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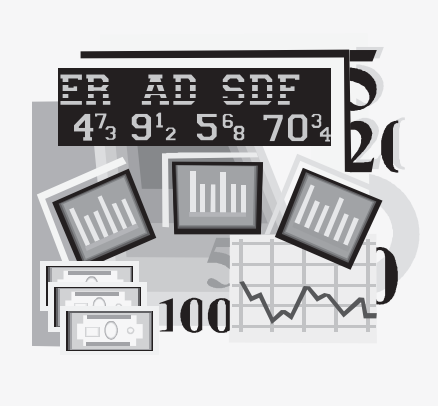
# Why Write Variable Products When You Can Put the Money Directly into the Stock Market?

by David N. Ingram and Stuart H. Silverman

For all our financial sophistication, we all need to find ways to bring our decisions down to earth sometimes. That is very difficult to do when comparing choices that have very different timing and cash-flow intensity. It is even more difficult when those cash flows have different levels of risk. But it is possible to develop a process for comparing complex insurance products to simple everyday investment choices that can help to guide our decisions. After all, insurance products do not exist in a vacuum.

Most pricing actuaries involved in setting profit targets for variable annuity contracts have experienced the queasy feeling that comes with having no firm place on which to plant their feet. Variable annuities seemed to have little net investment by the insurance company so the standards of returns based on ROE or ROI calculations did not always produce a usable result. Sometimes return on asset targets were substituted as profit markers. What do you do when there is a real change in the product that starts to produce risk? Additional risk should mean additional return, but how much is the right amount? And also, was the risk premium in the original product appropriate?

What is needed is a way to anchor those sorts of decisions to the ground in some manner. One way to accomplish that would be to make a comparison to a realistic alternate investment that has similar risk characteristics. In the case of the variable annuity contract, almost all of the risk comes from the stock market. The amount of M&E charges collected depends directly on stock market performance. GMDB risk is heavily dependent upon stock market performance as well. So what if you looked at the choice of either directly investing in the stock market or investing capital in underwriting a block of variable annuities? For example, assume that the variable annuity contracts have initial premiums of $100 million and initial surplus strain of $10 million. An alternative is that the $10 million could be invested in a mutual fund, whose assets are invested in the same manner as variable annuity accounts.




As one might suspect, there is a comparability issue between the two choices. The capital invested in the variable annuity changes each time there is a contract surrender or death. In order to make the pattern of investment over time of the two choices comparable, the mutual fund investments' yearly cash flows are determined as the investment gain plus the recapture of some of the principal. Principal is recaptured in a manner consistent with the variable annuity decrements (lapses and mortality rates). Furthermore, the mutual fund investments are assumed to be invested in the same funds as the variable annuity account values with the same investment management fees deducted from the market returns.

To satisfy the basic economic dictum of greater reward for greater risk, the variable annuity should return at least as much as the alternative investments for the same level of risk. Another way of looking at it would be the risk associated with the variable annuity must be less than the alternative investments for a given level of return. Otherwise, an investment in writing the variable annuity contract would fall below the efficient frontier.

Well, how do we define risk? While that is a question many people are struggling with, this article defines three risk measures: standard deviations of present value of profits, Contingent Tail Expectations (CTE), and percentage of scenarios where the variable annuity investment returns are less than the other investments.' The percentages are divided into four quartiles of scenarios, which were based on cumulative market returns over the surrender charge period.

## Assumptions

- We developed 1000 fund growth rate scenarios over a twenty-year projection period. The geometric average growth rate (before reduction of charges) was 8 percent.

- For comparison purposes, we assumed principal is withdrawn from the alternative investments in a manner consistent with the variable annuity capital released. Thus, the amounts invested in the alternative investments are similar to the investment in the variable annuity business.

- We assume each year's earnings on the alternative investment are released.
- We discounted profits released at the risk free rate (*i.e.*, 3 percent).

- To refine our comparison, we found that it was necessary to adjust the risk level of the mutual fund. We did this by mixing in various levels of "risk-free" assets. The risk free asset is assumed to earn a level 3 percent and the mixed stock/risk free portfolio returns are discounted at the risk-free rate.

- The expenses for the variable annuity are truly marginal expenses. It is not our intention to suggest that pricing should reflect only marginal expenses, but the comparisons that we make are most valid for calculations reflecting only marginal expenses.

## Caveats

- The analysis below only accounts for variability in market returns. It does not account for the additional business risk associated with variable annuities (i.e., lapse and mortality experience different from pricing, higher expenses than expected, or difference in liquidity between writing variable annuities and the alternative investments).

- The results below are not general in nature; they arise from the particular assumptions and product specifications we assumed for this article. The results are for illustrative purposes only. Other assumptions and product specifications would produce different results.

## Results

As you may imagine, results are heavily dependent on the variable annuity pricing assumptions. For a moment let's assume the variable annuity with return of premium GMDB is priced assuming 150 bps of gross margins earned by the company (i.e., net of investment management fees but gross of incurred expenses and GMDB claims). The results are shown in Table 1.

Under the 150 bps gross margin scenario, the variable annuity seems to be the better choice. Your expected return is better than the alternative investments and there is less tail risk (CTE90) than investing in the 100 percent stock fund. However, the higher standard deviation of profits for the variable annuity may cause greater fluctuations in earnings than other investments. Moreover, it is possible to derive an alternative investment with expected profits equal to the variable annuity, but the company would need to borrow money to invest in the stock

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**Table 1 (Dollar values are in thousands)**

| | Variable Annuity (150 bps) | 100% Stock Fund | 48% Stock Fund, 52% Risk Free Asset | 108% Stock Fund, -8% Risk Free Asset (borrowed) | 127% Stock Fund, -27% Risk Free Asset (borrowed) |
|---|---|---|---|---|---|
| Average NPV Profits | $5,391 | $4,237 | $2,050 | $4,558 | $5,391 |
| Std Dev | $4,649 | $4,322 | $2,091 | $4,649 | $5,498 |
| CTE90 | ($1,513) | ($3,127) | ($1,513) | ($3,364) | ($3,979) |
| Pct Scenarios | - | 10% | 5% | 21% | 57% |

**Table 2**

| | Variable Annuity (125 bps) | 100% Stock Fund | 90% Stock Fund, 10% Risk Free Asset | 84% Stock Fund, 16% Risk Free Asset | 65% Stock Fund, 35% Risk Free Asset |
|---|---|---|---|---|---|
| Average NPV Profits | $2,774 | $4,237 | $3,795 | $3,543 | $2,774 |
| Std Dev | $3,613 | $4,322 | $3,870 | $3,613 | $2,830 |
| CTE90 | ($2,800) | ($3,127) | ($2,800) | ($2,614) | ($2,048) |
| Pct Scenarios | - | 10% | 86% | 84% | 57% |

**Table 3**

| | Variable Annuity (132 bps) | 83% Stock Fund, 17% Risk Free Asset |
|---|---|---|
| Average NPV Profits | $3,516 | $3,516 |
| Std Dev | $3,906 | $3,586 |
| CTE90 | ($2,436) | (2,595) |
| Pct Scenarios | - | 53% |

fund, which leads to a much riskier investment. Other blends in the mutual fund would match the standard deviation and CTE90, but would achieve lower profits than the variable annuity. If the market allows for gross margins of 150 bps and your company is comfortable with the greater standard deviation of profits, then the variable annuity seems to be the better investment (assuming pricing expense, lapse, and mortality assumptions are met).

Now assume the same variable annuity is priced assuming 125 bps of gross margin. These results are shown in Table 2.

If the market does not allow gross margins greater than 125 bps, then it would be wise not to invest in variable annuities. Investing in a weighted portfolio of stocks and risk free assets will result in the same return with the less risk under the CTE90 and standard deviation risk measures. Furthermore, weighted portfolios can be derived resulting in greater expected returns with the same amounts of risk.

Clearly, the variable annuity investment is sensitive to pricing assumptions. Now assume the same variable annuity is priced assuming 132 bps of gross margin. These results are shown in Table 3.

**Table 4: Return of Premium GMDB**

| Quartile | Number of scenarios better to invest in the weighted portfolio | % of scenarios better to invest in the weighted portfolio |
|---|---|---|
| 1 | 134 | 54% |
| 2 | 154 | 62% |
| 3 | 148 | 59% |
| 4 | 93 | 37% |
| Total | 529 | 53% |

**Table 5: 4% Rollup GMDB**

| Quartile | Number of scenarios better to invest in the weighted portfolio | % of scenarios better to invest in the weighted portfolio |
|---|---|---|
| 1 | 249 | 100% |
| 2 | 242 | 97% |
| 3 | 192 | 77% |
| 4 | 104 | 42% |
| Total | 787 | 79% |

Based on the risk measures listed above (CTE90, standard deviation, and count of scenarios), from a risk/reward perspective, a weighted portfolio of 83 percent stocks and 17 percent risk free assets would be similar to the variable annuity. In other words, assuming pricing expense, lapse, and mortality assumptions are achieved, the variable annuity investment would produce the same return as the weighted portfolio for roughly the same risk.

Let's look a little further into the number of scenarios that the variable annuity present value of profits is less than the present value of profits of the alternative investment. Quartile 1 as shown in Table 4 is comprised of the 250 scenarios with the lowest cumulative market returns over the surrender charge period. Similarly, quartile 4 is comprised of the 250 scenarios with the highest cumulative market returns over the surrender charge period.

The distribution of scenarios producing better results for the weighted portfolio relative to the variable annuity seems relatively stable across quartiles. If the GMDB were more generous this would not be the case. The results for a product with a 4 percent guaranteed return on the GMDB are shown in Table 5.

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**Table 6: 4% Rollup GMDB – Price for CTE90**

| | Variable Annuity (139 bps) 4% Roll-up | Variable Annuity (132 bps) ROP | 83% Stock Fund, 17% Risk Free Asset |
|---|---|---|---|
| Average NPV Profits | $3,516 | $3,516 | $3,516 |
| Std Dev | $4,992 | $3,586 | $3,586 |
| CTE90 | ($4,262) | ($2,595) | ($2,595) |

**Table 7: 4% Rollup GMDB – Price for CTE90**

| | Variable Annuity (139 bps) 4% Roll-up | 114% Stock Fund, -14% Risk Free Asset | 146% Stock Fund, -46% Risk Free Asset |
|---|---|---|---|
| Average NPV Profits | $3,516 | $4,826 | $6,200 |
| Std Dev | $4,992 | $4,922 | $6,323 |
| CTE90 | ($4,575) | ($3,562) | ($4,575) |

Relative to alternate investments, the variable annuity with a 4 percent rollup would be considered incorrectly priced with gross margins of 132 bps. It would be wiser to invest the surplus in the alternate investments.

If the additional GMDB expense of a 4 percent rollup benefit was offset by the breakeven price of an additional 7 bps (i.e., 139 bps of gross margins), then the risk profile on Table 6 above shows how the risk increased substantially and that the breakeven pricing is, of course, inadequate to provide for the risk.

While the new 4 percent rollup variable annuity, the ROP annuity and the weighted portfolio investment produce the same expected return, the CTE90 and standard deviation show us the variable annuity with a 4 percent roll up GMDB is more risky. The company writing the variable annuity with a 4 percent roll up should be compensated for that additional risk.

The logical follow up question should be how much should the company be compensated for the additional risk? The company should price for an additional risk charge to equate the appropriate risk measures.

In Table 7, we have bracketed the risk of the VA with two different alternate investments. Neither fund comes very close on both measures of risk. The annuity with the 4 percent roll-up benefit has moderate volatility as measured by the standard deviation but has higher tail risk because of the structure of the death benefit. When management looks at Table 7, another discussion of risk tolerance can be held. The risk level shown in Table 7, which shows that a 4 percent roll-up benefit is equivalent to a leveraged stock fund, may be a higher level of risk than many companies will want to retain. This analysis can be repeated after the impact of a hedging or reinsurance program to view the residual risk and the risk reward

**Table 8**

| | Variable Annuity – Age 45 | Variable Annuity – Age 55 | Variable Annuity – Age 65 | 83% Stock Fund, 17% Risk Free Asset |
|---|---|---|---|---|
| Average NPV Profits | $3,784 | $3,516 | $2,850 | $3,516 |
| Std Dev | $3,714 | $3,906 | $4,532 | $3,586 |
| CTE90 | ($1,276) | ($2,436) | ($5,436) | ($2,595) |

trade-off. This technique provides a potential basis for evaluating partial reinsurance or hedging programs.

To match the return of the 114%/-14% fund, the variable annuity would need 152 bps of revenue. In other words, the risk charge to match the expected return of a market priced investment alternative would be 13 bps above the 7 bps expected cost. To match the expected revenue of the 146%/-46% alternative, an additional 27 bps would be needed above the 7 bps expected cost.

Another assumption the above analysis does not account for is the variability of the age of the variable annuity contract holders. The above analysis assumes the age of the contract holders is 55. As you can imagine, if the GMDB mortality charge does not vary by age, the average age of the variable annuity block has a large impact on the risk/reward perspective. Table 8 assumes 132 bps of gross margin and the GMDB is return of premium.

With a flat charge for GMDB costs across all ages, the risk reward comparison is highly dependent on the assumed distribution of ages. The risk that the ages of the future buyers will not match the pricing model may be substantial. Higher ages show slightly lower profits and much higher risk. If pricing assumptions do not distinctly account for age, the variable annuity block is susceptible to anti-selection.

This article presents a simple test to verify that the expected level of return from a variable annuity is adequate for the risk level. This type of test does not need to be limited to variable annuities. All variable insurance products are tied to market returns. Furthermore, modifications to the test should allow comparisons between general account products and investments in the bond markets. In the end, this approach works because many insurance contracts are essentially complex financial instruments.

*David N. Ingram, FSA, MAAA, is a consulting actuary at Milliman USA in New York, N.Y. He can be reached at* david.ingram@milliman.com.

*Stuart H. Silverman, FSA, MAAA, is a consulting actuary in the New York Life Practice of Milliman USA in New York, N.Y. He can be reached at* stuart. silverman@milliman.com.