SOCIETY OF ACTUARIES

Article from:

The Financial Reporter

February 2000 – Issue 41

Segregated Funds Seminar Illuminates Equity Guarantees Risks

by G. Thomas Mitchell

The Segregated Funds Seminar, September 13-14, 1999, in Toronto was a gem. Themes presented were "Long Term Market Returns" with an emphasis on simulation, global perspective, and impact on cost of guarantees; "Investment Returns for Individual Funds"; and "Policyholder Behavior and Policy Features," with a case study presented at the conclusion.

The full title of the seminar was a mouthful: "Symposium on Stochastic Modeling for Variable Annuity/ Segregated Fund Investment Guarantees." It was sponsored by the Canadian Institute of Actuaries, co-sponsored by the Society of Actuaries and The Actuarial Foundation with corporate sponsorships by RGA Financial Products, The Mercer Group and ERC Group.

Preparations for the meeting were extensive and thorough; the meeting itself well run. Kudos are due to Charles Hill and his organizing committee. All the papers were valuable, and most of the presentations were excellent. My apologies that not all can be acknowledged.

More than 200 attended. The breadth and quality of attendees was notable. Canada and the US were well represented, with some European and Asian participation (Japanese experience with equity guarantees has been quite poor recently, of course). The interplay between Canadian and US experience was illuminating. Attendees included life/annuity product actuaries, financial reporting actuaries, consultants and company people, academics, financial engineers, quantitative investment analysts, traders, Canadian bankers, and reinsurers. One gains a broad perspective from such a gathering.

Canadian Perspectives Valuable

A broad scope of products were covered, including Canadian Retirement Savings Programs (RSPs) roughly equivalent to U.S. IRAs, U.S. variable annuities and U.S. and Canadian mutual fund guarantee products. "Segregated Funds" is Canadian for "Separate Accounts."

The Canadian marketplace is very hot as to equity guarantees. Canadian experience with "living benefits" guarantees of equities is ahead of U.S. experience, which is mainly with death benefits. Guaranteed maturity values are common for RSPs and mutual funds.

Rollups at interest and ratchets to account balances are common guaranteed value formats, as well as 75% to 100% return of premium. Maturity guarantees typically rollover every 10 years. A recent development (fast disappearing because of hedging problems) is "voluntary resets" similar to a "shout option." The client can notify the company at any time (or with modest restrictions) to reset the base for his maturity guarantee to the current account balance. The maturity then is deferred to 10 years (plus possibly a fractional policy year) from the date of voluntary reset.

Companies thought this would cost nothing — that deferring the maturity date offsets the increased value promised. This proves to be not so, and the risk is devilish to model and hedge.

Canada is also a source of separate investment experience, partially coupled to the United States, with greater attention to international experience and currency exchange matters (sad ones in recent years).

To Reinsure, Hedge or Retain Risk?

Every carrier wants reasonably priced reinsurance to take them off the hook for guarantee risks. Every reinsurer would love to retrocede or lay the risk off to an investment banker at reasonable cost. Somewhere at the end of the chain someone has to take risk.

There is "sticker shock" at present — disciplined capital market pricing techniques develop costs several-fold higher than expected value results previously in common use. Risk takers, not surprisingly, want to be paid, and paid well, for taking risk.

There are two views on reinsurance — one that the market has dried up; the other that it is available, but high-priced. One approach by reinsurers is to offer coverage with significant exclusions, such as divergences between index and individual fund performance and divergences due to fund switches.

A practical approach is to carve up risk among risk-taking, hedging and reinsurance. In the real world, neither investment banks, direct writers, or reinsurers can take on the whole risk management and risk taking functions.

Reinsurers want clients to share in risks. The direct writer needs to determine their risk tolerance and take some risk. Direct writers are usually vague about their own tolerances.

Inside the Hedging World

RGA Financial Products in Toronto is active in risk management, asset liability work, trading, and hedging. Rishi Kapur, a modeler, and Marc Carpani, a trader, spoke in a practical vein. Hedging is

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dynamic, Greek-based (derivatives of value with respect to key market variables), day-to-day.

Futures trading costs are very small per London Re's Duc Ho. There are some indications options markets are "drying up." Perhaps insurers' new appetites for options are distorting the market and unbalancing it?

Ravi Ravindran, head of RGA Financial outlined the steps in hedging:
1. Identify all risks
2. Quantify possible risks at least crudely with arbitrary scenarios
3. Determine the important risks to hedge
4. Develop probability distributions
5. Price

Expertise needed to hedge correctly:
1. "Exotics" trading
2. Portfolio management
3. Actuarial
4. Quantitative modeling
5. Product structuring, securitization

Some "dirt" on hedging
Hedging using continual rebalancing using the Greeks can fail during market discontinuities.

Rebalancing is not, in practice, continuous. This gives rise to systemic costs due to higher order derivatives not hedged.

Capital cost of reserves is typically not taken into account in quoting hedging costs.

Emerging Product Features

One U.S. company offers a double your money in 10 years maturity value target (instead of guarantee). The payoff is limited to a percent of the funds, instead of guaranteeing the fund value no matter how low it falls.

Ari Lindner of AXA RE shared his studies on U.S. variable annuity guaranteed income benefits (IB). A typical benefit provides that on or after X years, fixed-income annuitization on a prescribed life contingent form will not be less favorable than the premiums accumulated at Y% (rollup rate) applied at guaranteed fixed-income annuitization rates. Typically X is 10 years. Typical guaranteed purchase rates are at 3%. Typically Y% might be in range of 4 to 6%.

He estimates a 20% utilization rate per year by clients when the feature is in the money. Partial withdrawals and methods of adjusting guarantees for partial withdrawals have huge cost effects. For example, if a premium of $100,000 has fallen in value to $80,000 with a $100,000 death benefit and $70,000 is withdrawn, there will be $10,000 of value remaining, and $30,000 death benefit under a dollar for dollar rule, but only $12,500 death benefit under a pro-rata rule. Results are sensitive to base static lapse rates. Dynamically, lapses may vary based on a mix of recent and long term investment experience on the policy (poorer performance, higher lapses). Guarantees could reverse the effect if they come into play, especially as IB becomes exercisable. Bond funds price cheaper than equities for IB, except at a high rollup rate they are more expensive because they are usually in the money.

Canadian products often are lapse-supported. This is openly acknowledged as both "OK" and a "problem." Note: This is anathema to U.S. state regulators.

Modeling & Computation Advances

Prof. Moshe Milevsky of York University won first prize for an amazing paper giving an analytical solution to the cost of rollup death benefit guarantees, in the case of static policyholder behavior and Gompertz mortality. He concludes on a real world probability basis that the expected value of return of premium or rollup benefits are quite modest versus mortality and expense risk charges.

Ken Seng Tan of Waterloo University won second prize for a good expository paper on "Low Discrepancy Sequences" as an improvement in Monte Carlo sampling efficiency.

Mark Tenney of Mathematical Finance Company described how to develop an economic scenario generator:
1. Develop Interest rate generator
2. Compute bond returns
3. Add equity return features
4. Introduce correlations
5. Build equity like assets

He focused on the problems of "latent variables" in the model that aren't directly observable, and the resulting problem of calibration. Some of these variables may have "reality." Others are mere artifacts of model construction.

Eric Thorlacius of Swiss Re talked about problems in getting an arbitrage free model out of a Monte Carlo "string" model, i.e., many independent scenarios. This compares to binomial or trinomial trees that are easy to make arbitrage free, but explode geometrically in calculations.

Vladimir Ladyzhets of SS&C presented a five-factor Wilkie-like model with three equity funds — EAFE, Small Cap and Emerging Markets.

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Policyholder Behavior

Mike Shumrak of Ernst and Young and Vince Darley of the BIOS think tank presented an ingenious "agent-based model" for policyholder behavior. It consists of many "economic agents" (not insurance

agents), each with a simple internal model for their decision making. It was impressively calibrated, but is definitely not the simplest approach. This interesting method is soundest when accompanied by ample investment in focus groups, interviews, and microeconomics skills.

Steve Craighead of Nationwide presented some policyholder behavior data. Distribution systems have a major impact on policyholder behavior.

He sees churning by broker/dealers (BDs). There is separation risk — a representative moves on, the BD does not reassign a representative so the BD keeps compensation. Thus no active agent is on the case and communication suffers.

Bank marketing is prone to mismarketing. He also sees fraud by agents who have all reports sent to them and charge clients added fees skimmed off of reports prepared by the agent.

The replacement situation is made worse by companies who subsidize surrender charges on an old policy by giving a bonus on the new policy. He also gave considerable real life data and cluster analysis on fund transfers.

Policyholder behavior in general represents systematic risk, poorly understood with poor data, and is not comfortable risk for investment houses, nor hedgable without new securitization techniques.

Shumrak pointed out we can model the policyholder as savvy or naive with big differences in results.

Mike Siegel of Gen Re presented substantial research on policyholder behavior. He compared options involving policyholder behavior to Capital Markets Pricing Model pricing. They are similar, but insurers assume policyholders don't exercise fully rational exercise behavior. The latest code word for policyholder behavior is "boundedly rational."

The policyholder can cancel the contract, unlike conventional option arrangements in finance; i.e., the options are "installment" or "cancelable." This jacks the price up. If the option becomes far out of money, the policyholder can cancel, and the income stream to finance the option dries up.

Steve Prince of Dion, Dunell presented a nice "mobility model" for lapses and fund switches he constructed. If one starts with base lapse rates, and assumes 1) extra lapses if market has just dropped, or 2) extra lapses if market has just risen, then costs are affected almost the same amount either way. This is because recent performance is not a predictor of future performance.

However, added lapses usually decrease costs simply because there are more lapses overall. Finally, lapses because of poor long-term performance do decrease costs.

Fund Returns — Just as We Suspected

University of Alberta's Professor Jacques Carriere confirmed that both U.S. and Canadian managers' performances average less than the indices, vary widely, are not homogeneous with respect to time, and that good long-term managers are rare.

Grant Paulsen of Rimcon found market indices perform close to the normal distribution. Individual funds themselves are much farther from normal. The outliers are mostly on the downside. Foreign hedging is much chancier than domestic. Global index funds have lower correlations with individual funds than North American domestic funds. Even index funds can under perform.

Duc Ho found correlations among world markets drop with longer time periods. Some interesting comments on international funds focused on parsing risk into currency vs. returns in local currency. Correlations, especially in global markets are unstable — they hold for a while then break suddenly.

Black-Scholes, Log-Normal and the Lamppost

There is an old joke about a drunk in a parking lot at night crawling on his knees looking for car keys beneath a lamppost far from where he lost the keys, "because there's more light under the lamppost."

Log normal models and Black-Sholes derived from it are wonderful in their self-consistency, tractability, and mountainous supplies of theorems and literature. Read on.

Christian-Marc Panneton of L'Industrielle Alliance compared lognormal, Stable Paretian Distribution (SPD) and GARCH methodologies for equity returns. Lognormal doesn't really fit. SPD gives a much better fit, but not a miraculous one. GARCH underestimates hedge costs.

The defective fit of log-normal and Black-Sholes is not news. But what to do about it?

Numerous speakers, mostly hedgers and traders, advocated Black/Sholes as the basis for pricing and hedging modeling. Tweak the model to make it work better, but don't trash it. They all warned against inventing different models, thus working outside the lingua franca. I understand this viewpoint for trading work, but it also makes me think of the lamppost.

Professor Mary Hardy of York University, Ontario, presented very interesting and promising research on a "two-regime" log normal model. Each "regime" works exactly like lognormal. Switches between two states are modeled by a Markov chain process (transition matrix). The regimes are distinguished principally by different volatilities, but also different drifts. "Normal" state has typical drift, calm volatility, and a small chance of flipping to "nervous" state. "Nervous" state has very high volatility, negative drift, and a relatively high chance of flipping out to normal state.

For the S&P 500 Index, she derives monthly factors as follows:

State:	*Normal*	*Nervous*
Drift:	.9%	-1.9%
Volatility:	3.5%	7.2%
Chance of State Change:	3.8%	32.8%

Scott Orr of American RE/ Munich Re presented a nice modification of the Wilkie investment /economic scenarios model. Overall Wilkie models were giving answers very close to log normal. Note that Wilkie is driven by log normal

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processes. SPD, regime switching and other modifications to lognormal mostly tend to increase costs. Traditional autoregression models tend toward lower costs, poorer fits. The worrisome costs and worrisome modeling are in the tails.

Actuarial Profession Shot Itself in Foot?

Professor John Hull, University of Toronto, of interest rate generator fame, gave an address on financial engineering compared to actuarial work. Financial engineers use no-arbitrage, risk-neutral pricing for valuing financial instruments. Actuaries use the "actuarial approach" depending on frequency of events in the "real world." Actuaries set up reserves, but financial engineers use "continuous" rebalancing (hedging) strategies. Real world frequencies are appropriate for reserving and scenario analyses. Our interests are converging, and our skill sets are similar.

The financial engineer points out that financial market risk (excluding risks relating to individual companies) is systemic and non-diversifiable. Hence, there is an unavoidable market price of risk. The financial engineer's thought about insurance risks is that they are diversifiable, hence should have no market price of risk.

Let the poor actuary do his/her present values on them, but the actuary is stupid to apply expected values to financial markets and sloppy to adjust for risk by guesswork. The handicap for insurance actuaries is we work in an incomplete, inefficient market without the disciplines of active marketplace pricing.

As an actuary, I see a profession that has been steeped in the expected value method, using realistic to conservative "real" probabilities. However, risk adjusment has always been a part of our profession. The classic approach by utility theory has never really been put to practical use. Ad-hoc margins used to be the norm.

This is now supplanted by stochastic modeling and risk adjusted option spreads since the 1980s. Risk neutral pricing, particularly using risk-neutral probability measures is new to many of us, unfamiliar technically, and baffling (even anathema) to many.

If we want to create a "Big Tent" for the actuarial profession, we are shooting ourselves in the foot by claiming (or not denying) that "actuarial method" equates to using expected values with real world probabilities, regardless of the application. I've seen this stated poorly too many times in recent articles by actuaries.

For the financial engineer's benefit, we need to educate them that there is systemic risk in insurance risks (societal levels of mortality, for example), greater parameter estimation risk than in financial markets, and at some global level, a limit to diversification (such as effects of global reinsurance capacity). Some risks (for example, hurricanes) exhibit very limited diversification potential.

Practice vs. Theory

Prince pointed out that futures exchanges are counter party for futures transactions. Exchanges have never defaulted thus reducing counter party risk. Others expressed doubt about any counter parties in extreme scenarios.

Various comments were made on the problem of evaluating "bad scenarios." Bad scenarios often have lots of good years in them, says Prince.

The issue of time diversification came up — the value of staggered issue dates, new business, anniversaries, reset dates and maturity dates in reducing costs. Those who had done studies on this indicated it had only modest impact and little impact on reducing the bad tails. Mean reversion models produce greater time diversification benefits than non-reverting models.

There were startling differences of opinion implicit in several talks on the accuracy of hedging. Some refused to give percentile statistics on results of hedging because "the cost is always the same."

Others ran rather realistic distributions of how hedging would work taking into account factors such as basis risk, non-continuous rebalancing, approximate hedges, or inability to hedge all facets. These showed distributions of costs that 1) had a higher mean cost than no hedging, 2) had about the same dispersion in the heart of the distribution, and 3) almost completely eliminated upside and downside tails.

Everyone strives for market based pricing for imbedded options — but there is effectively no market for 20 to 30 year puts. The resulting prices involve extraordinary extrapolations.

Prince stated modeling is no better than its weakest link, and there are many important links, which was soon well illustrated.

In the last session, enormous efforts by panelists in calculating several case studies using their different approaches were presented. Unfortunately, the main lesson learned was it is very tricky to lay out clear instructions to achieve comparability. The panel admitted chaos reigned in the results presented.

Even through the chaos, one easily perceived the further difficulty that every practical problem seems to have 10 to 20 critical parameters. Reasonable ranges of assumptions on any one parameter can easily make first significant digit differences in results.

The agenda and about half the presentations are available on the CIA web site at: www.actuaries.ca/meetings/segfund/ar19990913/sessione.htm.

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