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The Development of GMXB products

Dermot Corry – Life Strategies
Adam Stolz – AXA Group Risk Management

A new retirement reality

Changing retirement income sources

- Reduction in Defined Benefit Plans / Social Security to meet retirement income needs
- Increased reliance on Individual Savings Plans

Increased life expectancy

- Retirees are living longer – need for a 30+ year plan for retirement income
- Need for insurance against longevity risk

Inflation risk

- Retirees cannot afford to depend on fixed income
- 2% inflation over 25 years lead to a 40% reduction in purchasing power

Retirees need equity markets investments with guaranteed income

An unprecedented opportunity

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Agenda

- Development in the US and elsewhere
- Description of main benefits and features
- Key Risks and Risk Management
- Pricing
- Capital measures
- Ireland – reasons why people have used Ireland

Dermot Corry, Life Strategies

- AXA global VA developments
- Hedging
  - How does it work
  - Approach adopted by AXA
  - Worked examples
- A Global opportunity

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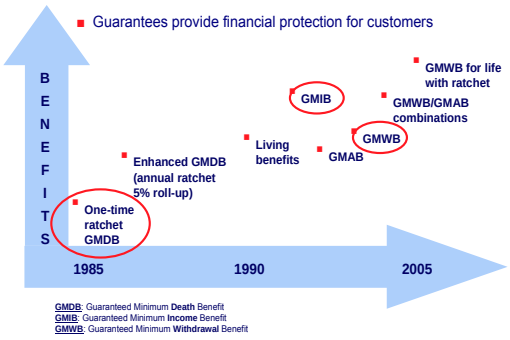
Variable annuities have offered sophisticated guarantees to meet customer needs



GMDB: Guaranteed Minimum **Death** Benefit
GMIB: Guaranteed Minimum **Income** Benefit
GMWB: Guaranteed Minimum **Withdrawal** Benefit

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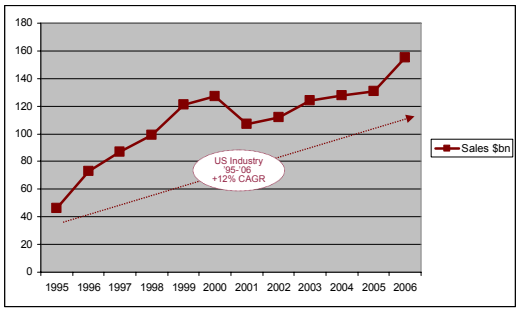
US VA sales $157bn in 2006



Source: NAVA

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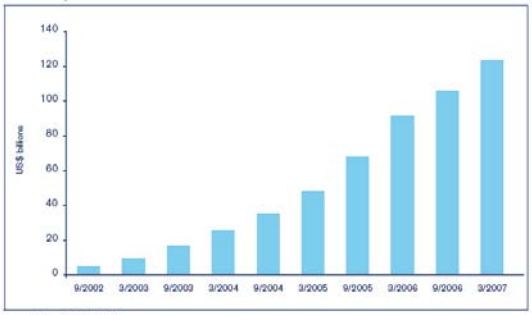
Japanese VA assets growing rapidly



Source: Heken Mainichi Shimbun.

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Developments in Europe

- UK
  - Hartford Life
  - Met Life
  - Aegon
  - Lincoln
  - Royal London
  - Others preparing?
- Other European
  - ING – Spain and Hungary
  - AXA – Germany, Italy, Spain, France, Belgium
  - Generali – Switzerland, announced intention for Europe
  - Many others actively considering
- Volumes generally low to date other than AXA Germany

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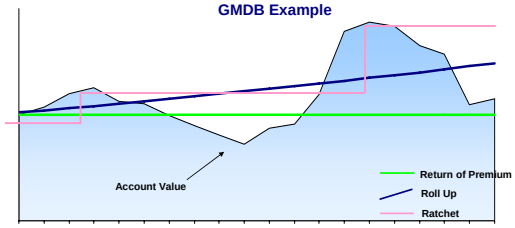
GMDB – Death Benefit Options

- Return of Premium: higher of total premium or account value, adjusted for withdrawals
- Roll-up: premiums paid accumulated at guaranteed rate, adjusted for withdrawals
- Ratchet: highest account value at contract anniversary dates, adjusted for withdrawals
- "Greater of" Ratchet or Roll-up: greater of annual ratchet or roll-up amount

GMDB Example



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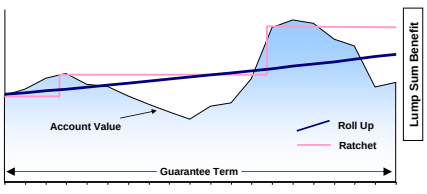
GMAB guarantees a flat or contractually increasing accumulated lump sum amount after a specified period

- Return of Premium: higher of total premium or account value, adjusted for withdrawals
- Roll-up: premiums paid accumulated at guaranteed rate, adjusted for withdrawals
- Ratchet: highest account value at contract anniversary dates, adjusted for withdrawals
- "Greater of" Ratchet or Roll-up: greater of annual ratchet or roll-up amount

GMAB Example



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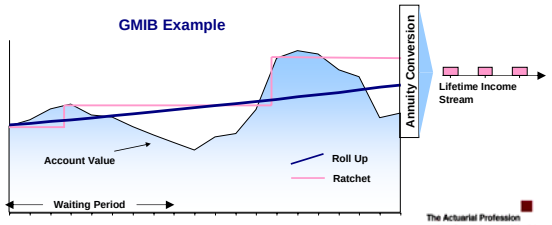
GMIB guarantees minimum annual income when annuitisation option elected

- Guaranteed Minimum Income Benefit calculated based upon Benefit Base
- Benefit Base is not an account value - only used to calculate guaranteed annual income if policyholder elects to annuitise after waiting period
- Benefit Base is the greater of roll-up and annual ratchet, adjusted for withdrawals, up to certain attained age
- Benefit "in-the-money" when guaranteed benefit exceeds what Account Value could purchase at the then current interest environment



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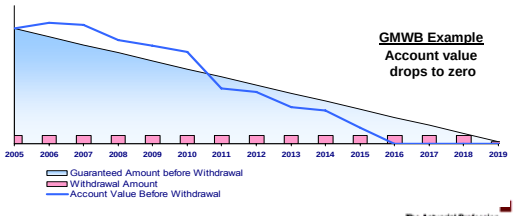
GMWB provides return of principal through periodic withdrawals over a number of years

- Guaranteed Amount: the value that will be returned over time through withdrawals is equal to the initial premium or account value at time of election, even if account value drops to zero
- Often includes reset options in which the remaining guaranteed amount may be stepped up to the account value
- Benefit payment amount: equal to a pre-stated percentage, is maximum withdrawal that may be taken each year



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Risks - What are the key financial & non-financial risks? And how are these risks managed?

- Risk management strategies for this product are not perfect – the company will always bear some risks
- Challenge is to find the right balance between Risk & Return for the Shareholder and the Customer
- Reinsurance is also a valid risk management option though rarely provides complete protection

Risk	Possible Risk Management Strategies
Equity market fall	Hedging of Delta (standard) Hedging of Gamma (advanced)
Interest rate fall	Hedging of Rho (after policy sold) Pricing with conservative interest rates (before sale)
Equity volatility increase Interest rate volatility increase	Pricing with conservative volatility (standard) Hedging of Vega using options (advanced)
Correlation increases between various financial risks	Pricing with conservative correlation
Customer behaviour worse than expected (lapses, withdrawals, election rates, mortality/longevity, business mix)	Pricing with conservative customer behaviour assumptions Design product to be less sensitive to customer behaviour Test behaviour given the product design
Funds do not track closely with market indices ("Basis Risk")	Select funds with historical track record of low basis risk Closely monitor performance of funds and adjust fund mix accordingly within limits of product terms & conditions
Secondary investor buys large amounts of the product it is in-the-money to make arbitrage profits ("Secondary market risk")	Prevent arbitrage in product design and/or look for opportunities to include clause in the policy conditions
Operational risks – eg. incorrect modelling of product, mistakes in hedging process	Robust processes to sign-off of pricing and hedging models Set up processes to prevent, limit and/or fix operational errors

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Customer Behaviour Assumptions

Setting assumptions for customer behaviour

➔ Not an exact science! Use all available information and use conservative approach where information is weak

- Mortality
  - Use mortality investigations and make appropriate allowance for improvement
- Lapse Rates
  - Base rates based on observed experience (which is probably limited)
  - Allow for shock lapse
  - Build dynamic lapse formula to allow for impact of "in the moneyness"
- Election Rates – GMIB/GMWB
  - Very limited experience in any company or market
  - Set election rate using prudent estimates based upon US annuitisation experience
  - Natural hedge GMDB/GMIB
- GMWB Withdrawal Rate
  - Limited experience at company or industry
  - Use dynamic formula
  - ➔ Limited experience would say that behaviour will not be totally rational but will reflect some dynamic features

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Price Determination

- Run large number of market consistent scenarios based on suitable ESG
- Project claims and premiums allowing for assumptions discussed earlier
- Calculate PV of Claims and Expenses
- Calculate PV of Premium of 1% of fund
- Average for all scenarios
- E.g.
  - PV of Claims = 3,800
  - PV of 1% of fund per annum = 10,000
  - Market Consistent price = 0.38% of fund per annum
- Final price to customer takes account of sensitivities, cost of capital and commercial issues

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Example Pricing Results – GMWB for Life

Difficult to define a perfect price – assumptions have a major impact:

Sensitivity	Costs as % of Fund Value
Base Case	0.38%
Yield + 1%	0.21%
Yield – 1%	0.63%
25% increase in Equity Volatility	0.53%
25% increase in Swaption volatility	0.39%
80% of base case mortality	0.45%
50% reduction in lapses	0.49%

Pricing is also broad brush – e.g. little variation by age etc so business mix will impact on price

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Capital

- US Approach
  - CTE – Conditional Tail Expectation
  - Reserve – CTE65 or CTE70
  - Total Capital – CTE90
  - Examines capital over full duration
  - Can take account of hedging strategy – clearly defined and demonstrated strategy
- UK approach
  - One year VAR – 99.5%
  - But need to consider Peak One
  - Consistent with current approach for Solvency II
- Need to take account of rating agency demands

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Why are people using Ireland

- Risk Management overhead means that companies prefer to have a single entity dealing with GMXB business
- Ireland is an established country for sales to other EU countries – leading cross border centre with over 40 companies and €15bn sales
- Established infrastructure, including legal and actuarial skills
- Irish regulation is principles based following EU rules. No specific rules for GMXB business means use of core principles
- Willingness to adopt International approaches – UK or US
- Can allow for hedging in the capital calculation – but only where there is a "clearly defined hedging strategy"
- Established practice is to use CTE approach but move to VAR inevitable with Solvency II
- Hartford Life, AXA, Met Life and Aegon all established in Ireland
- Generali have announced intention to establish in Ireland

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AXA is leveraging Accumulator® globally, and the roll-out is gaining momentum

	Launch	DB	AB	IB	WB	WBL	Distribution	2007 APE
US	1996	✓	✓	✓	✓	✓	Tied Agents, banks, brokers, IFAs	€ 925m
Germany	1Q06 (Twinstar Private) 2Q07 (Twinstar Riester)	✓	✓	✓			Tied agents, brokers, Banks	€ 84m
Japan	1Q06 ($) 1Q07 (¥)	✓	✓		✓	✓	Tied agents, banks	€ 56m
Southern Europe	1Q07 (Spain) 2Q07 (Italy)	✓	✓		✓		Tied Agents, banks, brokers	€ 13m
France	1Q07	✓			✓		Salaried salesforce, tied agents	€ 23m
Belgium	3Q07					✓	Tied agents, brokers, Banks	€7m

- MPS Vita Accumulator launched in 3Q07, but not consolidated in 2007
- Additional launch at the end of 3Q07 in Hong Kong (GMIB)

Q4 APE for non-US VAs: Euro 75 m

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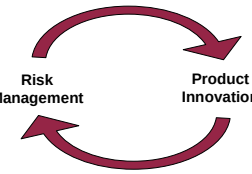
Customized local product design is important

AXA's Product Approval Process governs customized products for AXA's local markets

Risk tolerance and hedge program defined at early stage of product design



Continuous monitoring and modeling of actual experience

Product design	Starting point of VA risk management
Dynamic Hedging	Core component of VA risk management program, supplemented with reinsurance
Funds Management	Manage risk profile within product offering

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Germany - Twinstar

Successful 2006 Launch; Additional products in 2007

Target clients – Product positioning

Twinstar designed to look and feel like traditional German product, with 2 target groups:

- 20-40 year old wanting regular premium retirement savings
- 40-55 year old wanting to invest single premium for retirement income

Guarantees

- GMIB guarantees 3% pa average rate
- GMDB on sum of paid gross premiums

Distribution

- Tied agents (55% of APE to date)
- Third party, including bancassurance (SEB)

Funds (100% unit-linked)

- Klassik: Funds in account controlled by AXA (50% equity)
- Invest: Choice of 15 different funds (0% to 100% equity)

Challenges & Opportunities

- Development of single premium sales through third party channels

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Japan – Yen VA

Successful 2007 Launch

Target clients – Product positioning

Targets 50+ year olds investing lump sum retirement allowances. Represents an innovative solution to clients' longevity concerns, and provides capital guarantees on death

Guarantees

- GMWBL: 2% roll-up for 10 year deferral period + annual ratchet for life.
- Term-Certain GMWB: 20-year term with annual ratchet and 1% roll-up for 10 year deferral period
- GMDB with GMWB-like roll-up and ratchet

Distribution

- Bancassurance agreement with various bank distributors

Funds (100% unit-linked)

- Funds – Investors 70 years and younger invest in 40/60 (equity/fixed income) funds; Others invest in 20/80 fund

Challenges & Opportunities

- Distribution Network
- New entrant opportunity for AXA
- Competition from mutual funds and simpler GMAB products

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What is "Dynamic Hedging" ?

- **"Dynamic Hedging " is a technique derived from option management techniques used by investment banks**

Assets	Liabilities
Hedge assets	Guarantee Unit-linked

Δ of assets consistent with Δ of liabilities

Dynamic Hedging consists in building a portfolio of assets (hedge assets) that will vary like the guarantee

- **It consists of :**
  1. **Modeling the embedded option in Accumulator Guarantees using standard option modeling techniques (Black and Scholes)**
  2. **Analyzing the sensitivity of these options to market movement**
  3. **Buying financial instruments to be immunized against these market movements**

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Variable Annuities - Hedging secondary guarantees

VA guarantees are equity put options. Standard option modeling techniques (Black & Scholes) can model the embedded options

Mapping of policyholder accounts with hedge indices → **Hedge implementation** with futures for equity and swaps for interest rates → **Daily valuation of liability options and market monitoring** → **Weekly rebalancing of futures portfolio**

Very liquid instruments with no counterparty risk

Daily rebalancing is possible if needed

AXA's hedging policy

- Delta: sensitivity to equity
- Rho: sensitivity to interest rates
- AXA does not hedge Vega (sensitivity to volatility), as risk mitigated by a constant 95th percentile volatility level for option pricing

On top of financial hedging, AXA has a strong know-how and long track record in managing and pricing non hedgeable risks, such as policyholder behavior (e.g. GMIB election rate)

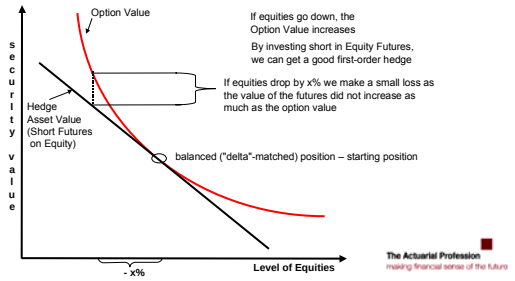
Hedging of AXA's variable annuities is centralized on two platforms

Product design & pricing	Hedging platforms	Trades execution
AXA Equitable	AXA Equitable's dynamic hedging team	AllianceBernstein
AXA Germany AXA Japan AXA France …	AXA Life Europe	Investment Managers

Organization ensures strong risk management, leverages Group scale and fosters innovation

Hedging – Generalised Example

- **Delta hedging for drop in Equity market**
  - Futures provide a linear approximation to the exposure of the guarantee
  - This hedging strategy will be effective for small-medium market movements, and less effective for larger market movements
  - It is important that the delta position is regularly rebalanced (typically weekly)



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How does Dynamic Hedging work? An example : the Japanese scenario (1/2)

- Japan scenario – Depressed equity and interest rate performance
  - Equities perform well in early years, setting guarantees at high levels (effect of annual ratchet). Then severe bear market, followed by several years of flat / negative equity returns
  - Interest rates decrease from about 5% to below 2% after the GMIB waiting period, when policyholders can elect to annuitize
  - Simulation uses 95th percentile volatility levels
- 20 year simulation for $1bn of max GMDB/GMIB sales shows hedging program results in breakeven versus a loss of $155m without hedging

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How does Dynamic Hedging work?
An example : the Japanese scenario (2/2)

	Market Environment						Gain / (Loss)	
$mil	Equity Returns	Treasury Rate	Year	Futures Gains	Actual Claims	Actual Premiums	Hedged	Unhedged
		5.0%	0					
	43%	5.4%	1	(44)	(0)	10	2	46
	15%	5.2%	2	(15)	0	13	3	18
	40%	4.6%	3	(33)	(0)	15	3	36
	29%	5.7%	4	(25)	0	19	4	29
	-39%	6.5%	5	61	(5)	22	(6)	(67)
	-6%	5.4%	6	19	(8)	21	3	(17)
	-22%	4.8%	7	59	(11)	19	(4)	(63)
	-2%	3.3%	8	29	(11)	18	6	(23)
	15%	4.6%	9	(40)	(10)	16	3	44
	1%	3.1%	10	30	(12)	15	(1)	(32)
	0%	2.8%	11	13	(47)	13	3	(10)
	-22%	1.9%	12	66	(55)	10	(3)	(69)
	-7%	2.2%	13	8	(53)	8	(3)	(12)
	27%	1.7%	14	(11)	(38)	6	3	14
	-20%	1.6%	15	19	(31)	5	(1)	(20)
	-28%	1.4%	16	19	(31)	4	(2)	(21)
	-19%	0.9%	17	10	(28)	3	(2)	(12)
	19%	1.4%	18	(4)	(24)	3	(1)	3
	TOTAL			**162**	**(364)**	**221**	**6**	**(155)**

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Questions?

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