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The VA Behavior System: Coping with Complex Interactions in Annuity Policyholder Behavior

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OVER THE PAST FEW years, guaranteed variable annuity ("VA") behavior risk has come into focus for insurance industry risk executives and actuaries, owing to a sharp increase in useful experience data coupled with several billion-dollar reserve charges attributed to VA behavior. The modeling of VA behavioral dynamics is a complex challenge for several reasons. In this short paper, we aim to help clarify one aspect of VA behavior complexity: the interactions between different behavioral assumptions and their impact on guarantee values. We first outline why this aspect of behavior assumptions is particularly challenging for models and then offer some potential approaches to dealing with the complexity.

I. OVERVIEW OF GUARANTEED VA BEHAVIOR ASSUMPTIONS

Three behavior assumptions drive VA cash flow modeling results:

- **Lapse rate functions:** The lapse rate functions determine the projected rate of full surrender for variable annuity policyholders, including how the lapse rate responds to the moneyness of the guarantee.
- **Timing of income election:** Timing of income election refers to the modeling of the "delay period"—i.e., the number of years the policyholder will wait between the policy issue and the withdrawal period.
- **Efficiency of income taking:** Efficiency of income taking refers to the extent to which policyholders maximize the value of their guarantee by taking the maximum withdrawal each month. Withdrawals can be categorized as either "efficient," "partial," or "excess." "Efficient" withdrawers withdraw the maximum amount allowed by the guarantee. "Partial" withdrawers withdraw less than the maximum (including cessations for products where the roll-up terminates post-withdrawal). Finally, "excess" withdrawers withdraw above the maximum which often results in a sharp reduction in the guarantee amount and guarantee value, as well as the value of future fees.

II. DEFINING THE PROBLEM

One of the key challenges in VA behavioral modeling is the interaction between the behavioral risk factors

Experience to date strongly supports several interactions between behavioral risk factors. For example, policyholders who take an excess withdrawal exhibit a higher propensity to lapse than policyholders taking efficient withdrawals; those taking efficient withdrawals tend to lapse at a lower rate. This poses a particular modeling challenge given the historical practice of examining behavioral risk factors (e.g., lapse rates) in isolation from other factors, and because of the profound impact these interactions have on cash flow valuation results.

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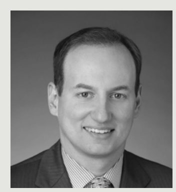

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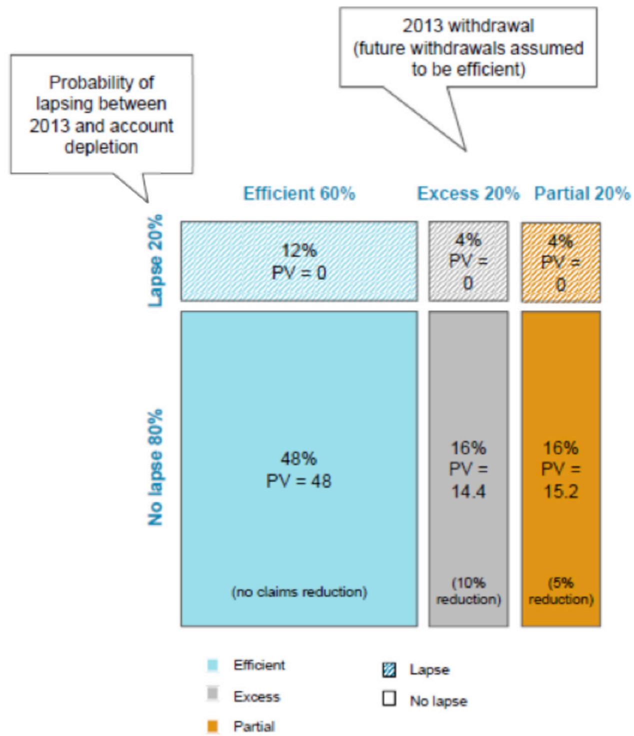
To further explore the impact of such an interaction, consider the interaction between excess withdrawals and lapses. First, experience data strongly supports a relationship between withdrawal efficiency and lapse rates. Policyholders with excess withdrawals tend to exhibit a very high lapse propensity (with about 50 percent percent lapsing in the five year period following the excess withdrawal). Policyholders who are not withdrawing lapse at a lower rate and the lapse rate for efficiently withdrawing policyholders is lower still. This behavioral pattern is intuitive since excess withdrawals can signal a range of policyholder circumstances such as a need for liquidity, a medical condition, or suboptimal financial decision making, any of which could also trigger a lapse. Second, this interaction drives model results. Consider the following stylized examples: both model a variable annuity with the following five assumptions:

- Probability of excess withdrawal in 2013 = 20 percent (claims reduced by 10 percent)
- Probability of partial withdrawal in 2013 = 20 percent (claims reduced by 5 percent)
- Probability of efficient withdrawal in 2013 = 60 percent (no claims reduction)
- All projected withdrawals post 2013 assumed to be efficient
- Probability of lapsing prior to account depletion = 20 percent

(These parameters are stylized to illustrate the point). The first model assumes no interaction between these assumptions (excess withdrawers are just as likely to lapse as efficient withdrawers) and the second model assumes a strong interaction between excess withdrawal and lapse (excess withdrawers considerably more likely to surrender).

Model 1 - VA guarantee claims valuation, assuming no correlation between assumptions



Total PV =77.6 (assumptions: PV of claims =100 for efficient withdrawers, 90 for excess withdrawers, 95 for partial withdrawers and 0 for lapsed policies)

> "Excess withdrawals can signal a range of policyholder circumstances such as a need for liquidity, a medical condition, or suboptimal financial decision making, any of which could also trigger a lapse."

By ignoring the interactions between the lapse and excess withdrawal assumptions, the first model would understate the guarantee cost for a simple reason: most of the policies taking excess withdrawals, who produce lower guarantee costs relative to their more efficient counterparts, would have lapsed anyway and so their excess withdrawal would have had no impact on the valuation in any event. While the 53 basis point cost understatement may seem *de minimis*, this 53 basis points would compound for each year that elective withdrawals are taken by policyholders. With an average life of 10-15 years, this could lead to a considerable reserve mis-estimation and raise the eyebrows of management, auditors, and other stakeholders.

This compound effect complicates behavioral modeling because the actuary must not only set assumptions but the degree of interactions between assumptions.

III. MODELING SYSTEM CRITERIA

No model can perfectly describe reality and VA behavior is a prime example of this for the reasons above. Choosing from a range of possible imperfect models, we suggest the following criteria to evaluate the quality of a chosen model:

- **Accuracy:** The model must correctly return the quantity being measured, at the level of precision required.
- **Ease of implementation:** The model must not be overly complex as to be intractable.
- **Monitorability:** The model must be sufficiently transparent that results and attribution can be communicated and monitored; a particularly important characteristic given the complexity of the model.

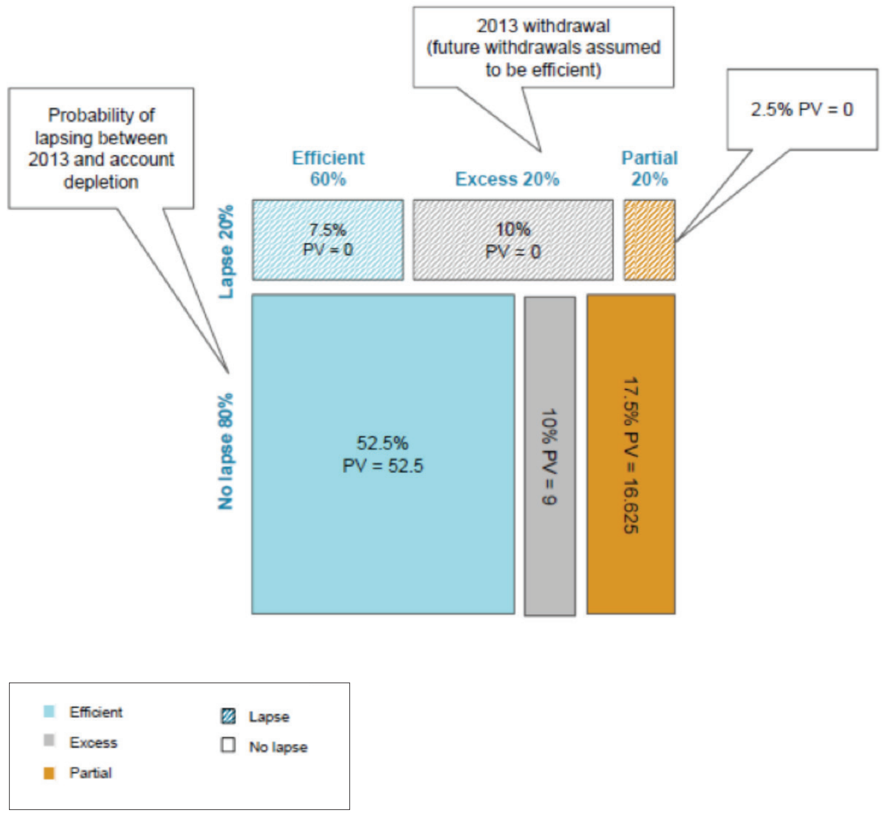
IV. SUGGESTED APPROACH

In the market today, we observe three common approaches employed by actuaries to cope with the interactions between VA behavior assumptions:

1. The "simplified approach": Assume no interaction between behavioral risk factors

Some actuaries altogether eliminate the model complexity by ignoring the interactions of risk factors.

Model 2 - VA guarantee claims valuation, assuming correlation between assumptions



Total PV =78.125

Because of its simplicity, this approach meets our ease of implementation and monitorability criteria, but, as noted above, can lead to gross mischaracterization of liability, failing the accuracy criterion. We believe that this approach can be used if all standalone behavioral risk factor are set conservatively and when a reasonable degree of model output precision is not required. This also needs to be adequately understood and communicated to model results users.

2. Explicitly model the interactions via a "Markov chain"

Under this approach, the actuary explicitly reflects the correlations between assumptions with a Markov chain. The actuary would define various "states" for a

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variable annuity such as (1) "no withdrawal," (2) "efficient withdrawal," (3) "partial withdrawal," (4) "excess withdrawal," (5) "lapse," and (6) "death," and define the state-to-state transition probability for each pair, thereby explicitly capturing the interactions between assumptions. This approach passes the accuracy test but performs weakly on the ease of implementation and monitorability criteria. Because a different set of assumptions is required for every state-to-state transition, and the states are very numerous, the model risks becoming intractable. The many state-to-state transitions to be modeled would include:

- The six states noted above
- Within the excess and partial withdrawal states, further buckets to distinguish different levels of excess and partial withdrawals (e.g.—excess, severe excess etc.)
- Potential further bucketing based on behavior in the year before last, if this behavior is seen to be correlated in some way with future behavior
- The standard demographic and economic data actuaries use to model behavior such as age, duration, moneyness etc.

For these reasons, we believe that the Markov chain approach can provide insight into behavioral dynamics when conducting experience studies, but is not practical for full model implementation.

3. Results-oriented hybrid approach

The third approach is a results oriented framework which focuses on model transparency and model output accuracy, at the expense of explicit best estimate input assumptions. The process for setting assumptions is as follows:

- Establish the lapse rate function: set lapse estimates based on observed lapse experience.
- Establish the timing of income start: also known as the "timing grid," this step determines when surviving policies begin to take income. These income takers are then modeled to be perfectly efficient.
- Set excess/partial withdrawal assumptions, but adjusted for differential lapse: Similar to the simplified approach, the hybrid approach sets absolute inefficient withdrawal & lapse assumptions that are not assumed to interact. However, unlike the simplified approach, the hybrid approach calibrates the inefficient withdrawal assumptions to return the projected valuation results, at the expense of precisely modeling who and when a policyholder may take inefficient withdrawals. This is analogous to an actuary using mortality experience weighted by policy size. Such a mortality table is not expected to accurately predict the number of people who will die, but would instead correctly quantify the impact of mortality on the valuation. Similarly, inefficient withdrawal assumptions are "weighted" by lapse rate to arrive at a properly calibrated inefficient withdrawal assumption.

To implement the results-oriented hybrid approach, in one analytical method, which we call the "policyholder breakage method," the actuary can supplement the traditional experience study, and its focus on demographic cohort behavioral choices, with a financial study of the historical impact of inefficient withdrawals on actual and projected claims. In this study, the actuary is not focused on the behavioral choices the policyholder made but on how these choices impacted the value of projected fees and claims. This financial quantification is called the "policyholder breakage rate." Future policyholder withdrawal behavior can then be modeled as efficient but the breakage rate is applied as a topside adjustment to model results to capture the expected impact of future inefficient behavior on claims and fee values.

V. CONCLUSION

Above, we summarized some of the challenges and potential solutions for guaranteed VA behavior risk management. We anticipate that this risk area will become an increasing focus for actuarial and risk management groups at VA manufacturers and that actuaries will continue to play the dominant role in managing and modeling this risk. Because of the obstacles noted in this paper, we do not believe that it will be possible to model and measure this risk with 100 percent accuracy. However, we do think that modeling approaches targeted to capturing the key dynamics at the expense of perfect accuracy will be crucial to ensuring insurance companies minimize the likelihood of further large financial restatements due to behavioral assumption unlocking. ■