SOCIETY OF ACTUARIES

# Equity-based Insurance Guarantees Conference
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# Managing and Modeling Policyholder Behavior Risks

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## Moderator

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# Variable Annuity Guaranteed Benefits Policy Holder Behavior

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Equity Based Insurance Guarantee Conference (Boston)
27 Oct 08: 1000 – 1210 hours

## VA Policyholder Options

- Total Withdrawals (i.e. Lapse)
- Transfers
- Additional deposits
- Withdrawals
- Resetting Benefits
- Exercising Benefits (e.g. WB, LB, IB)
- Etc.

## Two Topics

- Lapse Option Efficiency
- Detecting Model Errors in G/L Analysis

# Lapse Option Efficiency

## Lapse

- Guaranteed Benefits paid for generally through ongoing fee
- Option to stop paying fee by Lapse
- Incentive is higher when

  PV(Benefits) < PV(Fees)

## Surrender Charges

- Incentive to lapse is decreased by surrender charges
- A modification/elaboration of previous slide – Incentive to lapse when
  - PV(Fees) + SC > PV(Benefits)

## Other Influences On Lapse

- Age vs. Retirement Age
- Tax Rules
- Base Policy
- Etc.

## Simple Model Of Lapse Option

- 10 Year AB
- 100% Equity investment
- Flat and constant yield curve
- Policy with base fee and benefit fee as percent of AV
- Lapse as a function of PV(Benefit) vs. PV(Fees)

## Simple Model Of Lapse Option

- Seven year surrender charge schedule
  - 7, 6, 5, 4, 3, 2, 1
- SC as percentage of deposit
- Mortality – single life

## Lapse Behavior

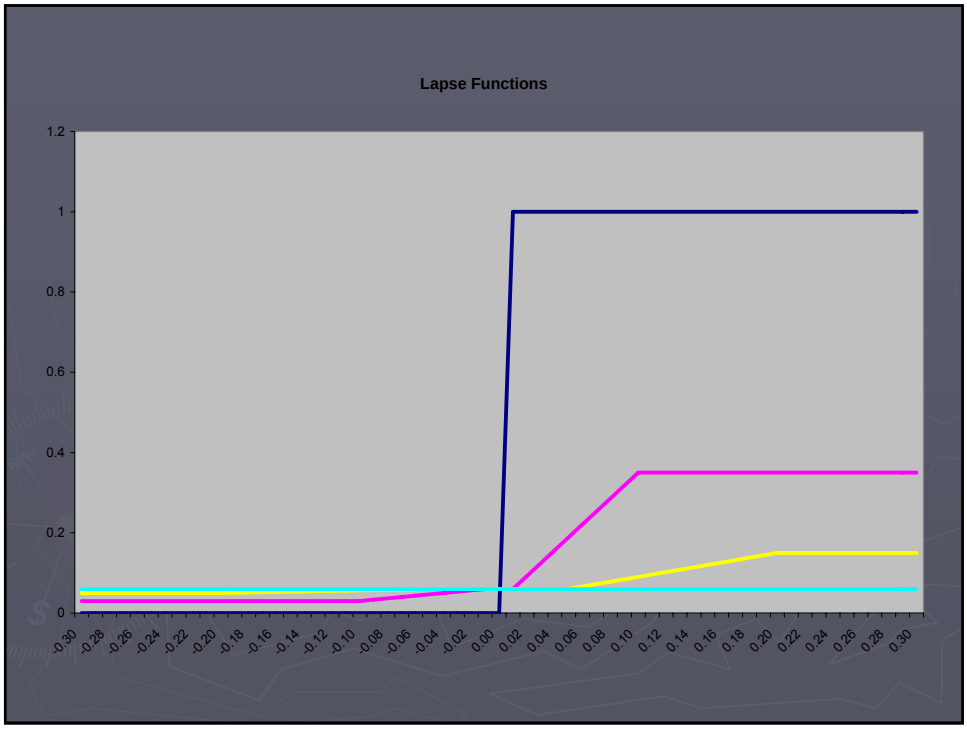
- Base Lapse Rate - Given neutral guaranteed benefits there are still lapses (many reasons)
- Friction – How big is incentive before policyholders act
- Sensitivity – How sensitive are lapse rates to lapse option being ITM
- Limits – Min and Max lapse rates

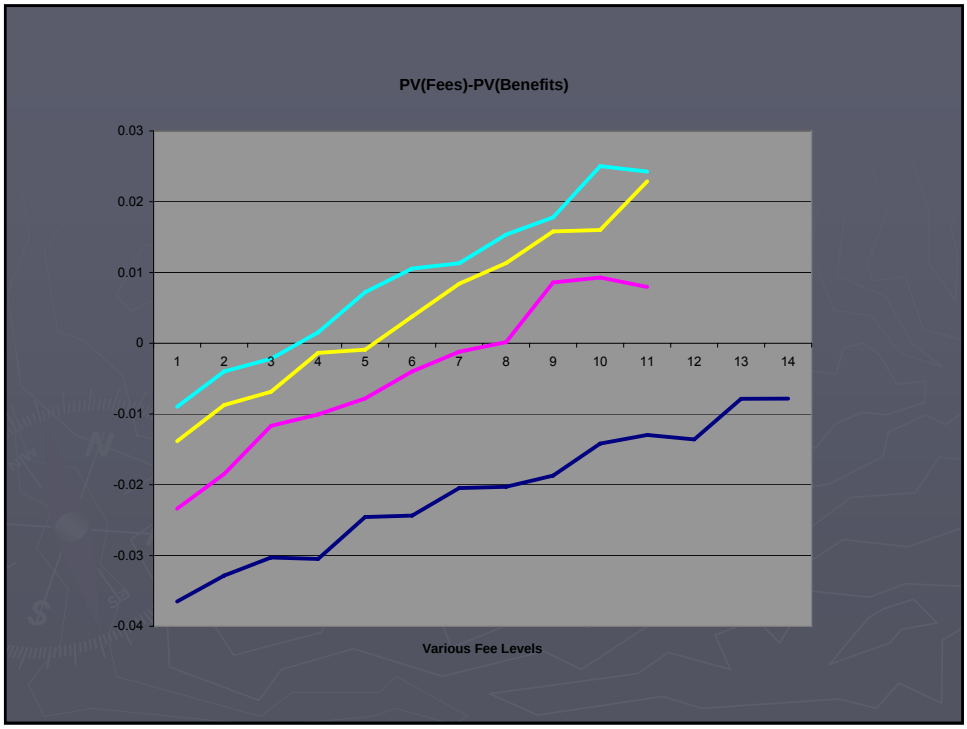
## Simple Lapse Functions

- Base Lapse Rate
- Friction – amount ITM or OTM prior to lapse rate differing from base
- Sensitivity – simple linear model – slope
- Min and max lapse rates

## Four Example Cases

- Efficient – 0% base lapse, no friction, infinite sensitivity, no limits.
- More Sensitive
- Less Sensitive
- Static – Only base lapse rate


Lapse Functions
1.2
1
0.8
0.6
0.4
0.2
0
-0.30 -0.28 -0.26 -0.24 -0.22 -0.20 -0.18 -0.16 -0.14 -0.12 -0.10 -0.08 -0.06 -0.04 -0.02 0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20 0.22 0.24 0.26 0.28 0.30


PV(Fees)-PV(Benefits)
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Various Fee Levels

## Efficient

- Note that PV(Fee)<PV(Benefit) at all fee levels
  - If increase fees then instant lapse (i.e efficient policy holder would not purchase)
  - For this model, this result is the same for 10 year benefit
  - Interesting that this exercise has no solution

## Detecting Model Errors in G/L Analysis

## Self Consistent Process

- Valuations of VA benefits if done correctly must be self consistent
- A corollary of this statement is that all G/L from the valuations can be attributed to the moving pieces of the model
  - Market movements
  - Policyholder behavior and mortality
  - Time passage

## Using Self Consistency to Detect Errors

- The self consistency implies that given what has occurred over a period in markets and policy holders, an expected valuation can be calculated from beginning-of-period in force file
- This expected valuation can be compared with end-of-period valuations and explained in terms of market moves, policy holders and time passage

## Using Self Consistency to Detect Errors

- Any differences that cannot be explained may point to errors.
- This is illustrated in the following example.

## Example

- Model stratifies policy holders for some behavior
- 50% are active with 50% probability to elect some option per period
- 50% are inactive with 10% probability to elect the option per period

## Period 1

- Percent of in-force not electing option is
  Percent active * (1-prob active elect) +
  Percent inactive *(1-prob inactive elect)
  = 50%*(1-.5)+50%*(1-.1)= 25%+45%=
  70%
  At end-of-period
  25% are active
  45% are inactive

## Hypothetical Error

- Model incorrectly assumes 35% are still active and 35% inactive
- This example is exaggerated to illustrate the idea. In an actual example the numbers can be small and hard to detect
- In this example assume actual=expected

## G/L Analysis

- At end of period – 4 valuations with beginning of period population
  - Active, Elect = A
  - Active, No Elect = B
  - Inactive, Elect = C
  - Inactive, No Elect = D
  - Expected Valuation on those not electing= .5*.5*B+.5*.9*D= .25*B+.45*D

## End of Period Erroneous Valuation

- End of period erroneous valuation on those not electing = .35*B+.35*D

  <> expected valuation = .25*B+.45*D

## Detection

- Notice that Actual-to-Expected elections are zero
- Notice that there is a G/L attributable to the elections (expected valuation <> end of period valuation).
- Conclude there is an error.

## G/L Analysis and Errors

- In practice the errors can be much smaller and actual-to-expected will not be zero
- Thorough G/L analysis, done frequently is necessary to be sure that all parts of the very complicated process and models are functioning properly.
- Valuations should be shown to be self-consistent.

# Policyholder Behavior

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**Equity Based Insurance Guarantees (Boston)**
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## Agenda

- Key Policyholder Risks
  - Measuring the Risk
  - Managing the Risk
- Practical Considerations
- Monitoring Experience
- Impact of Recent Market Activity

## Continued Focus on Policyholder Behavior

- Broad impact
  - Product design and pricing
  - Reserves and capital management
  - Risk management
- External focus
  - Rating agency and analyst view that predicting policyholder behavior is one of the most significant risk factors facing the industry
- Data, data, data
  - There continues to be limited experience, particularly in extreme or tail event markets
  - Cannot build credible behavior data set without going through a full economic cycle, that is an equity market going through both bull and bear markets
  - We may be in a better position now ... unfortunately!



## Key Policyholder Risks

- Key Policyholder Risks
  - Lapse
  - Benefit utilization
  - Asset allocation (and fund transfers)
  - Annuitization
  - Mortality and longevity
  - Renewal premiums

## Lapse Modeling

- Base rate adjusted by a factor based on the value of the guarantee

Base Rates x Dynamic Adjustment = Dynamic Rate

| Year | Rate |
|---|---|
| 1 | 1% |
| 2 | 2% |
| 3 | 3% |
| 4 | 5% |
| 5 | 25% |
| 6 | 15% |

→ x 0.65
*f* (ITM, Age, Duration) →

| Year | Rate |
|---|---|
| 4 | 3.25% |

- Dependent on the population, distribution channels, product designs, commission schedule, and so forth.
- For similar products, base lapse rates in may be different around the world.

- Stepwise, continuous
- Linear, polynomial, exponential, arctan
- Drivers (ITM, age, dur)
- ITM definition
- Min and max rates
- One sided, two sided

- Is there always a minimum level of lapse rate regardless of the value of the guarantee?
- Will the lapse rate increase beyond the base rate?



## Definition of ITM

- Dynamic lapse adjustment is driven by ITM:

| Guarantee | Common ITM Definition |
|---|---|
| GMDB | Guarantee Value / Account Value |
| GMAB | Guarantee Value / Account Value |
| GMIB | Guaranteed Annuity Income / Current Annuity Income |
| GMWB | PV Benefit / Account Value |
| GMWB for Life | PV Benefit / Account Value |

- Considerations for GMIB, GMWB, and lifetime GMWB
  - Discount factors and mortality improvements

## Global Dynamic Lapse Considerations

- GMAB is the most common benefit currently seen in Asia and Europe
  - It guarantees the return of X% of principal (e.g., 90%, 100% or 110%) after a waiting period (e.g., 5 or 10 years)
- Therefore, the dynamic lapse adjustment formula should incorporate the waiting period
  - The closer a policy is to the maturity of the GMAB, the more sensitive it is to the ITM
- For products with multiple guarantees, e.g., GMDB and GMAB, some companies compute two lapse adjustments separately and apply the more conservative factor



## Lapse Analysis

- So … is a lower lapse rate really that bad ?
- Lower lapse increases the ultimate cost of the guarantee, yet some insurers are offering incentives that may reduce lapses
- With proper designs, the additional income from the base contract can more than offset the increased cost
- Evidence from pricing report sensitivity runs and RBC C3 Phase II results:

| Lapse Run | IRR (50th Percentile) |
|---|---|
| Base Assumption | 13.2% |
| Base * 120% | 11.9% |
| Base * 80% | 14.6% |

## Managing Lapse Risk

- Product design features used to manage lapse risk
  - Loyalty bonus
  - Enhanced guarantee benefits
  - Surrender charge
- Commission structure
  - Commission chargeback
  - Trail commissions
- To a reinsurer participating only in the guarantee portion of the contract, a reduced lapse can have a pronounced impact



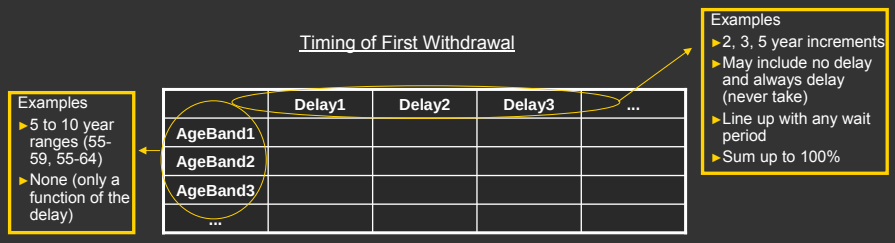
## GMWB and Lifetime GMWB Modeling

- The benefit guarantees a benefit payment of up to 5% to 7% of the benefit base for a fixed period or for life
- An increasingly popular approach to modeling the level of utilization is a cohort approach
- Split each inforce or pricing cell into multiple cohorts and project each out separately
- Cost of guarantee is very dependent on the level of utilization

| Cohort | Formula | % of Cell | RN Cost (bps) |
|---|---|---|---|
| **Cohort1** | *Base* | *20%* | *44* |
| **Cohort2** | *Dynamic f(ITM)* | *50%* | *50* |
| **Cohort3** | *100%* | *30%* | *108* |

## GMWB and Lifetime GMWB Modeling

- Timing of first withdrawal by model cohorts




- Many companies assume that those already taking withdrawals typically continue to take at the current withdrawal level
- Some companies assume withdrawals begin when first available but vary the withdrawal percentage.

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## GMWB and Lifetime GMWB Utilization

- Other considerations
  - Age dependent
  - Enrollment in a withdrawal program
  - Required tax distributions, such as Required Minimum Distributions (RMD)
  - Unique product designs, such as the ability to defer the withdrawal amount to the next year
- Be prepared for the "perfectly rational investors" who would utilize the benefit 100% from day one or at a time when it is optimal from their perspective

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## Managing Utilization Risk

- Ideally, one would defer the utilization as far out as possible
- To achieve this, GMWB and lifetime GMWB offer:
  - Loyalty bonus if no withdrawal is taken during the first X years
  - GMWB turning into a lifetime GMWB upon the attainment of age Y
  - Increased withdrawal percentage based on the timing of first withdrawal
  - Market based ratchets encourage investor to delay withdrawals
- Nonetheless, companies need to evaluate the cost and benefit of the incentive



## Managing Utilization Risk

- In the US, some companies increase the benefit base by 5% a year for each additional year of deferment
- This could potentially be an expensive option!

| Years to 1st Withdrawal | RN Cost (bps) |
|---|---|
| None | 45 |
| 1-year | 45 |
| 3-year | 49 |
| 5-year | 56 |

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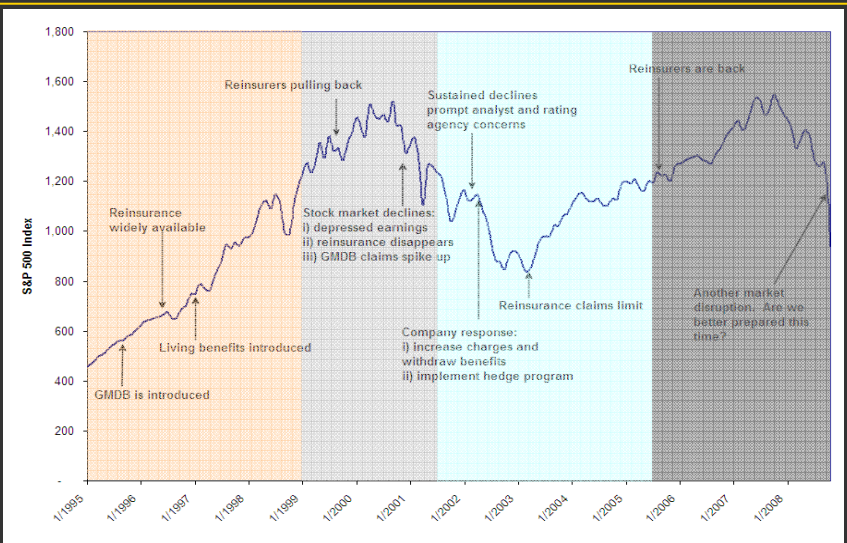
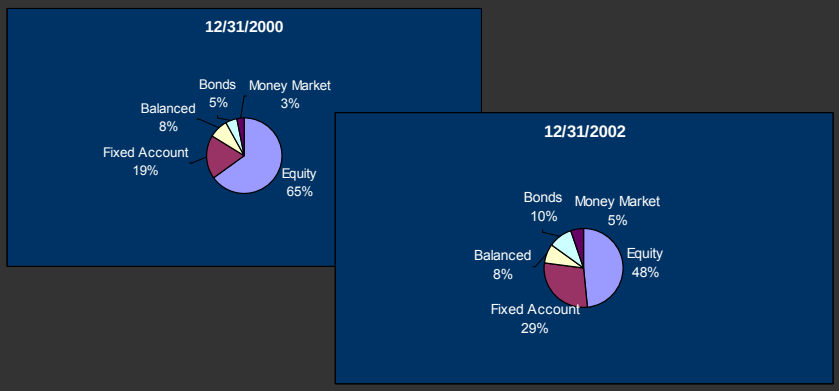
## Asset Allocation - A Historical View of the S&P 500






## Asset Allocation and Fund Transfers

- US variable annuity (VA) average asset allocation



## Managing Asset Allocation Risk

- Companies can control the risk by:
  - Restricting the equity portion of the funds offered
  - Offer funds correlated to an index to reduce basis risk
  - Limiting the number of fund transfers in a year and assessing a charge for each transfer
  - Requiring an asset allocation model and rebalancing regularly
  - Striking an agreement with fund managers to limit basis risk
- Lessons learned globally as Asian and European VA writers impose more restrictive investment options



## Annuitization Risk

- Similar to lapse and GMWB utilization, annuitization should be dynamic, based on ITM, which is dependent on the then-current interest rates and mortality assumption
- May expose the company to longevity risk
- The risk can be controlled quite effectively through
  - A low guaranteed interest rate
  - Conservative guaranteed mortality rates

## Other Risks

- Mortality and longevity
  - Use mortality improvement factors to reflect longevity risk
  - Death benefit and living benefit are complements of each other
    - Improved mortality hurts the cost of providing the living benefit, but that is partially offset by the continued fees collected from the death benefit portion
- Renewal premiums
  - Not material in US
  - More common in Asia, Europe
  - Prevent dump-ins by providing guarantee only on pre-scheduled premiums or premiums paid within the first X years of issue
  - Institute a cap/limit on the guarantee amount



## Practical Considerations

- Dynamic formulas
  - Vary widely and in large part have not been validated
  - Do not reflect the tendency for policyholders to persist when market performance is good and lapse when market performance is poor
    - Some companies experiencing increased lapse in current down markets
    - Policyholders put more value into the current account value over the future guarantee
  - Dependent on economic scenarios and thus the various choices of interest rate and equity models
- Model cells
  - Cell grouping may distort behavior patterns
  - Must make sure the key drivers of behavior are covered in your cell compression criteria
- Sensitivity testing
  - It is not always intuitive what constitutes a bad scenario in terms of policyholder behavior
  - Adverse scenario depends on the product design

## Practical Considerations

- Life events play a role regardless of market performance
  - Withdrawals driven by needs not markets
  - Supports the cohort approach to modeling
- Replacements or cancellations
  - Out-of-the-money policies
  - Agent influence
- New product offerings
- Secondary markets

(continued)



## Practical Considerations

- Rational vs. irrational behavior
  - Rational
    - Behavior that maximizes the benefit to the policyholder and thus maximizes the liability to the insurer
    - Correlated with market performance
  - Irrational
    - Behavior that undervalues the benefit and thus reduces the liability to the insurer
    - Cannot be explained by value of benefit alone
    - Consumer laziness, lack of awareness, lack of understanding
- Reality is a mixture of rational and irrational behavior
  - Policyholders have yet to fully recognize the value of the guarantee
    - For example, policyholders don't invest in the riskiest funds offered
  - Challenge with sensitivity testing
    - What if policyholders became more economically rational?
      - Baseline assumption pays claims in 50% of scenarios
      - Maximizing economic rationality pays claims in 80% of scenarios

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## Monitoring Experience

- Must understand the elements that are most sensitive and have the largest impact on the liability value and the risk
- Experience studies are the primary source of data
  - Sufficient levels and frequency of data collection is critical
  - Automatic provisions clearly tracked
    - Systematic withdrawals
  - One off activity results in less tracking
  - Group consistency versus local variation
- Industry data and publications are an alternative source
  - Policyholder behavior in the tail study
  - Reports for C3 Phase II, AG VA CARVM



## Monitoring Experience

- Frequency of experience study updates
  - Typical to see once per year in accordance with DAC unlocking
  - Volatile markets may require more frequent analysis
- Supporting data
  - Are we capturing the sufficient quantity and categories of data for the key drivers of the dynamic formulas?
  - When a policy actually lapses or takes their first withdrawal, are the systems and processes in place to capture the relevant data at that point
    - Age, AV, Guarantee Value, Policy Duration
- Mechanism to update formulas to reflect experience

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## Impact of Recent Market Activity

- Volatile capital markets, stressed financial institutions
- Initial policyholder reaction
  - Allocations
    - Transfer out of equity into fixed
    - May help provide stability in short term
    - May lock-in the NAR for the guarantee
  - Surrenders
    - General perception that down market is bad, particularly for older policyholders at or near retirement
    - Guarantee value should help persistency, but not always holding true
    - Policyholders leaving stressed insurers
      - Uncertainty over specific insurers can drive out policyholders, regardless of any value in the guarantee