adjusted value of distributable earnings (Chart 10). We can make two immediate observations. First, the utility is lower, and you'd certainly expect utility to be lower than expected value. Second, the curve itself has more negative convexity. That's particularly reflective of the conditions right now where interest rates are reasonably low. As interest rates rise, you have a more disbursed distribution. This is somewhat a function of our interest rate model. We have a utility value, and we have an expected value, or an option-adjusted value. We can use the contrast between these two elements to look at various hedge positions within the company. We could explore leaving the portfolio as it is with a surplus duration of 12.

All the way from the zero hedge to completely hedged, where we've matched durations and convexities of assets and liabilities, we have removed most of the interest rate risk. We'll call that a 100% hedge and look at various positions in between. For each of these hedge positions, we can plot both the option-adjusted value of the earnings stream and the utility of the earnings stream. We keep expanding the horizontal axis until we find a maximum of the utility (Chart 11).

Depending on the company's risk profile, we may add risk to the institution. As is typical in this curve, the option-adjusted value of the earnings stream declines with increasing hedge positions.



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CHART 10  
OAVDE and U(DE)

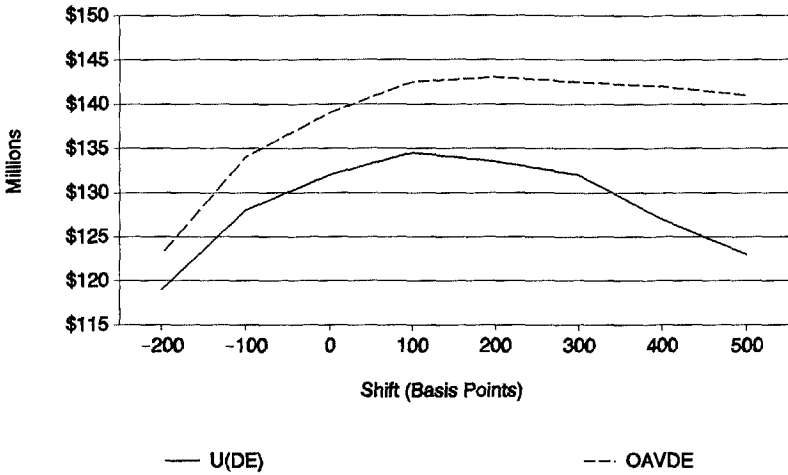
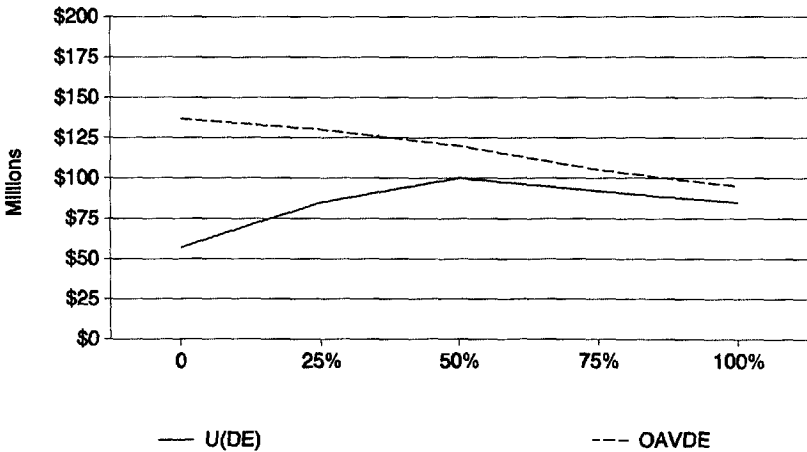


CHART 11  
Hedge Position  
OAVDE and U(DE)



This makes very little sense from an economic point of view, but we find that the accounting mechanisms have such a bias in terms of the timing for which they reveal risk posture, that there is a significant decline in financial statement performance with hedge positions, than without hedge positions, so we see a downward sloping

option-adjusted value curve. But we will always find a maximum in the utility curve. I simply present this as a possible method for making decisions in a risk-bearing environment. I think that this is where most of the work needs to be done over the next 5-10 years in terms of the decision tools that we apply to the measurement of risk. During the 1980s we spent most of our time trying to measure the risk. We're at the point now where the measurement tools are good, but the decision tools are still in their infancy.

In summary, there is, and will continue to be, a dramatic increase in the business constraints that we're faced with. These business constraints take many forms: increased statutory requirements, valuation requirements, risk-based capital, rating agency demands, and so forth. Most of these are not generally very good risk management tools, but they are the constraints within which we live. Unfortunately, risk bearing is not a dichotomous event, and finding the appropriate place in that broad continuum can be quite difficult. The priority message I'd like to leave you with is that the decision tools are necessary. There's work to be done, and I think you'll be hearing a lot about it in the next few years.

MS. PATRICIA L. GUINN: My presentation will cover the tools for success. I'm going to concentrate on the role of capital management within the overall executive function for a life insurance company focusing on how to report and translate solvency issues to management.

A colleague named Mike Tuohy, who is an avid sportsman and quite a competitive fellow, boiled down my whole presentation into, "solvency means playing by the rules." Rules are set by regulators, rating agencies and capital providers. Capital providers in a life insurance company are a diverse group. They include the policyholders, banks and pure equity investors. Within the context of playing by the rules, staying solvent should be one of management's top priorities.

I will start with a premise about management's function and how solvency fits in. Then I will discuss a case study and explore the capital management issues that are presented. I will look at a model for strategic analysis and performance measurement, touching on the importance of integrated performance measurement. Finally, I will propose to you that this sort of management process described in the case study can work for your company, too.

My premise is that measuring and keeping track of solvency is not a stand-alone function, but part of management's overall role to maximize value for stakeholders, and that capital management and solvency are critical to the success of the organization. There's a quote that I've used from *Harvard Business Review*:

Shareholder value is now widely accepted as an appropriate standard for performance in U.S. business. That's what drives long-term stock performance, and that's how we should manage. The key is to build the skill and the motivation to use shareholder value consistently, and to use it well. Only then will our organizations focus their attention and resources on the kinds of improvements that shareholders really value.

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These authors were talking about U.S. business in general. Our focus is much narrower: the life insurance industry. There are two principal forms of organization in our industry: stock companies and mutual companies. Historically, stocks and mutual life insurance companies probably have viewed value a little differently. In a stock company, value has been perceived in the executive offices as share price, or a proxy for share price. While in a mutual company, historically, the view of value has been a net cost of goods sort of concept. I think that an evolving view among mutual companies may be that a proxy for share price is a relevant definition of value. When the Equitable held its demutualization hearings, it was my understanding that there were quite a few representatives from other mutual companies there exhibiting some interest in the process, perhaps thinking that 200 years from now it might be time for them to demutualize as well. In order for demutualization to be a viable capital management option for those companies, they have to, at some point in the management process, pay attention to what's going to make their companies attractive in the capital markets.

Share prices are influenced by many factors, and some of them are external and beyond management's control. A proxy for share price that filters out uncontrollable factors is the easier management tool. The management tool I'm going to discuss is such a proxy: the embedded value of the organization.

Achieving a value-oriented goal means competing and winning in three markets: product markets, capital markets and human resource markets. Success in the product market might be defined as high market share, high margins, low delivered cost, and innovative products or innovative distribution systems. Another descriptor might be the company's reputation for providing good value. In the capital markets success might be described by a low cost of capital, ready access to debt or equity to be used either for capital or for liquidity purposes, and a good reputation "on the street." Actuaries don't often focus on the human resources market, but it's very important because a successful company needs to attract and retain the best people in the industry. A company needs to use its talent effectively in order to achieve high productivity and low overhead.

In the long run, success requires a competitive advantage, and a superior management process can be a real source of competitive advantage. The management process should integrate all of the goals of the organization in a management control cycle. This type of control cycle is a continuous planning and management process where external influences and the competition are identified and used as input for continually assessing the current position, making plans, implementing those plans, and monitoring progress.

Earlier I mentioned human resources and talent. Success requires understanding what drives value, and that's where the talent comes in. Actuaries are familiar with the importance of the business fundamentals with reference to what drives value: mortality, morbidity, persistency, investments, and expenses. I think that product market access also drives value -- identifying markets, a way to get the product to the market, and the ratings needed in order to have that market access. Over the long term, an organization's reason for being is more than to harvest its in-force value. This implies need for profitable growth, and profitable growth means profitable products plus attention to the balance sheet.

I think Shane and I agree that success requires understanding the stakeholder's risk/reward profile, and there needs to be a way to measure risk and reward effectively and to understand the implications of the decisions being made. Choosing the right strategy requires analysis techniques that really measure risk and reward. I will make the premise that the reward should be a value-based reward, and with respect to risk, the definition should acknowledge all the different stakeholders and their concerns, including policyholders, employees, creditors, and equityholders.

This case study will use the following players: the chief financial officer (CFO), the actuary, the investment officer, and a marketing person. These people have been working together inside an established company for a number of years. They're great personal friends, and they have a great working relationship, but they're a creative bunch, and their organization is stifling their creativity. They have decided that with their talents they'd like to buy a company and manage it. Because of their particular areas of expertise, the type of company they want to buy is an SPDA company. The players are well-known within their professions, and they're known on the street. They have access to the debt and equity markets. The hurdle rate for the equity they can attract is 30%. That means a 30% hurdle rate on a best estimate, or projected, basis. They need to be able to show the equity providers that there's at least as much upside in the deal as that over a five- to ten-year period. The decision tree at this point is simple. If the strategy is viable, buy the target. If it is not viable, keep your current job.

Here is a profile of the acquisition target. The company has \$5.25 billion in assets. About 75% of the assets are publicly traded bonds, and currently market value and book value are about the same. Of these publicly traded bonds, 40% are mortgage-backed securities. There is another 20% in investment grade corporates and about 15% in junk bonds that have an average rating between BB and B. With respect to the other quarter of the assets, 15% are privately placed bonds with an average rating between A and BBB, and 10% are in mortgages that are of fairly good quality. On the liability side, they have \$5 billion of SPDA liabilities. These products have been sold through a wholesaler in the stockbroker and financial institution markets. A mix of products has been sold. About 30% are vanilla, one-year guarantee products. Half the product have been three- and five-year CDs. Five- and seven-year market value adjusted (MVA) products have been introduced recently and comprise about 20% of the in force. The company has been in business for a number of years, but most of the in force has been written since 1985. The first product sold was the vanilla product, and the bailout's been pierced on that. The company has \$250 million in capital, surplus and mandatory securities valuation reserve (MSVR). Its sales over the last couple of years have been about \$1 billion per year. The expense structure in relationship to pricing allowances indicates that there's about a \$5 million expense overrun. The asking price for the company is \$500 million.

What does the acquisition group do now within the context of a control cycle? These people have identified the competition as far as the capital markets are concerned. They know who our funding sources would be. They know the equity people are looking for a 30% return. They know the owner wants to be paid \$500 million. The question is, can this deal be accomplished? First, they must assess the current position.

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On the capital management side there are three issues to consider: capital structure, cost of capital and required surplus. Let's look at the capital structure that might be used for this acquisition. A traditional structure that has been used in the last several years is to have a nonlife holding company, which is the acquisition company, at the top. It forms a shell life insurance company beneath it. The nonlife acquisition company raises the outside funds and passes the funds down to the shell company, which then buys the target company. The reason for putting the shell company in the middle is a tax consolidation issue in order to get the interest deduction on debt if there's any debt as part of the financing. With new accounting rules and new proposals for surplus notes, this structure may not work as well as it has in the past, and new types of structures are being employed, but this approach will work for our purposes here. The group needs to raise \$530 million in order to complete this \$500 million deal. Its sources will be \$210 million of bank debt, \$140 million of preferred stock, and \$180 million of common equity. The reason these people need \$530 million is because they have to pay \$500 million in cash to the seller. They will have transaction expenses of about \$15 million, and they need to keep some cash on hand at the acquisition company for an interest reserve in order to make sure that payments to the bank can be made on time.

The funds raised might have terms shown in Table 1. The bank debt would be obtained with a pledge of the life company's stock. It would include covenants about the appraised value of the company in relationship to the outstanding debt, earnings covenants on principal and interest coverage, covenants on growth, and limits on further borrowing. The bank will charge either a rate that's related to the London Interbank Offered Rate (LIBOR) or prime. For this example, I used LIBOR plus 200 basis points. I assumed this would be roughly 8%. The term of the debt would be five years with a payback schedule of 20% per year. The preferred stock would be a 7% fixed rate, 10-year cumulative preferred or a pay-in-kind where actual dividends don't have to be paid every year. The common stock, or the common equity, has a target ROE of 30% with a 12% minimum.

TABLE 1  
Terms of Funds

Bank Debt	Preferred Stock	Common Stock
Rate: LIBOR + 200 (8%)	Rate: 7%	Target ROE: 12% minimum 30% expected
Term: 5 years	Form: Cumulative	Investment horizon: 10 years
Payback schedule: Year    Amount 1-5     20%	Term: 10 years	Exit strategy: IPO or sale for multiple of GAAP book value

The equity investors need to be convinced that they have a better than average chance of making at least 12%, but their target is 30%. Their investment horizon is 10 years or so, and their exit strategy is either to do an initial public offering (IPO) for this company or to sell it for a multiple of GAAP book value in the future.

Let's look at the cost of capital for the holding company (Table 2). Initially, we have three elements in the capital structure: bank debt, preferred stock and common stock. The bank debt is 40% of the capital with an after-tax cost of 5.28% (8% interest rate on the debt, net of tax). The preferred stock is 26% of capital with an after-tax cost of 7%. Finally, the common stock, which is 34% of our capital, has a cost of 33%. The reason it's 33% and not 30%, is that the acquisition group wants 10% of the equity. The common stock investors who are actually putting up the capital are only going to get 90% of the common for their investment. So, they really need a return of 33%. If we take the weighted average of these different elements of capital, we find the total is 15.26%. So what's the required return on buying the life company? If you'll recall, the group had to raise more than \$500 million to buy the company because there were \$15 million in transaction expenses. Taking that into account, the required return on the operating company is 15.70%.

TABLE 2  
Holding Company Cost of Initial Capital

	Percent Total Capital	Aftertax Cost
Bank debt	40%	5.28%
Preferred stock	26	7.00
Common stock	34	33.33*
Total		15.26%

Required return of operating company: 15.70%

\* Acquisition group retains 10% of common equity

What is the ultimate cost of capital for the holding company? If the bank debt has to be repaid over five years, and the preferred stock has to be redeemed at the end of 10 years, does that imply that the ultimate cost of capital for the organization is 33%? I think the answer is no. In starting out, the group doesn't feel that its ultimate cost of capital is going to be more than 30%. There are various capital management tools available to these people. Debt and preferred elements have a long-term place in their capital structure, and the initial providers of the common equity want out in about 10 years, too. Eventually those 30% equity funds need to be replaced with cheaper funds. For the rest of this discussion we will assume that the long-term cost of capital for the organization will be somewhere between 13% and 15% and that the hurdle rate for making the decision about whether or not to acquire this company will be 15%.

The second question is, "When does solvency come into the picture?" The answer is that solvency is a part of managing a life company. First we look at required surplus. What are the requirements for this company? Given the stockbroker and financial institution markets in which it operates, its ratings requirement for ongoing sales are probably A+/AA-. A company's rating is influenced by a lot of factors, including its investment strategy, product mix, access to capital, and dividend pressure on the life company. There's a large element of nonfinancial analysis and subjectivity in the ratings process, but let's assume that surplus of 100% of the Moody's formula is required.

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The group determines that required surplus of 100% of Moody's is equivalent to a surplus-to-reserve ratio of 5% for the target company. The total required surplus needed is, therefore, \$250 million. You will recall that was the net worth of the company. So, the company has enough surplus to cover its requirements right now, but it has no free surplus.

Let's return to the question of whether or not to buy this company. Based on the company's current strategy, it looks like \$500 million (the asking price) is about what the company is worth at a 12% discount rate, but the group's hurdle rate for pricing this acquisition is 15%. Using normal actuarial appraisal value techniques, looking at three components – the distributable net worth, the value of the in force, and the value of future production – produces only \$435 million at a 15% discount rate. A goodwill element of \$65 million is needed to get up to \$500 million.

It's time for the group to do a reality check: Is this acquisition viable? There are two requirements for success, and both of these have to be satisfied before proceeding to buy the company. First, banks have to be convinced to lend now. They're not interested in best estimate cases; they're interested in security in bad times. They have to be shown that the money they lend is secure and that the current strategy supports debt repayment on time under very conservative assumptions. Second, the buyers have to find a way to turn goodwill into value. There are three things that they need to consider: increase the value of the in force, make new business profitable (because it wasn't profitable at a 15% discount rate) and eliminate expense overruns.

Within the context of the management control cycle, we're now to the point of developing plans. In analyzing the alternatives that are available for managing this company, the group must first identify what alternatives are feasible. It can look at different investment and crediting strategies, new business volume and mix and the expense structure. Often the expense structure is a part of the mechanics rather than a variable assumption, but there may also be alternative expense strategies to consider, such as in-house administration versus third party administrators, keeping the current system, or dumping it and starting from scratch. Next, the alternatives must be in the analyzed context of the risk/reward profile of the various constituencies and the capital implications of the strategies.

So, again, how can \$65 million of goodwill be turned into value? A continuum of strategies exist ranging from getting all of the increase from the in-force business to getting it all from new sales. What needs to be done at each end of the spectrum is a little different. If \$65 million more value is to come out of the in force, there are several things needed: First, eliminate the expense overrun. If the focus is on the in force alone, this probably means staff reductions. The risk-adjusted spread on the in force has to be increased by 45 basis points (the difference between a 15% discount rate and a 12% discount rate expressed in terms of spread). If the extra 45 basis points is achieved on the in force, \$65 million of value is created, but the new business must still be brought to a zero base (i.e., to yielding 15%). On the other hand, what if the strategy is to get the \$65 million increase in value all from new sales? In this case eliminating the requirements still include the expense overrun. Here, staff reductions may not be necessary; the strategy may be to grow the company out of its expense deficit. Another requirement would be to redesign

products to minimize surplus strain and required surplus. For example, eliminate bailout provisions and eliminate principal guarantees; move new sales more to market value adjusted products and introduce variable products. Finally, new business needs to be priced to add value at 15%. That is, it needs a rate of return of more than 15% in order to get any increase in value.

Those are just the end point strategies, and there are many more in between. Probably trying to embark upon a strategy of getting all of the needed value increase in the in force or all from new sales will not be acceptable. The group's choice would probably be somewhere between these two end points.

The strategy alternatives need to be analyzed in terms of the risk/reward profile in order to choose wisely. That is, the right strategy should maximize the potential reward for a given level of risk. Lots of care needs to be taken in defining risk and reward and in developing measurement methods for estimating risk and reward. In terms of this case study, the driving forces are cost of capital, the capital structure of the company and the exit strategy. Long-term measures for reward are the present value of distributable earnings at 15% and growth in value, or the value added to the organization year by year by pursuing this strategy. As a short-term measure, focusing on growth in GAAP earnings may be an appropriate reward measurement. Why GAAP? In terms of exit strategy, having a solid track record of growth and GAAP earnings would be very important for the success of an initial public offering.

On the risk axis, the constituencies that are driving this axis are the banks. They want to be sure that they get repaid, and they don't want to own this life company six or seven years down the road. Short-term measures of risk might be the probability that the debt can't be serviced from the in-force business, or that the value of the in force in relation to the outstanding debt falls below some minimum floor. With respect to growth, short-term risk might be defined as the need to get additional capital in a very short period of time. Risk could also be defined as the probability of a ratings downgrade; in order to measure the likelihood of a downgrade, one might look at the volatility of earnings or the volatility of new sales and surrenders under the different scenarios. A long-term risk measure that might be considered is the probability of adverse regulatory action, such as piercing minimum capital requirements. Another long-term measure might be the probability that the equity investors' minimum 12% return is not achieved.

As we all know only too well, the quality of the assumptions drives the quality of the results. In doing this type of analysis for a life insurance company there is a very long study horizon. We're probably looking at the next 20-30 years' worth of cash flows and earnings. There are a lot of complex and interrelated assumptions that have to be developed for policyholder behavior, investment behavior, behavior of the distribution system, and investor behavior. Monte Carlo or stochastic techniques, supplemented with sensitivity testing of key assumptions, can be useful ways to approach the problem. Broadly speaking, the requirements are: (1) build a model; (2) validate the model; (3) calculate the risk and reward profiles of the strategies in terms of probabilities. Evaluating risk requires looking at the tails of the probability distribution. In order to obtain credible results, many more scenarios are necessary than if one was only interested in mean or expected values. For those assumptions that are highly



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judgmental, sensitivity tests should be performed to test the effect on the relative risk/reward profiles of the strategies under consideration.

Let's say the acquisition group has done all that, and it looks like Strategy B will work. Strategy B is a balance of trying to increase the profitability of the in force and move new sales to more capital efficient products. Strategy B's risk profile is something that the banks approve. The company is purchased. Now it's time to implement the plans. Part of the implementation should be building the monitoring system because there are lots of ways things can go wrong. Without having a monitoring system that provides early warning of things going wrong, it's hard to get back on track. The monitoring system needs to determine key operating results, track plan assumptions and goals and indicate whether the company is doing a good job or a bad job against its plans.

The point of my presentation has been that succeeding in the management of a life company is a lot easier if the critical functions are integrated, and I call this integration process a control cycle. Integrating capital management with all the other management functions of the company is a worthy goal for any life insurance company. This can be tailored to a stock company or to a mutual company because the key tenets for doing something like this apply equally well across all companies. The capital is scarce. It does have a cost. Risk and reward can be defined on a practical basis. Actuarial tools do exist to support this kind of process, and markets do reward those who use capital efficiently and penalize the wastrels. Long-term success requires continuous planning because gone are the days when a strategic plan is a document that can just sit on a shelf and gather dust. You have to update plans as soon as variances occur, and update goals as the environment changes. Successful companies will be the ones that react quickly to changes in the rules and are on the lookout for new ideas in the product markets, in the human resources markets, and in the capital markets. In the capital markets that means being receptive to new forms of capital. Be on the lookout for new capital structures that may work better for your company and look at new corporate structures that may enable you to use capital more efficiently.

MR. STANLEY B. TULIN: I will be discussing solvency. I'm not sure whether or not I'm perceived to know a lot about that because I thought Shane's notion of an infinity deal was a good price, and my business judgment is, therefore, unquestioned, or because I'm also a lottery investor.

When Trish presented the structure for her new holding company that her friends were going to buy, I kept thinking to myself, "Now, when am I going to run into this company?" What you have to do is project a few years down the road when a variety of influences have struck this company that I will talk about in a second, and several things happen. We're going to end up with a little bit of a triangle. First of all, under target company life I want you to imagine a big, red box with the keys changed that says Rehabilitation Court Order. Up in the upper right there's going to be an arrow that goes from the acquisition company that says Bankruptcy Court, Chapter XI, VII, pick your number. Then off of that you can picture creditors, and then, of course, the creditors have nobody to look to at that point, other than the life company in rehabilitation. So, I want you to imagine an arrow dropping from the creditor's box or the bankruptcy court box down to the rehabilitation box at the

bottom. That scenario need not be imaginative or imagined today. It actually exists. It exists in three different matters. I think that Shane, Trish and I are all involved at least in some way in all of them, and many more of you probably are aware of them. It is not imaginary at all, and the problems and the risks we have been discussing here are what lead to rehabilitation and bankruptcy at the parent level.

Let me suggest that the dynamic for the actuary, and the theme of what I want to talk to you about, is less mechanical and much more judgmental. Shane alluded to both the analytical processes that developed during the 1980s, and I agree with him. I think that our analytical, technical and measurement skills both as a profession and also as an industry are now much more advanced than they were 10 years ago. Frankly, they are probably further advanced than they probably need to be, given some of the judgmental aspects. Shane also alluded to the decision process, and really I think a lot of what Trish was talking about, although from a different hardware store, was that same decision process.

I'm going to focus on the things that can lead to solvency problems, such as the role of the actuary (external actuary and internal actuary), and the responsibility of that actuary in performing analysis and, much more importantly, in setting, reviewing and thinking about the assumptions that go into that analysis. Again, I think that the techniques are there, and we need to be more than technicians. Now, let me go to the circumstances that can lead to an insolvency. Again we can borrow from Trish's company and make some more assumptions or think about some of the issues that might have taken it into rehabilitation. On the internal side, you can have asset problems, which certainly have led to a substantial number of the insolvencies that have faced the life insurance industry in this past year. They can come from either diversification problems (which we're seeing in real estate problems), poor quality (which we've seen in one company that had a junk bond portfolio at least at the time of takeover that was performing substantially worse than junk bonds in the market), or illiquidity. It was mentioned earlier that 45% of the industry's assets are in private placements and mortgages, and that those are fundamentally illiquid. However, I know a number of companies have been trying to sell private placements and some with some success. There have been all kinds of securitizations and other transactions done on mortgages, but the more difficult the mortgage is, the harder it is to liquify it.

On the liability side the company could have \$250 million of surplus that had \$68 million of surplus relief that gave no relief when it was needed. On the asset side, a problem could be that there was a substantial mismatch. It could be that this company was in SPDAs (typical market type SPDAs as opposed to market value adjusted type products) and that there was a substantial mismatch so that the company's liabilities, in effect, were underpriced relative to the option price. It could be, and these things are all related, that the company has insufficient surrender penalties or that it issued products with annual free outs.

The external influences that affect the performance of life companies today include the overall economy, public image of the life insurance industry, the financial markets, and the individual company in question. This country has expected a crisis in the financial markets ever since the S&Ls collapsed. People were writing about the life insurance industry as the next financial crisis before the S&L insolvencies of 1991. I

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believe, to some extent, they were self-fulfilling prophecies because the press coverage can create the run that ultimately the regulator must stop. So, public image and public response can be a very important factor and one that is difficult either to analyze or to control. The rating agencies also play a very important role. I think that the trick to plotting Moody's, at least with respect to my experience with Moody's, is to plot Moody's rates against real estate concentration, and you will find Moody's inverse. If you have a lot of real estate, you have a lot of problems with Moody's. I think Trish's basic point is very valid when she said that all of the rating agencies are taking a much harder look at the industry overall. I think we can expect them to pay less attention to size and more attention to real risk as they perceive it. I also think what we see in the rating agencies now is that several of them are reacting to the risks that face the industry in different ways. Again, I think Moody's view of real estate is significantly different than the other rating agencies. The rating agencies play an important role, and the interaction of the rating agencies and the press can give rise to regulatory action. The example that I like to use is that, if a reporter drives by a life insurance company's office, sees a line of people outside the office waiting to get their money and writes a story about the run on that bank, he is writing a news story and covering the news. If the reporter reads a downgrade by Moody's or S&P, writes a coverage that suggests that that downgrade mean a run, then a run ensues and the reporter covers it, the reporter is helping to create the news. Finally, if the reporter, before there's any action either by a rating agency or by the policyholders, decides to write an article about a company that exposes that company's problems prior to anybody else's concluding that there are any problems, and that in turn creates the run that creates the downgrade, then the reporter has again created the news. In 1991, we saw all of those from the beginning to the end, and I think we have to expect that we will continue to see all of those.

Now, in terms of what's being done to address the risks that face life companies today, there really are a lot of things that are being done. In the same way that our analytical skills have improved dramatically over the past decade, so, too, have the various publics that we have to work with improved their capacity to look at and understand the problems. There's a lot more that has to happen, and there are problems that we face in statutory accounting, in particular, that need to be addressed with respect to how to deal with some of the really troubling issues on the asset side. One of the things that we've all seen, and I think are happy with, is the NAIC asset risk classification, which is certainly helping and which probably will be improved over time. Risk-based capital is in its infancy. I believe there will be substantial implications of it in the decision-making process. As risk-based capital becomes more important to companies, the rating agencies and the regulators, it is going to force people to think about utility theory and the impact of required capital in their calculations. Also, the industry watchdogs have become much more vigilant. The press is much more vigilant and is more knowledgeable, although certainly not necessarily more responsible.

Duration and convexity matching has been used and will continue to be used. It's only as good as the analysis that supports it, and the analysis that supports it is only as good as the assumptions that go into it. Finally, cash-flow testing is about to be upon us in a big way, and it can be positive. However, I think all of these things are good ideas, but the problem that we face as a profession, and actuaries better than anybody else can understand this, is that, if we put garbage into our cash-flow

analyses, or garbage into our decision theory analyses, or garbage into our acquisition analyses, we will undoubtedly get garbage out.

Now, the problems with cash-flow testing basically involve those things, but there are some other issues. New York Regulation 126 is not enough, in my view. It's an excellent start, similar to the notion of what we call one lawyer at the bottom of the ocean. Much more has to be done in the area of understanding the interest rate risk, and much more has to be done in reviewing the analyses that are submitted. I've had occasion to see any number of Regulation 126 analyses prepared by obviously a wide variety of companies, and the attention both to detail and to the reasonableness of the assumptions varies widely from actuary to actuary and from company to company. We don't yet have any real easy way to do an apples-to-apples comparison of those analyses unless you can really get inside them and evaluate those assumptions.

The expense levels that go into cash-flow testing are very important. It's an excellent place for actuaries to make immaculate assumptions that allow the result to come out as favorable when, in fact, maybe it can't work because the expense cuts that were assumed can't be obtained. One of the problems that I see with cash-flow testing is that it's most effective in analyzing interest rate risk, and that for us as a profession the C-3 risk in the last decade has become quite facile, but we really have not yet been able to do a similar kind of analysis on the other risks that we face. I would welcome research or analysis on that as a member of the Society.

Nonperforming assets is a major problem, and in insolvencies that I've encountered, the debate that almost starts before the company goes in the tank and continues really throughout the period, is the valuation of, in effect, the invaluable assets or the assets that really are not subject to analysis. Typically, the more troubled the asset, the more volatile the views that people will hold with respect to its value. Bernoulli might have said that. I don't know. If he didn't, he should have, and that's going to be a general truth. So, therefore, in understanding and in putting together these analyses we need to look at a very wide range of assumptions with respect to these volatile assets, both to answer our own professional curiosity, and to provide information to the people who read actuarial reports and analysis and take meaning from them that may never exist if it's based on a spot set of assumptions on some of these things.

Synthetic assets require a range of assumptions. The mortgage securitizations, when you get into evaluating the last tranche, basically leave you with exactly the same question that you have when you're evaluating a troubled piece of asset. Economic value versus statement value is one of the things that I think Shane alluded to, and there's a substantial difference between the economic value of an asset and the statement value. It may not be as apparent. It is not necessary that the statement value is always less than the economic value. In fact, my guess today is that statutory balance sheets, if you take the industry as a whole, are nowhere near as overstated as they used to be. Any overstatement that exists in them has to do with the market value of the publicly traded portfolios. The mortgage, real estate and other portfolios are probably overvalued at statutory, but there is a difference between economic value and statement value. For a lot of things there is no well-defined market value, there's no real answer as to what to use. The actuary necessarily has

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to rely on other people to do his analysis. We'll never change that. What we have to do is make sure that (1) we still get a range, and (2) that we're getting responsible information from those other people. Internal views quite frequently can be overly optimistic for two reasons. One reason is that the person who takes the risk initially liked the risk. So, we may have very different views as to the lapse assumptions on that SPDA business. We may have very different views as to what is going to be required in terms of credited rates on that SPDA business, and we may have very different views about the assets that underlie all that business. The other thing is you have to get, at some point, understanding and acceptance of your assumptions and the process by upper management. Again, I think you face the same issues with upper management.

Some of the problems associated with cash-flow testing stem from the asset allocation to liabilities. All kinds of games can be played and will be played until our cash-flow testing looks at every line of business. As long as we can pick assets and allocate them to lines that we're analyzing, we can affect the results with our asset allocation. Then some assets just don't have any relationship to the basic thing that we're analyzing when we do cash-flow testing, which is interest rates. There might be some correlation between the stock market and interest rates, but there certainly is not the simple kind of correlation that we see with debt portfolios. In real estate there probably was at least some kind of perceived notion in the past that in times of lower interest rates real estate did well, but certainly the current times are disproving that theory.

In terms of what we have to do and how cash-flow testing should fit into the whole process in order for us to keep our credibility as a profession and for us to avoid liability either as individuals or as a profession, our testing must be realistic. That may be difficult. That may make people unhappy, but that is what we must do. We have to find a way to bound the possible outcomes and to explain to our constituencies that that's what we've done. Expected value analysis in today's environment doesn't do very much for anybody, and expected value analysis can't be proved to be correct anyway because expected value analysis is going to be based on one person's view of that asset or liability. A person can always say his or her expected value was 250 basis points of spread. Finally, it has to be used and understood by upper management. It has to be more than a tool that the actuary uses to file compliance and more than a tool that the actuary does in doing his own pricing. It has to be something that management understands and buys into.

Finally, I'd like to discuss how cash-flow testing has or hasn't worked in some live cases. In fact, they're so live that what I'm going to do before I discuss them is emphasize that what you're hearing is not my position and certainly not the positions of our clients. Rather, this is my review of what I've seen already in terms of analysis. So, I'm going to try to deal with fact here as opposed to opinion. In Executive Life, cash-flow testing was used extensively prior to the company's rehabilitation. The fundamental flaw was not the technique. The flaw was the assumptions, and largely the assumptions relating to two issues: (1) the assets, most particularly, and (2) lapse rates to a lesser degree. First Capital & Fidelity Bankers are cases where there was substantial analysis done of those companies. Again, I think the issues relate to the underlying asset assumptions and the underlying liability management assumptions. How much spread can you make? What will the lapse

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rates be? In the instance of First Capital and Fidelity Bankers, a critical issue in both of those was the external environment. Finally, Mutual Benefit is a case that's totally different and was largely affected by the external environment in the run. But again, to the extent that any kind of cash-flow testing can, will or should be done, I think all of those things are being attempted by miscellaneous people in the analysis of Mutual Benefit. The assumptions, with respect to roughly 50% of its portfolio in real estate and mortgages, are absolutely critical. The question ultimately will be, what will those assets deliver? In rehabilitation it's not particularly important that those assets be liquid, and that's one of the reasons why rehabilitation has become a solution. It is not a particularly pleasant solution, but it is a solution to troubled insurance companies because it eliminates the need for liquidity that many of the external factors create.