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Perspectives on Variable Annuity Guarantees

By Jason Alleyne, Ben Neff and Min Yang

CONSIDER FOR A MOMENT WHAT LESSONS we would be drawing upon today if the financial crisis had resulted in the bankruptcy of a large insurer brought about by their large book of Variable Annuity guarantees. Luckily for the industry the VA guarantee is still a relatively young product concept in the history of insurance and such a failure did not materialize. However, the recent crisis did see the birth of the word "de-risking" in the VA guarantee product space. This would seem to indicate that product designs had escalated to a point where they were only sustainable in certain "benign" economic environments.

Jason Alleyne FSA, FCIA, FIA, FRM, is VP & Chief Pricing Actuary at BMO Life Assurance and works in Toronto, Canada. He is the chair of the SOA's research project on Variable Annuity Guarantee Product Risk Evaluation Approaches. He can be reached at *jason.alleyne@bmo.com.*

Ben Neff, ASA, MBA, is a client support specialist at GGY AXIS in Indianapolis, IN. He can be reached at *bn@ggy.com.*

Min Yang, FSA, is an actuarial programmer at GGY AXIS in Toronto, Ontario. She can be reached at *my@ggy.com.*

In any case, the sudden fall in the equity markets both at home and abroad, and the disruption in the capital markets, has largely been a period for reflection on what is a sustainable risk design for these long term investment guarantees.

I have recently been handed the product development portfolio of a growing life insurer in the Canadian market. My company does not currently underwrite investment guarantees on its accumulation annuity book. The motivation for this article is to record some of my considerations in examining the viability of these high risk products within the context of what's occurred recently and what lies ahead in the foreseeable future.

THE PRICING PHILOSOPHY

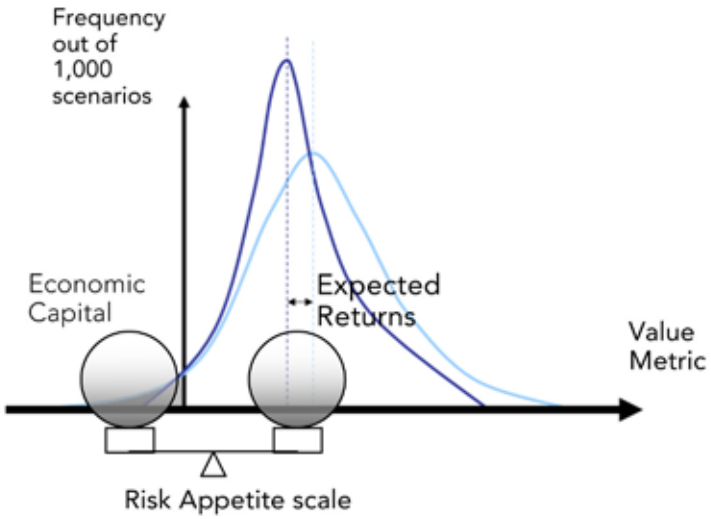
I begin this journey as any student of Stephen Covey's "Seven Habits of Highly Effective People" with the mantra, *start with the goal in mind*. As a stock company the goal is always to write profitable business that grows and enhances the franchise value of our organization. With this in mind, it is clear that I need to communicate to my Board of Directors why I believe this product—despite the spate of negative press to the contrary, is still a viable profit winner for a diverse life insurer.

The more I reflect on this I become critically aware that I must make transparent the pricing framework that will underpin the product design and profit measurement of my proposal. Pricing is really the cornerstone of good business management. Pricing ultimately must identify "On what am I betting my risk capital; and what's the potential payoff." To put it another way, I must define an Economic Capital measure that meets the approval of the Chief Risk Officer, and to ensure that the expected return on this capital investment will be sufficiently large and highly probable to justify the "bet."

Involving the key decision makers early in the process is critical to the success of any new venture. But it is even more so when the perception is that VA guarantees are complex products that have the potential to push a company into insolvency.

The key pricing concept here is that it is important to understand the key risk drivers for this type of product. Traditional life insurance relies on the law of large numbers and the benefits of risk pooling among largely independent risks. Variance from the mean will be relatively small and is often quantified by PfADs or deterministic risk margins. Investment guarantees do not have this mitigating feature. Market risks are all exposed to the economic system and all exposures can turn against the company at once. The key risk drivers in this context are the market drivers—e.g., equity growth rates, fixed income yields, correlations, equity market volatility and interest rate volatility, foreign exchange rates, credit spreads and liquidity. The corporate function of most companies would have a view on how these factors are modelled in forecasting the business plan as well as possibly the economic capital setting exercise. This is an important input into the pricing philosophy.

Consider for a moment that the product might be exposed to a number of future economic environments; assume for simplicity there are 1,000 such scenarios. The pricing decision will then present itself as a distribution that either fits with the company's risk appetite or not. Visually a fit would occur when the "weight" of the risk capital "bet" is properly balanced by the expected "value-add" of the business venture. In theory the scenarios should be the ones underpinning the economic capital or risk measurement of the business. And the value metric should be one that is fairly well understood such as ROI, or profit margin. In this framework it is possible to agree upon the risk appetite boundary, namely, what would be a viable product.



THE PRICING PARADIGM

Defining the risk appetite is a critical first step. But that in of itself does not tell us how to set the price of the product. The second important consideration is the pricing paradigm, namely how to first establish the rates for the product. To put it another way, the question is how to determine the risk premium or margins that fit within the established market place.

In general there are two approaches to risk pricing: (1) set price relative to observable market prices, i.e., risk neutral pricing or (2) establish one's own view, here referred to the actuarial approach (real world simulation).

The premise of risk neutral pricing is that there is an underlying law of one price (the market price of risk), and that the market's efficiency will force a convergence of any similar product/risk to conform to the landscape of existing prices in the market. Risk neutral pricing requires the existence of a deep and liquid market, in which case there isn't any one market maker who can arbitrarily alter the price landscape. In the typical short-term equity option and equity futures market this is certainly the case, and the risk margin or market price of risk is observed in the familiar implied volatility surface. Pricing a short-term option within this framework is essentially an exercise in interpolating between observable prices (or observable implied volatilities).

For long-dated options, such as those implicit in a VA guarantee rider, it is not so straightforward to assume that one can apply risk neutral pricing. For one thing, there certainly is not a deep and liquid market to reference for a list of implied volatilities. Also the contracts are not as homogeneous as the standardized contracts that trade on the exchange. Certainly many academics would have some pause in recommending a risk-neutral approach to this problem. To go this route there would certainly need to be some thought given to setting the implied volatility. The Milliman Hedge Cost Index would be worth reviewing as one potential source for doing so.

The other pricing approach would be to form an understanding of the price of risk as a value measure *above* the historical performance of the underlying risk drivers. By using a real world economic scenario generator model (fitted to relevant historical data), and to use this to simulate the risk components of the investment guarantee, one might be able to estimate the price that satisfies the funding of future guarantees with x percent probability. To put it another way, a price might be constructed such that say 70 percent of simulated future economic scenarios will result in over funding of the risk. Obviously there is some subjectivity in setting the 70 percent, but one could reverse engineer the prices in deep and liquid markets to see whether the confidence level is roughly in line.

In using this approach, the model used to simulate the product performance must encompass all economic

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risk factors—equity growth rates, interest rates, correlations, market volatility, foreign exchange and credit spreads. This could again tie in with the work by the corporate risk or capital management team. Unlike the traditional actuarial pricing that might use a singular profit measure, scenario based pricing uses a multi-dimensional measure. This will consists of desired levels for the tail measure, and various hurdle metrics for the profit percentiles around the mean (e.g., 50 percent-ile, 60 percent-ile, 70 percent-ile).

At the end of the day, this is simply a way of coming up with an initial price that might be reflective of market conditions. Finally, keep in mind that pricing is both a science and an art. So there is not likely to be one exactly right methodology. Instead there needs to be an element of judgement and trial-and-error in establishing the pricing paradigm that best fits with the risk being priced.

BASE CONTRACT DESIGN

Once an approach to setting the risk appetite and a market consistent pricing approach has been determined, the next important factor is the product design.

Risk is best controlled by good product design. Risk management is useful in reducing risk exposures to within some acceptable tolerance. But the risk design is what ultimately determines the exposures in the first place.

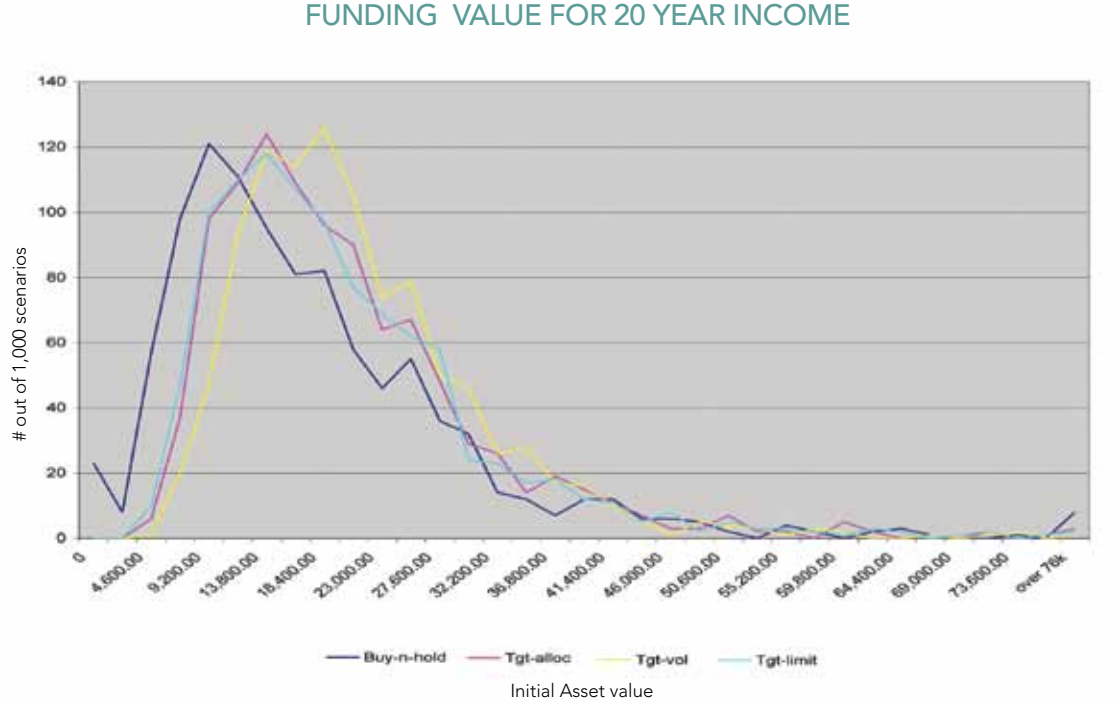
On the base contract there are several areas that could be considered in reducing the overall risk of a VA guarantee rider. First of these is the fund type. The more volatile the growth rates of the underlying funds, the more unstable will be the revenues generated by the rider fees and also the more costly will be the guarantees. So the first decision point is whether to support fully managed funds, exchange-traded-funds (ETFs) or index funds. For an initial offering, it might be prudent to offer only index fund guarantees. For more sophisticated players, and if there is a long history of performance records for their managed funds, then it might be possible to consider these more risky fund types.

The second consideration is the fee structure. For this discussion, I am assuming that the rider fee and base fee are considered as one style. The traditional fee is a spread or fund-based compensation. This style of fee is countercyclical to the risk; namely the benefit payout will be greatest at the very moments that the revenue generated will be the lowest. A flat fee or one based on the initial deposit is a better risk design that stabilizes revenue regardless of the market movements. More recently, fees have been engineered to move with the market cycle, namely more active markets and greater fund volatility would result in greater fees. This is certainly a benefit to the risk profile of the investment guarantee, but might be difficult to explain to the policyholder.

And the third consideration on the base underlying contract is the design of the fund allocation rule. In the typical allocation approach, the fund might have a mitigation mechanism that rebalances to a target proportion in a fixed income portfolio. This target allocation fund style would therefore sell off (buy into) equity to purchase (by selling) bonds when equity markets go up (down). From an investor perspective this has an attractive built in risk mitigation benefit over a buy-and-hold strategy. Furthermore, it is common to enhance this approach by setting a trading band in which the equity proportion can grow or fall before target allocation rebalancing kicks in.

A relatively new strategy that might offer a better risk profile to the investor is to consider rebalancing out of equity during volatility regime shifts. There are two benefits from this strategy. The first, from an investor's perspective, is that this strategy will outperform in the typical pattern of a market recession due to the relative persistency of volatility regimes. In the typical market down turn event, an increase in market volatility often precedes a sharp market decline; and this is followed by a subsequent fall in interest rates. If the fund rebalances away from equity during the volatility regime change, the fund will avoid most of the equity hit, and benefit from the gain on fixed income asset class during the subsequent fall in interest rates. The second benefit of this strategy is that it is designed to control the implied volatility of any guarantees on the fund value to within a narrow band. This in turn will ensure that any hedging of the investment guarantee will have more stable and predictable results.

FUNDING VALUE FOR 20 YEAR INCOME



RISK PROFILING OF FUND ALLOCATION STYLES

Consider for a moment a typical wealth management example, of 20 year accumulation followed by 20 years of regular income drawdown. We constructed a balanced fund built upon two fund types: (1) a single index equity fund modelled by a Lognormal-GARCH (1,1) process, and (2) a constant maturity bond fund targeting 10 year treasuries modelled with a CIR process. We examined four fund allocation styles: (1) buy-and-hold; (2) target allocation; (3) target allocation with limits and (4) target volatility. And we constructed two key value measures upon which to draw our conclusions—(1) The initial lump sum amount required to fund drawdowns of $1,000 monthly; and (2) The frequency of deficits for a fixed lump sum amount and fixed drawdowns.

First examine the funding value distribution, and note that the example was constructed such that the average for all four styles is the same. The key take-away here is that the target volatility approach has the narrowest or tightest distribution of the four choices.

This is further highlighted by the detailed results in the right tail, in which target volatility has clearly the lowest exposure to extreme funding requirements.

Initial fund ($)	Buy-n-hold	Target-allocation	Target-volatility	Target-limit
<=40,000	953	955	966	953
(40,000, 44,000)	14	14	10	16
(44,000, 48,000)	10	6	6	6
(48,000, 52,000)	2	9	8	8
(52,000, 56,000)	5	2	2	3
(56,000, 60,000)	1	6	4	3
(60,000, 64,000)	5	1	0	5
(64,000, 68,000)	1	1	1	1
(68,000, 72,000)	1	2	2	2
(72,000, 76,000)	1	2	2	1
>76,000	7	2	0	2

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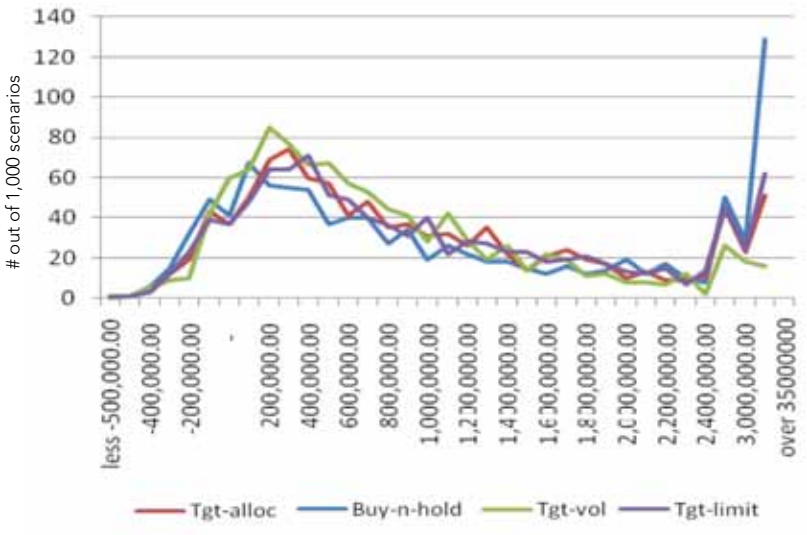
The distribution of the frequency of deficits tell a similar story, where once again the target volatility fund allocation style has the tightest shape. Therefore an investment guarantee written on a fund using a target volatility allocation style would be less costly, ceteris parabus, than one using a traditional target allocation approach.

FREQUENCY OF DEFICITS



In conclusion, the target allocation approach has a mollifying effect on the variability of the underlying fund relative to traditional target allocation approaches. This has benefits both to the fund investor and to the insurer of its investment guarantee.

The analytic approach shown above is a useful one for evaluating the riskiness of various product features. To view a product performance as a distribution over multiple scenarios provides an understanding of the tradeoffs between the potential benefits and the downside risk to the client. The analysis can be done over the very same scenarios that are used in the economic capital framework to ensure consistency between the customer's risk outlook and the business outlook.

GUARANTEE RIDER DESIGN

Now turning to the guarantee style itself, I consider the issues here as divided between two key risk drivers: (1) the design features that impact on the market risk exposures and (2) the policyholder behavioral exposures.

MARKET RISK FACTORS

The key market risk exposure is the basis risk inherent between the fund mapping and the risk mitigation strategy. Generally speaking managed funds included as underlying for investment guarantee riders were regressed against market indexes, which in turn had derivative contracts that could be used within a hedging program. This fund mapping implicitly determined the risk design of the rider. The fund mapping itself is designed to have a very high correlation to its mapped indices. However, the key lesson of the recent crisis is that the correlation might differ significantly between normal and distressed market conditions. Therefore it is actually more important to have a high R-squared factor in historical distressed markets than the normal periods because this is exactly when hedging cost will be extremely high. To increase the predictive power of the mapping, it might be better to group funds with similar characteristics into a fund of funds or a portfolio of funds. To do so would improve stability, because in any one fund a manager is likely to abandon his/her mandate to chase returns; but in a fund of fund these scope creeps net out such that the overall portfolio maintains its original risk profile.

Another risk consideration in the design of basis risk, is to charge for it. Namely, portfolios with higher volatility should be charged higher rider (and/or base) fees. This is quite common place in Canada, but not so in the United States

Another set of market factor considerations for product design is to utilize features that respond to the economic environment. One very good example of this would be to set the GMWB rollup rate based on the existing short term rates at the time the benefit base increases. Note that a fixed rollup rate exposes the hedging program to a step change at each anniversary that is near impossible to fund with only a delta position.

Note that generally, the market risk within a block of riders does not naturally benefit from any risk diversification—all boats sink in a falling tide. But clever risk design could engineer a natural maturity diversifica-

tion effect by setting benefit/payment start dates on an attained age basis. This would mean that a year's cohort of new business might have as much as a 10 year distribution of risk exposures. And this natural diversification could well mean the difference in a liquidity crunch.

BEHAVIORAL CONSIDERATIONS

The intensity of the risk of resets appears to be one that is well established—without fail recent de-risking involved reducing or removing the reset options in the contract. Resets do offer a powerful option to the policyholder, but the risk isn't only in the nature of the option, the risk lies in the fact that there is little data to evidence the level of rationality in using the option.

The key consideration in behavioral features is to understand the price of 100 percent rationality and to reverse engineer the level of rationality that is implicit in the "market" price. Rationality in a modeling context is probably best viewed within the framework of the scenario generator. It is probably not fair to model 100 percent rationality as perfect hindsight as would the financial pricing literature suggests; instead it does seem appropriate to set policyholder behaviour based on complete awareness of the underlying drivers of the economic environment (e.g., the instantaneous volatility in the case of a GARCH model).

An alternative risk design approach might be to offer fixed features such as look-back options or fixed ratchets. This would provide the same attractiveness of a reset product, namely one that responds to a rising tide, but at a controllable, predictable and known usage rate (namely 100 percent).

HEDGING

We have discussed a few risk design issues and certainly the above was not meant to be an exhaustive list. But hopefully the discussion demonstrates the framework in which to approach the decision making process. Risk design needs to work within the pricing philosophy and the chosen pricing paradigm, but also it needs to be practical and responsive to the market needs of the target client group. But what ultimately comes out of the design process needs to be managed to fit within the Board's risk appetite.

Therefore, the final key consideration in the development of new investment guarantee rider is the hedging program. If we consider that the market price might at best reflect that revenues (rider fees) would cover the guaranteed benefits in say 70 percent of the expected future scenarios, there is a considerable risk exposure in the tail. In the case of a GMDB, the exposure might not likely be realized due to the relatively small probability of death, and therefore the risk could be held open. But in the more typical case of any other guarantee type, hedging is used to reduce the tail exposure to an acceptable level to bring the product within the risk appetite of the company.

In this regard, I would recommend to position hedging evaluation in pricing as an exercise in reshaping the risk-reward performance of the product. With this in mind, the maximum expected returns from an investment guarantee product is when it is left un-hedged. In modelling the effects of hedging within the pricing of the product, hedging will necessarily reduce the expected returns but at the benefit of reducing the size and probability of excess losses. It is this reduction in the expected returns due to hedging that should be considered the "hedge cost." The pricing exercise would then be complete when the tail (expected excess losses) is brought within some risk budget limit (economic capital for the line of business), but that the expected returns are still sufficient to warrant a launch.

To do this type of analysis it is critical to include as much detail about the proposed hedge program in the pricing model. Also it is important to model the regulatory requirements, both reserve and required capital, to judge whether the hedges are effective on both an economic and accounting basis. Finally the value metrics used must be consistent with how Executive management views the business and that the product profitability fits within their risk appetite.

The following diagrams reflect some of the analytics that we've performed with an integrated pricing model to better understand the risk-reward of the hedging program in our product.

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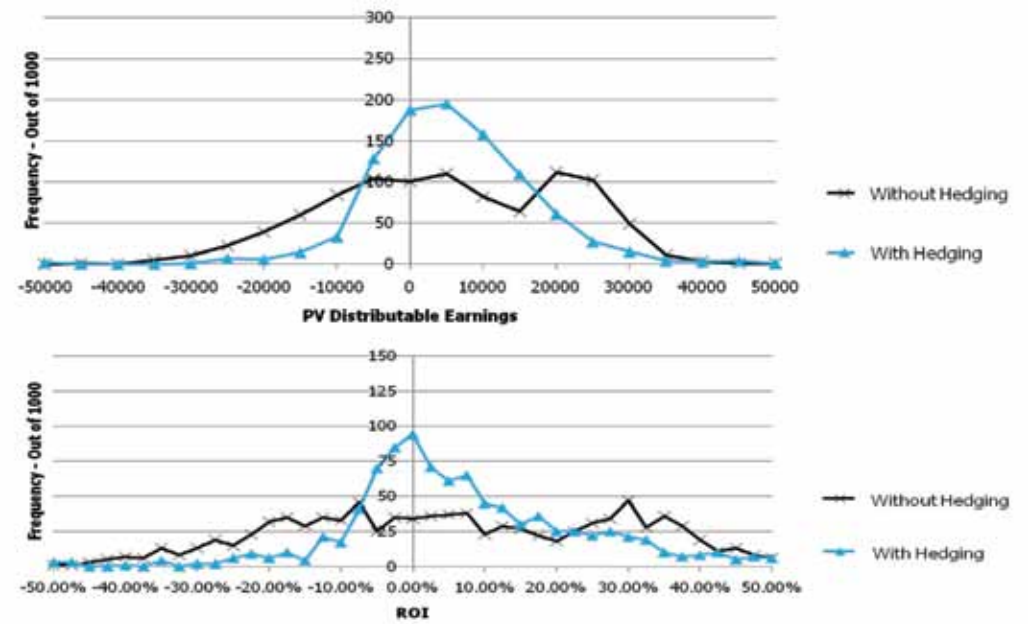

CONCLUSION

The investment guarantee contracts in the annuity market are an important product type that will likely remain a key line of business for the insurance industry. The recent crisis has resulted in some pause to review the product offerings in the market and how best to manufacture this risk going forward.

This discussion has highlighted the need to make transparent the pricing philosophy for evaluating this complex risk. Transparency of the pricing philosophy is important to gain buy-in from executive management, which in turn is critical in establishing a clear definition of the risk appetite for the product.

It is also important to decide on a pricing paradigm that reflects the organisations own view of this long dated risk, and the associated risk capital required to back it. The risk attenuating to all product features should be viewed with this in mind.

And finally the risk management aspects of hedging these complex long dated risks should be considered an art rather than a science. It is critical to evaluate the effective cost of a hedging program weighed against its benefit in reducing the expected excess losses. ■