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SYNCHRONIZATION OF CREDITING RATES AND INVESTMENT STRATEGIES

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Panelists: PETER HEPOKOSKI
P. ANDREW WARE
Recorder: YANG HO

- From the perspective of the investment area, the product area and the corporate owner the following questions would be asked:
  - -- What are the mechanisms for achieving coordination?
  - -- How is the process affected by the insurance market? By the capital market?
  - -- What is the effect of policy design?
    - Are different methods needed for different coverages?
      - -- Universal Life (UL)
      - -- Single Premium Universal Life (SPUL)
      - -- Immediate annuities
      - -- Single Premium Deferred Annuity (SPDA)
      - -- Flexible annuities
    - What is the effect of guarantees, bailouts, and other policyholder options?

MR. FRANK J. ALPERT: I'd first like to introduce our panel and then turn the floor over to the first speaker. Pete Hepokoski, vice president and investment actuary of Washington Square Capital Insurance. Pete will give us an analysis from the perspective of an investment representative dealing with client insurance companies, both stock and mutual. Andy Ware, managing actuary, investment products, Northwestern Mutual, will talk to us from the same point of the product actuary, the insurance representative. I am the moderator. I work for an asset management firm, but I also will be a panelist from the standpoint of what the corporation wants out of the process. And our recorder is Yang Ho. The first speaker is Pete Hepokoski.

MR. PETER HEPOKOSKI: When I first started planning for this topic, the cynical side of me said, "what synchronization?" Observers might argue that the insurers' patterns of crediting rates for SPDA and UL products indicate that the functions are not synchronized. They're independent, separate, maybe loosely coordinated at best.

But synchronization of crediting rates and investment strategies does have an important place in the management of these products. I'll discuss the subject in five parts. First, an overview of synchronization; second, the classic choice between protecting the spread and matching the market interest rates; third, product development considerations; fourth, renewal crediting rate considerations; and fifth, actuarial and investment coordination.

OVERVIEW OF SYNCHRONIZATION

The individual interest-sensitive product business is to a large extent a "spread business." Operating it as a spread business requires synchronization between the two sides of the spread. Crediting rate strategies and investment strategies are something of a "chicken and egg" activity. Investments depend upon crediting rate strategy and crediting rate needs. Crediting rates depend upon investment strategy and investment results. The decision points in this process continually cycle: a new product, investments, a new crediting rate, new investments and so on, ultimately leading to a new product and a whole new cycle.

My perspective is as an actuary and a portfolio manager for an investment advisory firm whose clients are insurance companies. I work with clients to set investment strategy often using asset-liability models to optimize the strategy for these interest-sensitive products. I have a tendency in this "chicken and egg" situation to see the crediting rate strategy as already being in place, and the investment strategy as being the dependent variable. However, during the modeling

activity, many clients go through the process for the first time of formally expressing their crediting rate approach. This becomes a very interesting exercise and keeps me involved in the philosophical considerations of crediting strategy.

The products I have in mind when I go through my discussion are SPDA, UL and other products with the common characteristics of an accumulation value with no market value adjustment. Many times these products have a pattern of contractual surrender charges in the early policy years aimed at expense recovery for surrenders, but otherwise, they provide book value guarantees. The SPDA and UL products do have differences. For the purpose of our topic, the greatest difference is in the interest sensitivity or C-3 risk. The SPDA has the higher interest sensitivity risk because it is more investment oriented. The extreme would be a jumbo SPDA sold through a stockbroker. The UL product is bought for noninvestment reasons and the deterrent effect of its smaller cash values relative to premiums in the early policy years keeps it less interest sensitive. The extreme case here would be a UL policy without a "dump-in" sold by a career agent in a niche market. The crediting strategy and investment strategy are likely to differ between these two products, and as a result the degree of synchronization is likely to differ as well.

I would like to put the insurer's crediting rate option into perspective. Investment strategy has received most of the attention in the 1980s and the crediting rate strategy deserves more. Industry exposure to the interest-sensitive options it has granted has been analyzed in much detail in panel discussions like this. The insurer is the grantor of embedded options in its assets, in the bond calls, mortgage prepayments and even in the forward commitment process which effectively grants a call to the borrower. On the liability side, the book value surrender allowed the policyholder is a put option.

The insurer may own some options on the asset side of the balance sheet, for example, putable bonds, extendable bonds or warrants. But these generally appear in small quantities, if at all. The crediting rate is the major interest-sensitive option accruing *to* the insurer.

PROTECT THE SPREAD OR MATCH MARKET RATES

The term *market rate* or *competition rate* in the broad sense refers to the rate on products that can attract existing policyholders away if the rate differential gets too large between these products and the insurer's product. Examples are certificates of deposit, money market funds, the insurer's own portfolio of other products, and other insurers' products that are available in the market in which the original product was sold. Regardless of the interest crediting philosophy for existing policies, an increase in interest rates hurts the insurer. This is based on the relationship assumed between lapse rates and interest rates.

One popular way to express this formula is demonstrated by the sample lapse formula in the Insurance Department of New York Regulation 126.

$$\text{(Base Lapse Rate)} + A\,(\text{Market} - \text{Crediting Rate})^{B}$$

$$- C\,(\text{Surrender Charge})$$

Here the excess of the market rate over the crediting rate, expressed in a percentage and increased exponentially is added to the base lapse rate.

If one decides to protect the spread regardless of competition rates, the advantages are that losses in continuing high interest rate scenarios can be cut off early and that the spread on persisting policies is protected. The disadvantages are the below-market crediting rate, leading to higher lapse rates, and the market value loss on assets. This market value loss is booked immediately if assets are sold or can be deferred if new cash flow is used to pay the increased level of surrenders.

If one chooses to raise the crediting rates to match the market rates, the advantages are maximized persistency and improved popularity with agents and policyholders. The disadvantage is the reduced spread, effectively spreading the market value loss on the assets into the future. Matching the market rates effectively makes the product an indexed one. This is analogous to retailers who advertise that they'll match any advertised price that's lower. This is probably, however, more

dangerous for our industry, because retailers are generally comfortable that the competition has a good handle on its cost of goods and won't mistakenly price to a great degree. I'm not sure if our industry can make that claim.

Many companies subscribe to consultant surveys of crediting rates, providing more circumstantial evidence that competitive forces do influence rate setting. Most companies end up somewhere between these two extremes of crediting rate strategies. In most companies, rate setting is done by some sort of committee which tends to be conducive to a compromise decision. However, as we'll see, modeling does tend to support the compromise approach.

As you'd expect, the compromise approach gives you some of the best and worst of both worlds. It helps agent and policyholder credibility in sales and helps persistency, thereby improving the "critical mass" of in-force business over which you can spread expenses. The compromise approach also moderates the exposure to realized capital losses to which the constant spread approach is exposed when market rates are high, cash flows are low and assets are "below water." It keeps an eye on the spread between the earned rate and the crediting rate, but it's not locked into it. In fact, by working both ways, it allows spreads to be widened beyond the target spread when market rates drop.

The compromise approach is also useful when interest rate rises are "blips." It protects persistency until the market rates return to the prior level, allowing the spread to be restored. Unfortunately, wishful thinking too often leads insurers to assume that the early stages of what becomes a long-term increase in interest rates is only a "blip." Companies are unable to tell which is which until it's too late. This brings up why a disciplined crediting rate approach is important.

There are two ways that the stochastic models we use at Washington Square provide for compromise crediting rate strategies. The first one deducts the spread for contingency and profit from the portfolio rate (net of expense and credit risk deductions), and then it adjusts this rate for competition only if the rate is outside certain boundaries. For example, if the result is more than X% below the competition, it raises the rate to X% below the competition. If the rate is more than Y% above the competition, it lowers the rate to Y% above the competition to avoid being unnecessarily competitive. The two extreme crediting strategies that I discussed do fit this method. If X and Y are infinity you're locking in the spread. And if X and Y are zero, you're matching the market rates. Our other model uses a simple weighing of the net portfolio rate minus the spread, and the competition rate.

These formulas can be used whether the crediting rate method is on a portfolio basis or on a new money rate basis. They can be applied in one fell swoop or by generations. One caution is that these formulas need to be realistic. There's a tendency in the modeling effort to use formulas that you wish you could use rather than formulas that accurately represent the decision-making process.

PRODUCT DEVELOPMENT

I'm going to discuss the product development process using the technique of multiple interest rate scenarios. This technique is becoming relatively popular. A paper in the September 1989 issue of the *Journal of Risk and Insurance* reported on a survey to which over 90 life insurance companies responded. Seventy-one percent of those who answered the question said they use multiple interest rate scenarios. The paper did not provide information on how many are only using the seven "New York scenarios" or who only use the scenario process for valuation actuary purposes. The process of multiple interest rate scenario modeling involves developing a set of interest rate scenarios and a set of interest-sensitive assumptions. These assumptions include the market (or new money) interest rate, the crediting rate, the lapse rate, the call and prepayment rates, the premium payment rate, and the sales level.

I'd like to review some sample analyses for an SPDA product. I emphasize these are sample results. I'll not cover most of the assumptions behind the analyses, for example, lapse rates or interest rate scenarios. Instead, I want to focus on the process of crediting rate synchronization.

Let's compare three crediting rate strategies. The first credits the net earned rate minus 1.5% in all scenarios in all competitive environments. Now, we're assuming the competitor is paying 9%. The second strategy says pay the market rate regardless of earned rate. The third says pay the earned rate minus 1.5% except do not allow the rate to be more than 50 basis points above the competition,

or more than 200 basis points below the competition. You can see the relationship of the strategies in Exhibit 1.

Exhibit 2 shows the modeling results for the profitability of these three strategies. It's on a present-value-of-after-tax profits basis, although the model can just as easily provide results on an ROE basis. This exhibit and the next few that we'll look at show the results for 40 interest rate scenarios. As you can see here, the compromise strategy in the third column shows a higher median profitability than the two extremes along with lower downside risks and more upside potentials, slightly higher than the competition rate in terms of upside potential.

We also need to look at the persistency implications of these strategies. In Exhibit 3, we have the percent of original issues remaining in force at the end of the 20th policy year. You can see that the compromise strategy in the third column has better persistency results than the fixed spread strategy, but it doesn't come close to matching the maximized persistency of the "pay-the-competition" approach.

Well, so far these exhibits show the results for a single investment strategy. The apparent advantage of one crediting strategy over another may be attributable to the investment strategy being appropriate for one and not the other. The process we use is to select a limited number of crediting strategies and run each through several investment strategies.

Exhibit 4 is an example of some investment strategy variations for a given SPDA credit strategy. I should add parenthetically that this is a different SPDA product than the prior two exhibits we just looked at. This one happens to be less interest sensitive than the one we just reviewed. Here you can see that the investment strategy that averages four years to maturity on the bond purchases looks particularly attractive. All 40 of the profit results are above zero and the median profitability does not lag far behind any of these shorter or longer investment strategies.

Once the investment strategy profile or the range of crediting strategies you're considering is understood, you can model them again using the most appropriate investment strategies for each. This can continue with as many iterations as is necessary.

I'd like to look at a couple of variations of the compromise crediting strategy. Exhibit 5 compares the compromise strategy that we have been analyzing to one where the upper limit of the crediting rate is equal to the competition rather than 50 basis points above it. This tighter upward limit appears to produce lower and upper boundaries on the profit distribution that are higher than the previous compromise strategy. Depending on the lapse formula, it may or may not produce better persistencies.

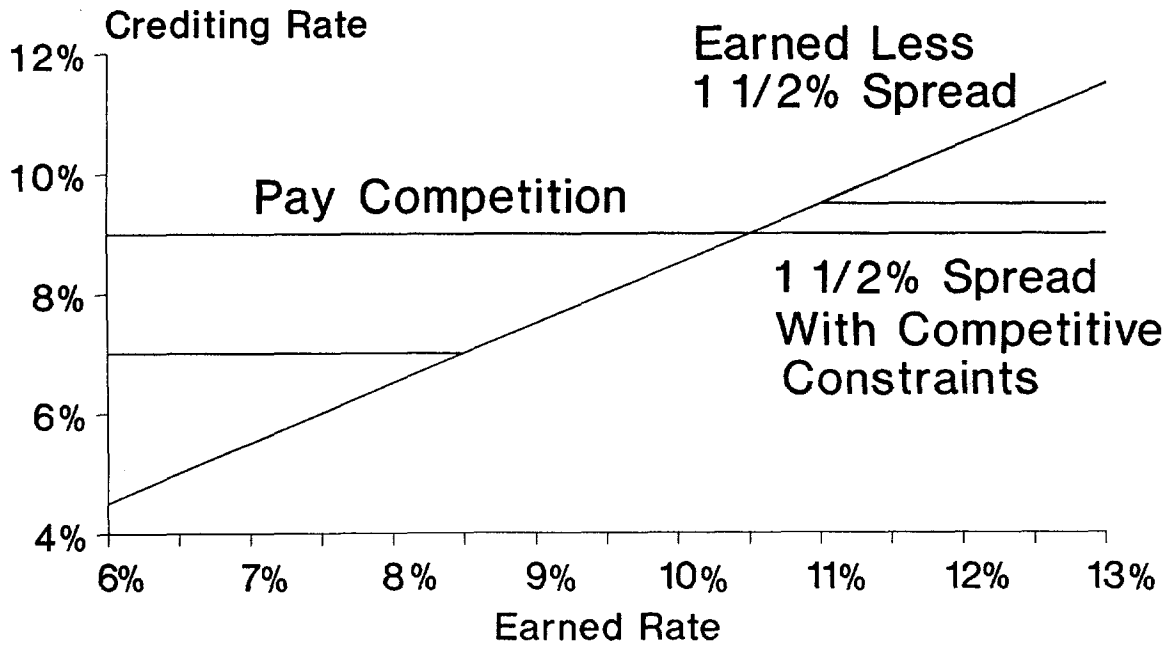
In Exhibit 6, we vary the lower constraint on the crediting rate. Here's the original compromise strategy that we had with a limit of 200 basis points below the competition. We'll compare that to a 100 basis-point limit and an unconstrained downside. And here we've used 50% or 5,000 basis points as our proxy for infinity. The tighter and lower boundary seems to produce a less desirable profit profile, while the unlimited boundary starts to look more and more like the "protect the spread" strategy that we reviewed earlier. When you consider the persistency effect of this sort of unlimited lower bound on the crediting rate, it would appear that this strategy is going to be far from optimal. Once again, these results are for given sets of assumptions and I wouldn't want to suggest that there are any universal rules of thumb that can be derived from these results.

One way that I find useful in reviewing these results is to build an efficient frontier. Those of you with investment exposure may be aware of the Markowitz approach to analyzing the risk and reward of various asset classes in portfolio management. You can see from Exhibit 7 that we show the average results for 40 interest rate scenarios on the vertical axis and the standard deviation of those results for the 40 scenarios on the horizontal axis. The theory is that we maximize return and minimize risk by seeking points as far to the upper left-hand corner of the graph as possible. A point is on the efficient frontier if there's not a point which is both above and to the left of it. For example, here we analyzed the present value of profits for the various crediting strategies. This is the strategy of matching the market or "paying-the-competition" -- zero tolerance for a difference between the crediting rate and the competition rate. And you can see that's far from the efficient frontier. The other strategies that we've tested are all a lot closer to the frontier and seem to be approximately the same. The two with the 200 basis-point downside limit on the

EXHIBIT 1

SPDA CASE STUDY

Graph of Sample Strategies Tested (Competition Paying 9%)



SPDA CASE STUDY
INTEREST CREDITING STRATEGY VARIATIONS
PRESENT VALUE OF PROFITS AT 15%

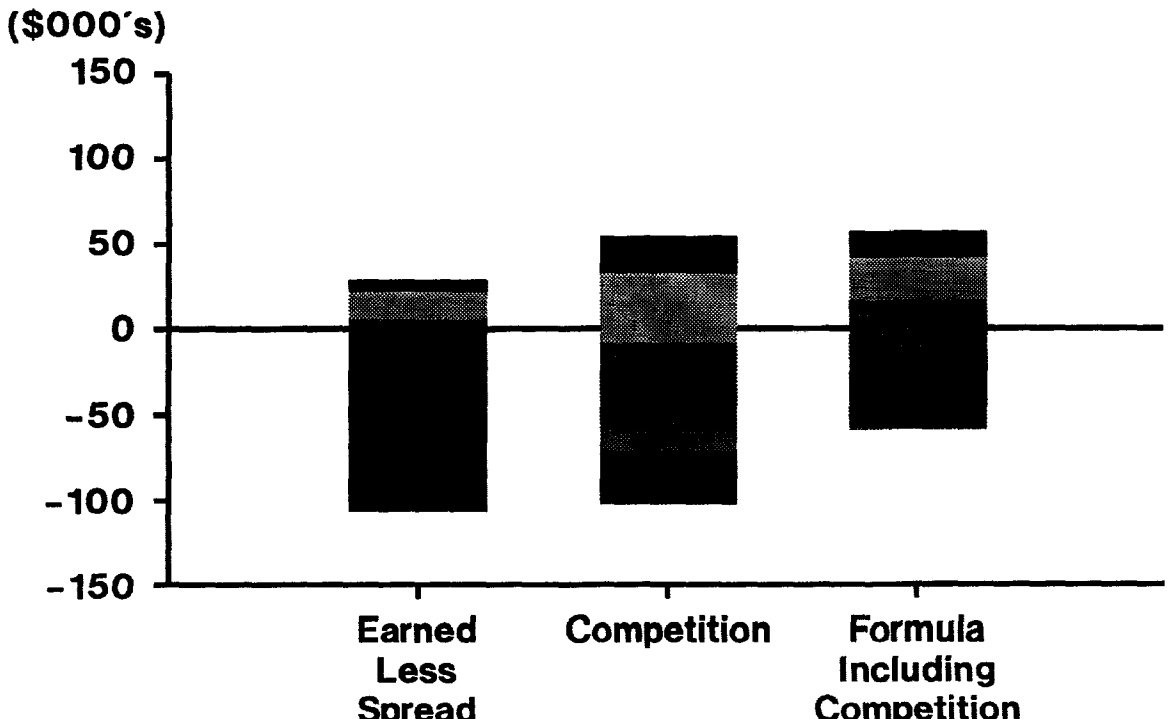
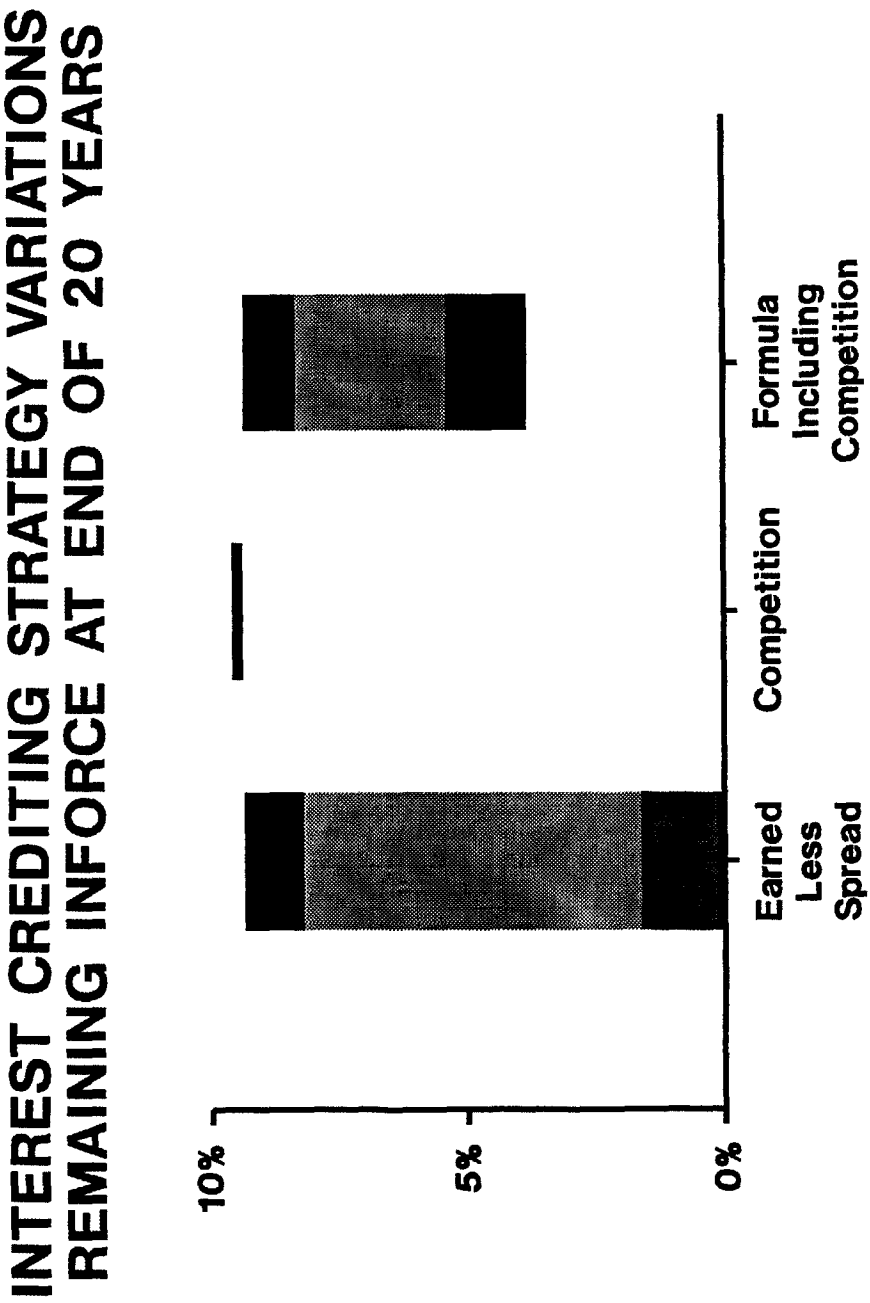


EXHIBIT 3


SPDA CASE STUDY
INTEREST CREDITING STRATEGY VARIATIONS
REMAINING INFORCE AT END OF 20 YEARS
10%
5%
0%
Earned Less Spread
Competition
Formula Including Competition

SPDA CASE STUDY
INVESTMENT STRATEGY VARIATIONS
PRESENT VALUE OF PROFITS AT 15%

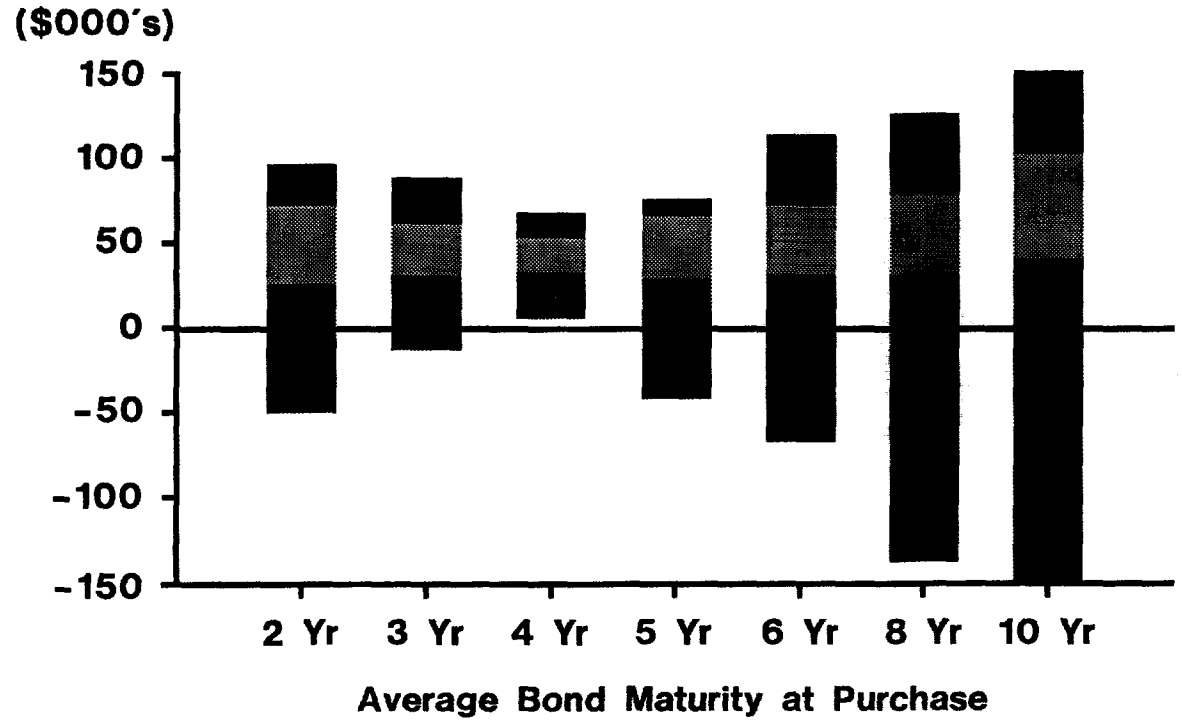
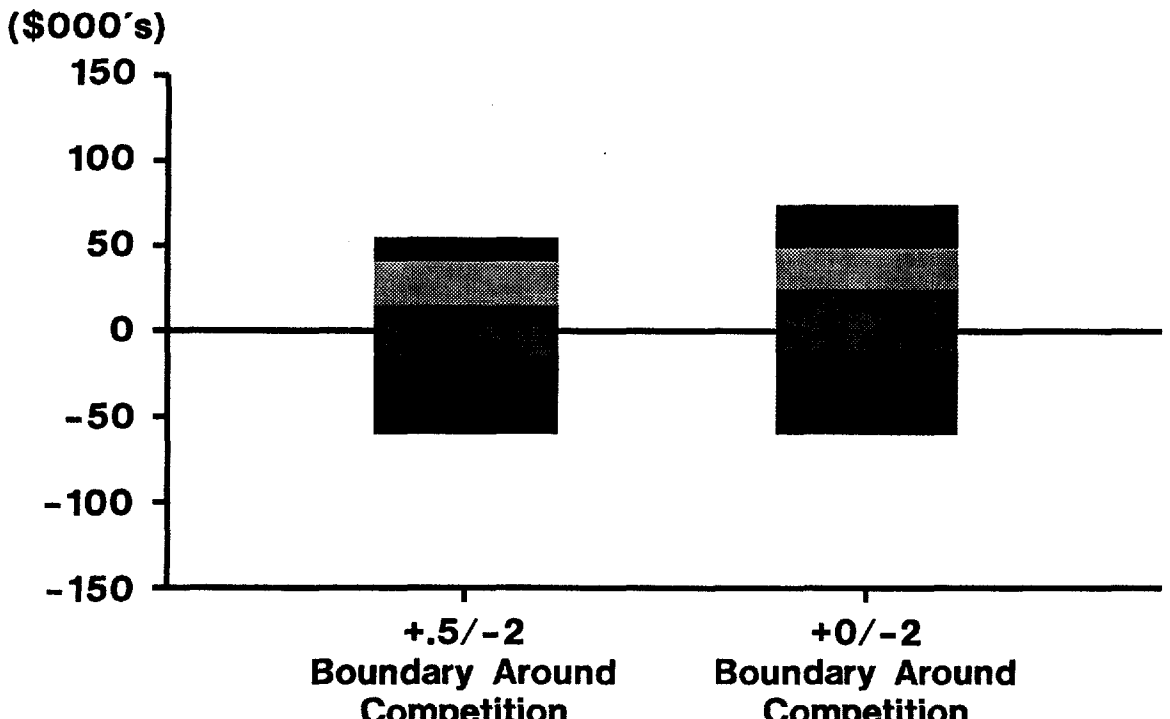


EXHIBIT 5

SPDA CASE STUDY
INTEREST CREDITING STRATEGY VARIATIONS
PRESENT VALUE OF PROFITS AT 15%



SPDA CASE STUDY
INTEREST CREDITING STRATEGY VARIATIONS
PRESENT VALUE OF PROFITS AT 15%

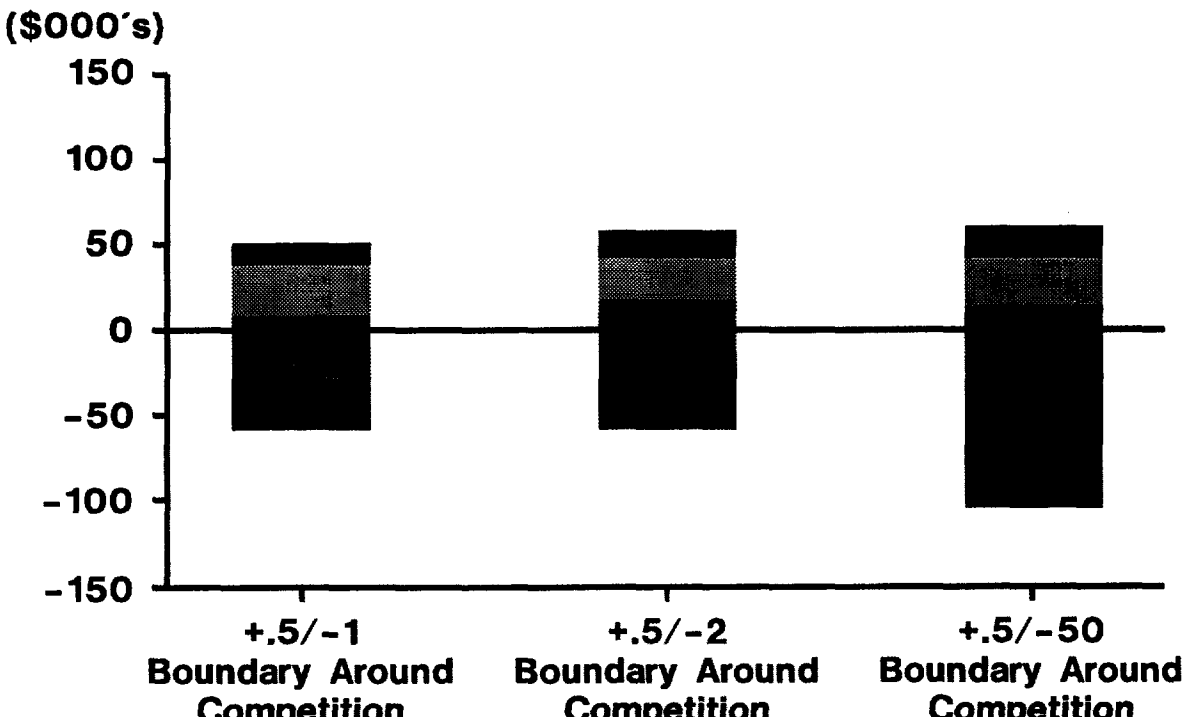
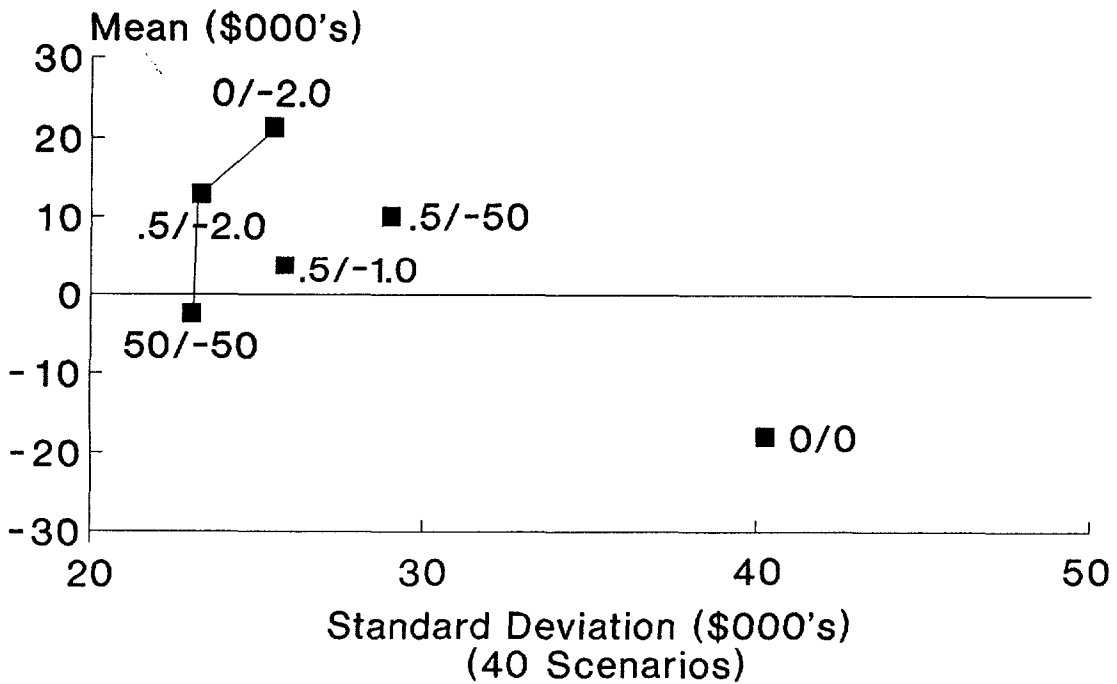


EXHIBIT 7

SPDA CASE STUDY

Interest Crediting Strategy Variations
Present Value of Profits at 15%



competition differential seem to be better than those with both lower and higher downside limits. This efficient frontier, Exhibit 8, covers the investment strategy variations that we looked at earlier. Here are the four-, five-, six- and ten-year investment strategies that are on the frontier with the four- through six-year range seeming to be the most appropriate strategy. We can build these efficient frontiers for other elements of the analysis, including the persistency results. They can be particularly effective for communicating results of our actuarial analysis to investment counterparts and top management.

There are a few other elements of crediting rates that influence product development and investment strategy. The analysis of the lifetime interest guarantee can be interesting these days, particularly with guarantees as high as 5% and treasury rates that are moderate by recent standards. For example, at one point last week, the entire treasury yield curve was below 8%. In some of our analyses, the worst case scenarios involve the long-term guaranteed crediting rate becoming operative in some low interest rate scenarios. This may be one of the more underrated risks that insurance companies are undertaking today. Regarding a front-end guarantee, the multiple scenario model is particularly useful to analyze the added risks and investment considerations of a given level and length of guarantee, particularly in a multi-year guarantee at a reasonably high rate of interest.

Other policy features that relate to crediting rates include a persistency bonus awarded to persisting policyholders at a future policy anniversary, and a bail out provision that waives surrender charges when the crediting rate drops below a predetermined level. Both of these can also be taken into account in our analysis.

RENEWAL CREDITING RATES

In theory, one should simply apply the crediting rate formula from the product development stage when setting the crediting rates on in-force policies, however, practicalities enter into the picture. For example, the model may deal with quarterly interest rate changes, but the insurance product manager sees daily changes in interest rates. Furthermore, competition and agent issues change, somehow always for the worse; and these forces tend to lead the insurer to set crediting rates that differ from the formula rate. Nevertheless, the formula rate is important as a reference point.

An approach to rate setting that I like involves establishing a horizon, for example, three months, over which the crediting rate is intended to last assuming no major interest rate shocks. Across that horizon you can then build your crediting rate from a series of elements.

You start with a gross effective yield of the underlying assets that support the line of business. This needs to include any cash or cash equivalents. This also needs to include the effect of any hedging vehicles, and the fixed rate and floating rate differential on interest rate swaps. If the asset portfolio is not segmented, this step may be more complicated, but it is a necessary starting point for the calculation.

Second, during the period to the horizon, there will be reinvestment of portfolio cash flows. In particular, the scheduled interest payments, the scheduled principal payments and the unscheduled principal payment need to be estimated. The impact of these reinvestments of the earned rate over the horizon period can then be reflected in the credit rate.

Third, the effect of any scheduled interest rate adjustments on adjustable-rate assets in the portfolio should be reflected.

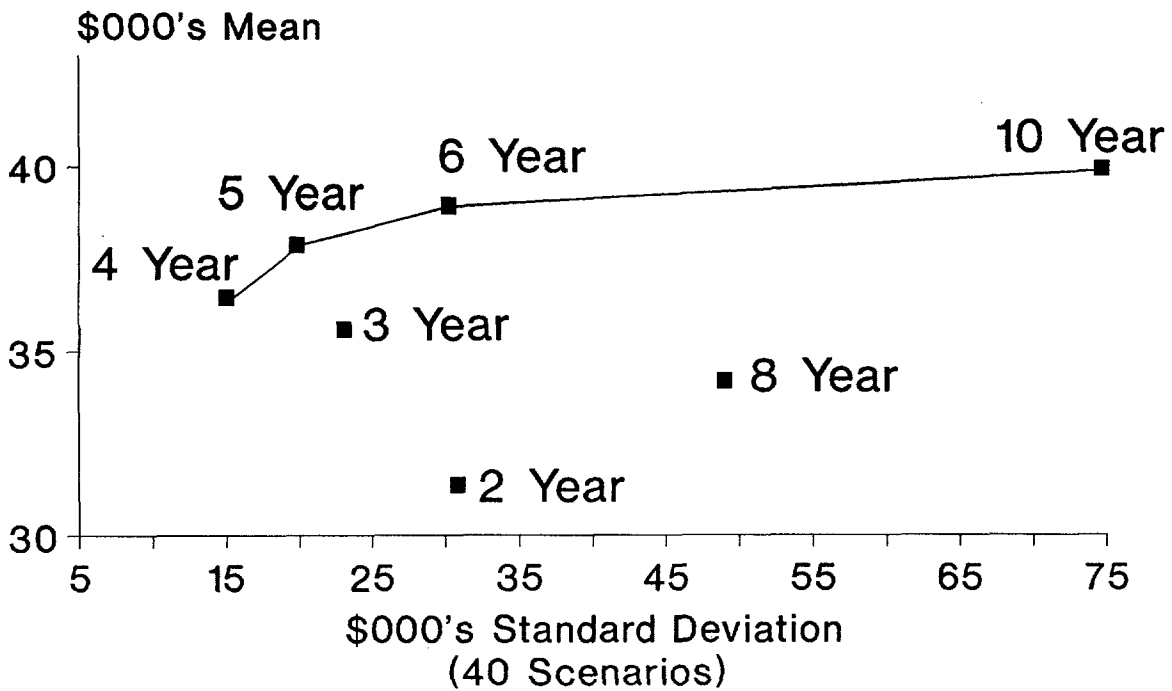
Fourth, if there are any unusual levels of cash anticipated during the period to the horizon, this will have an effect on the earned rate. This should be adjusted for.

Fifth, there needs to be an assessment for the credit risk of the assets. And those of you that have worked on this I'm sure would agree is one of the more difficult steps in the process. It will generally include one or more of these three elements. First, a formula charge for the C-1 or default risk for the company's typical level of credit risk accepted, for example, A-rated bonds; second, an adjustment for any unusual risks which may have been undertaken. For example, it may have been decided to put 15% of the assets supporting the product into the high-yield bonds. If that's the case, an additional assessment for the credit risk differential should be made. Third, depending upon the company's pricing philosophy, an assessment may be made for any existing problem loans of significance. For example, if there is a large amount of mortgage loans in a

EXHIBIT 8

SPDA CASE STUDY

Investment Strategy Variations
Present Value of Profits at 15%



depressed region of the country that is burdening the portfolio, it could be accounted for here if the insurance company's philosophy is to recover in that way.

Sixth, if the investment strategy includes some equity investments such as real estate, that have uneven returns but are anticipated in the long run to outperform the traditional fixed income investments, an adjustment may be made to level out the effect of those investments on the crediting rate. Seventh, an adjustment for investment expenses should be made. Eighth, the target or planned spread for profit and contingency charges should be deducted. And, ninth, finally, a market adjustment may be made to reflect the subsidy or extra spread that is obtainable depending upon what the market dictates or permits.

Although some of these adjustments are only a few basis points each, in aggregate they're important in providing good management information about the level of synchronization of asset rates and liability rates. The profit effect of any decision regarding crediting rates becomes explicit rather than accidental. In addition, this process can provide documentation to assist the company in responding to the annual statement interrogatories regarding nonguaranteed elements. The results also provide useful feedback to the product development stage in building the crediting rate formula that we reviewed earlier.

As an aside, I'd like to mention a couple of things about credit risk, maybe as much as anything to prove that I do come from an investment firm. Many companies are buying more high-yield bonds. This is not only because insurance companies are changing, but also because the markets are changing. For example, as we see in Exhibit 9, the high-yield bond market has grown dramatically during the 1980s. In 1980 there was $13 billion of high-yield debt outstanding. By the middle of the decade, it was $81 billion and the 1989 market is estimated at over $200 billion. I found Exhibit 10 even more revealing in that the median rating of all existing industrial bond credits declined by two full Standard and Poor's rating categories from 1981 where the median rating was A, to 1987, when the median reached BB.

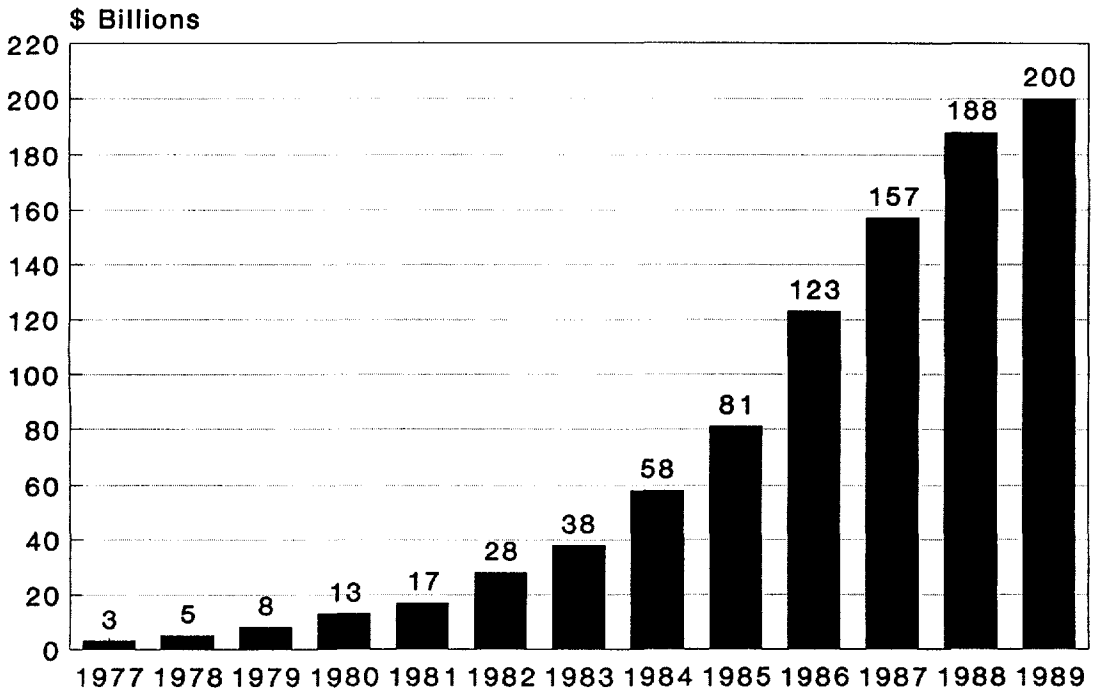
ACTUARIAL/INVESTMENT COORDINATION

The link between the actuarial side and the investment side is a critical one in this process whether the actuary or the investment staff is in-house or not. The concept of the actuarial and investment link may seem to be getting a little bit trite, but I think it's just as important as when it was a fresh topic. Although some of you may regard this as a self-serving comment, it's my opinion that the presence of an "investment actuary" in the investment, the product, or the corporate area is a valuable addition to this interrelationship. Education is a critical element of the working relationship. While the education works both ways, the key responsibility falls on the insurance product area to understand the investment side. It is essential to become an informed consumer of investment service. The product area should know the characteristics of the assets being purchased. This includes knowledge of the industries, and risk level and geographical distribution of the investments.

In today's market, investment analysts are continually addressing the concept of event risk. Actuaries need to understand what this means to their portfolio. One way to gain working knowledge with your investments is to read the write-ups prepared by the investment staff for proposed new purchases, especially, private market ones. At a minimum, a list of purchases and sales should be reviewed regularly by the product and pricing staff. It's also important to be exposed to new investment ideas, such as, Collateralized Mortgage Companies (CMOs), international bonds, the process of combining adjustable rate assets with interest rate swaps to make synthetic fixed rate assets and so forth. A lot of that is available at the Society of Actuaries' meetings and similar meetings, but a proactive investment staff that's in tune with the markets will generally be more than willing to look into these markets with its clients.

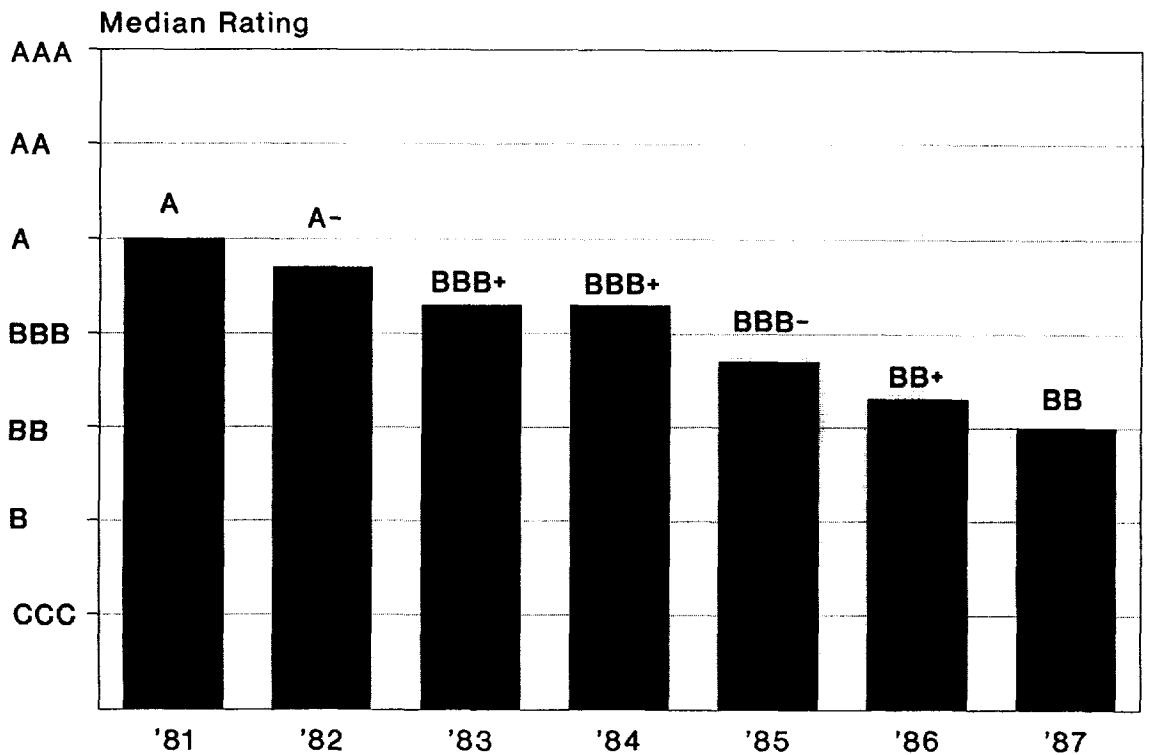
Synchronization is not going to work without an open line of communication. The two sides need to understand each other, especially with regard to risk-taking philosophy. There must be compatible goals and consistent incentive compensation practices in a few areas. Regular discussion is important for issues such as cash flow expectations, supply of investments in the market place, and interest rate needs and availability. Regarding interest rates, communication will also require getting over some of the natural terminology differences between actuaries and investment professionals.

THE HIGH-YIELD MARKET



- One quarter of the total corporate marketable debt in U.S.
- Fastest growing sector

INDUSTRIAL BOND RATINGS



Source: *High Yield Bonds -- Nature of the Market and Effect on Federally Insured Institutions*, May 1988, U.S. General Accounting Office, Washington, D.C., p. 181.

SYNCHRONIZATION OF CREDITING RATES AND INVESTMENT STRATEGIES

One form of communication and education with our affiliated client companies is called the Interest Rates Committee. Its members include the managing product actuaries for the major lines of business in the insurance companies and top management and portfolio managers from the investment advisory company. This is not a decision-making body but one of communication. The investment folks discuss the economy and their expectations, and they frequently make presentations on special topics from the investment market. The actuaries share their recent and upcoming interest rate issues which provide useful information for the other actuaries as well as the investment staff.

Beyond education and communication, the synchronization process requires some joint decision making. Probably, most importantly, this involves setting investment policy, including constraints and accountability. An example of the issues in this area is the degree of active portfolio management that will be allowed. The buy and hold strategy bypasses opportunities in the marketplace, but wide open active management would lead to significant complications due to capital gains and losses, for example, in tracking investment yield, especially by generations, and in managing surplus and taxes.

Regarding investment policy, I'd like to mention a book that many of you may have read and the rest of you who are interested in the topic may want to read. It's a book that I encountered when studying for the Chartered Financial Analyst (CFA) examinations. It's called *Investment Policy: How to Win the Loser's Game*. The author is Charles B. Ellis who, incidentally, will be the speaker at the Investment Section luncheon following this panel discussion. Mr. Ellis takes what might be regarded as a cynical or devil's advocate view of the way many investment managers and the clients view the market. However, I think it's a view that is very consistent with the way actuaries think, and expresses some of my intuitive feelings about the investment market and investment process.

The specific points that I want to bring you from Mr. Ellis' book relate to the process and responsibilities of setting investment policy and I'm quoting three sentences from the book: (1) "Clients, not their portfolio managers, have the most important job in successful investment management." (2) "Investment policy is the explicit linkage between the client's long-term investment objectives and the daily work of the investment manager." (3) "In brief, clients should subordinate portfolio operations to investment policy and should assert their responsibility for leadership in policy formulation."

It's clear that the synchronization of crediting rates and investment strategies is not going to work without a process that is clearly understood and features communication and leadership from the product actuary's side. A process that features these attributes along with a talented organization will be the one that accomplishes its objectives over the years to come.

My concluding message is in the form of a limerick. I'm sure some presentation of the panel discussion in the Society of Actuaries' history has featured a limerick, but I'm not aware of it. So just in case, I'm making sure there's at least one in the *Record*.

Actuaries and investment folks should link
Their energies and talents to think
Of how to coact
So they do, in fact
Manage to keep rates in sync.

MR. P. ANDREW WARE: It may be obvious to most of you that there's no perfect way to synchronize investment strategy with interest crediting. Especially, since the process of setting interest rates is often a political one. However, it's likely that there are some combinations and strategies that fit together better than others. I will attempt to outline a methodology which will help identify those strategies.

The first thing I'd like to clarify before I get started is a measure of synchronization. The definition that I will be using is that an investment strategy is synchronized with an interest crediting mechanism if the in-force business is maximized. And this does not mean that we need to just maximize sales, but the strategy must also try to preserve in-force business. And the second thing is the constraint that surplus is generated in sufficient quantities to protect against any losses. This implies that the difference between the earned rate and the credited rate must pay for

expenses and generate sufficient surplus so that there is very little chance of losses in excess of accumulated surplus.

Since I'm from a mutual company, I will approach this optimization program by holding surplus as a constraint and trying to maximize the amount of in-force business. A stock company wouldn't want to try to maximize profit, but either way the same technique can be used. There is no perfect solution; however, with enough analysis a "best" solution should become apparent. Now, this best solution would change over time as the situation changes either with the product assumptions or the investment market. But my presentation will concentrate on a modeling methodology which can be used in search of a best synchronization solution. In illustrating this technique I will use an SPDA, but the methodology would work just as well with universal life or a flexible premium annuity. This is only an illustration and no conclusions about any of the strategies should be drawn from this example. It is important to point out that each company has unique product, distribution and investment characteristics which need to be considered. Therefore, the conclusions reached by one company are not necessarily appropriate for another. This is especially apparent when the interest-sensitive assumptions, like lapses and production, are considered. The search for the best solution involves modeling a number of possible combinations of investment strategies and interest credit mechanisms. The results from each trial are analyzed and modifications to either the investment strategy or the interest crediting mechanism are made and modeled again. This interactive process should ultimately result in an optimal strategy. It is important to point out that during this process, even though it's been said many times before, there must be communication between investments, marketing, corporate actuarial and product actuarial. The optimal solution may not be the same to all of the audiences and it is important that there be buy-in at every step so that the end result will be understood and implemented.

The first step in the process is to define the market that the product is intended to serve. The characteristics of the market are important input in setting the interest-sensitive assumptions in the model. Suppose we are trying to define the investment strategy and interest credit mechanism for a single premium deferred annuity to be sold by brokers in a personal market in a large metropolitan area. The lapse assumptions, issue ages, average sizes and expected competitiveness would be very different from the identical product sold by career agents in rural areas. Therefore, knowing the market is the key to understanding the risk.

Next, the product actuary must be familiar with the company-imposed restrictions on investments. Each company is likely to have internal limits or restrictions on the types and natures of investments that are available to the investment officer to choose from. This may be less a function of the product and more a function of the company attitudes towards certain investments. In addition to constraints, there are likely to be favorite investments or biases. This is another important reason to get the investment department to buy in to the process. It is also more important to find any constraints that the marketers may have. An example may be that it is important to have a consistent rate that's in the ball park rather than having the highest rate one month and possibly the lowest the next.

Once the product and the investment constraints are known we need a model. Some of the characteristics of the model are dependent on the product, like bailout rates, limited market value adjustments or bonuses, and also, on the investments that we tend to model. But certainly, the model must be able to accurately reflect the behavior of assets and liabilities in various interest rate environments. Some of the common elements of an acceptable model are: (1) it must be able to adjust the level of sales from period to period in a manner which reflects relative competitiveness of interest rates credited to new money; (2) it would also need to adjust the level of renewal premiums on a flexible premium product if that were to be modeled; (3) the model must be able to set lapse rates on an interest-sensitive basis; and (4) it must be able to accurately credit interest according to the specified methods.

A key assumption in the model is the market interest rate. This rate is an estimate of the current interest rate level in the market at any point in time. It should be roughly comparable to the interest rates of competing products including any noninsurance company products being issued at any time. It is used in comparison to the credited rate in order to determine lapses and production. This rate must be defined in terms that can be measured by looking at the investment market. An example of a market rate definition would be the larger of a six-month T-bill or a seven-year treasury note plus 20 basis points.

A function which depends on the definition of the market rate is the sales sensitivity function. This function produces a factor which represents the relative amount of sales produced given a relationship between the credited rate and the market rate. This function produces a factor of one if the credited rate is equal to the market rate and a factor of less than one if the credited rate is less than the market rate. Likewise, if the credited rate exceeds the market rate, a factor greater than one is produced. In my example, Graph 1, the production factor is 0.1 if the crediting rate is one-half the market rate. And at the other extreme, the production factor is 5 if the crediting rate is 2 times the market rate.

Another interest-sensitive function is the lapse function and we've all seen an example of this. In my example, as shown in Graph 2, I'll use a function which has a value that can go no lower than 4%, and if the market rate is equal to the crediting rate, I'll use 7% lapses. And if the difference in rates ever gets larger than 5%, then lapses become more than 20%. Most companies may have a block of business in-force that can be used to estimate this function. Northwestern has a very large block of portfolio annuities which were sold up until 1985. They have provided a great source of data for determining this sensitivity function. In the early 1980s, Northwestern was paying between 500-700 basis points less than the market rate. And in the past few years, we have been paying 200-300 basis points more than market rate.

After the assumptions and the product features have been agreed to, the elimination process can start. As a first try, I picked three investment strategies and three interest crediting mechanisms. These are very simple, but later iterations can refine the best choice. The important thing is to get a feel for the interaction of each crediting mechanism with each investment strategy. Each combination will be modeled over four interest rate environments and the ultimate in-force and surplus results are compared.

For the first trial, I've chosen three interest crediting mechanisms: (1) in the portfolio method the rate credited to all money each year is equal to the rate earned on the entire portfolio less a spread; (2) in the investment year method, the rate paid on any money is equal to the rate earned on premiums paid in the same year less a spread; and (3) in the new money method, the rate paid on all money is equal to the new money rate less a spread. In all of these methods, the rate guarantee is for one year. This is, of course, a variable in the process, and the results are very different if interest guaranteed periods are longer than one year.

I've also chosen three simple investment strategies to start and each strategy purchases noncallable corporate investment grade bonds. The difference is the length to maturity, and I've chosen one, three, and seven year maturities to model. Obviously, these are simple minded, but even these can provide some valuable insight. More intricate strategies can be tested later in the process.

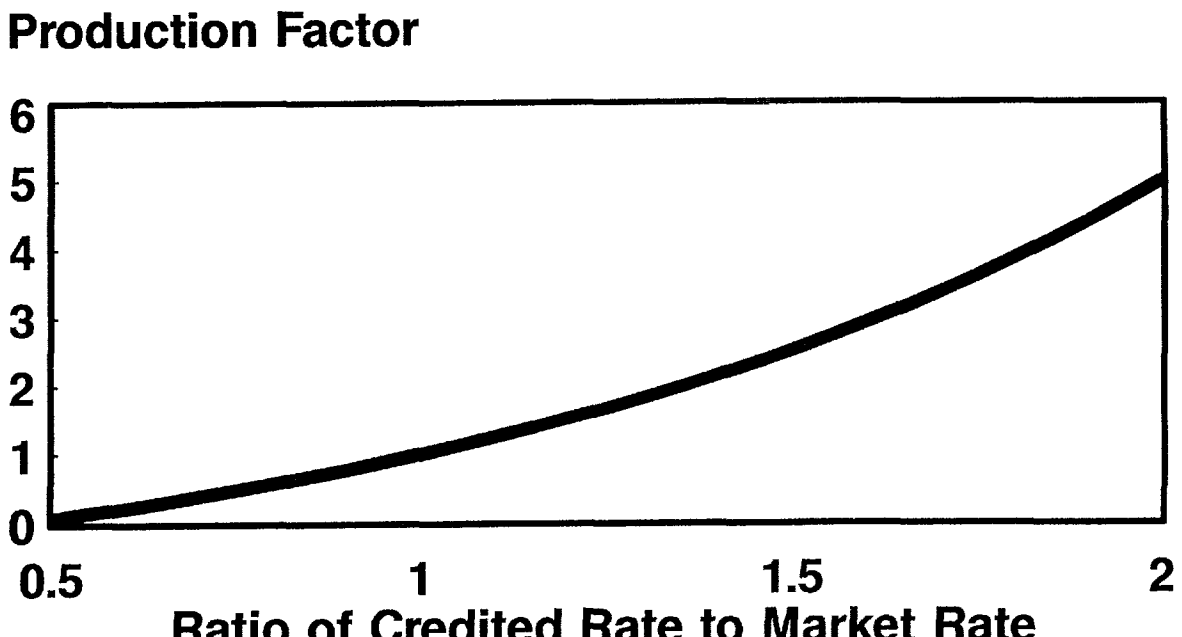
Each combination will be modeled over four interest rate scenarios that begin with a starting yield curve that looks like Graph 3. The yield curve here is fairly steep and it was done intentionally to make longer investment strategies look more attractive if interest rate risks are ignored. After the first year, the yield curve shifts in the following ways: rising at a .5% a year or rising at .5% a year for four years and then jumping and then a couple of falling scenarios to get a range of results. More scenarios can be chosen but these represent some extremes that should be modeled. Changes in the shape of the yield curve should also be tested. With my simple model here I won't do that. It becomes obvious which assumptions are important in the model after a few runs are made.

The objective is to find a strategy that performs well in an up and down environment. After a possible combination is found, refinements can be introduced before the final result is obtained. Before the model is run, one important consideration needs to be made and that is the surplus contribution. We know that the amount of surplus generated in a constant interest rate environment must be enough to pay for any expected loss due to a sharp increase in interest rates and any defaults which may occur. Of course, the amount of loss is related to the investment strategy and the interest crediting mechanism. Finding the correct required surplus level becomes another iteration in the process.

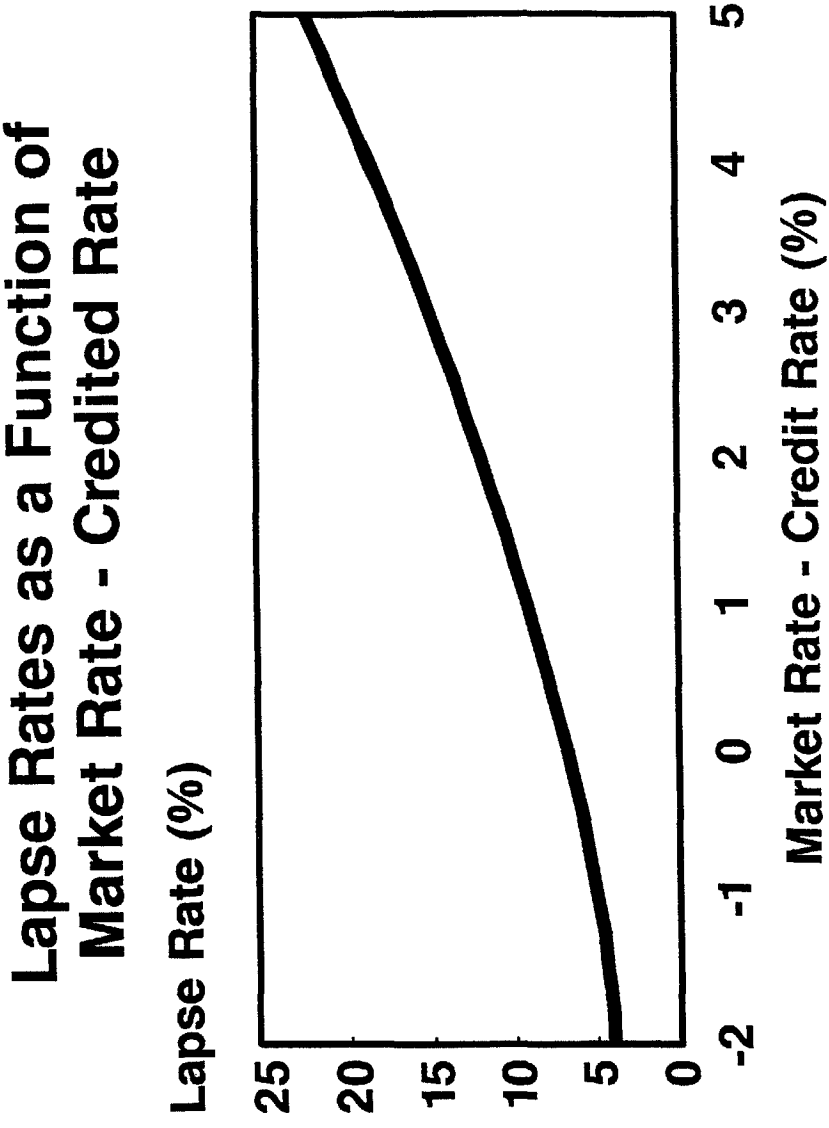
The required surplus levels I've started with are 1% of assets for the C-1 risk and 1% of reserves for the C-3 risk for a one-year bond strategy, 3% of reserves for the three-year bond strategy and 7% of reserves for the seven-year bond strategy. These were obtained by estimating the losses due to an interest rate spike of a thousand basis points over a period of one year.

GRAPH 1

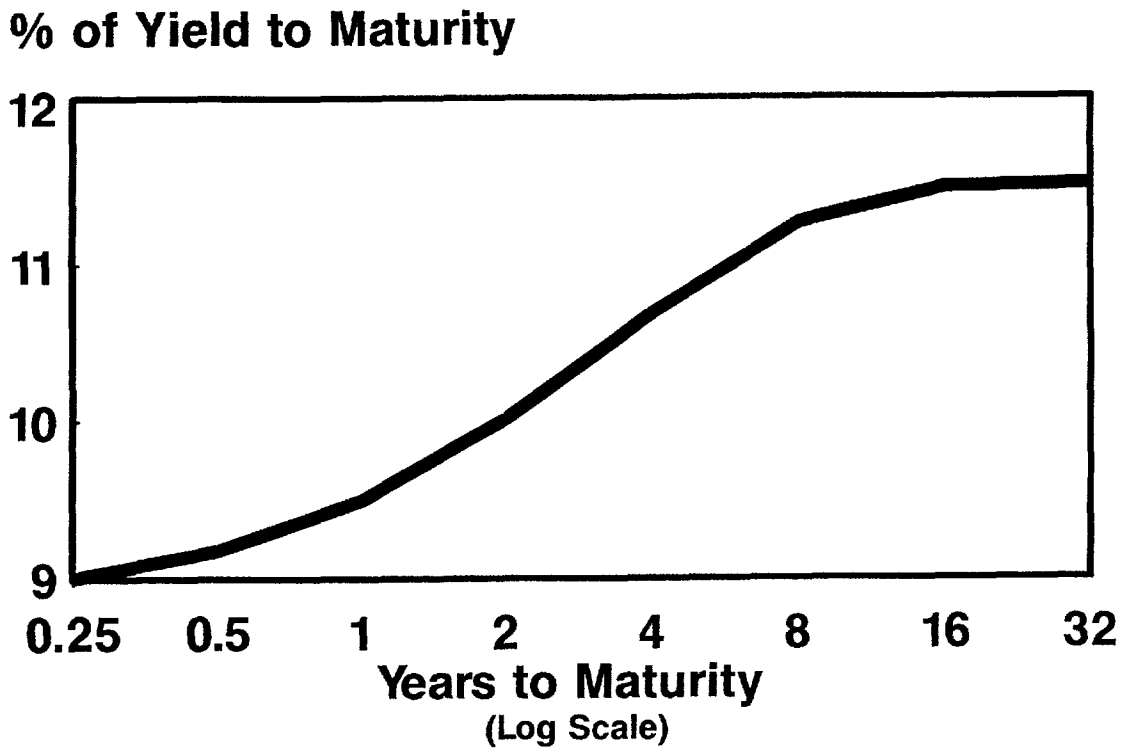
Production Factor as a Function of Credited Rate / Market Rate



GRAPH 2


Lapse Rates as a Function of Market Rate - Credited Rate
Lapse Rate (%)
25
20
15
10
5
0
-2
-1
0
1
2
3
4
5
Market Rate - Credit Rate (%)

Starting Yield Curve



At this point, the pricing actuary calculates the starting spread by pricing for a rate of return on invested surplus including required surplus. And after the first trial it became obvious that the new money crediting mechanism needs more surplus than the others. This results from the C-3 risk actually being larger for this strategy when investments of more than one year are purchased. The reason is due to the lapse sensitivity function. If the tested products were more lapse sensitive than I have assumed here, there would have been more C-3 risk evident in the investment year method (IYM) and the portfolio method. This points out the importance of the assumptions and the need for a sensitivity analysis of the assumptions.

The resulting spreads that I used in the model example are shown in Table 1. What this means is that a 1.5% spread to cover expenses and surplus contributions is needed for the one-year bond strategy. In the three-year bond strategy, the spread increases to 1.75% for the portfolio and the IYM method, and 2.75% for the new money method. And finally, for investments of seven-year bond strategy, 2.75% and 3.25% are needed due to the larger C-3 risk. The model was then run with these spreads and the in-force after ten years was averaged over the four scenarios and the results look like this.

TABLE 1
PRICING SPREADS

Investment Strategies	Portfolio	IYM	New Money
1 Year	1.50%	1.50%	1.50%
3 Year	1.75	1.75	2.25
7 Year	2.75	2.75	3.25

For Table 2, it shows that the optimum measure or the maximum in-force at the end of ten years was obtained through a three-year investment strategy and IYM crediting mechanism. However, before we can come to the conclusion that this is the best strategy, we must first look at the surplus constraint. Even though we have adjusted the surplus contributions to try to equalize the different combinations, some have more possibility of losses than others.

TABLE 2
TOTAL RESERVES IN TEN YEARS
(Millions)

Investment Strategies	Portfolio	IYM	New Money
1 Year	422	501	501
3 Year	560	572	503
7 Year	555	568	470

In Table 3, I have shown the range of excess surplus results at the end of ten years.

TABLE 3
EXCESS SURPLUS IN TEN YEARS
(Millions)

Investment Strategies	Portfolio	IYM	New Money
1 Year	-3 to 4	0 to 2	0 to 2
3 Year	-4 to 4	2 to 4	-4 to 5
7 Year	-11 to 6	-4 to 1	-6 to 1

It now becomes very obvious that the IYM three-year combination is optimum since there is always enough surplus to cover minimum surplus needs. In fact, the spread could be readjusted at this point and the IYM three-year method would improve and the rest would probably stay the same or become worse.

I'd like to reiterate my caution that these results are purely illustrative and should not be taken as the right answer for any company; however, the conclusion that optimal strategy is an IYM with a three- to-five-year investment strategy is not an unlikely one for any company.

I'd like to take this example one step further with regard to the length of the bond purchase and propose a method of communicating the risk of investing too long. The ideal length of assets purchased depends on the yield curve at the time the bond is purchased. The question that investors will ask is, "Are we getting paid enough for the additional C-3 risk assumed if we buy longer assets?" By using the model I have described, we can calculate a risk spread that must be deducted from the earned interest rate to provide for surplus. This risk spread is a function of the length of the assets purchased. The longer the assets purchased the greater the C-3 risk and therefore, the more surplus needed. The risk spread for any bond length can be subtracted from the yield to maturity to give a risk-adjusted yield. Risk-adjusted yields of this nature are frequently used in analyzing callable bonds and mortgages. At any point in time we can construct a risk-adjusted yield curve for our single premium deferred annuity. Graph 4 shows the yield curve. Risk adjustments, which I have calculated from my sample SPDA, are subtracted from the yield curve. Notice that the resulting risk-adjusted yield curve is concave in shape. The implication is the best place to invest is the maximum point on the curve. This is the point where the theoretical crediting rate is maximized. It is useful to express the adjustments to the yield curve as factors, because the maximum point will change as the shape of the yield curve changes. This enables the investment people to use these risk adjustments in comparing securities of different lengths.

Other asset types such as mortgages, CMOs, or more exotic types can be modeled as well as various quality level. Also, other types of interest crediting mechanisms or combinations of strategies can be modeled. The key is to try to hold as many variables constant and examine the interrelationship among a limited number of variables. For example, it may be found that quality of investments is not interrelated with investment crediting mechanism, but it is related to the length of assets. This may result in a trial being run in the modeling process which holds the interest crediting mechanism constant and varies the length and quality of the assets to find an optimum mix. The whole process of finding the absolutely perfect solution is endless. However, this process can result in finding very good strategies and help avoid the pitfalls that can result from biases and insufficient analysis.

MR. ALPERT: I work for an insurance conglomerate; a holding company that owns several different insurance companies. Our coverages range from automobile insurance through individual and group health insurance, SPDAs, universal life and traditional life.

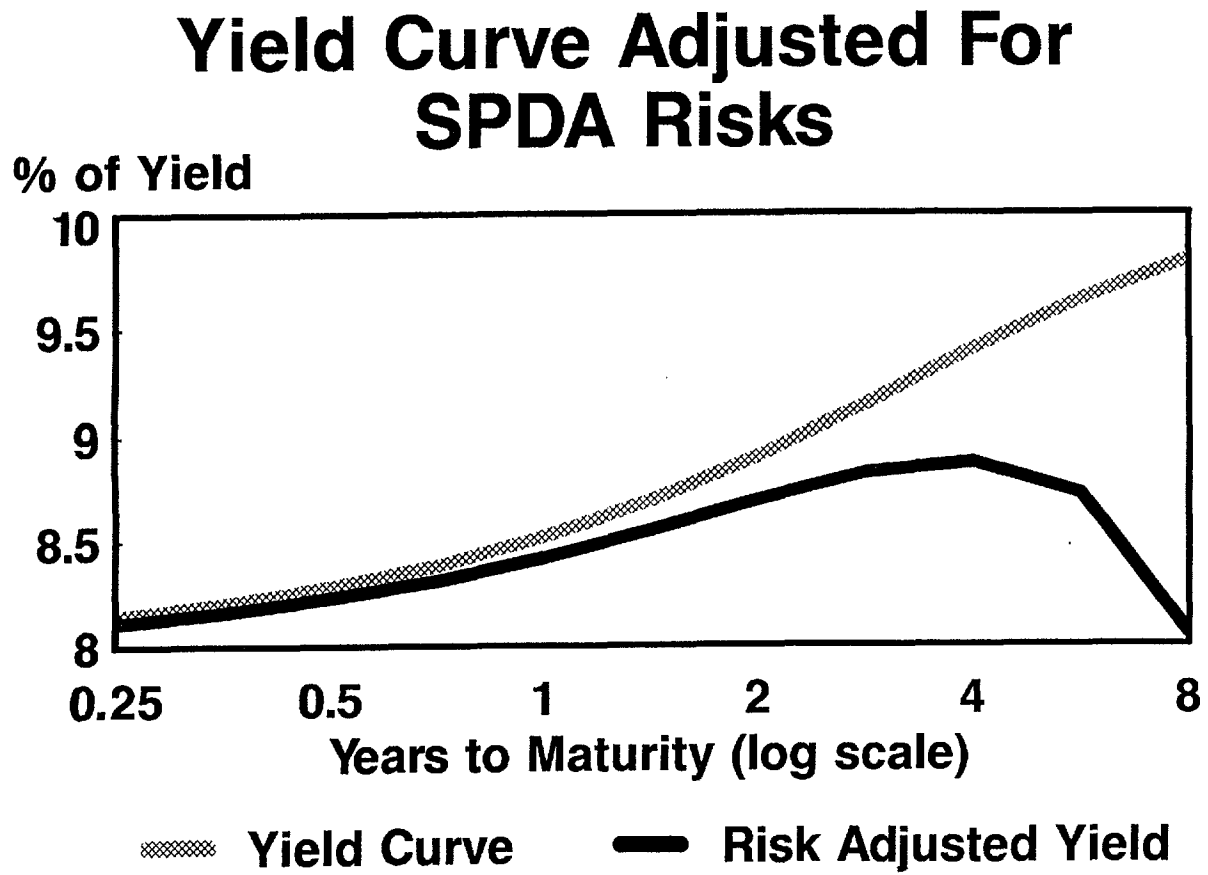
For all of these businesses the essential questions are the same. The analysis techniques may differ, and certainly, the answers differ, but the basic question is the same. The corporation wants the companies to act in such a way as to maximize the corporate worth. Maximizing the corporate worth really means that assets are larger than liabilities each year.

Now, the cash matching of assets and liabilities is an important consideration for all of us. It's possible perhaps to carry it to an extreme. I heard of one investor, a stockholder at Uniroyal. Uniroyal itself does very careful observation of its disbursements and its cash flows so as to manage properly all of its many bank accounts. After one dividend disbursement, they noticed that a stockholder was sitting on his dividend check. They called him and asked, "Did you get your dividend check? And he said, "Oh, yes, is something wrong?" They said, "No, there's nothing wrong on our part, but we just wondered if you were ever going to cash it?" He said, "Yes, I will." And they said, "Well, when? He answered, "I can't tell you that. See my practice is when I get these checks I throw them all into a box and then when I get a bill I rummage through the box to find a check of the right amount."

Our cash matching is not that exact, but in essence the view that future asset cash flows should exceed future liability cash flows, and that we are interested in net cash flows is, in fact, the central paradigm that informs all our analysis.

For every product, we have four big questions. We want to know the capital that will be required for the risks of the product and what is the expected return on the capital; what remaining risks or volatility we will have after we have put up that capital; what are the operating rules that we will follow in actually running the product; and what tracking measures we will use to follow the progress of the product and measure emerging experience. We go through a process of product development that defines and measures the risk based on various strategies developed for the coordinated advanced testing. In this process, we try to bring the investment people in touch with the product people at the earliest possible stage of product planning.

GRAPH 4


Yield Curve Adjusted For SPDA Risks
% of Yield
10
9.5
9
8.5
8
0.25
0.5
1
2
4
8
Years to Maturity (log scale)
Yield Curve
Risk Adjusted Yield

The capital requirements for the product fall into three categories: start-up capital, risk capital, and rating capital. Start-up capital is the amount needed for development costs, perhaps new systems, perhaps advance marketing expenses. Risk capital, perhaps the major part of the analysis, is formally defined in our company as the amount in addition to the funds supplied by the policyholders which is the larger of the following two quantities: the fund to provide that the asset cash flows will exceed the liability cash flow in every year to a high degree of probability, or the amount needed so that assets are always greater than statutory reserves; that is, so the statutory surplus is positive. Statutory surplus has been described as our license to do business and we have to pay for that license.

In addition to start-up capital and risk capital, we have rating capital, or the additional amount needed to earn a given rating for marketing purposes. This amount varies from company to company and obviously, depends on the marketing plan, the niche you are in and the products you are selling.

We find it useful to distinguish among these three forms of capital (in addition to the other forms that insurance actuaries frequently talk about). First, because they must be funded in different ways or from different sources. Second, you may expect different rates of return on different kinds of capital.

Having established that risk capital is a measure based on the future cash flows, those same cash flows will now be a measure of what profits you can expect -- what the return on this capital will be. We provide against the worst and measure expectations by the average.

Of course, future results are not absolutely predictable. There still will be variations. There still will be changes in circumstances or conditions. So in the initial testing we look at different questions: What will be the range of net cash flows? Will they all be positive or will most be positive? What will be the range of book profits, both year by year and present value over different scenarios? It is an important element in the decision whether expected ROEs will be 10-14%, or 0-24%. What is the difference between the book value of assets and the market value of assets? And at various points in various scenarios, what is the present value of the net cash flow expected in the future for that scenario as compared with other scenarios?

It is also an important matter for both the product manager and the investment manager to understand the conditions which will cause different earnings from year to year. How does the product react in rising interest rate scenarios? How does the product react when interest rates invert? What circumstances cause gains to appear? What circumstances cause book gains to evaporate?

The third step in the initial coordination is a description of operating rules. The strategies which have been tested through the various scenarios are not codified into operating rules for the product manager and for the asset manager. For the product manager we ask one or more of the following things: sales and in-force goals; crediting strategies in rising interest rate environments (perhaps separately for new money and old money); crediting rate strategies in falling interest rate environments (again perhaps split between new money and old money); initial guarantees and guarantee extensions and under what circumstances we might change the guarantees. Also to be considered is what elements of expense control will be put in place and what will be the planned practices for communications and services to the policyholder? Each one of these has a potentially powerful effect on the liability cash flows of the product line. We are interested in understanding the future cash flow because that is what the asset investments will be based on.

For the asset manager, the investment objectives may include one or more of the following: liquidity requirements, in the sense of quickly saleable at par; diversification rules, which depend on quality and are expressed in terms of limits for a given issuer; the importance of preserving yield -- at least over a short period of time; limits on realized capital losses; and an asset duration range. The use of duration and the asset duration range come directly out of our emphasis on cash flow analysis. Duration, a badly coined word, means the sensitivity of the present value of a cash flow to changes in interest rates. If the asset cash flow exceeds the liability cash flow in every year, the present value of the asset cash flow will be greater than the present value of the liability cash flow.

On the asset side, by definition, the value of the future cash flow of assets at today's interest rates is the market value. That market value will change when interest rates change, by some measure of sensitivity. For example, a duration of five means that a 1% change in interest rates should change the market value, or present value of the cash flow, by 5%. A duration of ten would change it by 10%. We set an asset duration range centering on an estimate sensitivity measure of the liability cash flow so that when interest rates change, the present value of the asset cash flows will change by about the same proportion as the present value of the liability cash flows. If the two cash flow values change by about the same amount, we know that the net present value will not disappear which indicates that future cash flows are out of step.

The fourth question we want to resolve in the development of the product is the tracking mechanism that will be used to monitor future performance. When possible, the tracking mechanism should relate to the risks of the product as well as standard accounting record. Thus, we have different tracking mechanisms for all different products. For one SPDA we use a system that involves the following quantities: the market value of the assets to track or the present value of the asset cash flow; the account value of the liabilities as an admittedly crude first approximation to the present value of the liability cash flows; and a product-specific index portfolio to see how the market is doing for this particular product. I should stress that the account value in this particular case is not too bad an approximation to the present value of liability cash flows (only for this particular product as verified by separate studies). For other products, it could be a terribly bad approximation.

The points discussed above can be illustrated for one particular product -- a plan vanilla SPDA. It has a one-year guarantee, a portfolio credited rate, no surrender charge and what would be described as a compromise crediting strategy in that we will never credit less than one hundred basis points below the competition and never more than the competition. The rate crediting strategy and the associated invest strategy were developed very early in the product development. Because it is a relatively simple product, we developed workable strategies with only one or two iterations, and the did all the testing.

The first test was the range of expected returns over different scenarios after putting in the required capital (Graph 1). The scenario in the middle, labeled number 7, is actually the average. As you can see, we have results ranging from very low to moderately good.

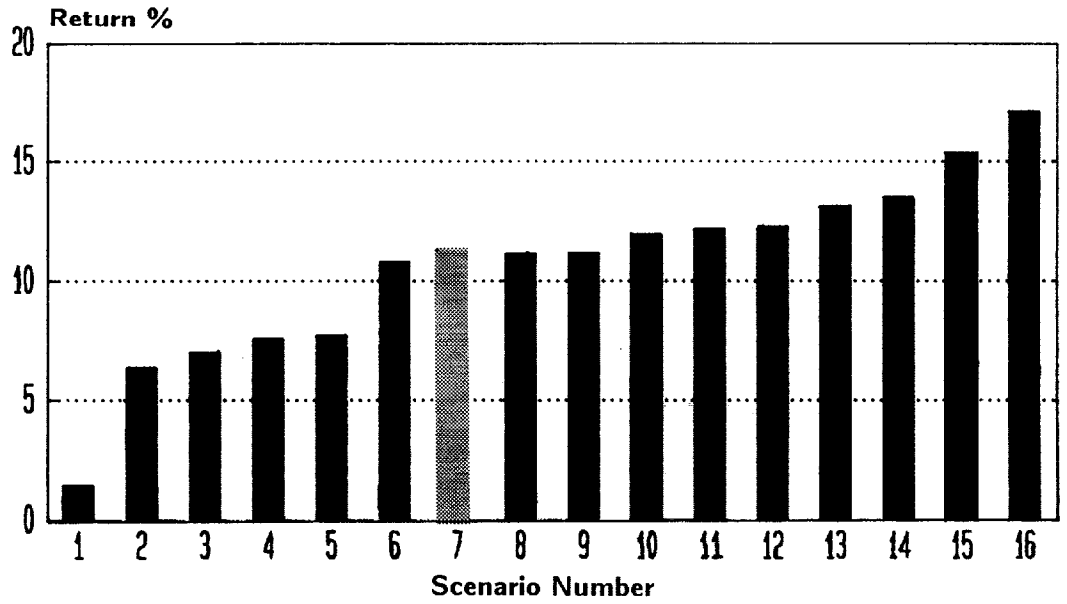
Did we put in enough capital to prevent absolutely negative cash flows? Not quite. Over the entire range of testing that we did there were three scenarios that have negative years for a total of four years with negative cash flow. This is out of about 300 scenario years. The results are consistent with our goal to prevent negative cash flows to a higher degree of probability, but not to absolute certainty. The present value of the largest negative is just under 1% of premium. To be absolutely certain against all possible adverse effects, we would have had to raise our capital requirement by at least 1% of premium which would have probably made us uncompetitive or made it very difficult to justify the return on it.

One of the things that we found in the testing of this particular product is that the book gains each year are extremely sensitive to the change in interest rates in the year. There was a consistent pattern through all the scenarios which can be illustrated with a single scenario. Out of ten years in which there was no change or a decrease in interest rates, we had substantially higher gains from operations than the average -- actually about 40% higher. In nine years in which there was an increase in interest rates, we had substantially lower profits, again, by about 40%. The phenomenon was so consistent that is sent us back to the drawing board to examine why. In this particular product, we had knowingly taken a maturity mismatch so that we were investing longer than the interest rate crediting pattern. This will always produce poor return when interest rates rise. In book accounting terms, we were still stuck with earnings from the assets purchased the previous year at a lower interest rate, but using a crediting rule that said we would be close to the higher current competitive rate.

All of the preceding figures were from the initial testing and, in that sense, prospective perhaps hypothetical. Since we have started issuing the product, this is the kind of comparison that we do each month. The actual numbers have been changed somewhat, but the format and conclusions are representative. The total of the account values is now $93 million, the asset market value is now $95.6 million. On a percentage basis we have credited an average 7.88% annualized. We have had a

GRAPH 1

SPDA
RETURN ON EQUITY
16 SELECTED SCENARIOS



total return on the assets of 10.31%. That is more than sufficient for the pricing spread that was built into the product.

The index market value represents the results which could be achieved if the tested investment strategy were used at all times. The market value has, in this period of time, basically performed where it should. The tested strategy would have produced the desired spread, despite some very difficult market conditions. A flat yield curve makes it difficult to make money on SPDAs. (But our chief investment officer said that "happiness is a flat yield curve" because there is no pressure from the companies to invest in long maturities.) I might also say that the CEO and the asset managers were delighted that they had beat the index portfolio by a substantial amount. Of course, in the month after this report was done, the market conditions changed and the numbers are in a different order.

To recapitulate, our primary goal is to maximize net cash flow. Net cash flow analysis, first of all, is determined by the respective crediting strategies and investment strategies. In turn, the net cash flow measures the amount of risk and the amount of capital that is required for that risk. It also measures that return, the profits and the expected return on that capital. It leads to considerations of asset rules and eventually, liability rules, including measures of sensitivity. It leads to a concept of tracking the economic value of the product as distinct from the appearance of statutory results.

Have we answered all the questions in our company? Certainly not, and since we have not, even for our products, I doubt very much whether any of the specifics would have that much applicability to another specific company although I believe that every company has the same basic questions.

The major issues we are trying to resolve include these: First, we do not have a good practical measure of the present value of the liability cash flows. There are several different approaches, but all of them involve massive computer runs which are simply not practical for us to do for any regular reporting. Second, there is a continuing unresolved tension between our conceptual focus on economic value, based on the market value of assets, discounted value of liabilities and total return, and the necessary reporting on book value basis, (either statutory or GAAP) which is required for so many other constituencies including CEO compensation. And perhaps the third item that we have not resolved is to be sure that the clear-cut strategy which is tested in advance is known to work. Knowing to control the risks will in fact be used as we move into the future. This is particularly difficult for the product actuary, who must respond very quickly to dynamic market situations which, as Peter Hepokoski said, always seem to be getting worse.

A quotation that I found may help. "We have not succeeded in answering all your problems. The answers we have found only serve to raise a whole set of new questions. In some ways we feel we are as confused as ever, but we believe we are confused on a higher level and about more important things."

MR. GARY A. FRISCH: Pete, it looks like we're doing some similar things to what you're doing. I think you're a little further along than we are. We use the seven New York scenarios and then we have three other ones that we developed from actual experience since 1971 and basically, that's a slow up, a fast up and a fast down. I was wondering what your view is on how much practical information can be gained by adding a lot of scenarios. I noticed you did 40 and I've seen studies that use 400 or even more. Is there really that much more to be gained, and if so, briefly, what advice would you have for someone in proceeding with that?

MR. HEPOKOSKI: The first comment I would have is that I think it's good that you're adding to the New York seven. I think adding a few more that involve yield curve shifts or some more irregular patterns adds a lot more understanding to your analysis. The other comment is that I'm not sure there's any magic number, but if you've got the right kind of software I think it's pretty easy to generate 40, 50 or more scenarios and I think there's a level of confidence to gain by looking at statistics that look at a greater number.

MR. ALPERT: I'd like to add that we use the New York seven plus a whole bunch of stochastic scenarios because there's a kind of feeling that most of the nasty things that happened were unexpected when they happened.

MR. JAMES R. THOMPSON: I noticed, as I heard it, you at Northwestern analyzed an old block of business in about 20 years and on a portfolio rate, but I've gained some insights that older blocks tend to be more persistent and they don't expect as much sensitivity and I was just wondering whether you found that to be the case with your block.

MR. WARE: Yes, this block was old, but it was sold up through 1985, so some of it was fairly new. But I think you're right. The older parts of that block were more persistent. You should probably try to have your lapse sensitivity act as a function of duration as well.