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This paper was originally submitted in response to a call for essays run by the Society of Actuaries' Product Development Section in 2003. Nothing has been updated from the original paper. On their 10th anniversary, these previously unpublished comments seem ever more appropriate in today's government manipulated low interest rate environment.

What Happens When Interest Rates Rise?

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Please note that the opinions presented in this paper are those of the author and not of his employer or any other group he might represent.

Interest rates in the United States have been dropping since early in Ronald Reagan's first term, with only a few blips in the pattern. Out of these short periods of increasing rates came most of the big derivatives blow-ups of the 1990s. Orange County, Procter & Gamble, Metallgesellschaft. These companies utilized strategies that worked great as long as interest rates continued to fall. As soon as they rose, even a little bit as in 1994, these entities realized that they had bet their future in order to earn some additional yield. This paper will address some of the risks present in a life and health insurance company, and attempt to describe modeling techniques that will show how susceptible a company is to these risks. This will also lead to strategies that can reduce these risks through proper asset/liability management and internal hedging.

Many exposures can be minimized using a rigorous program of balancing risks. By diversifying across a variety of products and assets, an insurance company can navigate through most interest rate scenarios. Core products are those that provide a base to an insurer regardless of rating. An example would be traditional whole life. Satellite products are sold as commodities, like SPDA sold through the stockbroker channel. Building a company around core products, with secondary emphasis on satellite products will maintain proper focus on the big picture. The proper mix of products and assets can be created through scenario and stress testing. While techniques such as risk neutral pricing scenarios might be useful for dynamic trading strategies, they should be reviewed for reasonableness when used for anything else. Common sense will take an actuary far as a risk management practitioner.

Managing the interest rate cycle

Interest rates cycle. They go up. They go down. They are rarely stable. The economy is too hard to manage to expect interest rates to stay level forever. The very fact that the market thinks they have stabilized causes risks to be taken that eventually results in renewing the seemingly dead interest rate cycle. The budget surpluses of the recent past led to a popular movement to lower taxes, and this legislation continues to progress while terrorism and the "Axis of Evil" is addressed at large cost. Guns and butter equal inflation. Period. It's only a matter of time. Thus, interest rates will eventually rise.

Moderate levels of inflation can have positive impacts, as consumers feel better having an annual merit raise than not, even if the real rate of increase is the same. Insurance companies who anticipate this upward movement will perform better in the coming years than those who survive by selling whatever is popular with the field. Commodity products carry large risks.

Duration matching

For many products, duration matching is a very useful exercise. For some it is not. Universal life duration changes so quickly with interest rate changes that it is nearly useless except to illustrate how little we understand the products actuaries have developed. Universal life in particular reacts in unexpected ways since the argument is circular; lower interest rates leads to higher than expected net amounts at risk, which are applied against cost of insurance charges. Enterprise duration is very useful and helps the company understand its internal hedges and risk exposures. Key rate durations have lost their popularity in recent years, as the shape of the yield curve has stayed fairly stable. A barbell cash flow strategy might work well in recent economic environments, but measuring this risk using option adjusted duration is a fallacy. If the yield curve inverts or flattens these risks will appear. Companies will claim to be surprised, but some additional analysis utilizing the key rate durations of both assets and liabilities will pay dividends later.

Hurdle rates

Capital allocation and hurdle rates are two of the most misunderstood metrics needed to successfully manage an insurance company. The two cannot be discussed independently. Companies can adjust either assumption, but only the opportunity dollar cost of capital really matters (capital times hurdle rate). Lowering one and raising the other has minimal financial impact in total. Whether a company uses economic capital or RBC as a benchmark, increasing interest rates will impact the cost of capital. Since interest rates cycle and products, once written, often remain on the books for many years, the opportunity cost (hurdle rate) should reflect both short and long term expectations for interest rates. Many successful investors do not allow their hurdle rate to fall below 10% for this reason. It builds in an additional margin of safety when rates are low.

Who are we kidding? Projections

Many people much smarter than I am have spent a lot of time devising interest rate generators designed to show what could happen in the future. How good are they? Are they used to make decisions? Should they be?

These models are very good in most interest rate environments in creating a variety of scenarios, including adverse ones. These are the interesting results. Which scenarios create bad enough results that a company should hedge its exposure? Unfortunately, when interest rates are low, these models have an upward bias. It's hard, if not

mathematically impossible, in most interest rate generators to replicate the current Japan scenario. Level and slow up scenarios are the norm. In the current low environment, deterministic stress scenarios are much more useful to manage risk. Most actuaries have a pretty good idea of which combination of products and asset types have large risk exposures when put into a certain interest rate environment. By using common sense, the actuary can head off these risks.

Most stochastic analysis is used for ALM work. If these projects show a large problem they will be shown to senior management, but if they don't then they become exercises dutifully performed. Companies with Asset/Liability Committees do somewhat better, but few companies can claim "quants" in their senior management. No matter how good the analysis is, if management doesn't use it to make decisions it is underperforming its potential. Basic ALM work can provide the platform to build efficient frontiers for investment strategies, crediting strategies, decisions to increase or decrease product lines and other marginal analysis.

Many companies project short-term results using a level interest rate scenario, or something similar. Perhaps the forward curve is unwound. Since the normal shape of the yield curve is monotonically increasing, this results in aggressive projections and a tough standard for incentive compensation. Of course, generally no dynamic lapsation is included in the projections, so even more optimism is generated. If the forward curve plays out asset spreads will likely tighten, making it tougher to hit the estimates. The curve in early 2003 is very susceptible to this risk since it is very steep (and has been as the Fed manipulates the short end of the curve).

Since the level interest rate scenario is often close to a best case for an insurance company, it is important to stress test projections using several recurring and consistently applied alternative scenarios. Included should be scenarios where the new money rates for general account assets are up/down 100 bps as well as several equity scenarios (both up and down). Often a scenario that cycles both up and down is the most stressful. Option exercise of liabilities and assets should be considered. Other scenarios, perhaps discussed qualitatively, would include excess mortality, morbidity and defaults.

Products – the liabilities

Insurance companies write a wide variety of products in various distributions. Each of these is designed to protect the insured from a difficult financial situation in return for a premium. The law of large numbers allows insurance to be a win-win for both policyholder and insurer. The policyholder pays more than the best estimate would require, and the insurer uses economies of scale to offset the additional expenses incurred. Many insurers have taken on risks where economies of scale and diversification through the law of large numbers do not apply. Interest rate and equity risk is non-diversifiable. Risk reduction requires hedging. Unfortunately, some insurers have not recognized this increase in risk taken. They have continued to price using point estimate

assumptions as if the law of large numbers worked in every case. While the Guaranteed Minimum Death Benefit feature of variable annuity products has received the most publicity thus far, it is not the only risk that fails under the law of large numbers. The actuarial profession needs to change the perception that point estimate methodology defines “actuarial pricing”. Dynamic assumptions must be used wherever possible, keeping in mind that some distribution channels are extremely savvy and will exercise their options efficiently. As equity markets dropped in recent years, many GMDB writers have publicly exclaimed their surprise that these features could impact their income statements. Had they performed the stochastic analysis that actuarial standards of practice require, and utilized the results, these companies would be better off today.

This is a wake up call for insurers who have taken undiversifiable interest rate risks through product design and corporate strategies. There is still time to hedge many of these risks, but time is running short and the cost is going up.

Individual Deferred Annuities

Single premium deferred annuities sold to individuals are the poster child for interest rate risk, so they both lead off and are allocated extra space in this paper. Many of the issues addressed here also apply to other product lines. There are several risks to be aware of.

- When interest rates rise slowly, this block should be able to maintain a reasonable profit margin. There won't be any outsized gains, but the block will not do poorly. Keeping the credited rate within about 100 bps of new money rates should keep excessive surrenders at bay for most going concerns.
- When interest rates rise quickly, this block will roll over through surrenders. Sometimes it will be an internal 1035 exchange, but usually the policyholder will look to a new company. This is especially true in cases where the marketer has no loyalty to the original insurer, such as a bank or stockbroker, and receives a new business commission when the policy is rolled. Unlike a decreasing interest rates scenario, if the company survives the flurry of activity associated with the run on the bank then it will have learned a valuable matching lesson without the resulting insolvency. Management will need to be very quick on its feet. Anticipating the situation by keeping some additional cash on hand and shortening the asset duration are techniques that will reduce the insurer's risk. Both techniques provide constraints that will also reduce the yield earned.
- Concentration risk occurs when your in-force block of business is controlled by a single entity. This could be a single agent who has been successful in the product or a single bank or marketer. If the controlling person changes allegiances, the insurer has no alternatives. A mini run on the bank results. In many of these cases the self interest of the marketer can work in the insurer's favor. If the marketer rolls the policy before interest rates rise and when it is a push to the policyholder they have done no favor to their clients.

- The SPDA product is generally sold as a commodity, rate driven, product. To be blunt (and hopefully not offensive), it is a whore's market. Highest rate wins. Every year the consumer becomes more sophisticated. One need only look to the recent binge of mortgage refinancing to understand that. Any company blindly assuming that their policyholders will not recognize that it is in their best interests to move to a new contract is making a bet. The bet might pay off for a while longer, but eventually it is a losing bet.
- Because the SPDA is sold as a commodity, there is great pressure on the investment departments of insurers to take risk to provide yield. Risks that are taken include liquidity (private placements), convexity (RMBS), credit (junk bonds) and duration mismatch. Many companies have taken advantage of the steep yield curve recently to mismatch their assets with liabilities. While either their income statement (if they keep the additional return) or their policyholders (if they pass it on) have benefited, it is a risky strategy. The very situation that they are trying to exploit, the steepness of the yield curve, predicts an increase in interest rates that has the potential to destroy companies using this strategy.
- Although this paper focuses on increasing interest rates, it is important to comment on the current interest rate environment as well. While the environment in the United States does not challenge the difficulties currently felt in Japan, the current low environment (the 5 year Treasury rate has been as low as 2.5%) can't profitably support a 3% interest rate guarantee. Lower guarantees are slowly being allowed in the states, and none too soon. Those who laughed at actuaries who wrote contracts where guarantees could be rewritten if the 5 year Treasury rate fell below 3% (they considered this to be an impossibility) are not laughing any more.
- An additional risk relative to the last two bullet points is the lethal combination when RMBS is used to support SPDAs sold to sophisticated investors. When interest rates drop, as has recently occurred, RMBS prepay at a rapid rate. Credited interest rates are able to reduce as well (at least until guarantees are hit). However, when RMBS are purchased to back product when interest rates are low and interest rates subsequently rise, an insurer loses on both sides of the balance sheet. The RMBS extend to become long bonds. The liabilities surrender, creating a run on the bank that has no liquid assets (at least not at book value). If the insurer maintains a competitive rate large income statement losses will follow and the only other option is to let the policies lapse and take the capital loss.
- Newer designs of deferred annuities include market value adjustments (MVAs), which help to pass through the risk of surrender to policyholders. They generally are sold with a fixed credited rate for a number of years that are coordinated with the surrender charge period. At this time everything resets, including the MVA.

Lowering guarantees, using back end commissions to encourage policies to stay longer, MVA features and keeping on top of competitor products can help to solve these issues. Using common sense is important; when others develop products that don't make sense a

company needs to pull out of the market. Hopefully this is temporary, but it does no one any good to write bad business.

The other product in this family of annuities is the recurring premium deferred annuity, sometimes called a flexible premium product. It has an additional risk not found in an SPDA; a policyholder can elect to put in more premium when it is convenient to them. This is generally not a problem when interest rates are rising, but is a major policyholder option when rates are low. Some distribution channels are starting to take advantage of this free option.

Immediate Annuities

Immediate annuities (also supplementary contracts), generally sold as single premium but sometimes multi-premium or annuitized deferred annuities, have limited interest rate risk in an increasing interest rate environment. If the product is priced appropriately in a low interest rate environment and rates rise, the benefit stays with the insurer since the policyholder's benefit is locked in at issue and is often not surrenderable. Even investing in highly convex assets like RMBS will not be a problem, although the insurer will not get extra returns. Newer products might be underwritten, with higher benefits payable to those with higher expected mortality. The interest rate risk on most of these policies is negligible, overwhelmed by the mortality bet being placed.

Group Annuities

The major risk in an increasing rate environment for group annuities is a duration or cash flow mismatch. Funding agreements are especially susceptible to the duration mismatch strategy. An insurer that is not cash flow matched, for example backing a floating rate liability with a longer floating rate asset, is exposed to the risk that spreads might widen before the liability renews or is resold. Of course, this is much better than backing a floating rate liability with a fixed rate asset (no matter how much extra yield was earned in the meantime). GICs and SPIAs sold in the institutional market will generally perform well in a rising interest rate environment as long as assets have not been invested longer than liabilities. Reinvestment risk is generally the bigger risk, and is minimized in a rising interest rate environment.

Life Insurance

Traditional life insurance products will generally perform better in a rising interest rate environment. While margins might still be challenged by earned rates less than pricing assumptions, it is an improving trend when rates rise. This argument should hold for participating whole life, non-par whole life, term life and group life. There will be some disintermediation, but these products won't be as sensitive as deferred annuities. If rates increase a lot and the "USA Today" effect takes hold, then mortality antiselection will be an issue. Policies sold in the senior market will likely see less sophisticated policyholder behavior, at least for a few more years.

Variable Annuities

The main risk to VA writers in a rising interest rate environment reflects the inverse relationship of bond market values. A guaranteed death benefit with a decreasing account value increases the net amount at risk. Of particular concern is the policyholder that has a large NAAR due to recent equity drops and switches out of equities, and into bonds, right as interest rates begin to rise. Communication to policyholders should make them aware of this risk as well, without attempting to predict the level of future interest rates. A smart policyholder with GMDB in the money would put all their marbles in one extremely risky basket, since this might be perceived as the only way to increase the policy account value at death.

Disability Income

Slowly rising interest rates will provide two positives to a disability income product line. Higher rates, not driven by stagflation, will mean that the economy has improved and loss ratios will improve as borderline disabled are able to find work. If the product was priced properly in a low interest rate environment, additional returns as the initial assets are rolled over at higher rates will accrue to the insurer.

Long Term Care

Unlike disability income experience, no one enters a nursing home facility because they want to. Interest rates will not impact the loss ratios. The investment returns are impacted, and for existing business the company will get to keep any excess profit. Since many of these older products have proven to be under water, this will help keep premium increases down.

Asset Types

Assets often have embedded options that allow the borrower to select against the group that loaned them the money when it economically suits them. Asset allocations should be reviewed to prevent unforeseen risks from impacting company solvency. Cash flow at risk, where stochastic scenarios drive asset and liability cash flows, is a tool that can help the actuary evaluate risks (especially those due to liquidity pressures). Other measures include duration, convexity and earnings at risk.

Alternative Investment Classes

Hedge funds are often driven by perceived inequities in the market value of an asset. Sometimes the investor has truly recognized a mispriced asset class, and sometimes the economic variable that caused the asset class to outperform reverts to more normal levels and the investor loses his shirt. Any fund that uses derivative instruments to perform well in a monotonically decreasing interest rate environment such as we have witnessed for over 20 years will do poorly in an increasing interest rate environment. Of course, this last statement is not entirely true. Rates during this period periodically increased for short periods of time. This is why everyone is familiar with the stories of Orange County and Procter & Gamble. They, and others like them, rolled the dice and lost. Of course they

later claimed to have not understood the risks they had taken. Long Term Capital Management (LTCM), proving that Nobel laureates should stay in academia, is everyone's poster boy for how not to use leverage when buying derivatives. Those who invest in hedge funds that rely on leverage have another risk to address. Their cost of funds will increase along with interest rates as their cost of borrowing increases. Watch for hedge funds to increase leverage to attempt to counter this effect. Due diligence is incredibly important in this asset class. If transparency isn't offered, at least with a lag, don't say you weren't warned to get out.

Residential Mortgages, RMBS and CMOs

There is no more sophisticated investor than the residential homeowner. Let me repeat that. There is no more sophisticated investor than the residential homeowner. Anyone who relies on non-efficient exercise of options granted to Joe Homeowner has already, and will continue to be, both rudely awakened and poorer. And this was when rates were dropping and you could adjust credited rates down on accumulation products. When rates go up and policyholders exercise their surrender options, what are insurers going to do? A residential mortgage written today will likely prepay only for non-economic reasons unless it is an adjustable rate mortgage. The refinancing boom will be over. How bad the result is for the insurer depends on the speed of the increase. Since RMBS assets have sinking fund schedules, some rollover occurs. If interest rates move slowly the impact will not be great. If rates move quickly, liquidity risk and a run on the bank are likely scenarios. Now the liability is gone and the insurer is trying to use a 15-year sinking fund schedule to provide the cash. Ain't gonna happen! The insurer can bleed slowly, trying to match market credited rates on new money, or bite the bullet and sell the asset. This will result in a large capital loss since the discount rate will be much higher than at purchase. This asset class should not be used indiscriminately to back products with surrender privileges.

Callable Bonds

Under increasing interest rates there is no advantage for a company to refinance. Remember, corporate executives own homes too. An insurer might as well collect the premium to allow callability. The premium is likely to be small, but can be considered free money. This is especially true when supportable interest credited rates are already below guarantees.

Equity (Stocks)

Stocks and bonds have both moved up in lock step during the decreasing interest rate environment just experienced. That is unlikely to happen going forward. Market values of investment grade bonds will go down as rates increase. Spreads will tighten initially as economic stability returns, but market values on bonds will reduce overall. If interest rates increase slowly, stocks should perform reasonably well. If they spike quickly due to an oil shock or repeated terrorist strikes that dry up fund supply, all bets are off for most stocks. In a stable, but higher, interest environment the discount rate used to value future

earnings and cash flows will be higher. This will be reflected in lower price to earnings ratios. Higher cost of debt will also lower stock market values.

Below Investment Grade (Junk) Bonds

Junk bonds are an asset type that could perform well in a slowly increasing interest rate environment as spreads tighten while the economy improves and the credit cycle moves beyond its high default/impairment state. The main risk here is not interest rate driven. If the economy tanks, these issues are toast.

Asset Backed Securities

These assets generally will perform all right as long as interest rates don't get so high that the underlying debt burden becomes too high. Credit card receivables should not be impacted since many are already charging close to 20% in order to cover the high defaults. Mobile homes or Harley Davidson loan defaults are driven more by the level of interest rates, so as long as they don't spike too high the ABS should continue to perform.

Derivatives

Derivatives that change based on interest rates are very expensive due to the high volatility recently experienced. It will often be cheaper to internally hedge or use reinsurance to reduce these risks. Swaps and caps are instruments that can help reduce the risk of rates rising, especially if they are written specifically to address scenarios that produce the worst results.

Conclusion

Interest rates will rise again. It is only a matter of when. Proper asset allocation and product balance will allow an insurance company to weather the storm. Internal hedges, writing non-interest sensitive business like traditional life when rates are low and avoiding commodity products like SPDA will also limit the exposure taken. A measure that incorporates duration matching and monitoring of key rate duration matchups will give the insurer a competitive advantage. Recognizing that the level interest rate scenario is yesterday's tool allows result distributions to take center stage. Knowing which risks interact with which scenarios to produce unacceptable results allows that actuary to take the biggest step towards dealing with those risks in an opportune fashion. Practitioners of risk management will build off of prior work and utilize their models to provide an advantage over competitors.

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