VA Guaranteed Options and Risk Management

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A. VA Guaranteed Options in US and Korea Market

1. GMDB (Guaranteed Minimum Death Benefit)
   - 1980s: Variable Annuity – ROP (Return of Premium)
   - 1990s: Ratchet (MAV – Maximum Anniversary Value)
     Roll-up (i.e. 5% Roll-up each year)
     Combo : Greater of Ratchet or Roll-up
   - Partial withdrawals ($ for $, pro rata) and Spousal continuation

2. GMAB (Guaranteed Minimum Accumulation Benefit)
   - Late 1990s: Guarantees a minimum account value on death or maturity (at the end of the waiting period)
   - ROP is the common guaranteed base, some plans allow reset to lock-in the gain but restart the waiting period
   - Some plans have the guaranteed base of ROP * (100%+ X%) with a longer waiting period
   - Simpler to explain but higher potential financial risk
   - Partial withdrawals ($ fro $, pro rata)

3. GMIB (Guaranteed Minimum Income Benefit)
   - Late 1990s: Guarantees a certain minimum value on annuitization with a preset payout rates
   - Waiting period (5 to 10 years) before the policy can be annuitized
   - ROP, Ratchet and Roll-up types are very common
   - Using very conservative mortality and interest rates for the calculation of annuity payments
   - Partial withdrawals ($ fro $, pro rata)

4. GMWB (Guaranteed Minimum Withdrawal Benefit)
   - Early 2000s: Guarantees the return of premium (ROP), but the money must be taken as partial withdrawals over a number of years
   - Latest: Enhanced GMWB with lifetime payment
   - GMWB with Ratchet, Roll-up or Combo are very common
   - GMWB benefit base reset feature
   - Sales of VA with GMWB increase significantly in 2006 for major VA insurers (19%) – Hartford, AXA, AIG, ING, Pacific Life, MetLife, John Hancock, Jackson National, Nationwide and Loncoln.

5. Japan – Variable Annuities with Guaranteed Options
    - 1999: ING Life introduced VA for the first time in Japan
    - 2000: Hartford Life entered Japanese market
    - 2002: Deregulation on Bank Channel accelerated annuity sales
    - End of 1st quarter of 2006, VA net asset reached roughly US$ 110 billion
    - Common guaranteed benefits include: GMDB, GMIB, GMAB and GMWB
    - Major players: Hartford Life (31%), Mitsui Sumitomo MetLife (15%), ING (13%), Sumitomo Life (8%), ManuLife (6%), Mitsui Life (6%), ALICO – AIG (5%), T&D Financial (4%), Dai-ichi (3%), Tokyo Marine (3%)

B. What Risks VAs Have

1. Actuarial Risks
    - Lapse Rates (Base and Dynamic)

      Base : This tends to be a function of the products, surrender charge period etc. This assumption cannot be hedged – do not group policies according to policy year.

      Dynamic : This tends to be a function of the in-the-moneyness of the liabilities, interest rate levels in addition to the base lapse rates. This assumption is typically applied to living benefits. In a nutshell, these risks tend to be big contributors to the risks embedded in the products. Additionally, whenever there are Dynamic lapse rates, the hedging program tends to be more volatile since as the market conditions change, the lapse pattern changes.
    - Mortality Risks

      The mortality risks embedded in this product is analogous to the maturity date of the guarantees in the sense that the moment the policy holder dies (or the option matures), the insurance company is exposed to policyholder claims if markets fall below their guaranteed levels.
    - Fund Switching Risks

      Any risk can only be managed for a pre-defined fund allocation – which in practice happens to be the current fund holdings of the policyholders.

      The assets transacted on existing fund holdings need to be unwound to buy assets on indices replicating the new tilt of fund holdings.
    - Annuitization and Withdrawal Risks

This type of policyholder behavior is philosophically similar to the policyholder behavior under the Dynamic lapse rate section. The only difference here is that this assumption is very much specific the products as to how policy holders will annuitize or withdraw or reset as a function of in-the-moneyness of the liabilities, duration of the policies, amongst other things.

2. Financial Risks

- Basis Risks

  Exchange-traded commodity futures contracts call for delivery of the underlying commodity at specific locations and specific dates.

  The actual commodity to be bought or sold may reside at a different location and the desired delivery date may not match that of the futures contract. This general problem of the futures or forward contract not representing exactly what is being hedged is called basis risk. This risk is inherent the moment the hedges involved indices. The reason for this is simply due to the fact that actively managed funds when replicated by indices introduce tracking error. As such, the replication of the equity fund returns by appropriate indices needs to be well-tested using historical data over appropriate economic regimes using a time horizon consistent with the hedge rebalancing.

- Equity Market (Volatility) Risks

  This risk is related to movements in both absolute fund and index values as well as potential movements in these underlyings. In practice what is required are hedges that move in sync with the liabilities throughout drastic changes in the equity markets and volatilities in these markets. The insurance companies running a dynamic hedging program do some of the following:

  - Use historical volatility as an input – a single value is used as an input
  - Use the implied volatility term structure as an input
  - Use implied volatility surface as an input – the risks underlying the liabilities are more accurately quantified using the volatility surface.

- Interest Rate Risks

  This risk is related to movements in both absolute values of the yield curve as well as potential movements in interest rates. Interest rate risks enter this product through the following 3 ways:

  - Replication of fixed income funds
  - Growth rate of equity markets
  - Discounting of cashflows – this basically refers to the interest rate assumption

used to discount cashflows or contingent cashflows.

- Annuitization/Withdrawals – This refers to the impact of interest rates when the annuitization and withdrawals are left to the discretion of the policy holder.

3. Operational Risks
   - Model Risk – This refers to the validity of the model used to project out the fund values, predict lapses and mortalities.
   - Computational Efficiency – This refers to the trade-off between implementing the "holy grail of a model" versus a model that is easy to implement and has the ability to produce risk numbers "live" so as to manage the risks real-time.
   - Data Cleanliness – This refers to the information stored by the direct writer pertaining to policyholder's age, sex, fund holdings, deposits, withdrawals, fund switches, types of benefits purchased etc.
   - Corporate Governance – This refers to the corporate governance relating to G30 guidelines that is a pre-requisite to running a prudent and well-defined hedging program.
   - Credit Risks – This refers to the counterparty risks that the writer is exposed to when trying to hedge these risks using over-the-counter instruments.

4. Accounting & Regulatory Risks
   - This relates to how the revenue and liabilities are reported on the balance sheet
   - Liabilities are not marked-to-market
   - Required capital that needs to be set aside – direct writers should set aside capital for exposures not hedged using stochastic scenarios generated.

C. Strategies to Manage Risks

1. Naked

   Not doing anything and is also called "self-insurance" – due to the fact that the writer sets aside the appropriate capital.

2. Reinsuring Risks
   - Reinsuring the risks partially or completely using whatever is available at the marketplace for a reasonable cost.
   - This is the best solution if available
   - Reinsurance has various caveats:

- Finite capacity
- Limits on single claim
- Limits on total annual claim
- Changes in premiums

3. Static Hedging
   - This revolves around purchasing long dated OTC options from the investment banks.
   - Lapse and mortality risks are still borne by the direct writer since the investment banks are not allowed to take on non-market related risks.
   - Availability of these options gets lesser as maturity of these derivatives exceeds 10 years
   - The derivatives purchased are usually linked to indices
   - Very expensive

4. Dynamic Hedging
   - What is being done under the static option but in a more dynamic fashion.
   - A procedure for hedging an option position by periodically changing the position held in the underlying asset.
   - Flexible and potentially cheaper over long term.
   - Revolve around the use of liquid instruments like futures, equity options (both exchange and OTC), swaps and swaptions.
   - See the appendix A for details

5. Quasi-static Hedging
   - Hybrid of the Dynamic hedging, OTC static options and Reinsurance strategies. The instruments used for implementing these strategies also include reinsurance and long-dated options in addition to all the liquid instruments used for a dynamic hedging program.
   - The motivation is driven primarily by the fact that when the market conditions are not favorable to transact in long dated options or reinsurance is not available for a reasonable price, the hedger would be using dynamic hedging to manage the risks.

D. Pricing, Reserving & Liability Accounting for GMxB

1. Embedded option valuation methodology

a) Actuarial approach

- Real-World model： using real assumptions, rate of return is the risk-free rate plus the risk premium
- A stochastic model based on the economic scenarios generated to approximate the real-world equity return
- Commonly used for VA pricing, setting capital and reserving of Variable Annuity in US
- Conservative assumptions are used to provide a risk margin
- Conditional Tail Expectation (CTE) is a typical method used to calculate capital requirement and reserving
- Current SLI VA pricing method is an actuarial approach, the actuarial approach is still commonly used for pricing by US insurers

b) Financial approach

- Risk-Neutral model： assumes that all assets return at risk-neutral rates, it is also used for discounting
- This method is used for option pricing, and GMxBs are basically "put option" sold by the insurer
- Calculate the approximate current market value of the guarantee
- By knowing the market value of the guarantee, the insurer can buy and sell market instruments that offset the risk. In essence, this is the "Hedging".

2. GMxB fee pricing ：How to set safety margins

a) Risk Measures

- Return on Equity (ROE) / Internal Rate of Return (IRR) are commonly used in US, Japan and Europe for profit measure. The profit & loss calculation is done after the M&E charge of the guarantees is factored in as an income
- Insurers without hedging procedure usually use actuarial approach to calculate the guarantee cost, 50th to 75th percentile of all scenarios is used as a risk measure
- Hedge cost plus profit margin method is also used by some insurers
- Risk-Neutral model is recommended to calculate the hedge cost
- SLI is using the actuarial approach to calculate the guarantee cost

3. GMxB reserving & accounting

a) Korea

- The reserve for annuity is the fund value
- The reserve for guarantee benefits is the accumulation of guarantee fee (M&E charge)

b) US

- US statutory reserves for guarantee benefits are based on Actuarial Guidelines – AG34 & AG39
- AG34 uses one drop and recovery scenario
- AG39 requires insurers to establish a VAGLB reserves and to perform Cash Flow Testing (CFT) with stochastic and deterministic scenarios
- US GAAP: GMDB & GMIB are subject to SOP03-1, there is no clear guidance to what kind of scenarios should be used
- US GAAP: GMAB & GMWB are subject to FAS133, risk neutral scenarios are required as they need to be fair valued

c) Other Countries

- European Union (EU): The reserving and accounting requirements are based on IFRS, which is a fair value accounting scheme
- Asset Backed approach which the UK and Ireland have adopted
- The guaranteed benefits are fair valued – current market value is calculated
- The hedge assets are fair valued, as the value of the guarantee benefits and hedge assets can move in sync
- If you have a hedging program in place, the reserve is the hedge asset value

4. Solvency requirement

a) Korea

- Guideline for minimum annual reserve requirement
- If reserve held is less than the minimum requirement, additional capital (or reserve) injection is required

b) US

- RBC-C3P2: A principles-based approaches to calculate the required capital
- It is still in the process of being finalized
- 10,000 prepackaged scenarios are recommended by American Academy of Actuaries
- These scenarios are viewed as real-world scenarios
- It is basically a percentile method, or CTE(X) method, but the X % is not

decided yet

c) Japan

- The solvency requirement is factor based
- There is a 2% charge on guarantee value for any type of death benefit
- There is additional 2% charge for any type of living benefit
- Reserve credit is given to co-insurance but not to YRT
- No reserve credit will be given to hedging program

d) European Countries

- Regulators want to have an unified solvency requirements, but no conclusion yet
- The EU Solvency I requires up to 4% of the fund value to be held as solvency capital
- The new products and hedge techniques are likely to be more capital efficient under Solvency II
- Solvency II will lead to capital requirements similar to RBC-C3 Phase II requirements in US

Appendix A

Dynamic Hedging

- Concept
  - Hedging method periodically changing the position of financial derivatives(i.e. futures or options) to offset the change of the guaranteed option value of the in-force contracts
  - Long put options or short index futures

- Dynamic hedging using the index futures
  - Hedging method periodically changing the short position of the index futures in order to offset the change of the guaranteed option value according to change of stock price
  - Periodically calculating & adjusting the number of futures contracts sold satisfying 「GMxB Delta - the number of index futures sold × (Delta of index futures) = 0」

- The reason why the dynamic hedging becomes the primary hedging method in the US
  - Due to the difficulties to define the volume of hedging transaction in advance
  - The hedging transaction position and volume are affected by lapses, withdrawals as well (primarily by stock price and interest rates)
  - It is necessary to periodically adjust the hedging transaction volume reflecting the changes occurring from lapse and withdrawal.
  - Accounting regulation
    - FAS 133 describes GMAB and GMWB of VA to follow "Fair Value" (marked-to-market) method from 2004.
  - Due to the difficulties to find the reinsurers

- Hedging cost
  - GMAB Hedging Cost = [G · exp(-r · T) · N(-d2) - F · (1-m)^T · N(-d1)]
    · (# of in-force contracts at time T)
    d1 = [ln[F · (1-m)^T/G] + (r + 0.5 · σ^2) · T]/(σ · T^0.5)
    d2 = d1 - σ · T^0.5
    N(·) : cumulative normal function, T : the duration of guaranteed option
    σ : volatility of fund performance G : guaranteed level
    F : current fund value , r : risk free rate, m : fund cost %

- Hedging strategy
  - Periodically replicating the guaranteed option using the short position of futures

contracts and investment to risk free assets

・The short position of futures contacts :

(ΔF/ΔS) · F · (1-m)^T · N(-d1)・(# of in-forced contracts at time T)

∵ ΔHC/ΔS = ΔHC/ΔF · ΔF/ΔS

・Investment to risk free assets :

G・exp(-r・T)・N(-d2)・(# of in-forced contracts at time T)