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NEW INVESTMENTS AND NEW INVESTMENT STRATEGIES

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- Nontraditional investments, and innovative assets and investment management techniques, and their applications to:
  - -- Pricing considerations of interest-sensitive life insurance and annuity products
  - -- Determining appropriate levels of surplus
  - -- Limiting the insurer's risk exposure to the economic environment
- A focus on the types of nontraditional investments available, their market place limitations, and their application to traditional actuarial problems

MR. PETER F. CHAPMAN: It is one of the numerous ironies of our business that we are assuming unprecedented financial risks just as we are beginning to understand the nature and measurement of these risks. Competitive interest rates are essential to maintaining an agency force and to preventing the loss of funds. Margins between the rates earned and the rates credited have narrowed or disappeared.

Some companies have maintained their margins at the cost of more surrenders, less new business, and lost agents. Many have compromised their margins and are operating with inadequate risk charges, or actual statutory losses, in the hope that, as Mr. Micawber would have put it, "something will turn up."

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Part of the discussion will address two other solutions that are being used to generate margins. One is the purchase of bonds whose quality is considered to be of less than investment grade. These are commonly referred to as junk bonds. As one of our panelists will explain, there is high-class "junque," there is ordinary junk, there is garbage, and there is an even lower category characterized by a descriptive term that cannot appear in the *Record*.

The other is the synthetic asset. The synthetic asset is an attempt to simulate a traditional product by combining two or more high-risk elements with a series of low hedges. The intended result is a higher yield with some safeguards against the additional risk. Jim Barry of the Mellon Bank will describe some of the building blocks that can be used to construct synthetic assets.

Finally, we have to address the broader topic of investment risk. No matter how conservative the investment strategy, no matter how responsive interest credits are to current yields, forces beyond our control can create an imbalance by creating, or aggravating, the mismatch between asset and liability cash flow, generating either losses from forced liquidation at reduced market values, or from inadequate returns on reinvested funds.

We are going to try, to take hedges such as futures, swaps, and options, out of the ivory tower and into the actuarial front lines. We suggest that you think of these nontraditional investments as the counterparts of stop loss reinsurance. Stop loss allows the actuary to swap current incomes for a ceiling on the amount of mortality or morbidity claims. While the cost of stop loss reduces the margin for profit, it also reduces the amount of adverse deviation that must be provided in the pricing structure. The art of buying stop loss reinsurance consists of avoiding a material mismatch between the cost and the protection.

Similarly, in the investment products we will be discussing, there is a tradeoff between the cost of the risk limitation device and the reduction of the prudent margin for adverse deviation. This tradeoff clearly affects the pricing of all products but especially of the so-called interest-sensitive products. It also clearly affects the amount of risk surplus that the company needs to retain for protection against the investment risk of the company's entire book of business.

NEW INVESTMENTS AND NEW INVESTMENT STRATEGIES

Jim Barry will walk us through the inventory of commercially available products that permit stop lossing (if there is such a word) the investment risk. These will be the tools which will carry us through the next two discussions.

Jim will be followed by Peter Noris of Morgan Stanley. Peter's specialty is research and analysis on fixed income products as they relate to insurance companies. He will discuss pricing strategies for single premium deferred annuities (SPDAs) and single premium whole life products. His presentation will include analysis of the characteristics of mortgage-backed securities and, of course, junk bonds.

Then Peter Hepokoski of Washington Square Capitol will wrap it up for us. Peter will relate the available nontraditional assets to the traditional task of surplus management controls. Ultimately of course he will be talking to us about the balance between cost and risk and investment strategy and the appropriate compromises between growth and solvency.

MR. M. JAMES BARRY: The volatility in the financial markets ushered in by the oil price shocks and financial institutions' deregulation of the late 1970s and early 1980s has caused all financial institutions to reexamine the nature of their business. Increased competition has significantly reduced the margin for error in asset-liability management even as increased customer sophistication and market volatility have combined to change the duration characteristics of traditional financial assets and liabilities.

So you can all take comfort in this -- all informed financial institutions today, commercial banks, thrifts, and insurance companies alike are facing the same problems.

1. The variance of expected returns on pools of floating or fixed rate assets has significantly increased, whether the assets are prime-based loans, floating-rate mortgages, treasury bonds or what have you.

2. The duration of assets and liabilities has changed even more fundamentally, to the point where nominal contract maturity has little relevance if the value of the underlying option (value to the holder) can change. This holds true

whether the instrument is a Certificate of Deposit, a Guaranteed Investment Contract (GIC) or a long-term corporate obligation.

3. High volatility has produced historically high values of these options imbedded in many traditional assets and liabilities, changing the way these must be evaluated.

My role at the Mellon Bank is to act as an interest rate management consultant to assist our financial institution customers in dealing effectively with the volatility in the current interest rate market. I am going to list some of the products that are available at commercial banks for hedging these options' risks.

The solution to proper management of the asset-liability mix is at once simple and complex: identify and value the option characteristics of each type of asset and liability, adjust the duration-weighted portfolio accordingly and make a determination, based on the amount of adjustment and the amount of duration-weighted position of the portfolios, of the risk that will be taken to generate an appropriate return on invested assets. The complexity develops from the difficulty associated with identifying the options included in these assets and liabilities and evaluating the potential impact these options will have on the duration-weighted value of any particular item. My colleagues will be describing some of the techniques used by the market to value these options.

Fortunately, the financial community has recently developed a number of products which attempt to synthetically alter the option characteristics of a particular asset or liability. The basic products offered by commercial banks come in two forms: (1) the interest rate risk management products; specifically, interest rate swaps, interest rate guarantees, and forward rate products; and (2) the standby liquidity facilities. Singly or in combination, these products can be used to hedge against the change in value of a stream of cashflows, thereby mitigating the change in value of the underlying option.

Interest rate swaps are contracts between two parties to exchange interest payments based on an agreed upon notional principal amount. The term notional is used because no actual principal changes hands. Each party agrees to pay the other an amount determined by multiplying the appropriate contract rate by the notional amount. The swap is normally between a fixed rate and a floating

rate instrument, since the purpose of the interest rate swap is to alter cash flow characteristics. The floating rate payable at any point will be determined by an easily verifiable index. Common indexes include: LIBOR (London InterBank Offered Rate) (with 1, 3 or 6-month rate reset), 1-month commercial paper, 1 or 3-month certificates of deposits, national prime rate and the 3-month treasury bill (reset weekly).

Interest rate guarantees are the stop-loss products Peter referred to in his introduction. For a one-time, up-front premium, a bank or an issuer will contract to reimburse the insured party for the amount by which actual interest rates are above or below a predetermined interest rate level (the strike rate). If the contract stipulates that the bank will reimburse the beneficiary when the interest rate falls below the strike level, the guarantee is called a floor. When the guarantee pays off above the strike level, it is called a ceiling, or a cap. These two products can be combined to create either a collar, which is a purchased ceiling combined with a sold floor, or a window, which is a purchase of both a ceiling and a floor.

The third category of interest rate risk management products is forward rate products: the forward rate option (FRO) and the forward rate agreement (FRA). The FRO is similar to an exchange-traded option in which the base instrument is a US Treasury security and the strike price is a specific yield on that instrument. This is an American option, one which may be cashed out at any time prior to the maturity date. On the other hand, the FRA closely resembles a futures contract in which two parties agree on the price of interest rates for some future period. Unlike exchange-traded futures, which have daily margin requirements, FRAs are settled quarterly, with the required payments based upon the average differential between actual rates and the strike level.

A second set of products are designed to reduce the risk associated with some assets and liabilities that have imbedded put or call options. A good descriptive term is standby liquidity facilities. These are structured to become activated when certain nominal characteristics of underlying instruments change. Should additional liquidity be required because of default or excess puts of long-term funds, or change in capital structure, banks can supply the necessary funds.

So far I have described the basic tools utilized in developing an interest rate risk management program. These products are all designed to change the cash flow structure of the underlying assets, or reduce the respective portfolio exposure to fluctuations in interest rates. I would like now to take a few minutes to describe general portfolio applications.

Interest rate swaps are utilized to synthetically convert the nature of the cash flow. The most common application for swaps to date has been to convert floating interest to fixed and vice-versa. With this approach the portfolio manager can retain fixed rate assets on the books, while converting the interest rate earned on those assets to a floating rate. In this way the portfolio manager can retain ownership of the asset while protecting the value of the asset if interest rates should move significantly.

For example, if you purchase a 10-year bond at par to yield 10% and you wanted to hold it to maturity but were concerned about interest rate movements over the next two years, you could enter into a two-year swap in which you would pay the fixed rate and receive the floating rate to enhance the value of the cash flow. In this example, the index is the LIBOR rate plus 180 basis points.

If rates fall, the bond's market value will rise. The swap will reduce the yield, so you can sell the asset for more than its book value and terminate the swap. The realized capital gain on the sale of the bond should exceed the swap termination fees if those fees are based on market value.

If interest rates rise during the period, the synthetic yield rises because of the swap. If the bond is called, the loss of the discount would be offset by the gains on the swap termination. The net effect is to hedge the value of long-term fixed rate assets for periods of uncertainty, while maintaining the assets on the books, without the expense of executing trades in the cash or futures markets.

A second use for interest rate swaps is to change the duration of a portfolio. This is particularly useful when the duration of the assets does not match that of the liability. A pool of assets with a 10-year stated maturity can be converted into an asset pool with a duration of five years by entering into two simultaneous transactions: one ten-year interest rate swap paying a fixed rate

and one five-year swap receiving the fixed rate. In this way, an asset/liability manager can match the duration of the assets and liabilities and protect against higher interest rates on the liabilities that will be repriced in five years.

Although it is not commonly done in life insurance, banks often engage in interest rate swaps between two floating rate payors. Such a swap alters the frequency of floating rate changes for the parties. This application is utilized by asset/liability managers to lock-in the spread between floating rate assets and floating rate liabilities that might otherwise have a different index; for example, LIBOR versus Treasury bills, prime rate versus LIBOR, etc. This spread is most critical in compressed rate environments where movements in the basis can seriously erode narrow profit margins.

Interest rate guarantees are generally used as stop loss insurance by financial institutions and corporations in a position to benefit from selective mismatching of fixed versus variable rate assets but are unable to afford negative spreads if floating liability rates exceed the fixed rate yield. In periods of stable or declining yield rates, the guarantee providing a ceiling on the liability cost should be relatively inexpensive.

For the portfolio manager, guarantees can be utilized to alter the return characteristics of a fixed rate portfolio. Purchasing a ceiling will cause the yield to decrease by the amount of the amortized premium when the floating rates are at or below the strike rate and be supplemented by the excess of the strike rate over the actual rate. The portfolio manager sacrifices current yield for protection against decline in margin when interest rates are rising and for hedging the value of the asset should additional liquidity become necessary. Although the market value will have declined because of the increased rates, the guarantee will have increased in value, and when sold, will enhance the price of the asset.

Guarantees can also provide disaster insurance for purchasers of higher risk, higher yield assets. Often the cash flows supporting the coupon payments are subordinated to bank or other debt and therefore less certain in periods of high interest rates. This uncertainty can be hedged by purchasing a cap with a strike rate at the interest rate at which it is anticipated that the cash flow will become uncertain. Because this rate differential should be fairly wide compared

to market rates at the time of purchase, the cost of this disaster protection should be quite low.

Forward rate products are used to hedge the repricing risk on short-dated assets and the rate resets on floating rate instruments. Portfolio managers often desire to hedge the next reset on a portfolio of short-dated assets in order to maintain a margin over a corresponding liability portfolio.

If the concern is that rates can move in either direction, the FRA is the most effective safeguard. No matter what the actual rate reset will be, the reset can be locked in now. This application can be utilized in cases where private placements are being negotiated and the borrower would like to lock in the rate. The lender can use an FRA based on equivalent maturity treasuries to provide that protection for the borrower and to increase its yield on the transaction by charging a fee for the FRA.

If the concern is that rates can move only in an adverse direction, the FRO becomes the more appropriate vehicle. Portfolio managers can purchase an FRO to guarantee the reinvestment rate on an instrument, or to limit the upward movement of the cost of certain liabilities.

Other forms of hedging are more direct. Standby liquidity facilities are specifically designed to transfer liquidity risk during periods of high interest rates. During periods of high and volatile interest rates, investors may decide that the penalty for cancelling a fixed rate deposit will be more than offset by the higher returns available elsewhere. This can be particularly costly to insurance companies which historically match funded term liabilities with longer term assets. These assets will have declined in value if they carry a fixed rate of return, and current rates are higher. Even worse they may not be readily liquified if they are of the nature of commercial real estate mortgages. Therefore as more term liabilities are put to the firm, the greater the potential problem can become. The standby facility can alleviate the need to liquidate assets in satisfaction of these claims, preventing small problems from becoming major crises. Combined with the appropriate use of FRAs these facilities will avoid the need for untimely asset sales.

A specific form of this standby liquidity facility is a GIC liquefactions facility which is aimed directly toward pension funds, the major investors in GICs. Such funds, if they can borrow, can elect to take a bank loan in preference to redeeming the GIC at market value or holding it to maturity when rates have increased. There are many benefits to such a facility. It provides the issuer with a method of addressing liquidity without disrupting the insurer's liability or asset/liability management structure. Since the underlying assets are not being taken off the books, the only real concern to the insurer is satisfying his customers. This product may also alleviate severance penalties imposed by the insurance company issuer on the contract holder for early termination of the GIC.

A second specific product is the "agent balances purchase facility in which the bank contracts to purchase agent balances from the insurance company for a period not to exceed 180 days. The purchase price of these balances is based on the average collection performance of the insurer's portfolio of agent balances. This enables the insurer to convert agent balances into admitted assets.

Finally, most of the applications discussed so far have focused on a high interest rate environment. Probably less likely but potentially as hazardous to cash flow is the low interest rate environment. Many insurance asset/liability managers can become caught in an excess liquidity position, where higher yielding fixed income assets prepay, but the GICs and other similar term liability instruments remain in place (due to their above-market yield). This has the potential to create cash flow problems for the firm, as high yield assets are replaced with lower yielding investments.

Some of the solutions to this problem include the use of the following:

1. Interest rate floors guarantee a minimum portfolio yield rate. Since these applications are tied to a notional amount, strike rate and money market index, the actual composition of the asset portfolio is of no concern to the purchaser of the floor.

2. Forward rate products, both FROs and FRAs, protect the reinvestment rate on the assets replaced. To the extent that the yield necessary to avoid negative cash flow against the matched liability is known, strips of FRAs

can be purchased at the time of the first put in an amount sufficient to hedge the remaining term to maturity of the liability.

This discussion has been intended to give you a flavor of the types of products available on an over-the-counter basis to assist you in managing the risks associated with exposure to interest rate fluctuations.

MR. PETER D. NORIS: First, I'll describe what Morgan Stanley has been doing recently in establishing what we have come to call base line indices. These mimic the price and performance characteristics of the insurance liability and as such they become the target for the asset manager.

We can define a base line index with a few numerical parameters:

1. The price of the index. Start with the beginning price -- its worth in today's interest rate environment.

2. We have a notion as to how that price changes if interest rates go up or down. That has become known as the property of duration, or price sensitivity to changes in the interest rate. You can take that notion a step further in a lot of these instruments that have imbedded options -- that is the right for policy owners to cash out, or the right for bonds to be called in the future. These types of cashflows have durations that drift as interest rates change. That is a property that is know as convexity.

3. In order to determine these prices, we have to price the cash flow. That means we have to discount it at an appropriate rate of interest -- that is the yield characteristic we are going to use. We start with a risk free yield structure that is a term structure of interest rates, normally defined by the current treasury bond curve. To that we add an appropriate spread, what our investment managers can return year in and year out, over and above treasuries. We also want to make certain that we have adjusted this spread to remove any prepayment options that are in the bonds themselves. We want to identify a true call-free spread that we can earn over the lifetime of the liability.

It isn't easy to price these interest-sensitive cashflows, or to price products such as SPDAs and single premium whole life on the liability side and price investments like government national mortgage association (GNMA) securities on the asset side. They are all highly interest-sensitive cashflow. You can't simply lay a cashflow out on the timeline and discount its values back at one rate of interest. An option pricing model is required to discount these and define the price. While I won't describe the option pricing model today, I will allude to it in a number of places.

I'm going to build an example starting with the infamous SPDA and then add on some benefits and create step-wise a single premium whole life product.

The cash-flow characteristics of the SPDA start with a three-year guarantee of 7.25%. After the third year, the interest rate on the SPDA will reset, in this case annually. We are going to have a very aggressive resetting strategy in the future. We're never going to guarantee more than the initial guarantee, even if rising interest rates permit us to do so. However, if interest rates should decline below the beginning level, we will take advantage of every opportunity to lower the rate we are crediting to our SPDA policyholders. As you can see, it is a very aggressive reset strategy.

Furthermore, we are going to assume that we won't get hit too hard by interest-sensitive lapses. There will be some repositioning on this product, but just to show how dramatic some of these effects are, we are going to take it to the extreme and show low interest-sensitive lapses on this product. In effect, maybe this was sold through a captive life agency force rather than being sold through a commercial stock brokerage house.

After we take a look at the SPDA, we will add another benefit on to it. We will add a death benefit on to the base line SPDA. This death benefit is going to pay 1.8 times the initial premium if the insured is lucky enough to die while it is in force. We are going to give this death benefit away; there will be no cost of insurance charge.

If this is starting to sound familiar, let us take the next step and add a loan provision. We now have what has come to be a typical single premium whole life product. The loan provision will have a small charge if the policyholder borrows

the accumulated interest on the product. If the policyholder dips into the original principal, however, a rather hefty charge of 2.5% on the borrowed principal will take effect.

Let's first look at the SPDA. The left hand graph of Graph 1 which has a broken line going from the upper left to the lower right is the price characteristic of the SPDA (the present value of all the intended cashflows and benefits on that SPDA). That price has a beginning price which is indicated by the zero rate change on the axis. The beginning price was set equal to the initial net premium that we received on the SPDA sale. This is a state of equilibrium.

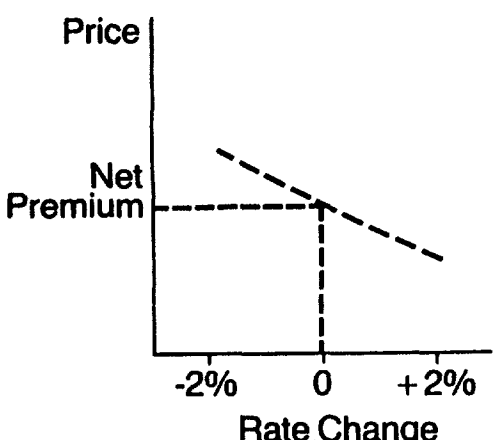
The graph is saying that in the interest rate environment in which we priced the SPDA, we had enough funds and enough net premiums to support all future benefits. If interest rates go down or up, we will need more or less funds to pay out all of those benefits, guarantees, expenses and profits. As you can see, if interest rates go up, we will need less funds to provide the benefits; if interest rates go down we will need more funds. Remember that this is a 3-year fixed rate guarantee.

Since January, when we priced this SPDA guaranteeing 7.25%, rates have declined more than 100 basis points. This illustrates how volatile the interest rate markets are. At that time we needed treasuries plus 75 basis points to support the 7.25% guarantee on the SPDA. The way the price on the SPDA goes up or down is the duration characteristic. The slope of that price line is the price sensitivity of the SPDA. That is shown on the right hand side of Graph 1 by the broken curved line.

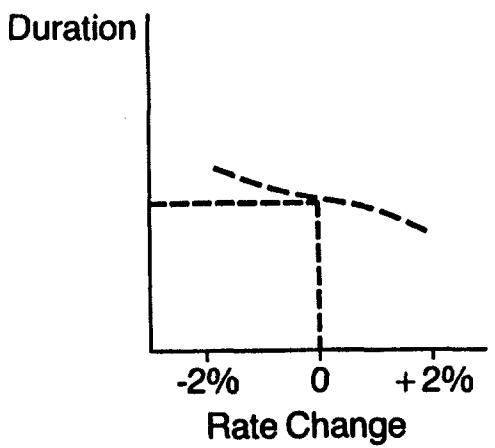
At issue, the SPDA had a duration (price sensitive) of 5.3 years. This is somewhat longer than its initial guarantee period because of the aggressive reset strategy. Anything that dampens the amount that you will need to reset your rate in the future will lengthen the duration of a product. Anything that causes you to reset the rate more often will shorten the duration of the product.

We were pursuing an aggressive reset strategy. We weren't moving the rate very much regardless of interest rate movement. As we mentioned earlier, this tends to lengthen the duration. The duration line itself has some convexity to it. It slopes from the upper left to lower right (convexity can be either positive

SPDA Baseline Index



- This SPDA price curve was generated using Treasury yields + 75 basis points.
- An SPDA which guarantees 7.25% has a price equal to the net premium (after commissions, expenses, and profit). This is equilibrium.
- This price will rise and fall with interest rate changes.



- The duration (rate of price change) of the SPDA is 5.3 at issuance.
- The duration will also rise and fall with interest rate changes. The pattern shown above indicates highly positive convexity.

or negative). It is highly positive in this case because as interest rates go up, we would expect lapses to increase; that will shorten the duration of the SPDA. Hence we have a duration line that slopes from the upper left to the lower right.

Let's add a death benefit and see what that does to our price curve. On the left hand side of Graph 2 -- the dotted line is the old SPDA, if we add a death benefit it raises the price curve. That is, our premium is now insufficient to cover all of the benefits including the death benefit. We don't have enough net premium to support all benefits. We have three choices.

1. We can change our profit assumption and accept less profit on the product.

2. We can attempt to earn a higher yield on our investment portfolio. We can assume a higher interest rate environment for discounting these cashflows.

3. We can change the product. Instead of giving away the death benefit, we can impose a mortality charge; or, alternatively, we could lower the 7.25% rate guarantee.

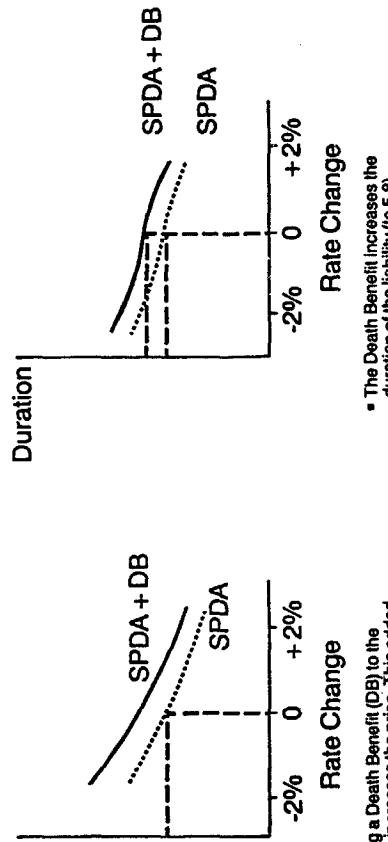
I am going to skip ahead to the final indices so we can move on to some of the assets. We are going to assume that we earn a higher yield on our investment portfolio. We want to see how much more we have to earn to support the death benefit.

To refresh your memory, our base line index on the SPDA was a duration of 5.3 years. It required a yield spread of treasuries plus 75 basis points. If we add a death benefit, our duration doesn't change too much. However, we now have to earn treasuries plus 147 basis points in order to support this product. Therefore, an additional 72 basis points of yield is needed to provide the death benefit.

If we take it a step further and add a loan provision, our results indicate that it requires an additional 125 basis points to support that loan provision. We are now up to treasuries plus 272 basis points in order to make this a viable single premium whole life product. I really don't want you to extrapolate these results to your own products. This was only one test case. It varies depending on the cost structure, the guarantees, the product itself, and your marketplace. You

GRAPH 2

Effect of Adding a Death Benefit (DB)



- Adding a Death Benefit (DB) to the SPDA increases the price. This added cost can be supported three ways:
  1) Accept less profit.
  2) Earn a higher spread on investments.
  3) Change the product (institute a mortality charge or guarantee less than 7.25%).
- Note that a Death Benefit is relatively more costly as rates decline.
- The Death Benefit increases the duration of the liability (to 5.8).

get different results for every analysis. This is just to point out the need to do this type of analysis and to set base line indices.

Another interesting property of the loan provision is that it lowers the duration characteristic. One would expect that anything that causes cash to flow from the insurance company to the policyholder will lower the duration of the product; that's exactly what happens if you have a loan provision.

These are some pretty hefty yield spreads. We obviously need to get aggressive on the investment side to try to earn them.

If you invest in treasuries, you are obviously not going to earn the necessary spread. You have to take some risks in your investment portfolios. If you are going to choose to invest in treasuries, you are going to have to mismatch and anticipate which way interest rates move. Short of that, you are going to have to take some other kinds of risk: a credit risk, a currency risk, or, possibly, a callability risk.

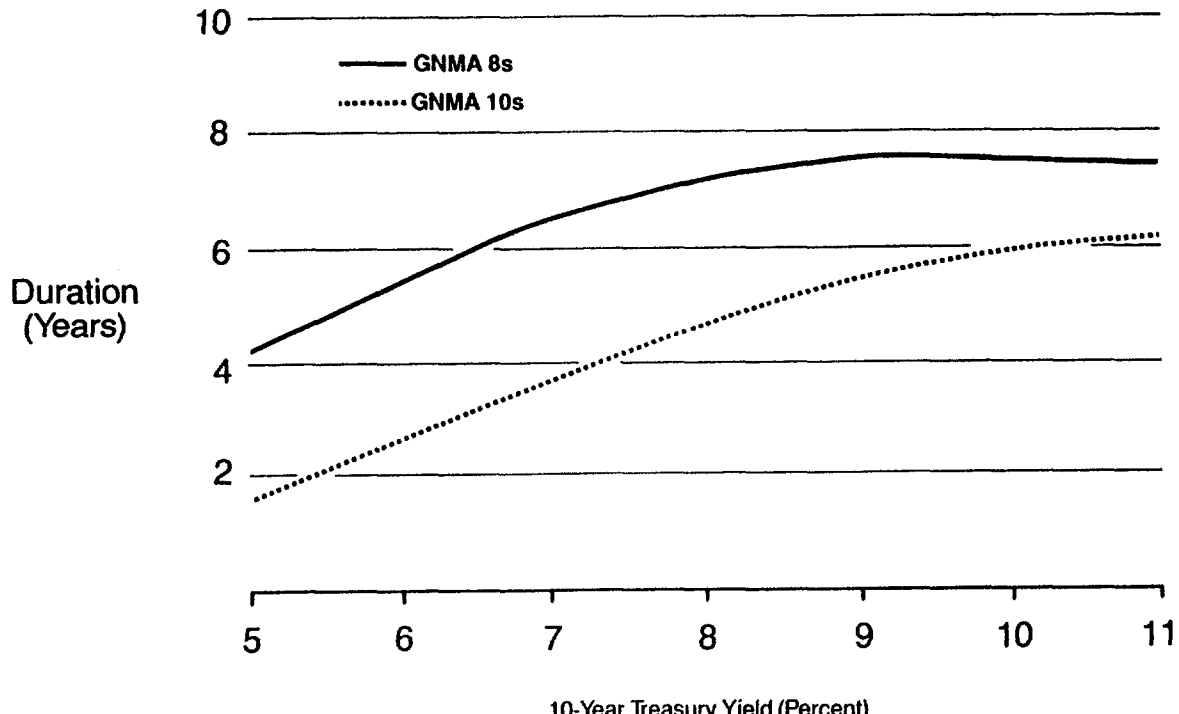
The typical investments that insurance companies have used are GNMA Securities. GNMA is a federal agency which pools together residential home loans, puts them into a big package, and sells them back to investors. It is mortgages on homes. You get the cash-flow from those mortgages and we can see that it will be a highly interest-sensitive cash-flow. As interest rates go down, one would expect homeowners to prepay their mortgages. This generates additional cash flow. If interest rates go up, people are happy with their mortgages and do not prepay, giving you a very long security.

As in the case of our SPDA or single premium whole life, we have an interest-sensitive cashflow stream. In fact, we use the same models to analyze the GNMA as we do to analyze the SPDA. The interest-sensitive cashflow of the GNMA leads to a very interesting duration property. It looks almost exactly opposite to the durations we just looked at for the SPDA or the single premium whole life.

The duration property of the GNMA slopes from the lower left to the upper right (Graph 3). As interest rates go up the duration gets longer; as interest rates go down the duration gets shorter. This is exactly opposite to the duration

GRAPH 3

Duration versus Yield



properties we had on the SPDA and single premium whole life. This is neither good nor bad but it presents another risk. We can match the duration of our assets and liabilities and we can get these lines to cross the duration lines of the SPDA and the single premium whole life. But as you can see it will quickly get out of the match position if interest rates should vary either up or down. We have to know if we are being fairly compensated on the GNMAs. Was it a good or a bad investment?

A number that indicates to us the value in the GNMAs, drops directly out of our pricing models. Essentially, this is the same model that we use to analyze insurance liabilities. All our models first start with a current coupon treasury curve. From that treasury curve we will generate a number of interest rate scenarios to use in our cash-flow analysis. Using these interest rate scenarios, we will project cash-flows along each scenario and analyze what type of cash-flow instrument we have. In order to project the cash-flows, we need a prepayment model. The interest rate scenarios and the contractual terms of the mortgage backed security or the GNMAs are going to drive the prepayment model. Given a particular interest rate environment and the terms of the GNMA, our model says it will prepay at a certain rate which gives us the cash-flow. We do that quarter by quarter for each interest rate scenario.

We could replace the prepayment model and contractual terms for the mortgage backed security sections of our model with a prepayment model and the contractual terms of the single premium deferred annuity or the single premium whole life. It's the same principle: we are just trying to project cashflows along some interest rate scenarios. Choosing the interest rate scenarios is very complicated because they must be based on option pricing theory.

We then take our projected cashflows and discount them back at treasury rates plus an interest rate spread. We iterate for the interest rate spread that gives us the current market price on a GNMA security. If this interest rate spread is high it indicates the GNMA is probably a good buy. If this interest rate spread is low, it indicates that it is probably a lousy buy.

While that is all good in theory, we would like to go back and test it and see if it really works. We were able to do that and Table 1 has some of the results.

If we purchase the GNMAs at particular spread levels, what kind of return did we get versus the U.S. Treasury of the same duration?

The top line of Table 1 shows that if we purchased the GNMAs whenever its option adjusted spread was zero or below, we got a marginally higher return: 14 basis points over treasuries over a 6-month holding period. However, it was just as likely to underperform treasuries as it was to outperform them.

If we went to the other extreme and bought the GNMA whenever its option adjusted spread was above 100, we achieved a differential return of 367 basis points. This happened 100% of the time over the period we back tested this. This was a five-year period during the decade of the 1980s. The 367 basis points is a very hefty additional return. That exceeds 3.5% over 6 months or 700 basis points per year. Are we being compensated enough by this extra yield?

During the period from 1974 through 1986 Graph 4 illustrates that the default rate on junk bonds has varied quite a bit from year to year. The default rate has been as high as 4.49% of outstanding junk bond assets in 1977, and as low as .19% in 1979.

The number for 1986 was preliminary when we made this graph. It finally came in at 3.4% for 1986. That's primarily because of LTV Corporation and its default. Thirty-three issues defaulted in 1986, and 10 of these were related to LTV.

The average default rate for this entire period was 2.22%. That isn't the net cost of defaults, however. When a junk bond defaults, it is worth something in the secondary market. It is obviously worth part of its par value. Some years, it is a very good value -- up to 60% after it goes into default. In 1986, the average recapture rate on junk bonds in default was 35.5%.

If we consider the market value of junk bonds in default, the net cost of default over this period, from 1974 through 1986, was 154 basis points. So historically speaking, you have been more than compensated for the risk of owning junk bonds.

Identifying Value Relative to Treasuries

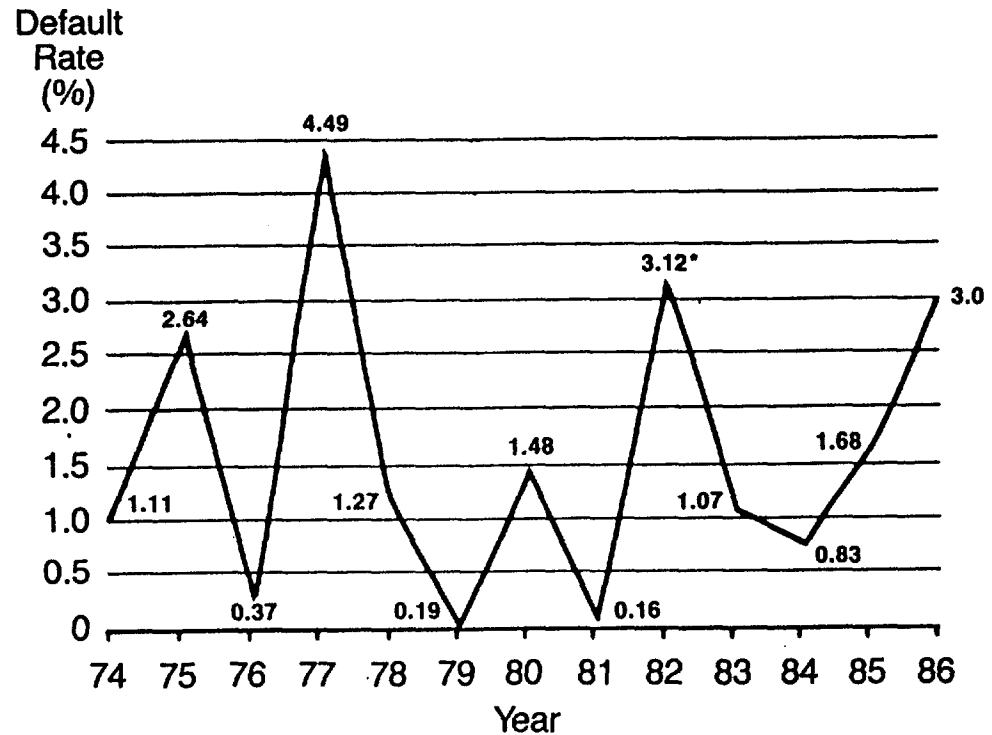
Comparison of 6-Month Total Returns
Mortgage Backed Security (MBS) versus
Equivalent Duration Treasuries

TABLE 1

Option-Adjusted Spread	Differential Return	Frequency of MBS Outperformance
Below 0	14 basis points	47%
0 to 50	18	59
50 to 100	191	88
Above 100	367	100

- When option-adjusted spreads are historically high, MBSs regularly and substantially outperform duration-matched Treasuries over 6-month periods.
- The converse also holds: MBSs generally underperform Treasuries in periods of low option-adjusted spreads.

Public Straight Debt Default Rate As % of High Yield Debt Outstanding



*Excludes Johns Manville. If these issues were included, the 1982 default rate would have been 4.06%.

Another question is, can you buy a large enough portfolio to get the default rates of the marketplace? Obviously, if you own one bond it either is, or is not, going to default. So you have to buy a diversified portfolio. How many bonds do you need in this diversified portfolio? Maybe not as many as you think.

We have found that the standard deviation of your returns are reduced rather quickly as you add extra bonds into the portfolio. Graph 5 indicates that as few as 8 to 10 bonds randomly selected and placed into a portfolio will give you the characteristics of the entire junk bond market. Of course, you would want to temper this with your own credit analysis and also try to diversify some of this credit risk by diversifying industries and maturities.

The last property I would like to mention about junk bonds is that they are not entirely bonds. They also have some other characteristics.

Let's look at a simple capital structure for a company: Our company has two components; a $100 million bond issue and some common stock. As long as the firm is worth more than $100 million, as shown on the "X" axis of Graph 6, the value of the firm is the sum of the $100 million worth of debt and the residual amount, or the equity value, of the firm. However, if the value of the firm falls below $100 million, the equity is worth nothing. In effect, the bondholders now own the firm since they have a claim on $100 million worth of assets.

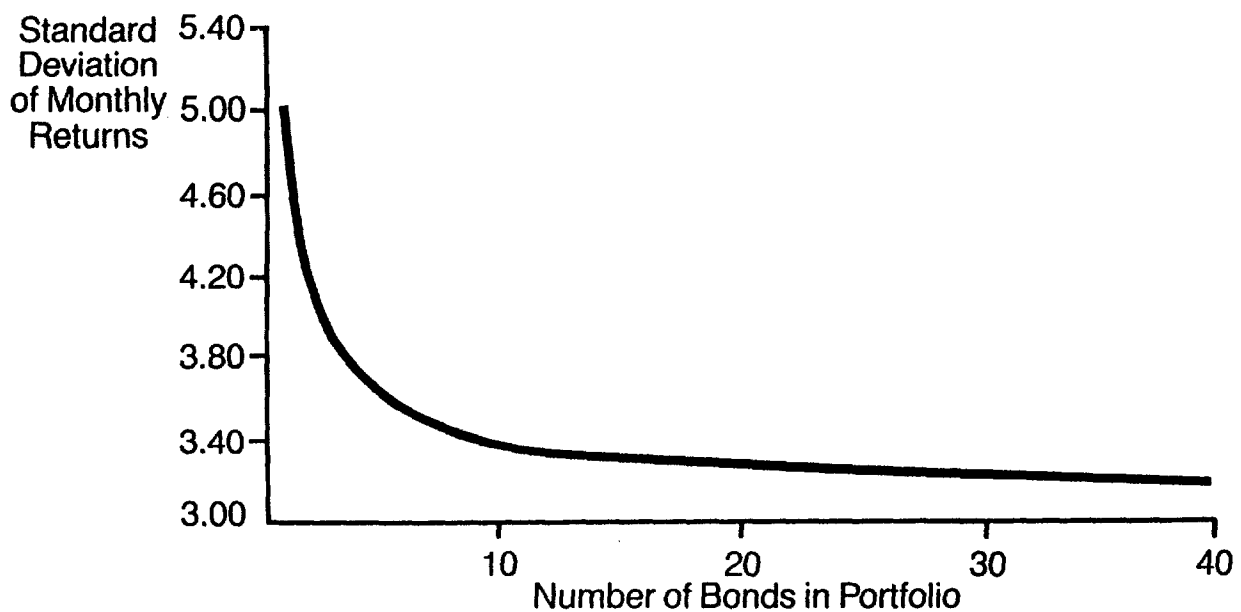
You can see that the lower the value of the firm relative to the amount of outstanding debt, the more the debt should behave like the equity of the firm, and not like a bond. We, in fact, see this property when we look at it in Table 2.

As we look at the correlations of price movements of corporate bonds against the price movements of interest rates, as indicated by treasury bonds, and also as they correlate against the price movements of the underlying common stock of the corporation, we can note some very interesting results.

If we stratify the universe simply by looking at the debt rating, we can see that investment grade bonds, triple A down to single A, have a very high correlation with movements in interest rates. You would expect this; they look like bonds. They have a very low correlation with what the underlying stock is doing.

GRAPH 5

Reduction in Standard Deviation Through Diversification



GRAPH 6

Equity and Debt Components of Firm Value

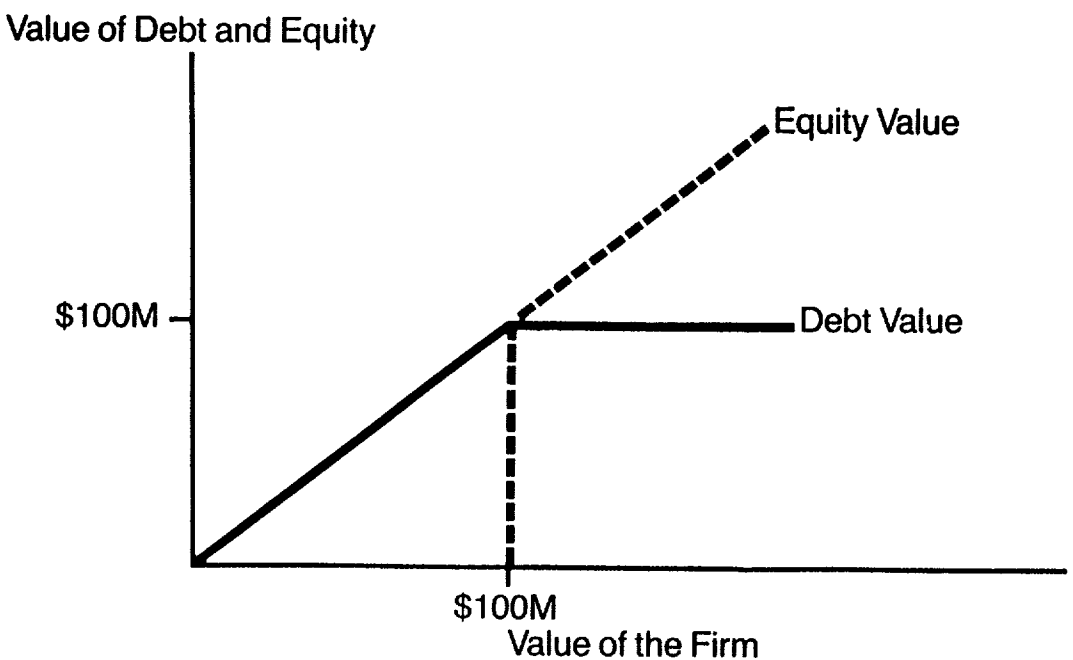


TABLE 2

Corporate Bond Correlations

Rating	Correlation with Treasury Bonds	Correlation with Equity
Aaa-A	.86	.09
Baa-Ba	.77	.25
B-Caa	.51	.28

However, if we get slightly into the low investment grade to the high class junk bond area, we see this correlation with treasury bonds start to deteriorate and we see the bonds starting to behave more and more like the equity of the company. Instead of moving with interest rates, they move with stock prices. If we go all the way down into the real junk, we see that only 50% of the price movement is now coming from movements in interest rates. The rest of the price movement is coming from what's happening with the economics of the firm itself. As the debt/equity ratio grows you could make the argument that these should be held at market value much as an equity would be held rather than continue to hold the bond at statutory amortized values.

MR. PETER HEPOKOSKI: I will be discussing life insurance company investment strategies from a surplus management perspective. This is an intriguing issue that combines two topics that are timely for our profession: first, the concept of target surplus, or required surplus, and second, life insurance company investment strategy. This combination allows us to study the trade-offs between interest rate risk and the cost of controlling interest rate risk, and to measure these trade-offs in terms of required surplus and return on equity. We will discuss a process that uses C-3 management techniques that are becoming more widespread and popular each year.

In my discussion this morning, I will review the C-3 risk and the required surplus concept, cover some analyses that have been made and discuss where we are and what's left to be done, especially with respect to models and to these new investment products and techniques that you've heard about this morning.

These days there are some very sophisticated new tools available. They can be dangerous if we don't fully understand them. I will try to create an awareness of the issues and risk that we need to understand. I will try not to make this highly technical, but it will be necessary to skirt the edges of some technical issues and concepts along the way.

THE C-3 RISK

Let's consider the C-3 problem for life insurance companies. Here is an example of a company that has matched its assets and liabilities for a hypothetical interest-sensitive line of business.

	MARKET VALUE (000,000)	Duration
Assets	$500	4.0
Liabilities	475	4.0
Surplus	$ 25	4.0

Here the market value of the assets and liabilities are shown along with the surplus numbers. The durations of the assets and liabilities are equal at 4.0, and accordingly, the market value surplus also has a duration of 4.0.

For small interest rate shocks the price curves of the assets and liabilities have essentially the same slope. The durations and their derivatives with respect to interest rates are equal. The prices change by a four-for-one factor; that is, a 4% change in price for each 100 basis point change in interest rates.

For large interest rate shocks to the hypothetical interest-sensitive product line, the market values of the assets and liabilities do not move in concert. The shapes of the price curves are very different and unless interest rates stay within a limited range, surplus will be impaired. The mathematical explanation for this is the convexity difference. Convexity is the second derivative of price with respect to interest rate. Peter Noris alluded to convexity earlier.

In this example, the convexities of assets and liabilities are not equal, so durations, and thus the market values, diverge as interest rates move further and further. If I can accomplish anything here today, I hope it's to impart an appreciation of convexity to go along with the appreciation of duration that many of you already have.

We should note: the more the convexity, the better for the investor or lender. For most traditional assets, an estimated market value based on duration times change in interest rates is conservative. This is true regardless of the direction of the change of interest rates. The price curve pulls up and away from the tangent line that represents duration. The faster it pulls up and away, the greater its convexity and the greater its price relative to a lower-convexity price curve. If it pulls down and away, it has negative convexity.

Embedded options are a key reason, though not necessarily the only reason that the convexities are different for assets and liabilities. If we were to summarize the typical problem, it is that the insurer is a writer of options on both sides of the balance sheet. On the asset side there are calls and prepayments. On the liability side, there are policy surrender and loan privileges which are put options.

Relative to an option free balance sheet, when interest rates change the insurer suffers an adverse market value change on one side of the balance sheet without a corresponding change on the other side. This puts the squeeze on surplus. This is why the insurer doesn't realize its apparent interest rate spread, no matter what traditional assets are bought. This is the C-3 Risk -- the risk of loss due to change in interest rates.

The insurer, as the writer of the options, may not have anticipated the possible interest rate shifts, either as to degree (by underestimating the volatility of interest rates) or as to speed (by assuming that occasional rebalancing could address the shift adequately). Alternatively, the insurer may have failed to price the option. As the writer of the option, the insurer should collect a premium for the option. That's what some of the yield spread is for.

Our challenge is to control C-3 Risk exposure by the best choice of traditional investments and possibly supplement them with new vehicles like those discussed today. Our task is to figure out how to minimize the C-3 Risk in the face of our needs for profitability and surplus.

REQUIRED SURPLUS

Let's consider the concept of required surplus. Surplus is a precious commodity in most life insurance companies. A recent paper by Richard Kischuk, "Strategic Management of Life Insurance Company Surplus" *TSA* XXXVIII, outlines a methodology for surplus allocation. Each line is allocated surplus in relation to the risk it undertakes, using a measure of probability or threat of insolvency. The required surplus is related by formula to the level of risk. More risk means more required surplus. More surplus means that more investment income is necessary to meet the return-on-equity target.

One major component of the required surplus formula is a provision for the C-3 Risk. I'd like to review some analyses of this C-3 component of the required surplus formula, some published and some the results of my own research. The general approach on all of them is to use an asset/liability simulation model across a number of scenarios. The data I'll discuss is illustrative only. It is up to you to appreciate the degree to which investment strategy may affect the risk. Please don't fix on the level of the numbers as being appropriate for your particular case.

The results of these analyses depend on pricing and reserve assumptions, on interest rate scenarios, on the assumptions as to the relationship between cash flows and interest rates, and on the severity of the criteria for defining surplus adequacies.

An example was presented in the Kischuk paper regarding the C-3 Risk component of the required surplus formula for an individual annuity with no surrender charge. It showed the C-3 risk component would produce (1) no additional required surplus if the assets mature in one year; (2) required surplus equal to 5.5% of assets if the average maturity of the assets was 5 years; and (3) required surplus equal to 8.5% of assets if the average maturity of the assets was 10 years.

The C-3 Risk Task Force produced some research papers in the early 1980s. This was impressive work considering the "state of the art" at the time. One of the papers presented some "reserve adequacy factors" for a single premium deferred annuity. Using an investment strategy of seven-year bonds with sinking funds, no additional surplus was needed for the C-3 Risk. For a 10-year bullet bond strategy, 6% of reserves were needed as additional surplus, and for an investment strategy of 20-year bullet bonds, 39% of reserves were needed. The criterion they used in their analyses was sufficiency by the end of the projection period and not for each year during the period.

Last spring, Allan D. Affleck and Dennis L. Stanley presented a paper, "Universal Life -- Target Surplus Requirements for the C-3 Risk" at a seminar of the Individual Product Development Section. They used statutory solvency each year as their criterion. They looked at two investment strategies. One was a mix of maturities that averaged 8.4 years at purchase; it produced, for

this universal life product, a required target surplus of 4.8% of reserves. The second investment strategy averaged 12.9 years at purchase and the required target surplus was 10% of reserves.

I have done some universal life modeling that used 50 interest rate scenarios stochastically generated, and criteria of 95% and 98% confidence in ongoing statutory solvency for the line of business. These were the results:

C-3 COMPONENT OF REQUIRED SURPLUS
(% of Assets)

Average Asset Maturity at Purchase	95% Confidence	98% Confidence
3 years	5%	7%
6 years	6	9
9 years	9	17
12 years	18	36

It was particularly interesting in our work to notice that some of our worst case scenarios involved the underlying guaranteed crediting rate becoming operative in some low interest rate scenarios. With the level of interest rates today, this may be one of our next real interest rate risks.

All of this analysis so far used traditional investments. Our panel has been discussing some new techniques and instruments that have the potential to reduce C-3 Risk further, by lowering the probability of adverse deviations and lowering the required surplus accordingly.

Keep in mind, however, that buying these types of stop-loss insurance in an efficient market may reduce the return as well as the required surplus. The return on equity still needs attention. To achieve a low required surplus with substandard return on equity is generally not desirable.

Risk-taking is our industry's business and we make money by knowing our risk tolerance and taking justifiable risks. Frequently this involves finding market inefficiencies, or niches, or areas of expertise and this can take place on either side of the balance sheet. If we can use some of these tools to reduce the interest rate risk, we can potentially accept more of the traditional insurance risks with which we have historically had more expertise. Later on, I'll discuss this concept further.

(As an aside, keep in mind that the C-3 Risk is influenced from both sides of the balance sheet. We need to think of insurance product design and dividend and interest rate crediting strategies as tools for C-3 Risk management. For example, I would refer you to the Affleck/Stanley paper that stressed the significant impact of interest rate crediting strategies on required target surplus.)

EVALUATING THE NEW INVESTMENT TOOLS

Evaluating these new investment instruments and techniques becomes a challenge. Let's assume you've used some required surplus/profitability analysis to help choose a basic investment strategy, to schedule maturities and duration of assets, perhaps even whether or not to gradually shorten the investment strategy over the lifetime of the product.

Let's further assume that you are considering buying options or creating synthetic assets. You are aware that these options have extreme convexity (frequently negative and frequently very large in absolute value), but that they will help offset the imbedded options in your balance sheet and reduce your C-3 Risk. However, you are worried about the cost of the hedge, because you are paying someone else to take part of the risk that you have insured the policyholder against. You want to know how to evaluate your alternative. How do you do it?

First of all, understand that this is a tough problem for the entire industry, or at least the part of the industry I have talked to. There is an infinite number of combinations of investment products and I'm going to offer more questions than provide answers.

Research, discussion, and published analysis is only in its infancy relative to what we'd like. Our products, on both the asset and liability sides, are new. Most of us are still getting "up to speed" on the first level of asset/liability management; for example, matching durations or modeling straight bonds against insurance liabilities.

Furthermore, each tool is not necessarily good or bad. It may increase or decrease the C-3 Risk and so it has to be used appropriately. This is analogous to some discussion we had a few years ago with an insurance department that

suggested that using interest rate futures was speculative. We suggested that not using interest rate futures was speculative. The response to both suggestions is that it depends upon the assets and liabilities.

MODELING

In my opinion, modeling is necessary in order to evaluate the risk control products we've been learning about. There are two ways to approach modeling. An option pricing model, which is a traditional vehicle of the investment industry and an asset/liability simulation model.

These models are variations of the same theme. They both involve looking at possible interest rate paths. They both require assumptions as to the effect of interest rates variance on cashflows. They both run through a number of possible outcomes and analyze or calculate a price depending on the possible outcomes.

The models are useful on a trial-and-error basis, or through an optimization routine, to select an investment strategy. But there are some significant differences between the option pricing model and the asset/liability simulation model.

Regarding the option pricing model, the investment industry is beginning to develop some generic ones and some very specific ones for fixed income securities. These are usually binomial models that handle simple options one at a time, and calculate only a price, as their name suggests. These can be useful to help understand options. One way is to shock interest rates twice and get option prices at three different interest rate levels. From this you can derive some implied duration and convexity numbers and compare them for various options. The reference I would suggest for the option pricing model is the Robert P. Clancy paper, "Options on Bonds and Applications to Product Pricing" in Volume 37 of the *Transactions* and the discussion of that paper, especially that of Peter D. Noris and some of his associates regarding the pricing of options in an SPDA.

The second model is the asset/liability simulation model. This is the basis for the required surplus data that I reviewed earlier. This model involves simultaneous simulation, or projection, of all relevant cash flows and financial results

on both sides of the balance sheet. It requires a big program, but it is focused on our industry's products. It will handle different options at the same time and handle tax and accounting influences better than an option pricing model. This model will provide profit measures of asset/liability appropriateness and direct feedback on the required surplus effects.

The most effective approach for analyzing these new investment products would be to modify our asset/liability simulation models. Most are set up to handle straight bonds or mortgages usually with standard call or prepayment assumptions. They do handle exotic products on the liability side. We should seek to customize the models, as they are needed to handle some of these exotic investments such as option, mortgage-backed securities and interest rate guarantees. Then we can get our results in terms of profit, return on equity and required surplus, and we can get them with confidence limits.

Perhaps we are not far from achieving this. We are getting better as an industry; our computers are also getting better. In fact, computers are largely responsible for many of these new investment products existing in the first place. Some of you may already have expanded some of your modeling capabilities for these new investment alternatives.

What should the rest of us do for now? First, make sure that you have done your Level 1 analysis, which is asset/liability risk measurement considering the traditional fixed income investments. Then, do some research. Your investment people are hearing about these new investment products and techniques that are becoming available. The investment houses are presenting research data quantifying some of this. The Society of Actuaries is providing sources; one I would recommend specifically would be the tape of the "Dynamic Investment Strategies" seminar that they presented last December and January. Try some option pricing models, or write some simple ones of your own. Compute the duration and convexity of some asset and liability options and estimate their effects on surplus with changes in interest rates. Finally, if possible, make enhancements to your asset and liability models. Perhaps the next wave of modeling after the consultants have their valuation actuary support in place will take care of our needs in this area.

THE NEW INVESTMENT TOOLS

Now, I have some specific comments on the tools that we have discussed here today. GNMAs and other mortgage-backed securities as Peter Noris suggested tend to have low or even negative convexity. The high nominal yield spread over the Treasury market compensates for this low convexity. If interest rates stay within a narrow range, the mortgage-backed security performs beyond expectations. But, if interest rates make a significant move in either direction, the advantage turns to a disadvantage. This pattern is very different from bonds. And this is important -- don't do your asset/liability analysis assuming that regular bonds determine your optimal maturities, or even durations, and then buy GNMAs with the same average maturity or same duration, and think that you have the same level of C-3 Risk.

I recommend research from the investment houses regarding option adjusted spreads for GNMAs, such as the type that Peter Noris has just reviewed.

Interest rate swaps shorten or lengthen the fixed-income securities without altering the basic characteristics. It is reasonable to model these as if the shorter or longer investment strategy were in place except that the original embedded option risk must be recognized. These instruments have particular value for an existing line if you're developing a required surplus system. As Jim Barry pointed out you can adjust your asset/liability mismatch and required surplus needs without a huge asset trading program.

Junk bonds influence the default (C-1) Risk the most and also affects the required surplus formula. But spread risk is also a factor. Yields are likely to be more volatile for junk bonds than for higher quality bonds and the volatility measure must be set accordingly in the required surplus calculation for the C-3 Risk component.

I have seen some of the more exotic instruments, for example, interest rate guarantees, which were discussed here today; but I don't have any answers on those. Our industry will need to analyze them because they are very powerful tools with significant implications. Modeling will probably be helpful here as well.

RISK-TAKING

What about a risk-taking strategy going forward? Interest rates are unforgiving. There are some tremendous subtleties to understand about interest rates; for example, convexity or the characteristics of GNMAs. The severity of the interest rate variance is also not always apparent. The importance of interest rates to our competitiveness and profitability, however is very apparent.

At the risk of comparing poisons, consider that other insurance company risks are generally more fathomable, if not more easily handled. For mortality, pre-AIDS anyway, fluctuations have traditionally been handled. For morbidity, we have had wide swings but these are generally understood. For these risks, we already have reinsurance alternatives which we understand as an industry. The expense risk is more controllable through actual expenditures or through expense allocation methods. The C-1 Risk may compare to the C-3 Risk in terms of its potential impact, but we have a reasonable concept of its effect on profitability.

If we can shift more of our risk-taking from interest rates and into these areas, we may achieve a more desirable, better balanced risk exposure profit and make better use of surplus. This is a decision that each company has to make, considering its specific situation.

CONCLUSION

I would like to conclude my presentation by leaving you with four goals:

1. Understand the C-3 Risk more and more. This includes interest rate variance, interest rate dependent cashflows, duration and convexity and required surplus effects.

2. Learn about available investment tools, their practical uses, their cost, and their value.

3. Put the knowledge and tools together and develop sound products and techniques to manage them. Modeling is a particularly useful technique.

4. Be ready and able to put together a panel discussion at a future Society of Actuaries meeting with more answers to the issues we have discussed here.

MR. CHAPMAN: I want to direct one question to Jim Barry and one to Peter Hepokoski.

Jim, I interpreted your discussion of maintenance of cashflow in the face of defaulted or near defaulted assets as meaning, in effect, that the bank issues a standby letter of credit based on the credit worthiness of the bond issuer. This raises the regulatory issue that has surfaced recently -- just how much junk should a company own? Is there a volume of junk that would simply overwhelm the bank rating facilities or that would require, to use a reinsurance metaphor, a high level of retention by the ceding company? How would you look at the apportionment of risk between the liquidation mechanism, the type of standby letter of credit you are issuing, and the availability of the junk bond?

Peter, the results of your own simulations as well as the other studies that you referred to indicate the very strong need to go short and to maintain portfolios with limited maturity periods. Has there been a significant amount of research in the relationship between maturity and yield? I think we all remember the inversions of 5 or 6 years ago. Second, how much emphasis does this place on the need to hedge against declining interest rates when you are rolling over your portfolio relatively frequently?

MR. BARRY: You really hit on one of the key issues surrounding all the risk management products. How much risk is too much risk and therefore, how much are you willing to pay for it? How much junk companies can stand is going to be tied very closely to how much they want to pay for these standby facilities.

That in itself will be tied to the level at which they want these facilities to kick in (i.e., the junk bonds' standby purchase facility which kicks in at 60% of stated value is going to be a lot cheaper to the holder than one that kicks in at 75% or 90% or 100%).

Therefore the question becomes, how much risk of default do you want to hold? That will be based on the type of a portfolio you will hold. As Peter has

shown, the default risk diminishes significantly once you hold a fairly diverse portfolio of junk bonds.

Should you decide that that is an avenue to follow, then you might go ahead and purchase a diverse portfolio and then buy the stop-loss insurance, either in the form of a liquidity facility, or in some other form in an amount that is going to cover a reasonably small amount of default risk which hopefully is what would remain in that portfolio. As Mr. Hepokoski noted we do raise a lot more questions than we answer, so it really becomes a matter of doing your own analysis and determining how much risk you want to take. Then we can sit down and discuss what kind of pricing that will entail.

MR. HEPOKOSKI: Some of the required surplus numbers that we talked about might suggest that we should go very short in our investments or recognize that this is from a surplus protection prospective.

We definitely need to look at the profitability and the return on equity numbers. It may very well be that to get an appropriate return, we've got to accept more of this surplus risk. Therefore, we can't say that these numbers alone suggest that we should shorten our assets. We need to look at many more factors.

Looking at the yield curves in an inverted or declining interest rate scenario stresses the importance of choosing a model that produces a wide range of plausible, possible interest rate scenarios.

One of the best things to do after you've done some of this modeling is to look back at some of your worst cases and see if it was an inverted yield curve that clobbered you in that projection. Or was it declining interest rates?

In one of the universal life models mentioned earlier, with the level of interest rates having come down over the last five years, declining interest rates may be one of our real risks. This risk is particularly true with the 4-4.5% underlying guarantee that characterizes many of our products.