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Most policies being developed today request or require that the insured make use of a company "care coordinator," who will review the person's need for services at claim time and develop a "plan of care," making use of the most effective and cost-efficient services.

Long Term Care policies are required, under the NAIC Model as well as under tax-qualification requirements, to offer the insured both inflation protection and a nonforfeiture option (in the form of a shortened benefit period).

Results vary by company, but about 1/4 to 1/3 of insureds are selecting the inflation protection.

Nonforfeiture options are very recent developments, and it's believed that less than 5% of insureds are selecting them.

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Part II: Segregated Funds— "No Loss" Proposition

by Boris Brizeli

Editor's Note: This is the second part of a two part article. Part I ran in the June 1998 issue of Product Development News.

Risk Management Tools for Segregated Fund Guarantees

Running the risk

An insurer that decides to run the risk may have many justifications for this approach, among them historical market performance of the guarantee, diversification across markets or high lapse expectations.

Accepting the risk, without any hedging, is consistent with the view that accumulated option payoffs will be less then the accumulated value of the guarantee fees, at a very high degree of confidence. Such an approach has the appeal of being profitable in several scenarios, especially those that involve rising markets. The resets are then "free" and the company realizes a profit from the collected fees. The risk that the adopted market view is incorrect and corresponding option payoffs are less than the accumulated guarantee fees, is compounded by the following issues:

- Potentially volatile earnings, given that the reserves would likely capture any market volatility.
- Potentially severe required capital requirements.
- Marketing risk of having to increase product prices.

The exposure under this approach is extremely high on the downside, but is only limited to receiving the fees on the upside. This is effectively a put option exposure.

When running the market risk naked, insurance risks (lapse and mortality), while lesser in magnitude, are also retained.

One approach of running simulations to estimate the loss distribution and calculate prices sufficient to fund the benefit with a specified degree of confidence is sometimes suggested to manage the risk of the SF guarantees. In addition to the above issues, this approach's main limitation is model mis-specification (the capital markets behavior is different from the one modeled).

Static Hedging

Under this risk management approach, the insurer exchanges with a third party, for a price, the market risks of the guarantees and accepts the resulting counterparty risk (credit risk). The potential third parties in such an arrangement are investment banks since such long dated and complex options are not currently traded on any exchange.

When approached with requests to structure customized options for these risks, some investment banks have quoted guarantee prices significantly (as much as 100%) in excess of the prices implicit in currently marketed products. Several other constraints exist, such as:

1. minimum and maximum volume restrictions
2. unwillingness of investment banks to transact in certain markets and strike prices
3. high and unstable prices
4. unwillingness to take basis or correlation risks
5. high bid/ask spreads
6. regulatory constraints on assuming non-capital market risks

Thus, such an approach would provide only partial mitigation of the market risks and the insurance risks would still remain with the direct writer.

Reinsurance

Few reinsurers in the Canadian market are prepared to accept the GMB (Guaranteed Maturity Benefit) risk at a

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marketable price. Those reinsurers that transact in this market place volume restrictions on their clients and are prepared to transact in the necessary markets and prices. They are also prepared to accept the insurance risks of the product, of which the lapse risk is the most significant. The prices quoted by the reinsurers exhibit high variability at different points in time and between different reinsurers. Reinsurers also appear receptive to unbundling the risks and reinsuring only specific components of the total risk.

Given the scarcity of the reinsurers in this market and the size and nature of the risk, counterparty risk is of paramount importance, if this risk management approach is adopted. Given the catastrophic risk profile and the size of the liabilities, balancing the prices with the reinsurer's credit quality and size is significantly more important than in a traditional reinsurance transaction.

An additional consideration in using reinsurance is the potential use of unlicensed retros by the reinsurer. Given the virtual absence of the reserve and surplus requirements, the price is not affected by the unregistered retro's status. However once such requirements come into existence if such retros are the sole source of capacity, the lack of reserve and MCCSR credit to the reinsurer could imply price increases to inforce and new business.

Dynamic Hedging

In this instance, dynamic hedging is a risk management approach that pursues as its objective the ability to replicate the liability payoffs through synthetic manufacturing. Dynamic hedging can only address the investment, and not the insurance risks. It is similar in concept to duration and convexity ALM of interest sensitive liabilities. Below are the most common "Greeks"—sensitivity parameters used:

Delta	Change of derivative price with respect to changes in equity markets
Gamma	Change of Delta with respect to changes in equity markets
Vega	Change of deriviative price with respect to changes in equity market volatility
Rho	Change of derivative price with respect to changes in interest rates
Theta	Change of derivative price with respect to time drift

"Greeks" based on other parameters or combinations of parameters can also be used depending on the situation or hedger's objectives or constraints.

The process of dynamic hedging involves, in this case, the "manufacturing" of complex long-term options using in exchange traded underlying assets, interest rate futures and short-dated options on the underlying assets. Through a process of re-balancing, based on frequency or shift in parameter criteria, these securities are combined to track some or all of the Greeks of the liability.

Dynamic hedging has the appeal of being a flexible process, which can apply to changing liability profiles over time. It also transacts in liquid, market-traded securities, thus minimizing credit risks and the bid/ask spread on the transactions in the underlying securities.

A few of the main issues to consider while adopting this approach are:

- Specialized risk management expertise needs to be developed.
- The risks of managing an equity derivative's portfolio are very different from those that an insurance company usually takes.
- Since the cost of the dynamic hedge price depends on actual volatility encountered during hedging, adverse outcomes are possible—this is not a foolproof solution.
- Extreme events (crashes, stampedes, and liquidity holes) can cause significant trading difficulties if not properly managed.
- Correlation risks remain and cannot be dynamically hedged. The reason for this follows from the fact that no correlation bearing instruments trade readily in the marketplace.
- Significant model risk.
- Lapse and mortality risks still remain with the hedger.

Dynamic hedging is an approach that should be considered only by those companies that understand the consequences of retaining the risk, and are prepared to develop the necessary internal expertise or hire the necessary expertise from the outside. In deciding to use dynamic hedging one should answer the question: " Why won't investment banks do it at a good price and we can?"

Securitization

Using a conduit to repackage the cash flows corresponding to a particular risk of the segregated fund guarantees, into a marketable security, has proven to be a successful risk management approach for some insurance risks. Examples of such successful securitizations include catastrophic event bonds and notes backed by future profits of a company or a product line. One of the main sources of appeal for these securities is their use as a diversifying component in a portfolio exposed to capital market risks.

The basic rationale of securitization is to create an asset with significant

"Reinsurers also appear receptive to unbundling the risks and reinsuring only specific components of the total risk."

negative correlation to a material risk of the liability. If this approach is applied (and it hasn't been yet) to segregated fund guarantees, some of the risk candidates from the segregated fund's guarantees are market and basis risks, and the insurance risks. The purchaser of the securitized market risk would be essentially writing long-dated puts and it is not known whether there's an appetite for such a risk from investors. Securitizing the lapse and mortality risks of the guarantees is certainly possible and represents, in our opinion, an interesting risk management vehicle for the asset issuing company and for the purchasers of the assets. Any attempt at securitization would depend on market demand for the resulting assets and other critical mass considerations.

It is interesting to observe that if a diversified company has a risk exposure in one of its businesses that is negatively correlated to segregated fund's guarantee risks, then deciding to sell segregated funds is similar to securitizing the risk exposure. Making markets in other products can also be seen as an implicit securitization.

Developing a Risk Management Approach

When developing a risk management approach, particularly for the SF guarantees, one has to first clarify:

I. Management and stakeholders risk attitude toward specific classes of risk
II. Presence or absence of expertise in risk management of specific risk classes
III. Willingness to manage or sell the risk in specific risk classes.
IV. Market price dynamics (price taker or setter) and marketing strategy (penetration, skimming, price leadership or differentiation).
V. Risk size and correlation to other company risks.

The lack of complete or efficient markets for many of the segregated fund's risks and lack of uniformity in the modeling of the liability risks implies that the risk management tools will impact the total risk distribution in different ways. Combining different tools to manage different portions of the risk is a valid risk management approach. Consider the following examples:

1. A company feels comfortable in retaining the GMDB (Guaranteed Minimum Death Benefit) risk and hedges the capital market risks through buying appropriate market traded hedges. The GMB risk is considered one that the company is not prepared to retain. Reinsurance is used in this instance.
2. A company feels that the upside momentum in the market will remain over the term of ten years. It is concerned about the extreme catastrophic risk for GMB of market dropping 25% or more and staying there. They choose to hedge this risk with deep out-of-the-money, high quality, OTC put options. The lapse risks are retained. The company believes that mortality experience on their product will be favorable and they manage the corresponding market risk through dynamic hedging.
3. A company monitors the "Greeks" to evaluate the capital market risk exposure. Based on market conditions, they pursue a scheme of using different management tools based on their relative attractiveness, including running the risk in times of high volatility.

Development of the risk management approach must account for the model risk, especially if running the risk or dynamic hedging is considered. Depending on the model used, the margin necessary to cover this risk can exceed the price generated by the model!

Given the distinctness of the pros and cons of the different risk management approaches of SF guarantees, when a company is clear about issues I-V, the choice of the risk management approach most consistent with its views can be methodically developed.

"The basic rationale of securitization is to create an asset with significant negative correlation to a material risk of the liability."

Pricing of the Guarantees Modeling

When we consider the nature of the premium for the guarantees segregated fund, we observe that few funds provide a meaningful limitation on the fees. The reinsurers may, on the other hand, guarantee their fees up to the earliest of next reset or maturity date. We have already described the option to reset as completely analogous to a full surrender and redeposit (without any adverse tax or expense consequences to the policyholder). Now, assuming that the new business price is "fair," meaning that, at issue, the market value of the guarantee fees is equal to the market value of the guarantees, we can make the following observation:

It is "optimal" to reset (i.e. surrender and get a new "fair" price contract) if at the point of reset the market value of the guarantee fees that the client will pay is above the market value of the guarantees.

An alternative description is this: at issue, the buying of the guarantees is equivalent to entering into a swap of guarantee fees for the value of the guarantees. The option to reset is then equivalent to an option to terminate this swap early. This is known as a puttable swap. Mathematically, reset if:

$$MV(\text{GuaranteeFees}) > MV(GMB_{FR}) + MV(GMDB_{FR})$$

To restate in option terms this is a chooser with the payoff:

$$\max[o, MV(GMB_{FR}) + MV(GMDB_{FR}) - MV(\text{GuaranteeFees})]$$

The FR subscript reflects the valuation, at a given decision point, of the value of

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the future reset options. This condition establishes an optimality barrier that needs to be monitored. We can now describe some key modeling considerations to value the guarantees under a simulation approach:

1. Process: Geometric Brownian motion is assumed for the fund price process. The drift of the distribution is adjusted to reflect the deduction of the fund management fee and the SF guarantee fees. This is a key point as it increases the price of the guarantees.

2. Process parameters: As much as possible capital market parameters are used (this presumes that hedging approaches will be based on capital markets). That means that interest rate and volatility curves need to be modeled. The "volatility smile" (variation by strike price) needs to be reflected. Since we are including the guarantee fee as a process parameter, we need an initial guess and a numerical procedure to calculate the final guarantee fee.

3. Reset: If the reset can occur only at specified points in time the barrier needs to be monitored only at that point of the simulation. If resets are to be elected within a period of time, the barrier monitoring frequency needs to be simulated, and a somewhat different optimality condition must be used (this is an additional American feature). Since the barrier monitoring depends on value of future resets, the valuation has to proceed backward, recursively calculating the barrier.

4. Scenario Generator: Since the option is Bermudan or American in nature, the scenario generator has to be modified to value such options. Tilley's [1] algorithm allows such modifications.

5. Actuarial Assumptions: Mortality and lapse (those that do not monitor optimality of reset) assumptions need to be made. This lapse assumption has a significant impact on the ultimate guarantee price.
6. Asset Modeling: If hedging is pursued, especially dynamic, the bid-ask spreads and transaction costs upon rebalancing need to be modeled. This allows to reflect in the model the impact of differences in liquidity. An additional degree of realism is thus introduced, especially if a rebalancing criterion (regular frequency, magnitude of price move) that is used in the model, is the one that will be followed in practice.

The model can be further enhance by modeling fund correlation to a market benchmark and correlation of different funds if Type II (on sum of all fund balances) guarantee is used. Modeling of fund transfers as a financial option has several challenges and has not been fully addressed by the author at this point.

Some Observations

The above model comes at a very high computational expense as do any Monte Carlo simulations. Variance of estimates is compounded by the fact that estimates are used recursively in the valuation (thus errors would propagate). Variance reduction procedures may need to be used, see for example Hull [2] for six different approaches. One notable advantage of the above approach is that, with some modifications, other product's guarantees can be priced in a capital market framework, notably the minimum interest rate guarantee in universal life.

Alternative methodologies can be used to value the segregated fund guarantees. For example, processes can be based on parameters derived from historical data and resets can be modeled behaviorally. The assumed process and derived parameters carry significant

model risk. In absence of experience data, behavioral modeling is at best tentative, and an error in estimate can mean an insufficient hedge if hedging is pursued. Even if experience is available one could argue that using data from one past scenario to generalize scenario-based behavior is unsound. In other words such models can be viewed as bets. We would prefer to use the above approach as it allows for risk measurement and valuation in a capital market framework and with sufficient enhancements can be used for hedging purposes.

The implementation of pricing and hedging examples of the segregated fund guarantees, using the above approach, will form the subject of an upcoming paper.

Boris Brizeli, FSA, FCIA is a Principal with Insource Limited in Toronto, Canada and a member of the Product Development Section Council. *He would like to thank Alan Ryder (ERC) and Dr. Ravi K. Ravindran (RGA Financial Products) for their review and thoughtful suggestions.*

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