RECORD OF SOCIETY OF ACTUARIES
1990 VOL. 16 NO. 3

MEASURING INTEREST MARGINS -- PART 3 -- MEASURING REQUIRED INTEREST

Moderator: ALAN J. ROUTHENSTEIN
Panelists: PETER B. DEAKINS
LAURA B. ROSENTHAL
Recorder: ALAN J. ROUTHENSTEIN

- What are the considerations in determining interest requirements?
  - -- Risk charges for reinvestment risks
  - -- Risk charges for defaults
  - -- Risk charges for bailout provisions
  - -- Risk charges for responding to competition when interest rates rise
  - -- Margins incorporated in mortality or expense charges
- How finely are data subdivided so that profitability or different blocks of business within a segment can be evaluated?
- What sensitivity of withdrawal/termination rates to interest rate fluctuations has been observed for various products?
- How have companies responded to maintain margins when interest rates change?

MR. ALAN J. ROUTHENSTEIN: This session will focus on life insurance companies' considerations in determining required interest margins and some innovative financial measurement techniques insurers use to attain profit objectives.

Pete Deakins, our first speaker, will discuss interest rate margins from a general perspective. Laura Rosenthal, our second speaker, will discuss interest margins as they pertain to guaranteed investment contracts (GICs). I will be the third and final speaker and will discuss the effects of liabilities and asset options on margins as they relate to the single premium deferred annuity (SPDA).

My name is Alan Routhenstein. I'm replacing Randy Palmer, who was scheduled to speak and be the moderator. I'm an Assistant Vice President at Merrill Lynch Capital Markets, in New York. I'm part of a group called the Insurance Strategies Group, where I serve primarily as a consultant to the life insurance industry on investment strategy and asset and liability matching techniques. I've been at Merrill Lynch for about six months.

My prior experience includes two years of pension consulting with the Philadelphia office of William M. Mercer, and about five years of group health and individual life and annuity pricing, product development, valuation and financial reporting at Provident Mutual, also in Philadelphia. I graduated from Temple University with a BBA (Bachelor's in Business Administration). I am an FSA, and I am a member of the American Academy.

I'd like to introduce Pete Deakins. Pete is with the Philadelphia office of Milliman & Robertson. He's been with the firm since 1980. His area of expertise is life insurance

company consulting, including individual life and annuity and group annuity product development and pricing, asset segmentation and asset and liability management. He also has significant experience with financial projections and profitability analysis. From 1983-1987 he worked extensively with the rehabilitators of the Baldwin United Corporation Life Company subsidiaries. Pete graduated from the University of Pennsylvania with a bachelor's of science degree from the Wharton School.

He is a Fellow of the Society of Actuaries and a member of the American Academy of Actuaries, and he is, as many of you are aware, a member of the Society of Actuaries Committee on Valuation and Related Areas and a frequent participant at professional meetings.

MR. PETER B. DEAKINS: I want to talk a little about measuring interest margins and a variety of things related to that. To me the whole issue of measuring interest margins implies that we know what interest margins are. And I don't think we do know what interest margins are, so I want to step back and talk a little about what the interest margin means.

What does the interest margin mean, and what should the goal for interest margins be? I think the way that we technically, in the industry, have thought about interest margins is somewhat of a holdover from the days when we sold traditional life in a very stable environment. We tend to think that your credited rate is just your earnings rate less a spread, and that spread emerges evenly over say 10 or 20 years, and that's your profit margin. Really when you think about the products we sell and the environment we're in today, that is not a very realistic model at all of the world. I think it's important that we think through that model of the world, what our view of reality is, when we start talking about measuring interest margins and setting goals for interest margins. I'm going to talk about how you set goals for interest margins, what the interest margin means, and a little bit about some ideas for how you achieve some of the goals.

I'm not a real proponent of the concept that you need to get 150 basis points every year, not 148, not 152. As you'll see emerging, my concept is much more one of looking at maximizing the profitability of the product over the lifetime of the product, and one of pricing products to achieve acceptable profit margins, but not necessarily thinking at all in terms of, "We will achieve this spread in this year and we will achieve that spread in that year." I'm going to try to redefine the interest margin, because I do focus a lot on interest margins, but in a very different sense, I think, from the classical way actuaries and the industry have looked at interest margins. When you talk about your required interest margins, there are a lot of critical factors.

First of all, you must consider your strategy for resetting crediting rates with interest sensitive products. One of the things that you start thinking about is your interest crediting strategy and what you're going to do as interest rates change. You'll start realizing that, unless interest rates are extremely stable, as a general rule, any sensible strategy is going to result in a margin that is somewhat erratic. And as a general rule, unsensible strategy will also result in an erratic margin, although it may arrive at these results in a different way. Second, obviously prevailing market conditions have to be a critical factor in any discussions about what you can achieve in terms of interest margins.

It's fine to say our goal is 150 basis points, but you have to understand how you're going to achieve that goal, given market conditions.

Another issue is quality over equity and good will, depending on whether you're a mutual or stock. It's important to consider, if you talk about what you're going to do with interest crediting rates, what implications your strategies have on the way policyholders view your company and the way management views the company, and how good you feel about yourself. Certainly in terms of thinking about margins, policyholder options are going to be a factor in thinking through what kind of a margin you need. For example, the SPDA policyholder's option to lapse with a nominal surrender charge becomes tremendously more valuable when you have a five-year guarantee on an SPDA than a more typical one-year guarantee. Certainly in terms of thinking through what kind of a margin you need and what kind of a strategy you should follow, a critical issue is going to be how volatile you think the interest environment is going to be. As I said earlier, the classic assume-a-spread strategy actually makes sense if you assume that the yield environment is going to be highly stable. And in fact, that's basically the implicit assumption in probably 95% of the pricing for interest sensitive products that is going on in the insurance industry.

There are some additional factors. Certainly as you get into lower grade securities, or even these days with event risk, high grade securities, you have to think about default risk and that has to be a factor in your calculations. To the extent that you make longer guarantees or to the extent that, as interest rates change your crediting rates are sticky, you have to think about reinvestment risks. We already mentioned option risks. Another consideration is the extent to which other margins are available to support these risks and costs.

Let's get into a little of what the pricing study means. The way I think about a pricing study for an interest sensitive product is, that it tells you what your initial target spread is. In other words, it tells you what you want the differential to be, between the rate at which you are investing your new money and the rate you're crediting initially to policyholders. Really in terms of pricing that's all you can determine. You know what your crediting strategy is going to be and you know how you're going to react on investments, so I don't see how you can say, at issue, that we're going to get 150 basis points in policy year three, when you don't know whether interest rates are going to be 5% higher than today, 5% lower than today or right where they are today.

When I think about interest sensitive products, I try to focus on what spread we need to achieve our target profitability initially, between what we can invest and what we're going to credit to policyholders. When you talk about that, it's important that you do that carefully. For example, if you've done all your pricing, assuming that you're going to be investing in three-year noncallable bonds, and the investment department is out there investing in seven-year callable bonds, that may be fine if those are more attractive securities, but you need to adjust the initial required spread. You can't drop the same spread off of a seven-year callable bond that you would off of a three-year noncallable bond.

Once you've developed an initial target spread, it gets kind of interesting. One of three things is going to happen. The first one is going to happen about twice every year. That is you're dropping your initial target spread off of what you can invest in, resulting in a credited rate that is basically right in the middle of the market. When that happens, it's fairly obvious what you do. You credit your target rate and you're off to the races.

The second thing that can happen is that you drop your target spread off of the new money rate that you can achieve and you find that produces a rate that is higher than what's available in the marketplace. That's obviously kind of "glory hallelujah" time. That's one of those situations where you can't make a mistake. Basically, if you look at the marketplace and what you would like to credit is higher than the market, you have two very attractive options and a third option which is to blend them. The first option would be, you can drop your credited rate down to the market, and get a reasonable amount of sales at rates that are very attractive to you. The second option is, you can come in above the market with a credited rate somewhere near what your pricing model dictates, and in that case, you'll get a ton of business and an acceptable profit level.

A lot of people when I talk about this say, "Well, that's the one that will never happen." If that's really the case, then you have to think that your pricing study is fairly meaningless, and it's time to be moving out of the product line. I mean, if you do your pricing analysis, you come up with this initial target spread. One of the first things I tell my clients to do is take a look at over the last five years, on a week-by-week basis, where that initial target spread would put your product relative to the market. If you find, over the last five years, that there are four days where you'd have been in the market, that says it's time to get out of the line. It's not an attractive line to be in. All the other insurance companies, either they know something you don't, or they're all crazy wild men, or both.

The third thing and certainly the one everybody thinks is going to be happening all the time, but in reality if your pricing makes any sense at all this should only be happening about half the time is, what do you do when your target spread results in a credited rate that's below the market? You're earning 9.50% on new money, you think that you need a differential between the rate you can achieve on new money and the rate you credited of 1.75% and that puts it at a 7.75% new credited rate, and the market, because it tends to move downward slowly is at 8.25%. What do you do? What a lot of companies do is credit the market and moan about the wild men.

My instant reaction as an actuary and as realist, is just credit 7.75% and you won't get any business. But, a lot of people when I say that, say to me, "Well we've got to maintain market presence and have to maintain credibility. You can't really turn the tap on and off in these marketplaces." I have my doubts about that, but if we grant for a second that that's true, then what I think you want to do is move your credit rate up enough to achieve that market credibility and market presence, but not enough that you get significant sales. So if the market is at 8.25% and you think you ought to be at 7.75%, then probably I would think you'd want to go to 8%. That would be enough to achieve credibility and maintain your presence, but not enough that you get any money. That's kind of the way I look at what the pricing study means and how you use it. And I think that's a lot different from the way that we've historically looked at pricing studies

in terms of, "We've got to earn 175 basis points more than we credit." That, to me, given a volatile interest environment, is not a very meaningful statement.

I'll go through quickly how you might do the pricing. The first thing you have to do, to do a realistic pricing analysis, is develop assumptions about what you're going to invest in. It's important, in my mind, to get the investment department people heavily involved in the pricing process. It's important to talk to them about what they can achieve in the investment marketplace. Here we've said that you're going to be able to earn a series of spreads to Treasuries. It's critical to make some assumptions and to properly reflect the call provisions in the assets, as they have a tremendous value. So you make an assumption about, at what point in time the bonds you're buying will be callable and what kind of call price you'll have. It's important that the assumptions that you make about the spread to Treasuries, and the assumptions you make about calls should be closely related. So for example, if the investment guys tell you one spread and it's off a noncallable bond, that's one meaning. If they tell you a spread and it's off of a callable bond, it's very different. It's important to realize and pin the investment people down, when they say they can get 150 or 175 or 125 or whatever over Treasury, as to what type of security that is. Then you need to make an assumption about when callable bonds will be called, typically in some kind of declining rate environment when it becomes attractive to the issuing company. You also need to make assumptions then about defaults and investment expenses.

On the other side of the coin, you need to make an assumption about interest scenarios. In Table 1, I've made an assumption that Treasury rates can go as low as 2% long and 1% short or as high as 20% short, 18% long. Basically this represents an assumption that rates could go as low as they were in about 1949 or a couple percent higher than they were in the early 1980s. You can see here that we've assumed that the five-year rate has a 2% standard deviation, which would be consistent with the kind of volatility we had in the early 1980s.

TABLE 1

Treasury Yield Curves for Pricing Analyses

Curve	Short Term Rate	Five-Year Rate	10-Year Rate	30-Year Rate
1	1.00%	1.81%	1.98%	2.00%
7	2.82	4.73	5.13	5.18
13	6.59	8.46	8.86	8.90
19	12.32	13.01	13.16	13.18
25	20.00	18.38	18.03	18.00

Interest Rate Volatility: 2% standard deviation
Curve 13 is the initial curve (June 30, 1988)

Then you need to make all the classic pricing assumptions that you would normally make: the level of premium, expenses, mortality, etc. In addition, you have to make a few additional assumptions that are a little different from what we've traditionally done.

First of all, you have to make an assumption as to what your crediting strategy is going to be. Here we've used a real simple one. Just credit whatever the market is crediting: certainly, a strategy that has been achieved by quite a few players. Then we made an assumption as to what the competitor's rate would be. Here, for simplicity, we've just said that your competitors will always be crediting a rate equal to the seven-year Treasury rate. Typically, you'd probably want to be a little more sophisticated. Then you need to make an assumption about lapse rates and how they're going to vary as interest rates change. Basically you need to somehow get a set of stochastic results and some number on which you want to focus. Typically we have focused on the mean present value of profits result for 50 interest scenarios. Table 2 presents a summary of present value of profits results using various sets of assumptions.

TABLE 2

Summary of Results
Present Value of Profits at 15%
Universal Life
(Values in Millions of Dollars)

Run Description	Mean	Low	Low*	Level
UL: 7-Year Bonds	(1.3)	(9.5)	(11.5)	1.2
UL: 20-Year Bonds	1.8	(21.2)	(37.8)	4.6
UL: 7-Year Bonds, Credit Earned Less 115 Basis Points	(2.6)	(9.0)	(13.7)	1.3
UL: 7-Year Bonds (+ 50 Basis Points)	1.6	(6.4)	(7.4)	4.0
UL: 7-Year Noncallable Bonds	2.5	(7.5)	(8.8)	1.3
UL: 7-Year Bonds (Expenses Doubled)	(3.2)	(11.6)	(13.9)	(0.7)
UL (ALT SC): 7-Year Bonds (+ 50 Basis Points)	3.9	(4.0)	(5.2)	6.3
UL (ALT SC): 7-Year Bonds (+ 50 Basis Points) Credit Earned Less 165 Basis Points	2.1	(4.3)	(7.8)	6.4
UL: 7-Year Bonds (+ 50 Basis Points) (3% Standard Deviation)	(1.6)	(13.3)	(20.4)	4.0

* Low present value at asset earned rate

One of the things you'll see here is that the mean results you get under multiple interest scenarios tend to be significantly worse than the results you get if you assume interest rates never change. This is important and goes back a little to what I said on developing your view of volatility.

For those of you who say, "Well that's fine, but we're just going to earn our spread and I don't see where we can have any problems, since as long as we always earn our spread, we're golden." It's not true. Think about what happens when you always credit your earned rate. If interest rates go down, your earned rate typically tends to track the market more slowly, so you end up crediting the policyholder a rate that is above market for a while. If interest rates go up, you hold your credited rate because your earnings rate tends not to track market up very quickly, and what will end up happening is, because you're holding your rate at below market rate, the policyholder will exercise his option to get out. Basically what you've got is a heads we break even and tails you win type of a situation when you credit interest rates strictly based on the earned rates.

I talked a little about what I call market driven versus spread driven management. Recently I've been calling it market responsive versus spread driven management. The classical insurance company's way to manage an interest sensitive loan of business is to manage to earn a target spread. What I think makes a lot more sense. You should take a prospective outlook with regard to renewal credited rates, and given where the market is, credit the rate which gives me the maximum value of the block of business. This approach says to forget about the earned rate. The earned rate in effect, if you think in economic terms, represents a sunk cost. So what market driven does not mean is, always credit whatever the market is. What market driven does mean is, credit interest so as to maximize future profitability, given market conditions. When you credit based on your earned rate, you'll typically either be crediting more than you have to or less than makes sense. It is almost only by coincidence that you will be crediting what you ought to be crediting.

I want to talk a little about universal life. One caveat with universal life is what I call the leverage effect. We have illustrations in the industry. What I call the leverage effect is the fact that in universal life products, where you're paying level premiums, what you credit in the first few years does not have a big impact on the overall profitability of the product. So everybody is saying, well we'll credit 9.50% the first two years, but you know, in future years, we'll make up our spread and we'll make our spread for 25 years. One of the concerns you have is by crediting 9.50% in the first two years, you create some expectations in the policyholder, and if rate levels don't change, you may be reluctant to credit a lower rate in later years. That's not as easy to do as you might have thought, if you've created expectations in the policyholder that he's going to be getting that higher rate.

Let's talk a little about a lot of these pricing issues. A critical thing, when thinking about crediting strategies, is to focus both on competitiveness and profitability. One of the things you can do, since the interest environment changes much more quickly than the crediting marketplace, is to be nimble and move in and out of the market as the interest environment changes. Basically, if you always get your money at the top of the market,

and your competitors are always on average, getting their money at the bottom of the interest rate market, you'll have a competitive advantage.

The kinds of things I've been talking about make it real critical to be able to move in and out of product lines quickly. In terms of coping with excess capacity, one of the things I hear all the time when I start discussing these kinds of strategies is, well that's fine, but if we move out of the market, we're not covering our overhead. And I think one of the things that you've got to do is think through what the whole pricing study means and marginal versus fixed cost issues. When I think back to my most basic college economics courses, every decision fundamentally is made on the basis of marginal cost. Fixed costs only come into play in decisions to shut down or to not shut down. On a day-to-day management basis, what you have to do is price on a marginal cost basis. You always look at your marginal cost, look at the place where your marginal revenue versus your marginal cost equals out. I mean that's just classic business theory and economics. I believe the insurance companies that more accurately reflect this theory in their pricing will over time outperform the rest of the industry. In thinking about interest margins, you need to think through what product features you have that might protect against this intermediation, that can have an impact on all of the calculations that you're making. As I mentioned earlier, if you have a short guarantee period, that helps an awful lot to reduce the value of the surrender option that you give to the policyholder. Another thing is obviously, bigger surrender charges can help lessen the impact of changes in market rates on policyholder decisions.

I now want to go through a quick example of how insurers should make resource allocation decisions. Any pricing and resource allocation decisions you make need to be on a marginal cost basis. That doesn't mean you don't consider the fixed costs. Fixed costs come into play in your major decision, should I be in this line or not? Should I make this investment or not in this line? Fixed costs should not come into play in your day-to-day pricing. Products should be priced at the point where the expected present value of profit is highest, given the sales level that will be generated from the pricing.

So let's take a real simple situation. You're considering launching a CD annuity with incremental fixed costs of $500,000 a year. The first question you need to ask is, what level of sales is necessary to justify the expenditure of the 500,000? Our methodology will calculate the present value of profit per dollar of sales on a marginal basis, and then look at what level of sales it takes to make this thing work. Then what you do is basically take that unit profitability and determine a break-even sales level. Then you hold the marketing guy's feet to the fire, and say, "Look, I can price it here, and this is what the unit profitability will be and you need $66 million of sales, or I can price it over here and the unit profitability will be a lot lower, but it will be a much more competitive product. Then you'll need to sell $200 million to make this work. Now what product do you want?" What can you do? I think it's a methodology much more in line with rational business decision making. One of the main issues that will come up certainly as you start thinking about this, is semi-fixed overhead. You have overhead that is kind of fixed, but also kind of changes with volume levels. You need to think that through very carefully, along with asset liability issues.

MR. ROUTHENSTEIN: Laura Rosenthal will be our next speaker. She will be talking about GICs. Laura is an associate group actuary at John Hancock Financial Services in Boston. She works in the Group Pension area with a $10 billion portfolio of GIC and single premium annuity contracts for qualified plans. Laura has been in the group pension area of John Hancock since 1985. Her prior experience includes some work in corporate financial reporting, pension plan valuations and group insurance. She is an FSA and MAAA, and she has a BA from Mount Holyoke College and an MS from Virginia Tech.

MS. LAURA B. ROSENTHAL: I'd like to switch gears now from individual products to group pension products. Specifically, I'll be talking about how we develop interest rate margins on guaranteed investment contracts, or GICs. But the concepts behind pricing GICs apply to other interest sensitive products as well.

A GIC, like an individual SPDA, is a fixed-income investment vehicle. GICs are generally sold to employers whose funds are qualified defined contribution pension plans, such as 401(k) plans. GICs, which behave something like certificates of deposit, are one of the favorite investment alternatives. The plan's sponsor decides how much of the plan's money to invest at any one time, and the insurance company guarantees an interest rate on that amount. The GIC contract is between the insurer and the plan sponsor. However, the plan sponsor doesn't fully control the actual amount invested in the GIC at any one time. Individual employees, who participate in the pension plan, determine how much money they want to contribute, and those contributions make up a large portion of the plan's funds. They can choose how they want to allocate their contributions among the various investment alternatives. They can also change the amount and allocation of their future contributions. Participants are also allowed to withdraw amounts from the GIC either for investments at another option within the plan, or for use outside the plan. Participant withdrawals from the GIC are paid at book value, regardless of the prevailing interest rates. Unlike individual SPDAs, there is no surrender charge.

The pricing of GICs, like that of most other interest sensitive contracts, is dependent on the determination of the interest margins. Very simply, the interest margin is the difference between the gross interest rate available on the investment and the net rate guaranteed under the contract. This difference can be summarized as deductions for profit requirements, expenses (since GICs don't have either a front- or a back-end load, the only way to recover expenses is through this basis point charge), and risk charges.

These risk charges are for both asset and liability risks. The asset risks consist of default and call. The liability risk is whether or not the employees will use their options to change their contributions or make withdrawals when it is in their own best interest to do so, and it's to the detriment of the insurance company, i.e., investment antiselection.

Since we all know about expense charges, I'd like to focus on the profit requirements and risk charges. Looking at them in a different way, they can be reclassified into two categories: those which are sensitive to interest rate movement or volatility and those which depend on quality.

Within the first category, there are two kinds of risks. On the asset side there's the prepayment or call risk. On the liability side, there is the risk of unexpected contributions or withdrawals at book value, coming at inopportune times.

There are also two types of charges which vary by quality. The first is the asset default or credit risk, which is determined by the quality rating of the assets in the insurer's portfolio. The second is the basis point reduction of the GIC guarantee rate for profit requirements. This charge for profit should take the quality rating of the insurer into account. The higher the quality of the insurer, the greater the amount of capital backing the GIC, and in order to achieve the same return on capital as a lower quality insurer, the basis points of profit charge must increase.

Looking first at the category of risks which are interest sensitive, we have three types of risks from embedded interest rate options. There are call risks on the asset side, and on the liability side, we have both the risk of unexpected contributions and unexpected withdrawals.

With each of these options, interest rate movements create situations which may generate losses. To determine how much to charge for these options, the pricing actuary must make assumptions regarding interest rate volatility, or the future expectations of interest rate movements.

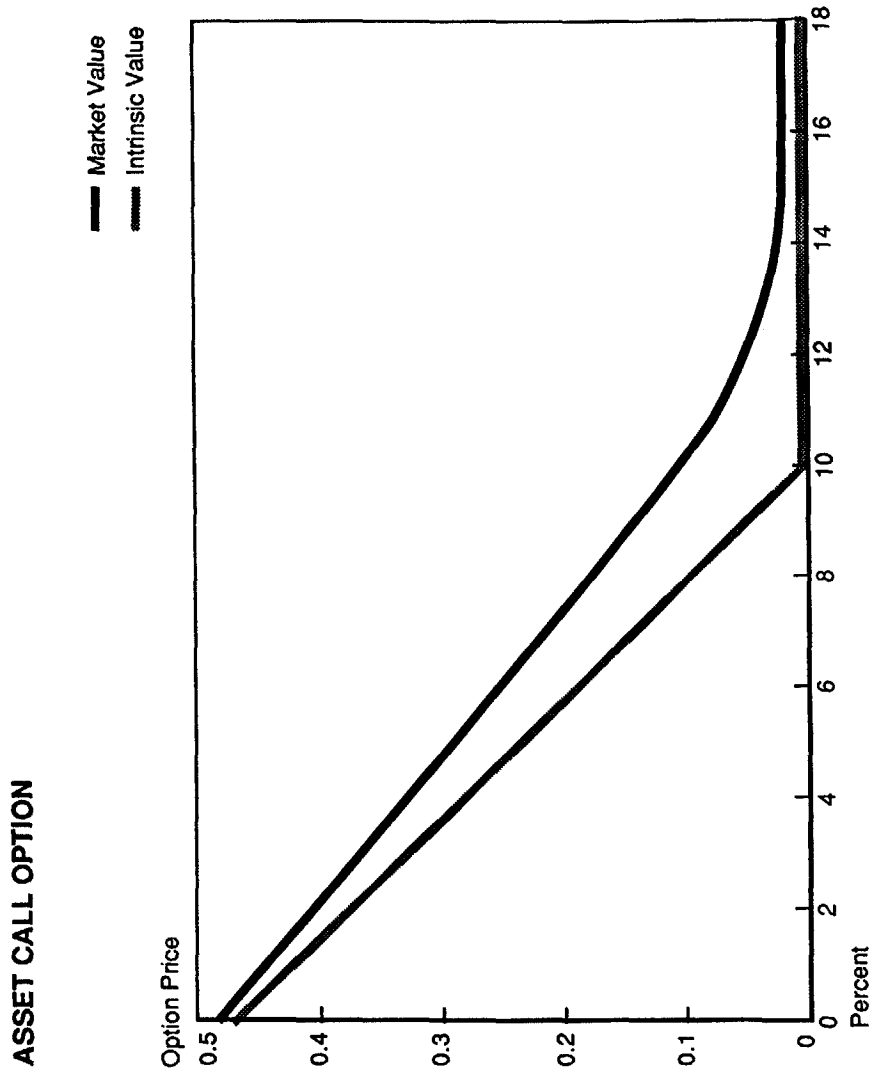
Interest rate volatility is the measure of movement in interest rates, or the standard deviation of interest rate movement. In pricing options, an assumption of volatility indicates the uncertainty about the degree of future movements in interest rates. If the actuary gives a value of zero to assumed volatility, that means that she or he believes that the level of interest rates will be completely predictable in the future. Assuming any volatility percentage greater than zero increases the value of an interest rate option, since it increases the chance that the option will be in the money at some point. In periods of high volatility, interest rates fluctuate more, creating opportunities for the investor to profit from the implied price movements when rates change.

Let's first look at the value of a call option embedded in a bond acquired by the insurer. A high call option value represents an opportunity to the insurer since the coupon yield will be higher, but also a risk to the insurer, since the bond will be repaid if rates fall and the insurer will have to reinvest at a lower rate.

This call option can be diagramed as in Chart 1. The intrinsic value is a profit today for surrendering, not selling the bond. For interest rates at or above the price of 10%, the option has no intrinsic value, since it's not in the borrower's best interest to refinance the bond at higher interest rates. Below 10%, the price increases rapidly. However, the intrinsic value of the option is not the market value, because the intrinsic value assumes no interest rate volatility.

The actual market value of the option exceeds the intrinsic value since volatility is assumed to exist in the market. The market value is determined by an option model and is heavily dependent on the assumed volatility rate. Clearly, higher volatility increases the price or market value of the options.

CHART 1


ASSET CALL OPTION
Market Value
Intrinsic Value
Option Price
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14
16
18
Percent

Ideally, we can avoid the prepayment risk by purchasing only noncallable assets. However, since that is not practical, the prepayment risk must be covered by a basis point risk charge. Since the risk charge is based on the option price, the greater the volatility assumption, the higher the risk charge. On the liability side, the risks of 401(k) plan participants, who contribute more money into the same guaranteed fund when interest rates are falling, behave exactly like the call option on assets.

In both cases, the insurance company will find it has more money than expected and must invest it at lower rates. If rates move down, it is in the participants' best interest to increase their contributions to the fixed rate GIC. The risk charge for this option is, again, dependent on the assumption of how much interest rates will move, or interest rate volatility. The option price rises when volatility is high.

The other liability risk is whether or not participants will withdraw their funds when interest rates are rising. When interest rates are high, it is in the participant's best interest to take money out of a comparatively low yielding GIC for investment elsewhere. Chart 2 shows how the price of the book value withdrawal option moves in exactly the opposite direction from the price of the asset call options. The withdrawal option is, in fact, a put option.

Once again, the option price exceeds the intrinsic value, and the key reason for this is the assumption of volatility. Notice that from the insurer's perspective, in an efficient market, losses are inevitable whenever interest rates move at all. When rates go up, participants will withdraw their money. When rates go down, they will contribute more. Therefore, it is vital that we understand these risks and charge accordingly.

Plan participants, like borrowers, need to react, that is, to actually move their money when interest rates move. Fortunately, for insurers, it turns out the participants as a group react somewhat inefficiently. Some participants do react quickly to take advantage of rate moves, but others may wait or do nothing at all. In addition, restrictions within the plan will inhibit some withdrawals and switches. This inability to take full advantage of an interest option is what we call exercise inefficiency.

Exercise inefficiency can be modeled using an interest rate corridor, such as assuming rates need to move 50 or 100 basis points say, before participants react. This corridor can be seen in the intrinsic value (Chart 3). We're looking again at the liability put option, where participants have the option to withdraw their funds at book value when rates are high. As rates leave the 10% strike price, and move to 11%, the intrinsic value remains at zero because of the exercise inefficiency. Inefficiency also reduces the slope of the intrinsic value line. The inefficient option price includes this inefficiency assumption, as well as an assumption of interest rate volatility. The efficient option price from the prior chart is shown to give you an idea of how inefficiency works to lower the option value.

Exercise inefficiency works the same way for the liability call options, where participants contribute extra money when rates are low.

CHART 2

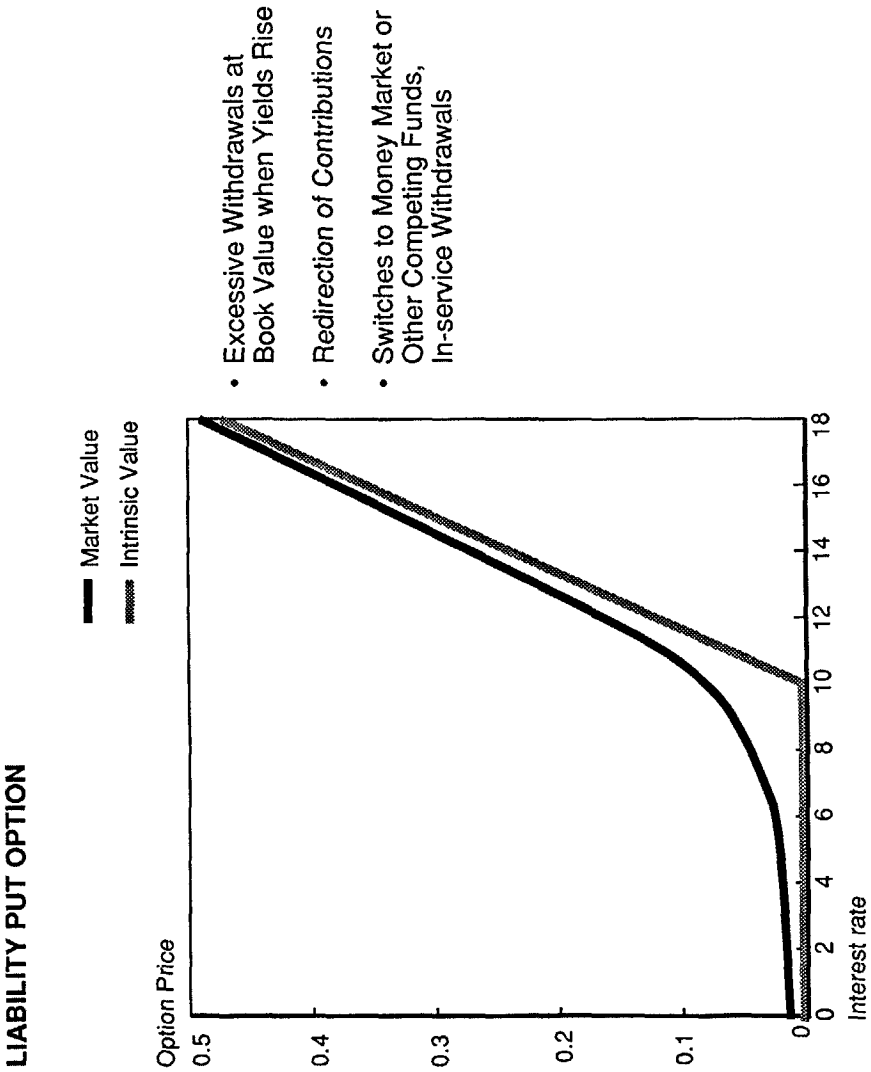
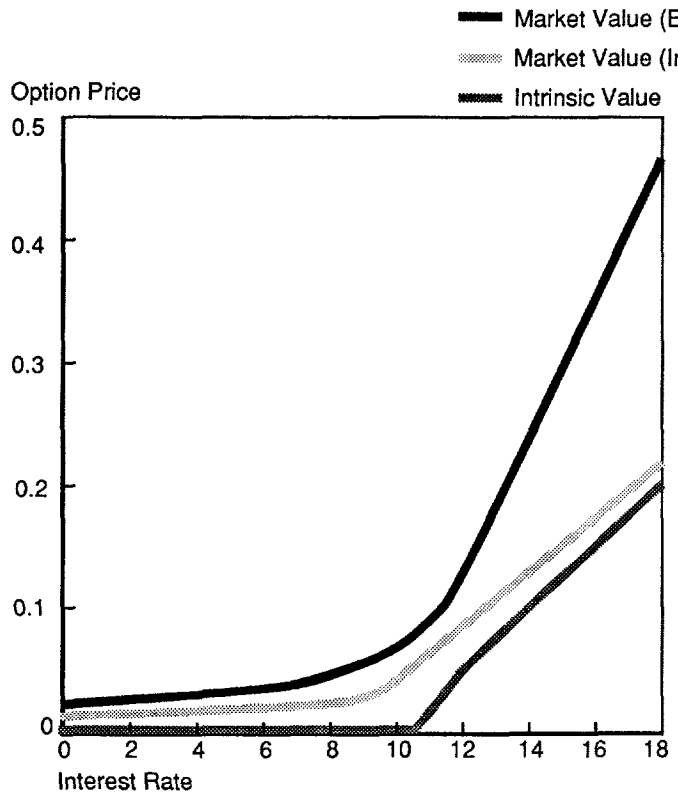

LIABILITY PUT OPTION
Market Value
Intrinsic Value
• Excessive Withdrawals at Book Value when Yields Rise
• Redirection of Contributions
• Switches to Money Market or Other Competing Funds, In-service Withdrawals
Option Price
0.5
0.4
0.3
0.2
0.1
0
0 2 4 6 8 10 12 14 16 18
Interest rate

CHART 3

LIABILITY PUT OPTION
Inefficient Exercise



- Options Not Always Exercised When Financially Advantageous
- Restrictive Plan Provisions, Unsophisticated Participants, Inertia
- Corridor and Smaller Slope

Risk charges must increase rapidly with higher volatility, and greater efficiency. Inefficiency and interest rate volatility assumptions are vital in pricing options. Actuaries tend to look to history for guidance in setting these assumptions at reasonable levels. First, let's look at the efficiency assumptions. For the asset risk, we have found call on private placement bonds to be quite efficient over the past three years. There is some inefficiency which can be attributed to business reasons, not linked to interest rates.

For the liability risks, due to contributions and withdrawals, we have seen much less efficiency than on the asset side.

Unfortunately, this recent favorable experience cannot be expected to continue indefinitely. GICs are in the news more frequently now, leading to participant awareness of how they work. Also, as the population ages, participants are more concerned that their assets are working at maximum capacity. This will probably lead to more transactions at the insurer's expense.

It is difficult to estimate the antiselection risk in our interest sensitive products. Using recent historical trends, is not appropriate, since interest rates have declined since the early 1980s. However, one readily available source of information on how people react to interest rate changes in a declining interest rate environment is prepayment data on high coupon Government National Mortgage Association (GNMA) bonds.

GNMAs are mortgage-backed securities and reflect the actions of homeowners as opposed to professional investors. Homeowners are typical of some of those who are responsible for the contribution and withdrawal risks on GICs. So GNMA data may help us in determining 401(k) participants' reactions to declining interest rates. However, I would caution you to use these carefully.

We have performed a regression against the prepayment fund, GNMA securities with above market rates, and found that prepayments increased almost 9% for every 100 basis points declined in mortgage rates (Table 3). While efficiency of antiselection is difficult to predict, it is probably harder to predict interest rate volatility.

TABLE 3

Interest Rate Sensitivity of GNMA Prepayments
(GNMA 13's for 1984-1989)

Decrease in Mortgage Rates	Rate of Prepayment
0%	3%
1	12
2	20
3	29
4	38

Source: Data from John Hancock Statistical Analysis

I would now like to briefly show you how interest rates have behaved in the past. Chart 4 shows the level of interest rates over the last 15 years. After the Federal Reserve changed its policy in the fall of 1979, interest rates soared.

Chart 5 shows the interest rate volatility for seven-year treasury yields over the past 15 years, based on yields shown in the prior chart. The dark line shows the absolute change in rates, from one period to the next, expressed as a difference in basis points. The shaded line shows the relative or percentage change. Both of these methods of measuring volatility show that volatility was very high during the 1980s. The current percentage of around 14% is still high, although it may seem low by comparison to the volatility of the early 1980s. However, it is important to remember that in pricing for all interest sensitive risks, asset call and liability contribution and withdrawal risks, the basis point deduction and the interest margins must be sufficient to cover that risk for the entire length of that contract. While volatility has declined somewhat, low long-term volatility does not appear to be a reasonable assumption.

What does "quality" mean? And how does it affect pricing? Quality is clearly an issue now, with the news media's negative publicity on junk bonds and at least one insurance company; we as insurers are very aware of the credit risks on bond issues. Pension plan sponsors are becoming aware of the quality of insurers. Sponsors have a fiduciary responsibility to place plan assets with financially strong companies.

As mentioned before, there are two types of basis point charges in the interest margin which vary by quality. On the asset side, we have the asset default risk. On the liability side, we have the profit requirements as determined by the quality of the insurer. Let's start with the asset side.

One of the biggest risks we have is the asset default or C-1 risk. C-1 risk has been recognized for some time, and I'm sure everyone here attempts to assess an appropriate risk charge for asset defaults.

As you can see from Table 4, asset default varies significantly with the quality of the investments. Default is minimal in the investment grade category of AAA through BAA and increases sharply below that.

TABLE 4

Average Default Rates
(1970-88; 222 Issuers; No Special Events)

	5 Year	10 Year
Aaa	0	---
Aa	.3%	.9%
A	.3	1.1
Baa	1.2	2.8
Ba	7.2	12.2
AB	21.5	29.9

MEASURING INTEREST MARGINS -- PART 3

CHART 4

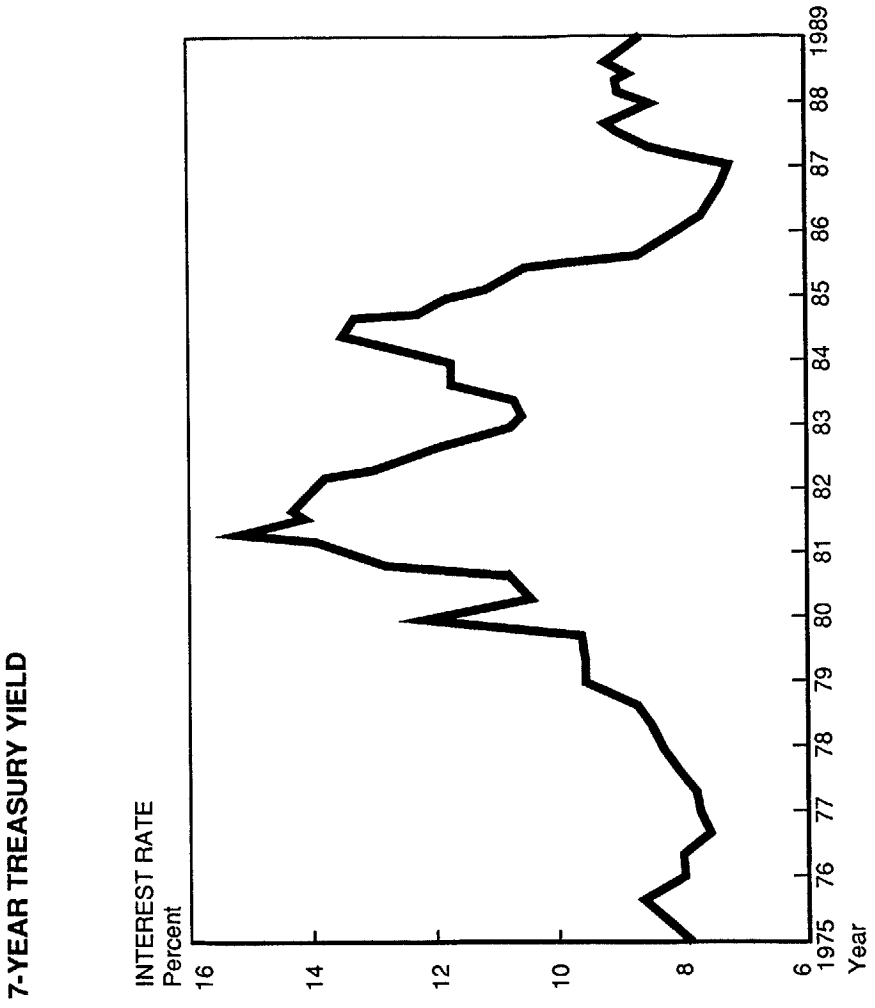
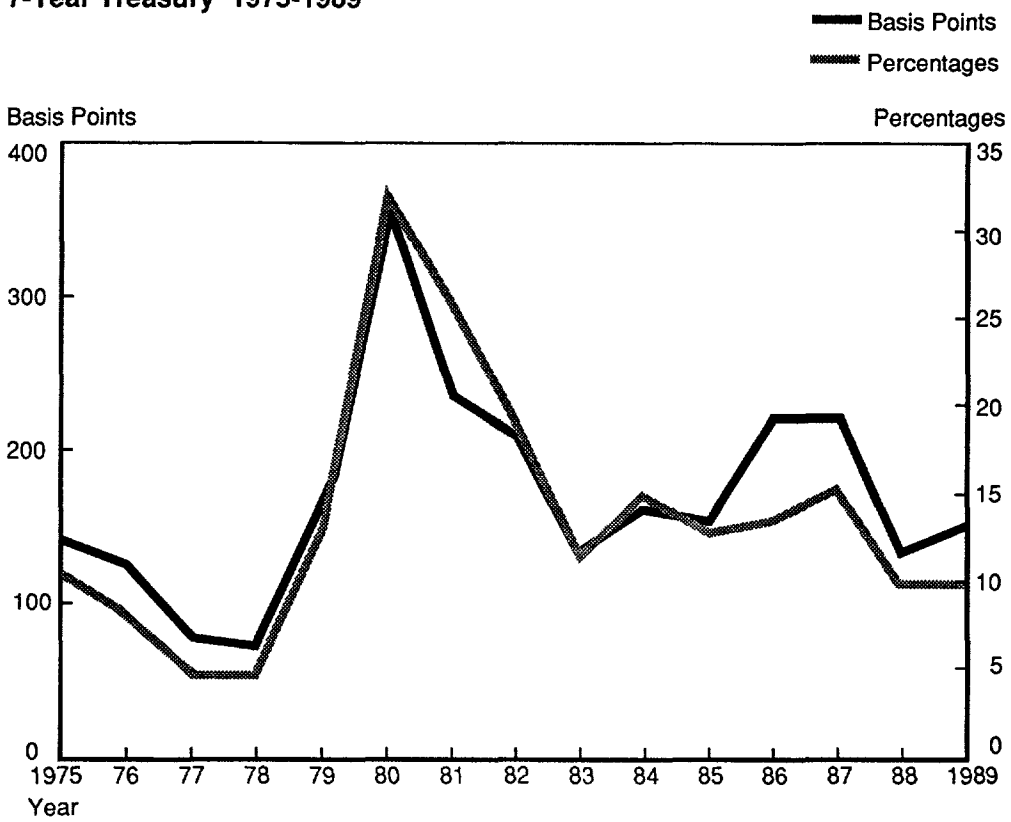


CHART 5

INTEREST RATE VOLATILITY
7-Year Treasury 1975-1989



When pricing for default risk, we determine the default risk factors for each asset quality. In addition to incremental amounts of default risk inherent in each asset quality class, there are large swings of annual default experience within each class. The GIC issuer needs to set aside sufficient capital, to withstand not only the average asset default loss expectation, but also annual swings in that experience. Therefore, each investment is forced to earn an incremental return adequate to support its extra capital requirements. We determine this required return before we calculate a yield that can be credited to a customer. In this way, we feel confident that we're being compensated for an extra investment risk assumed.

This method of pricing quality uses the capital asset pricing model, a model used by financial markets. Basically, the model assumes that investors need an incremental risk premium, represented here as a required corporate credit spread, in order to place assets with a riskier investment. The higher the financial quality of the investment, the lower the required basis point spread.

By financial quality, we mean the ability to withstand risks. The greater this ability, the higher the financial quality. The clearest indication of ability to withstand risks is additional risk capital, the basic cushion against financial shock and bankruptcy.

While this is a common approach to pricing for asset quality in an investment by an insurance company, a GIC that we issue, which is a liability to us, is an asset to the 401(k) plan sponsor. A plan sponsor looking to buy a GIC, should look at the insurer's quality the same way insurers look at the quality of a bond. The plan sponsor should be willing to pay for the insurer's quality, and the GIC pricing actuary should include the appropriate quality charge in determining the GIC guaranteed interest rate.

From the insurer's perspective, its financial quality is its ability to support risk, and if additional capital will provide that ability, then the GIC profit charge must be increased to support an appropriate return on the additional quality risk capital it has available.

The profit requirements can be determined using a standard formula for return on equity (ROE). In this formula, ROE comes from two sources. First, the return from assets in which the equity capital is invested and, second, the profit margin charged in the GIC supported by the capital.

In Chart 6, a 15% after tax ROE can be achieved in a business with a 5% equity or capital base, a 10% pretax investment return, a 34% tax rate and a 63 basis point profit margin. Using the same example, we can turn the formula around and solve for the profit margins required to achieve a 15% ROE.

We can derive profit margins for various combinations of capitalization and target returns on equity. Just as you might expect, profit margins increase with increasing capitalization rates. The higher quality insurers have a stronger capital base, and hence, require a higher basis point profit margin.

PANEL DISCUSSION

CHART 6

Return on Equity

$$ROE = ROS \cdot (1-T) + \frac{PM \cdot (1-T)}{E}$$

$$= 10\% \cdot (1-.34) + \frac{.63\% \cdot (1-.34)}{5\%}$$

$$= 15\%$$

ROS	=	Investment Return on Surplus
T	=	Tax Rate
PM	=	Pre-Tax Profit Margin
E	=	Equity (as a Percent of Assets)
ROE	=	After-Tax Return on Equity

Here are some of the numbers behind Chart 6. In order to achieve a 15% ROE, we need 51 basis points of profit on a 4% equity base. However, if the equity base is at 6%, the required profit margin increases by 25 basis points. The required profit margin increases less, if the ROE objective is 10%, but even 10 basis points makes a significant difference in the rate sensitive GIC market.

Going back to quality spreads on assets, in the bond market, spreads between AA and AAA, medium-term corporate bonds have averaged 17 basis points over the past four years. In the GIC market, spreads between AA and AAA insurers are nowhere near this large. For GICs and bonds of similar duration, there is no theoretical justification for spreads in the GIC market being different from those in the bond market.

In the GIC market, on average, a customer can get a higher rate from a AAA insurer than one that is AA rated. In general, GIC customers are able to get additional quality and protection with no extra cost.

Quality spreads between AA and AAA GIC issuers, are very different from the quality spread on bonds.

From these numbers, it seems as though most GIC issuers have been pricing for a return on equity, using the same risk capital base. However, in theory, the GIC market should be much more reflective of differences in capital requirements of the GIC issuers.

The issue of quality, of course, is determined by the rating agencies. It is clear that they expect a certain level of capitalization, that is, extra surplus, based on the company's own assets and business risk profile. It's become relatively common to hear complaints that, in order to maintain our ratings, the rating agencies are forcing GIC issuers to hold more surplus than we think we need.

Until now, the extra capital required by the rating agencies has not been evidenced in GIC pricing. I expect, as rating agencies focus further on capital adequacy, that high quality GIC issuers will pass through the expense of extra capital needs in their GIC margins.

Of course, the capitalization rate alone doesn't explain quality. The rating agencies go through a very involved process and base their ratings on a close understanding of each company's business, the risks associated with the lines of business and how well those risks are managed. However, it does seem clear that additional capital plays a role in the market assessment of financial quality. Profit charges should include appropriate recognition of the return on required capital. GIC customers are much more aware of quality differences in the wake of the thrift debacle and Drexel Burnham's collapse. The GIC market should demand the quality differential now, and if you'll pardon the pun, we should capitalize on the opportunity.

In summary, we have examined two categories of basis point deductions which make up interest margins and pricing GICs: those dependent on interest rates and those dependent on quality. Where interest rates are concerned, interest rate volatility plays a major role in determining the price of the various assets and liability options. We believe that both volatility and exercise efficiency will increase in the future. In any event, the basis point charges in the interest margin must cover these contingencies over the entire life of the contract.

The charges which are dependent on quality must reflect capital requirements. In particular, profit charges should reflect the issuing company's return on equity of that company.

MR. ROUTHENSTEIN: I think for those of us who have worked in individual areas and have not been involved directly with GIC pricing, we really learned a tremendous amount from your presentation.

What I will be talking about, as far as measuring required interest, is the effect of asset and liability options, perhaps from a more general perspective than did Laura, and then I'll be moving along to look at an SPDA analysis with regard to the asset and liability options. I also will attempt to tie in what Pete had discussed, with regard to more accurate pricing as far as managing a business.

Options are interest sensitive cash flows. Option risk is really a subset of interest rate risk. Now interest sensitive cash flows are cash flows that vary, depending on the level of interest rates. Interest rate risk is the risk of reduction of business equity, due to interest rate changes acting differently on assets and liabilities. It exhibits itself in two ways: as market value risk and as reinvestment risk. The market value risk is realized when interest rates rise. At that point in time, our liabilities realize more lapses than we would have expected, and these lapses, perhaps net after a surrender charge, are really at book value. They're not at market value. Whereas, the assets decrease in value in accordance with market value. This was what we actually saw in the early 1980s, where a lot of companies took tremendous hits to surplus, due to lapses significantly in excess of those expected.

Reinvestment risk is realized when interest rates fall. Most assets have call provisions, either explicitly as part of the definition of the asset or implicitly a part of the asset. With callable bonds, it's easy to remember there is a call option in there. For CMOs (collateralized mortgage obligations) and other mortgage-backed securities, common

investments for supporting SPDA and other insurance products, it's important to realize that the prepayment option that the mortgage holders hold is really a call option.

To help a little bit in terminology, I'll review the way Wall Street tends to talk about call options and put options. The holder of a call option profits when the market value of the underlying security increases over the book value, and that happens when interest rates decrease. On the other hand, the holder of a put option profits when the market value decreases and falls below that of book value, or cash value, and that happens when interest rates rise.

Now what I'd like to talk about relates a little bit to what Pete spoke about, in that I think a premise for the way we do things at Merrill Lynch with regard to asset and liability matching comes down to the objectives of management in an insurance company. An important focus that actuaries try to impress upon all of those who are involved in the pricing and business decision process, is that all business decisions should really have one objective and that is, increasing the value of the company. At Merrill Lynch, our definition of the value of the company is the economic value or market value. Given that the financial community values assets on a market value basis, we value liabilities also on a market value basis to ensure consistent asset and liability matching analyses. What we have concluded is that changes in the market value provide a complete measure of interest rate risk, whether positions are maintained or eliminated.

I'd like to discuss a couple of principles of interest rate risk measurement. We measure the changes in the market value equity or in a sense, the net market value effect on the value of the company, with regard to changes in interest rates acting differently on assets and liabilities. An important thing to realize about the market value of an asset is the tremendous amount of information, including current political and economic events, that is considered in the determination of value. I think we tend to get some very distorted images from the media and perhaps from undergraduate business education as far as different techniques that are used to value stocks. What it comes down to in investment banks, the same way as in insurance companies, is that the business units that are most profitable are those that accurately price their products in semi-efficient markets and stick to their price in competitive situations. They don't want the business when they're going to lose money on it. They let the competitors outbid them for unprofitable business and they outbid their competitors for profitable business. As computers have gotten more and more powerful, a tremendous amount of research has been done to develop models to more accurately and statistically model behavior of complex assets, such that the current market value of an asset accurately reflects both fixed cash flows and interest dependent cash flows, or options.

I'm going to focus on a few different interest rate risk and reward measures. They are market value equity, option adjusted duration, option adjusted convexity, and option adjusted spread. Market value equity, as I mentioned before, is the net increase or decrease to the market or economic value of a company, due to the fact that interest rate changes operate differently on assets and liabilities.

Option adjusted duration is a term which differs from what we typically call Macaulay duration, or the mean term. Option adjusted duration, and also I've heard it referred to

as effective duration in one of the earlier sessions in this three part series, is a first order measure of price sensitivity. From a calculation standpoint, it's the negative of the first derivative of the price curve, with respect to changes in interest rates, divided by the price at that point in time.

The option adjusted convexity is the second order of measure of price sensitivity. It is the second derivative of the price with respect to changes in interest rates, divided by the price. Because the option adjusted convexity is a second derivative and the option adjusted duration is the first derivative, the convexity is a measure of the sensitivity of the option adjusted duration to changes in interest rates. An important concept mentioned by Laura and several others at different sessions at this meeting, and for those of you who were here for the annuity product development session, is that there is a tremendous convexity mismatch inherent between assets and liabilities from an insurance company's perspective. I'll touch on that a little bit later with some graphs that will help illustrate it. The other point, as far as the option adjusted convexity, is that you can look at a graph of a price curve and determine the sign of the convexity based on elementary calculus in that positive convexity means that it's concave upward and negative convexity means it's concave downward.

Option adjusted spread is another term that we've heard bounced around a lot over the past couple of years. This term has several different meanings, depending on the context. It's a term used in the capital markets to refer to the difference between the static yield to maturity and the option adjusted yield after you perform an option pricing analysis. On the liability side, what we tend to mean when we use the term option adjusted spread, is the required spread over Treasuries that your assets need to earn if you're perfectly matched, in order to break even and earn the risk free rate of return.

I'd like to touch a little bit on the development of option pricing models. They were not around 20 years ago, perhaps because computers lacked the necessary computational power. They've been developed as the capital markets developed more complicated fixed income securities, such as mortgage-backed securities, since where there are embedded call options and there aren't easy ways to approximate the value of these options, you really have to do a tremendous amount of analysis to value the assets. Theoretically the idea behind an insurer using an option pricing model is that, they're used on Wall Street by traders, salespersons, and investment bankers, to more accurately determine what they believe is the fair price of an asset.

There are three different types of factors affecting interest rate risk. One of them is yield curve changes. At Merrill Lynch, we've gotten involved with some state-of-the-art research performed by three of our Ph.D. "rocket scientists," Doctors Herman, Dash and Beilis, who spent two or three years doing all kinds of statistical analyses and writing papers that were basically internal papers for the benefit of Merrill Lynch. What they did was determine that there are three principle types of yield curve changes. There are parallel changes, where the yield curve shifts up or shifts down in a parallel manner. These are the ways in which we typically think of changes in interest rates.

There are also tilt changes. A tilt is just a change in the slope of the yield curve, and the Merrill Lynch research has produced a probabilistic analysis to more accurately measure

that tilt. When a tilt occurs, at some point in the yield curve in order to have a change in the slope, you're going to have a fulcrum that stays the same. That fulcrum can be anywhere on the curve, but is usually between four and six years.

The third type of yield curve movement is called a flex. A flex is really a bulge or bend in the yield curve, not explainable by parallel or tilt movements. What our research has concluded is that, through these three different types of yield curve changes, we can in a sense, accurately explain 97-98% of historical yield curve changes. The parallel alone only gets you about 80-85%, a tilt another 10-15%, and the flex another 2-3%.

One part of this story I think you'll enjoy particularly is that an actuary at Merrill Lynch, Sheldon Epstein, was the first person to put this research to practical use. He spent quite a bit of time discussing the theory with our research team, and he built a model so that it could be used to more accurately price the cost of interest rate options. This is what we today call our interest rate path generator. We use this interest rate path generator at Merrill Lynch to price options, swaps, and all kinds of fancy derivative instruments, most of which have considerably more interest rate sensitivity than insurance liabilities. This generator is one of our important competitive advantages, in that it enables us to profit from arbitrage opportunities in the derivative instrument marketplace, since we can price interest rate options more accurately than our competitors.

Now moving along a little bit, the other two factors that affect interest rate risk are volatility changes and spread changes. Laura had mentioned some different types of volatility assumptions that are used for GIC pricing. We expand on that theory and come out with volatility assumptions for parallel, tilt and flex changes in the yield curves. Now in reality, if you want to develop such an assumption, you begin with historical measurements over some period of time. Obviously, for different periods of time you're going to have different volatility. In our interest rate path generator analysis, we assume that prospective volatility stays the same. We also assume that spreads do not fluctuate on the future. We thus can use the path generator, together with an asset cash-flow model, to determine an asset's level option adjusted spread above the Treasury yield curve. It's also possible to model stochastically both spreads and volatility. For any of you who have been involved directly with option pricing, I think you'll agree that it's complicated enough as it is, without adding those two features in a stochastic manner. Sensitivity testing generally includes sensitivities to changes in volatility and/or spreads.

Let me outline some ideal requirements for what you'd like your option pricing model to do. One thing you'd like it to do is not just project one interest rate over time, but actually project a yield curve over time. The way our model works is that the user selects how many scenarios he wants to run. The number of scenarios required varies depending on how interest sensitive the cash flows are. If you are pricing a zero coupon bond, theoretically all you need is one scenario. You need a level interest rate scenario, and you don't need any volatility in your analysis, because there aren't any interest sensitive cash flows. The number of paths that you want to use also depends on how accurate your model is. You'll find a wide degree of variability between organizations as far as how many paths are used for pricing different types of securities. At Merrill Lynch typically for an SPDA, for example, we'll use 100 paths. There is always a time and accuracy tradeoff. You can use 1,000 paths or 10,000 paths, but you might have to wait

all night for the computer to run. I think as time goes on, we'll be able to more quickly use more interest rate paths, so probably the number of yield curve paths used will, in general, increase in the future.

In applying our generator, for 100 different yield curve paths, we look over a specific time horizon that is appropriate for the security being analyzed. For an SPDA we typically look 10 years into the future, and we do a quarterly analysis, as opposed to the typical annual analysis that is done by insurance companies. The reason why we like quarterly is because it more accurately reflects interest rate options and can be linked with the quarterly financial reporting cycle. So, what we typically do is look out over 40 quarters, along 100 different paths, and at each quarter, we have a complete yield curve along each path.

After you build one or you start playing with an interest rate path generator, you want to make sure it works properly before you rely on it to help you manage your business. The first step to test a model's credibility is to make sure noninterest sensitive cash flows, such as zero coupon and noncallable coupon bonds, can be accurately priced. Then the next step is to price more complex securities at market levels. In order to do that, you need what I call an Actuarial Asset Model, and I believe that the investment community has developed actuarial asset models to price these complex securities. The investment community has, in a sense, borrowed the theory and technology that we've been using for 100 years to model complex liabilities, and it has used that to model complex assets.

A third desirable characteristic of an interest rate path generator is that it generates realistic scenarios for actuarial scenario analysis. Another ideal requirement of an option pricing model is that it is arbitrage free, and thus does not present any theoretically unjustified opportunities to buy risk low and sell it high. Our model is about 90% arbitrage free. We know how to make it 100% arbitrage free, and we've decided that the accuracy improvement to fully eliminate arbitrage is not currently worth the running time concession, and that results are more accurate than with other models currently in use.

An insurance company's options pricing model has several components. First you have an interest rate path generator, which requires as input an initial yield curve and some volatility assumptions. For each scenario generated, cash flows are created by cash-flow simulators. If you're modeling an entire insurance company block of business, you use perhaps a different cash-flow generator for each type of asset and liability. For each cash-flow generator, you use actuarial assumptions which are of two categories. The first category includes traditional actuarial assumptions, and the second includes parameters for interest sensitive cash-flow modeling to reflect the path that you've actually come along to get where you are right now. Theoretically there might not be an empirical basis for the exact parameters or formulas used to model interest sensitive cash flows, but the general idea is that the rate at which options are exercised (lapses, prepayments, etc.) moves in the appropriate direction and with reasonable magnitude, with regard to a scenario's pattern of yield curves. Coming out of the cash-flow simulators are going to be cash flows, which perhaps might be separated into beginning, end, and mid-period cash flows. What we do now is apply a discounting process to both asset and liability

cash flows to calculate market values. The methodology we use is a common way assets are priced in the marketplace: cash flows discounted back at an option adjusted spread over Treasuries, using the 90-day rates along the path to which the cash flows correspond.

For assets this defines a circular relationship among the market value, the option adjusted spread over Treasuries, the exact yield curves generated, and the corresponding interest sensitive cash flows simulated. We apply that same technology to liabilities, using the actuarial cash-flow models, to calculate a market value of liabilities. Of course, one trick with calculating market value of liabilities is that there is a certain leap of faith in that, you can't go and call a broker dealer and ask him what the current market value is of a certain block of SPDAs with a certain description. On the other hand, given that you're pricing the liabilities in a way consistent with the asset market, you can get comfortable with this market value measure, and you also realize that what it comes down to is that the interest rate path generator seems to work, because for all these different asset models, we're accurately pricing assets. Theoretically you can think of a market price of a liability as perhaps the assumption reinsurance premium your company would be willing to accept to assume the in-force block of business. Your degree of comfort with your liability market value results is consistent with that for the liability side of your present value of profit results with regard to statutory and GAAP analyses.

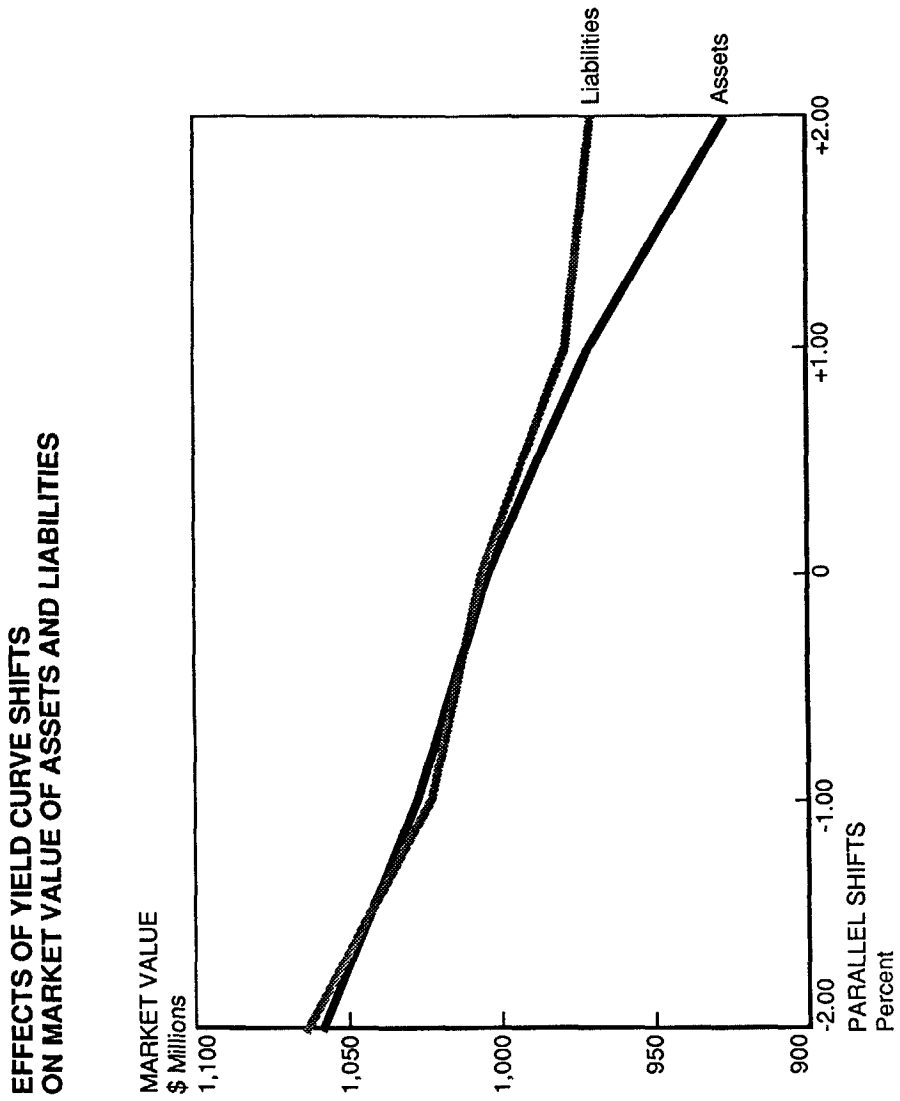
The implications of such market valuations of insurance liabilities is that we can determine a true interest requirement or option adjusted spread. We can determine total portfolios which are immune to interest rate movements by matching asset and liability price curves. The asset/liability manager in the insurance company can take calculated risks rather than blind risks, and can quantify portfolio risk in terms of summary statistics. The pricing actuary can use these approaches to price interest sensitive product features and modify them to achieve desired results.

In actuality, there are two different ways in which you can use this analysis. One is in the product development process, and the second is, after you've designed your product so that you're happy with it, in your asset liability managing process with regard to investment strategy and your use of derivative instruments to hedge your interest rate risk.

We did a study for one client of ours on one of their blocks of SPDA business. It has some one-, three- and five-year initial guarantees, a one-year renewal on most of its products and a five-year on one of them. Some of the products have bailouts, and some don't. Perhaps it's not much different from your company's block of business. Like every smart investment department, our client's people are constantly changing their mix of assets, in order to take advantage of relative value in the marketplace. At the time of the study they had 26% in CMOs, about 39% in other mortgage-backed securities and 35% in callable corporate bonds and Treasuries. Note that in this particular portfolio there were no hedges. This is a company that is very interested in interest rate risk, but it hadn't really found a way to measure it in a way in which it felt comfortable.

Chart 7 is a graph that shows the effect of immediate parallel shifts of the yield curve on the market value of assets and liabilities. In order to concentrate on investment strategy

CHART 7


EFFECTS OF YIELD CURVE SHIFTS
ON MARKET VALUE OF ASSETS AND LIABILITIES
MARKET VALUE
$ Millions
1,100
1,050
1,000
950
900
Liabilities
Assets
-2.00
-1.00
0
+1.00
+2.00
PARALLEL SHIFTS
Percent

and asset and liability matching, we subtract out surplus and set equal the initial market value of assets and liabilities.

Chart 8 is a graph of the option adjusted duration as it varies with parallel shifts in the yield curve. This particular company thought it was doing a pretty good job of matching its assets and liabilities on a Macaulay duration basis, but we determined that the price duration on the company's assets was about 3.5 years and the duration of its liabilities was about 2.75 years, so it was running about as .75-year duration mismatch. The graph also shows that the duration gap changes when interest rates change.

As interest rates rise, liabilities decrease in duration, and assets increase in duration. That makes sense from a Macaulay duration perspective. Higher interest rates increase lapses and shorten liabilities, and simultaneously lengthen assets, since the call options embedded in the assets move further out of the money and are exercised less frequently than originally expected.

As interest rates drop, liabilities increase in duration and assets decrease in duration. The liabilities lengthen since policyholders can't move their money and do better elsewhere. The assets shorten because loans are prepaid and refinanced at lower rates on both sides of the balance sheet, call options are exercised against the company.

Chart 9 lets us take a step back to see the effects on market value equity or the economic value of surplus. This chart shows the excess of assets over liabilities from Chart 6. As you see on the right-hand side, you take a tremendous hit when interest rates move up just 200 basis points on a parallel shift basis. When interest rates move down a little bit, the market value equity increases, but if interest rates move down even further, call options are exercised and the assets become insufficient. For those of you who are familiar with options technology, this is really called a short straddle position.

I'll touch briefly on option adjusted spread. Chart 10 shows what this particular company was using, on a static basis at this point in time, for pricing purposes. It says that the company needed 185 basis points between its gross earned rate and the net credited rate, to meet a target profit spread of 85 basis points. The company believed it was earning an extra 14 basis points profit due to value added by the investment department.

We took a close look at the company's assets and liabilities and determined that there were some expected costs of the options it was granting, which were not included in the static spread analysis. These are the risk charges to which Laura was referring in her GIC analysis. You see that the options cost for liabilities was about 17 basis points, and for assets was about 30 basis points, so the total expected cost was about 47 basis points. The implications are that the 99 basis point expected profit spread drops by 47 basis points to 52.

These expected option costs are averages looking along all 100 different interest rate paths. The actual cost is a random variable, whose value depends on the particular scenario realized. If interest rates never change, the actual cost will be zero. On the other hand, if rates change significantly, the option cost realized can be much larger than the expected value, and might be as high as 500 basis points.

CHART 8

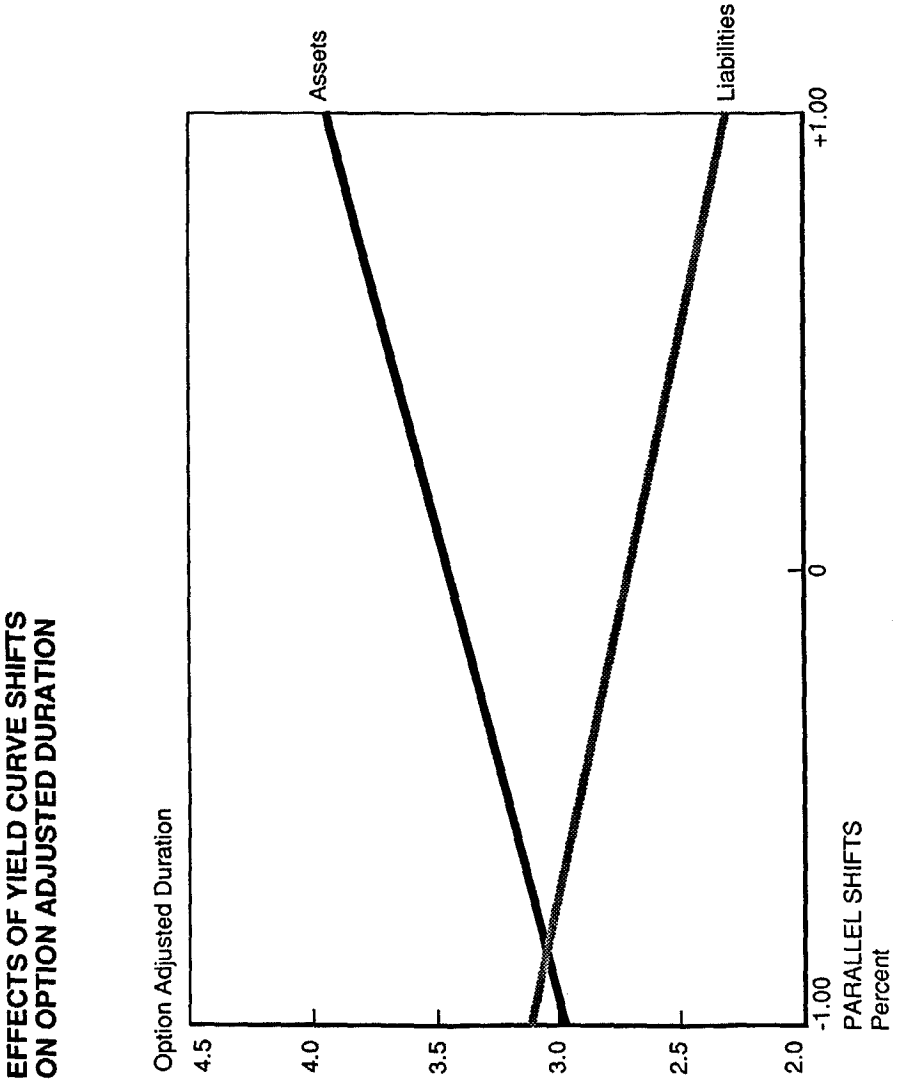

EFFECTS OF YIELD CURVE SHIFTS
ON OPTION ADJUSTED DURATION
Option Adjusted Duration
4.5
4.0
3.5
3.0
2.5
2.0
Assets
Liabilities
-1.00
0
+1.00
PARALLEL SHIFTS
Percent

CHART 9

EFFECTS OF YIELD CURVE SHIFTS ON MARKET VALUE EQUITY

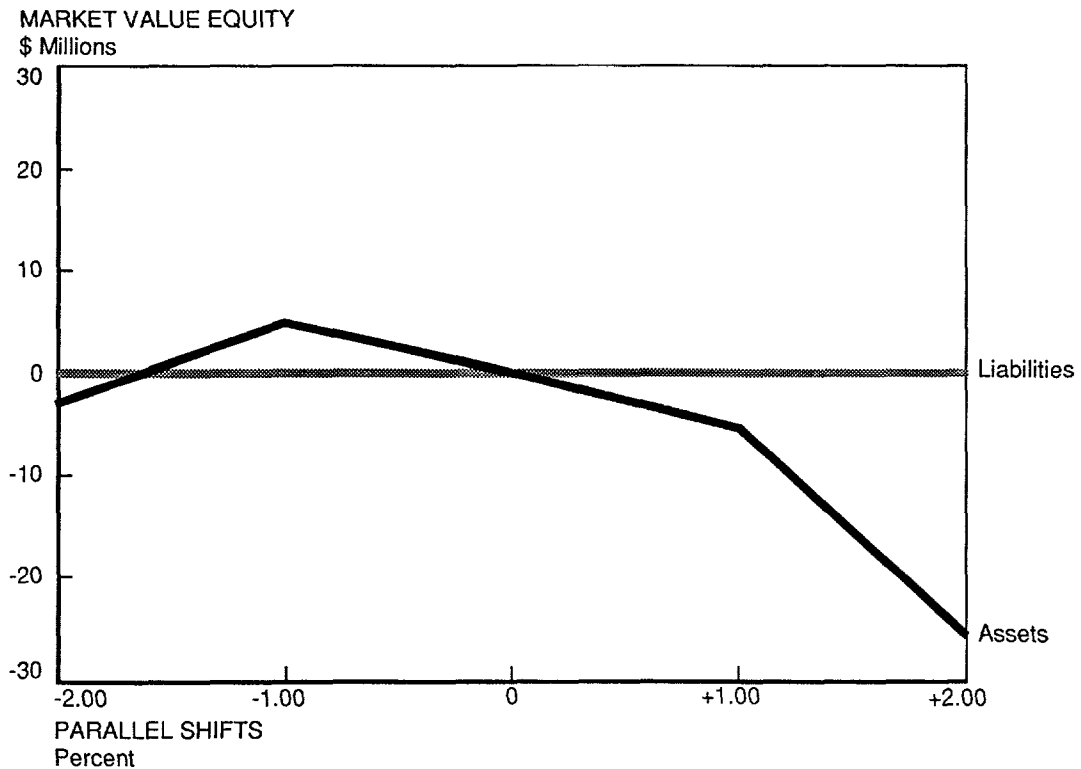
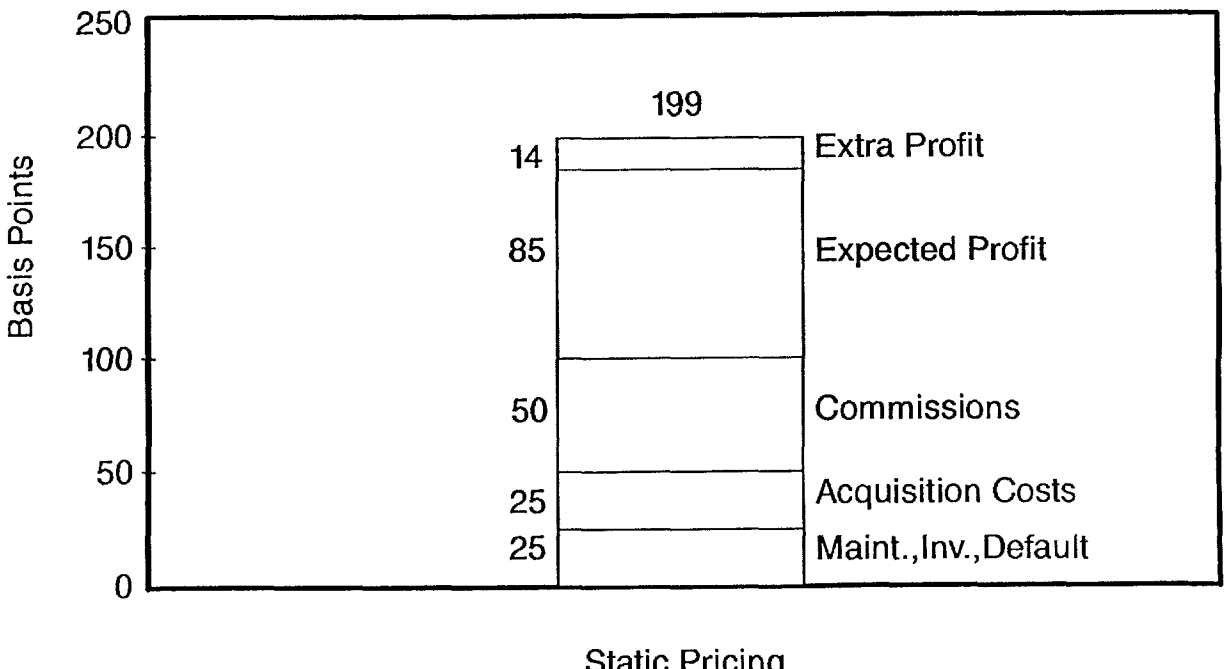


CHART 10

GROSS-SPREAD EXCESS OF ASSET EARNINGS OVER LIABILITY CREDITED RATE, IN AGGREGATE



Insurance companies have traditionally self-insured interest rate risk. Years ago when surplus levels were higher and the industry was less price competitive, spreads were adequate to provide for expected option costs, although explicit risk charges were not used. Given current industry conditions, many insurers today are concluding that they both have to price for expected option costs and hedge against or reinsure interest rate risk to the extent they are unwilling to absorb these costs with surplus.

MR. LARRY H. RUBIN: I have a question for Laura. In your slide you showed some very high interest rate volatility in the late 1970s, early 1980s. In the late 1970s and early 1980s, the Federal Reserve embarked on a policy of maintaining a constant money supply in an attempt to control inflation. It later banned that policy in the mid 1980s, primarily because it didn't work; the only result was very high interest rate volatility. Since the Federal Reserve is highly unlikely to go back to a failed policy, to what extent do you feel that the early 1980s volatility can be considered as an experience not likely to be repeated?

MS. ROSENTHAL: I think that the Federal Reserve doesn't necessarily have the control over the interest rates that it did in the 1980s. The economy has changed to a more global economy, such that we're subject to other countries, as well as our own.

MR. ROUTHENSTEIN: I'd like to add something to that. One advantage that we have at Merrill Lynch in being involved with the markets in which highly interest sensitive assets are priced, is that we can look at the implied volatility at which the market is pricing these securities. What we do in our pricing is look historically at what levels of volatility were, look at what the market is doing today, as far as its current assessment on expected volatility levels, and using other relevant economic data choose our own volatility assumption. You might believe that volatility is going to be a little bit lower than other companies, and that's where you see differences in the pricing of interest sensitive assets.

MR. DEAKINS: I just wanted to comment. You think you can make a case that volatility of the early 1980s is an aberration. On the other hand, you want to be careful. As Laura pointed out, the Federal Reserve is not the only factor that changes interest rates. To my mind, the thing you have to be concerned about was prior to 1979 anybody you asked would have said that interest rate behavior like we had in 1979-83 would be an aberration. The point or concern about unexpected changes in interest rates is, in fact, that they're unexpected. I would tend to agree that the Federal Reserve is not going to pursue that same policy, but there may be some other lurking factor that you don't know about that is going to change rates. The whole point is that we don't know what aberration is going to happen next.