Society of Actuaries in Ireland

Investment Related Guarantees SAI Working Party

11.12.2013

Agenda

- Introduction
- Essence of an investment guarantee
- Valuation, risk management and hedging challenges
- Case study
- Conclusions

No stochastic calculus experience required!

Working party membership

- Eric Brown
- Mike Claffey (Chairman)
- Dave Kavanagh
- Niall Naughton
- Liam O'Keeffe

Terms of reference

- No formal terms of reference
- Objective: to provide taxonomy of investment related guarantees as a useful resource for actuaries
- Concentrated on guarantees encountered by Irish actuaries
  - especially those where some ideas on risk management, pricing, and reserving of most use
- Educational and non-binding in nature
- Not exhaustive!

Activities

- This evening meeting
- Paper (2014), describing for each guarantee:
  - its nature
  - how companies can price it and use product design as a risk mitigant
  - how companies can manage the risk associated with it
  - reserving for guarantees
  - includes a reading list
- Educational sessions (2014)

Also mention paper has a longer discussion of product details and guarantees.

Scope

- Unitised With-Profits (UWP)
- Guaranteed annuity options (GAOs)
- Guaranteed minimum death benefits (GMDBs)
- Loyalty bonuses (e.g. rebate of past amc's)
- Capital Redemption Bonds (CRBs)
- Structured Products (GEBs, Trackers, SCARPs)
- CPPI
- Variable annuities (VA)

Out of scope

- Non-linked (even though investment optimisation is important)
- Conventional with-profits (discretionary aspects add non-model aspects to the investment guarantees)

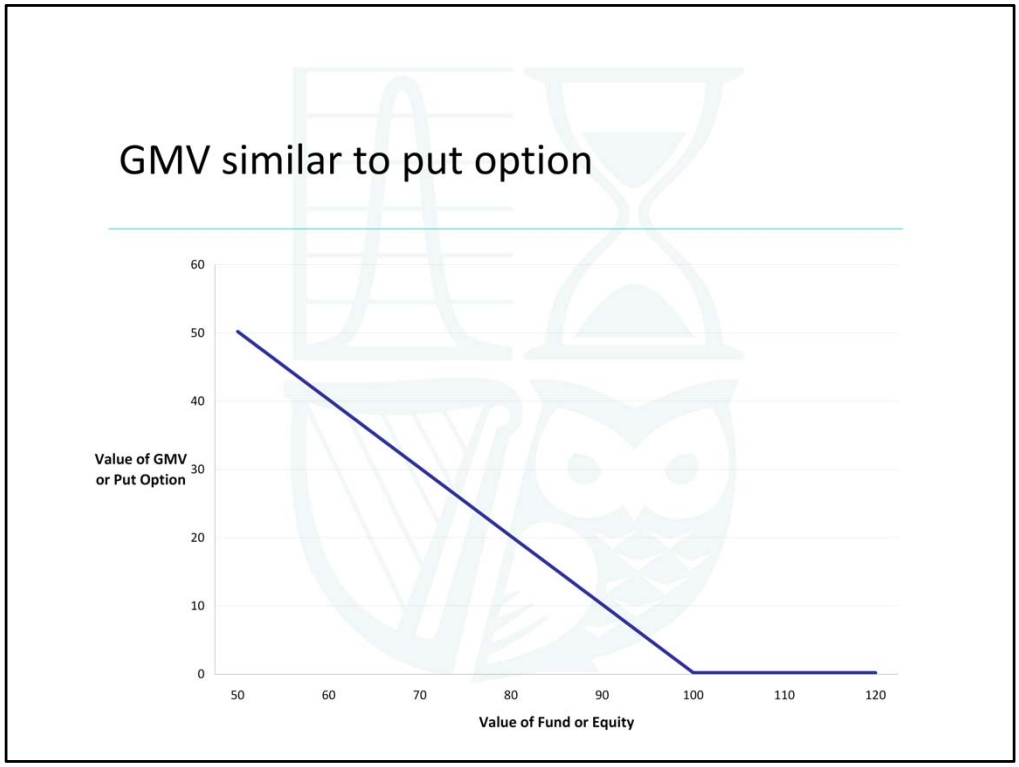
Essence of an investment guarantee

…linking product categories to option pricing

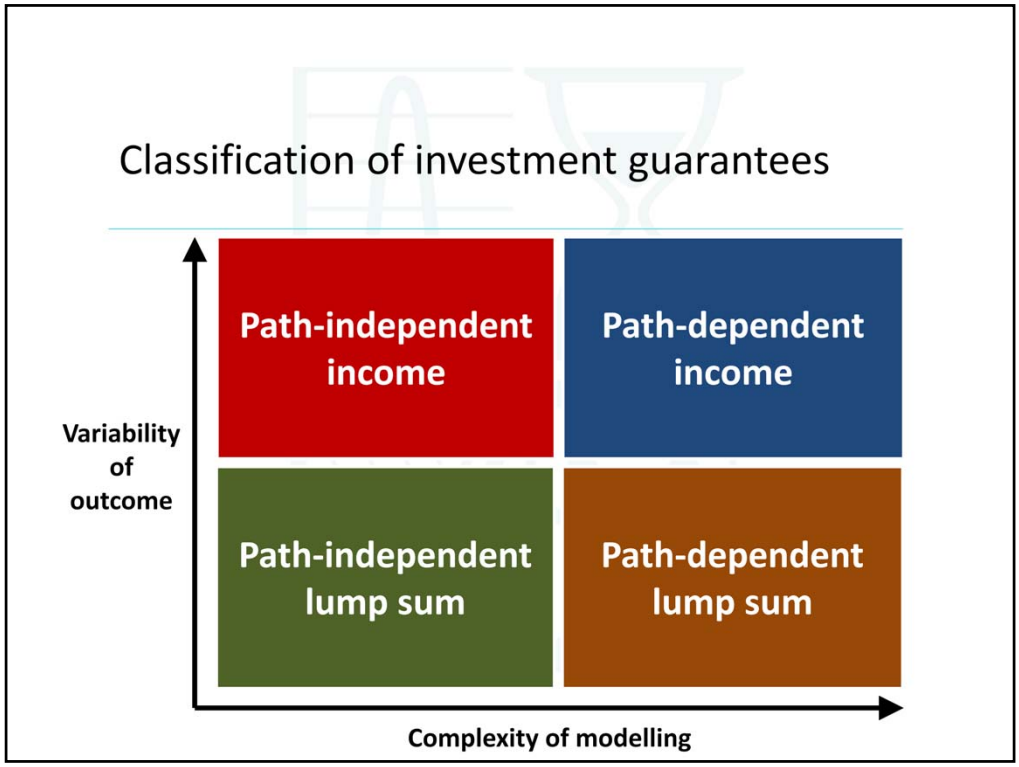
Types of investment guarantee

- Tracker bonds
- CPPI
- GAOs
- Variable annuities
- GMDB on Investment Bonds
- Capital Redemption bonds &c.

A lot of different guarantees offered by Irish life offices, with different names, tax treatments, regulatory treatments, &c..
However, they are all similar in nature to derivatives.



For example, a guaranteed maturity value is similar to a put option on an equity.
If the equity ends up below the strike of the put option, the option is valuable; and the further below the strike the equity is, the more valuable the option is.
Similarly, if a policyholder's fund ends up below the GMV, the guarantee is valuable; and the further below the GMV the fund is, the more valuable the guarantee is.

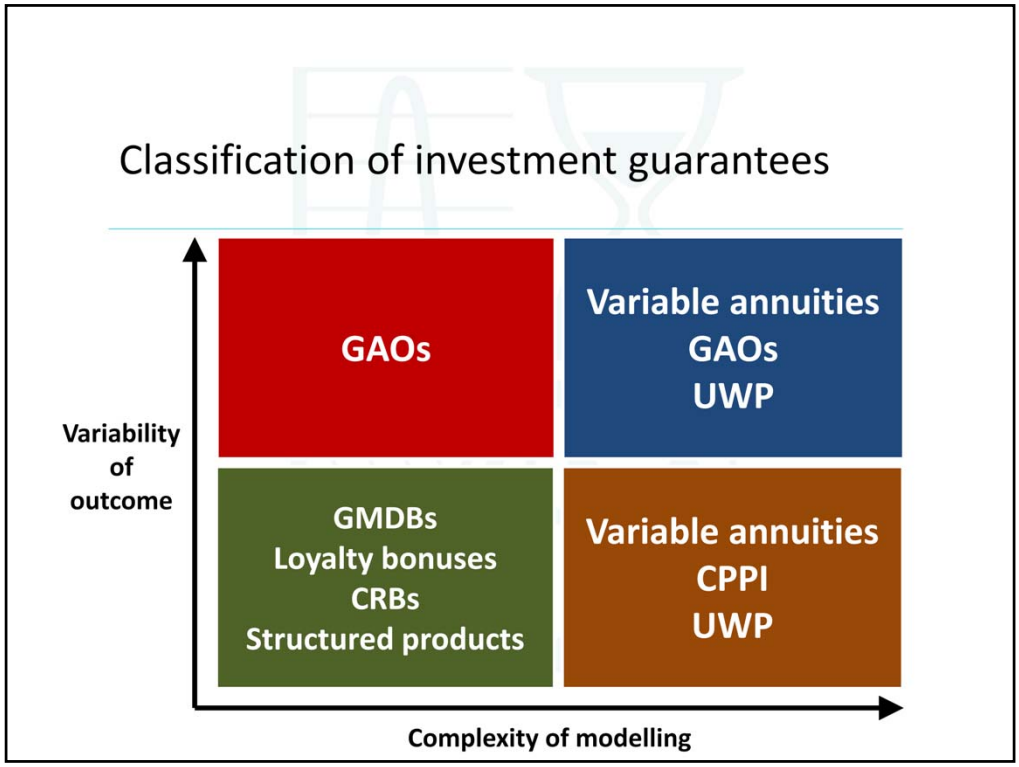


Derivatives can be classified by whether their pay-out is a lump sum or an income, and investment guarantees can be similarly classified. For example, GMDBs and tracker bonds pay out lump sums, while GAOs pay out incomes.

Derivatives can also be classified by whether they are path-dependent. Path-dependency means the value of the option depends not just on where, say, the equity ends up, but also on how it got there. That is, not just the destination matters: The journey matters too. Path-dependent derivatives are often called American options, while path-independent options are called European.

Investment guarantees can also be classified by path-dependency. For example, with a GMV, all that matters is where the fund ends up, and it does not matter whether it got there steadily or had massive falls & rises. But with something like CPPI or a variable annuity with a ratchet, the journey does matter, because the guarantee is reset every time the fund reaches a new high.

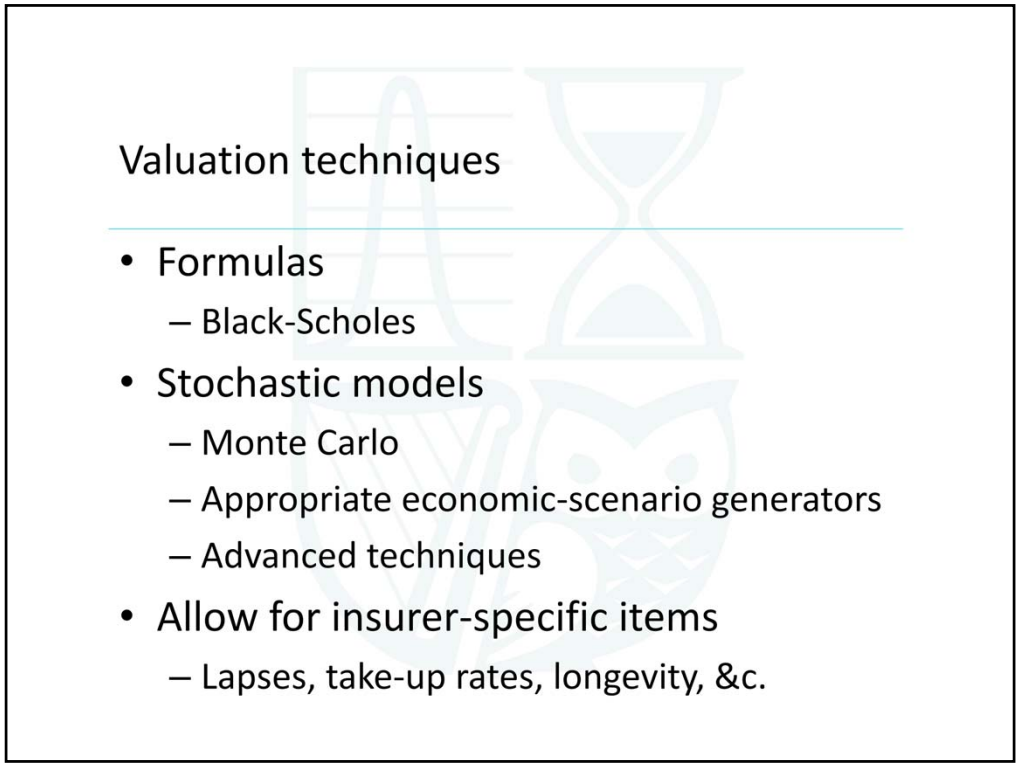
Generally, a guaranteed income is more variable in cost than a guaranteed lump sum, because it has more drivers. And path-dependency adds complexity to a guarantee.



The exact product details will determine how complex and variable a particular guarantee is.

As an aside – we see with-profits as an insurance option where the company can reset the path dependency (within limits) by management of the bonus philosophy. However the governance of these powers places less and less power in discretion and disclosure and transparency is limited the range and impact of the management actions available to the company.

Valuation, risk management and hedging challenges



Because investment guarantees are very similar to derivatives, the valuation and risk-management techniques used by investment banks for derivatives can also be applied by life offices to their guarantees.

For example, GMVs can be valued as put options using Black-Scholes.

More complicated guarantees can be valued using Monte Carlo. That is, calculate what the pay-out from the guarantee will be in each of thousands of possible futures, and the value of the guarantee is the average. The possible futures come from an economic-scenario generator, which will have been calibrated to market instruments similar to the guarantee, for example, bonds and options.

The combination of the ESG and the Monte Carlo calculation is essentially just a complicated interpolation formula that calculates the value of a derivative or guarantee by referring to the known values of similar derivatives. Therefore, it is essential that an insurer uses an ESG that has been calibrated to appropriate instruments rather than using a generic off-the-shelf one.

Investment banks often use more advanced techniques than formulas and Monte Carlo simulations, but they are usually not needed by life offices unless they have a large, complex book of guarantees. These advanced techniques are needed for valuing complex derivatives very quickly, and they are the reason investment banks hire so many Physics PhDs. They can be difficult to explain to senior management.

It is usually straightforward to include insurer-specific items in the valuation techniques, especially Monte Carlo. For example, allowing for longevity when valuing GAOs or the possibility of lapses for most guarantees. It is important to make sure that any dynamic policyholder behaviour is allowed for; for example, the take-up rate of GAOs will probably increase as the guarantee becomes more valuable and more attractive compared to tax-free cash or an ARF option. Similarly, lapses will probably decrease if a guarantee has become more valuable.

If a life office has issued a policy with a guarantee rather than passing on the investment risk to the customer, then it has three main options when it comes to managing the risks: fund the guarantee, hedge it, or sell it.

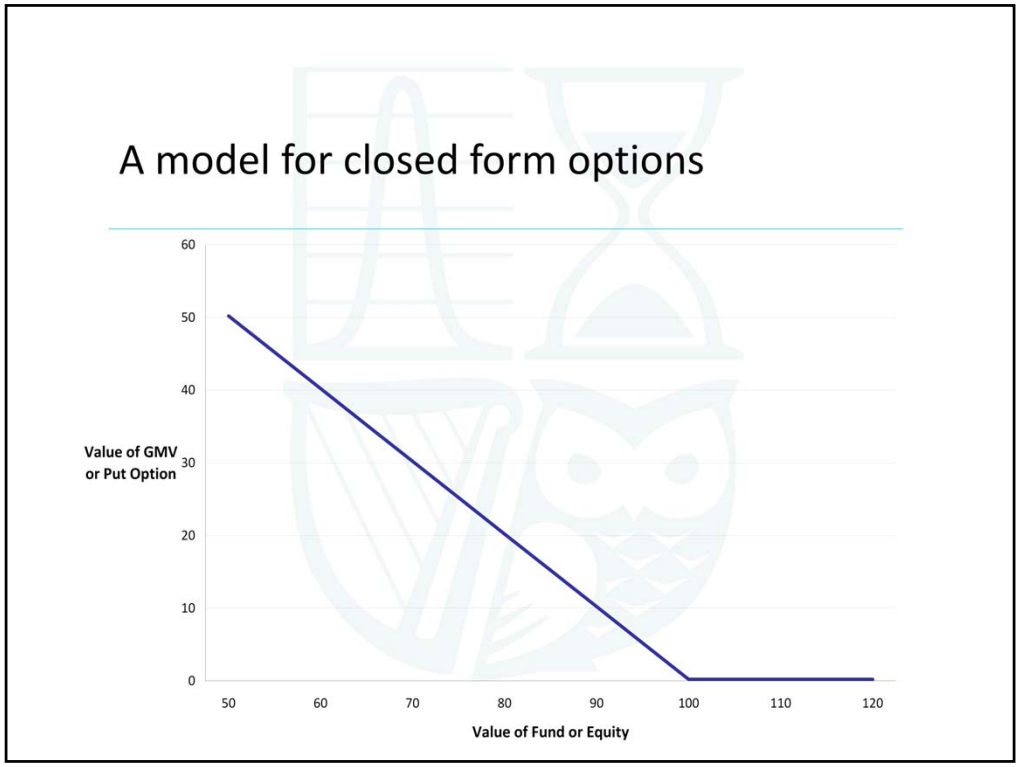
Funding the guarantee involves holding sufficient capital to meet the guarantee even in worst-case scenarios. It does not mitigate the risk, but it can be appropriate if the guarantee is not material.

Hedging the guarantee involves borrowing techniques from investment banks. Life offices can use a static hedge by buying & holding derivatives similar in nature to the guarantees; for example, a put option for a GMV or a receiver swaption for a GAO. A static hedge is unlikely to be perfect, but it is simple & easy to maintain, and it will broadly protect the insurer against most market movements. For some guarantees, a dynamic hedge will be more appropriate. This involves calculating the guarantees' Greeks or market sensitivities and then buying & selling market instruments so that the hedge has the same Greeks. It is more complicated and harder to maintain than a static hedge, but it can offer better & more comprehensive protection against market movements.

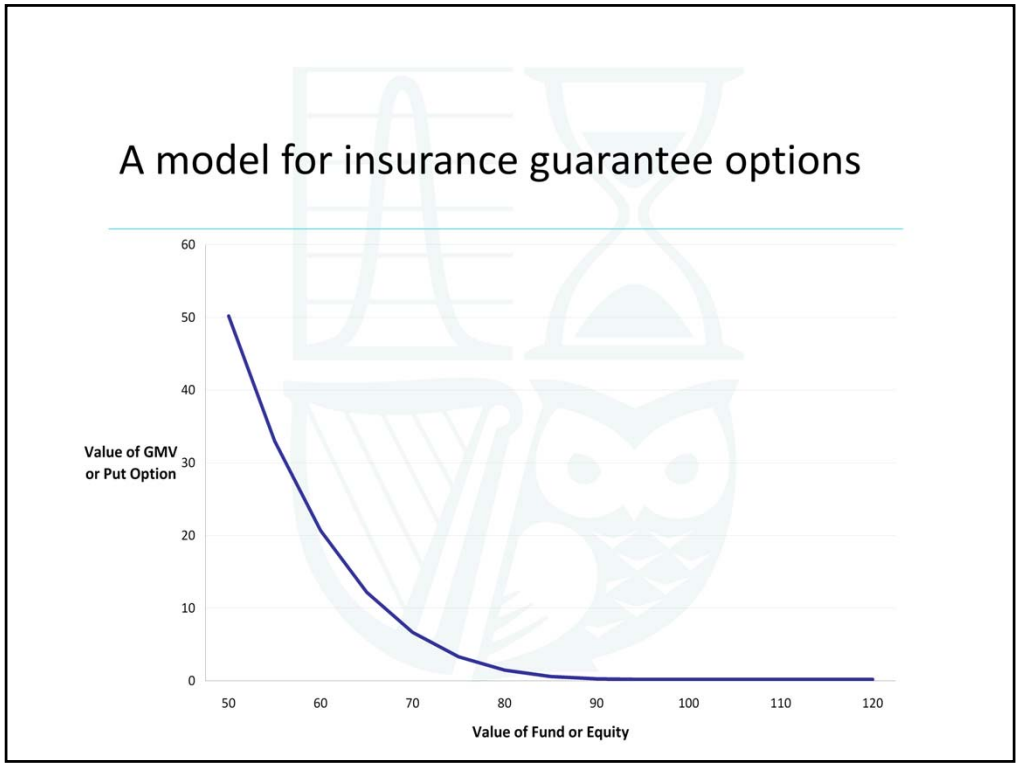
The third option is to sell the guarantee. This means reinsuring the guarantee, which can have the added benefit of protecting the company from demographic experience, or buying a tailored hedge from an investment bank.

Any life office that has sold a guarantee must adopt one of the three approaches. For example, when GAOs were first launched, the most common approach was to fund it, because in an environment of double-digit interest rates, the GAOs were never going to be valuable. As interest rates fell, companies started using simple static hedges, usually involving very long bonds. Then as interest rates fell further, more companies started

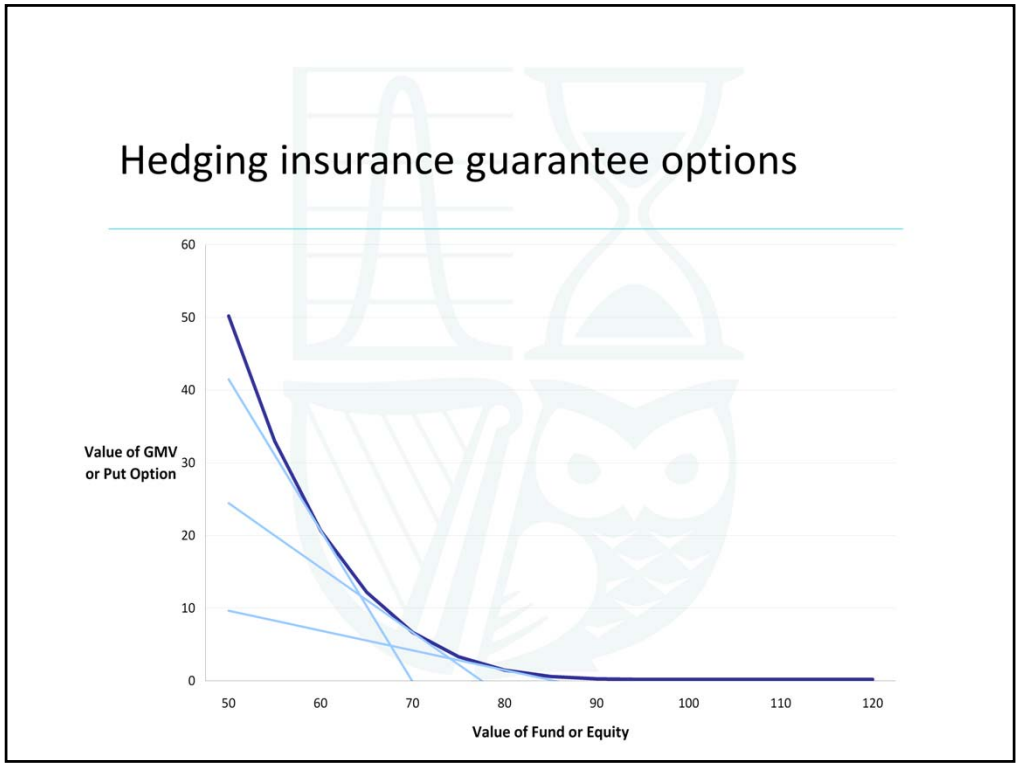
hedging using receiver swaptions or looking for a reinsurer or investment bank to take the guarantee. So, think about any guarantees you offer and figure out which approach you are using for each; if the answer is none of the above, then you need to re-evaluate. Remember, GAOs started out as just minor bells & whistles on pension products, but they now often take up more management time than the rest of the product. And tracker bonds were not guarantees, because the policyholder bore the risk, until the investment bank defaulted and suddenly they were guarantees. Guarantees that look immaterial or non-existent have a nasty habit of becoming real & significant, so don't just hand-wave a guarantee away.



In reality, investment guarantees are not quite as simple as the GMV we saw earlier. Sometimes, the guarantees have features such as ratchets that complicate them, and sometimes policyholder behaviour can make even the simplest guarantee complicated. These complications can turn this nice & simple straight line into…

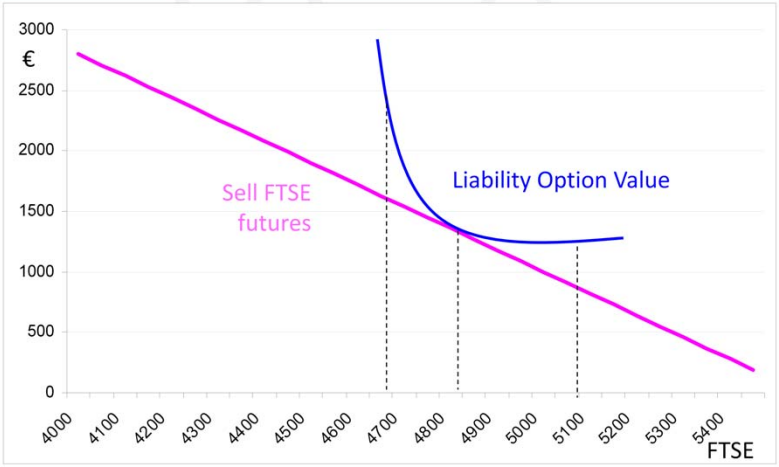


…this curved one. And this curve is more difficult to hedge using only simple market instruments…



…although you can get close if you use multiple instruments or some other more complex hedging strategy.

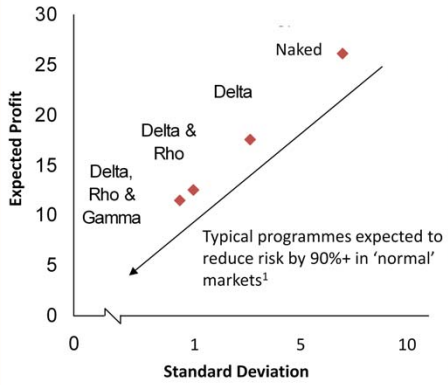
Delta hedge offsets against the “put option”



Note if markets moves up or down, you lose money (gap between future put and liability option value)

Typically, market risks can be managed efficiently by hedging

Cost / Benefit Assessment (Illustrative)



Observations

- Hedge efficiency is a function of the expected costs and benefits of a hedging programme
- Costs of a hedge programme
  - Reduction in expected profits (risk premiums)
  - Transaction costs for rebalancing the hedge portfolios
- Benefits of hedge programme
  - Release of statutory capital
  - Stability of earnings and economic capital
  - Depend on risk appetite

1 Industry benchmark; source: Oliver Wyman
Source: Client project; calculations with *ATLAS*

Liability option value over time – unhedged

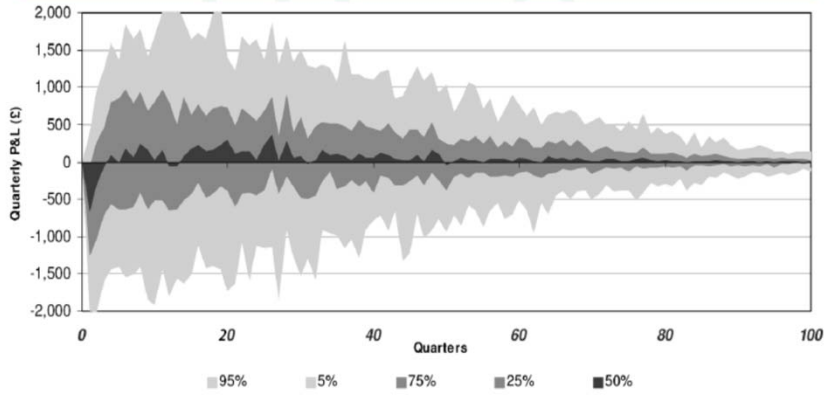


Figure 10.9.5(a). Unhedged quarterly P&L distribution WB product (£)

Source: VA working party 2008

Thanks to VA working party 2008

Liability option value - hedged

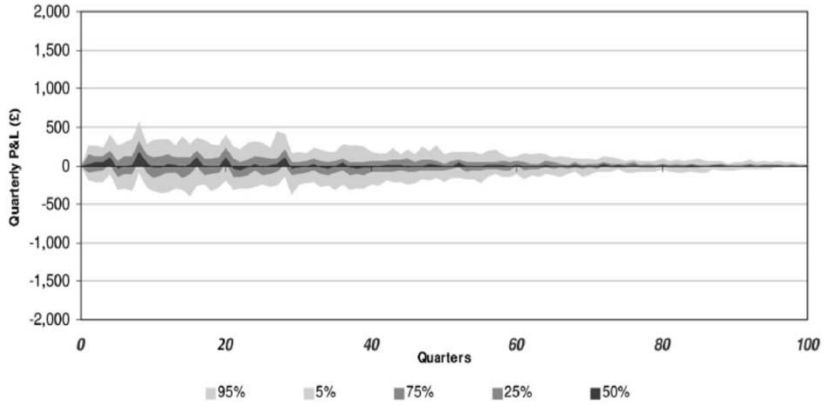
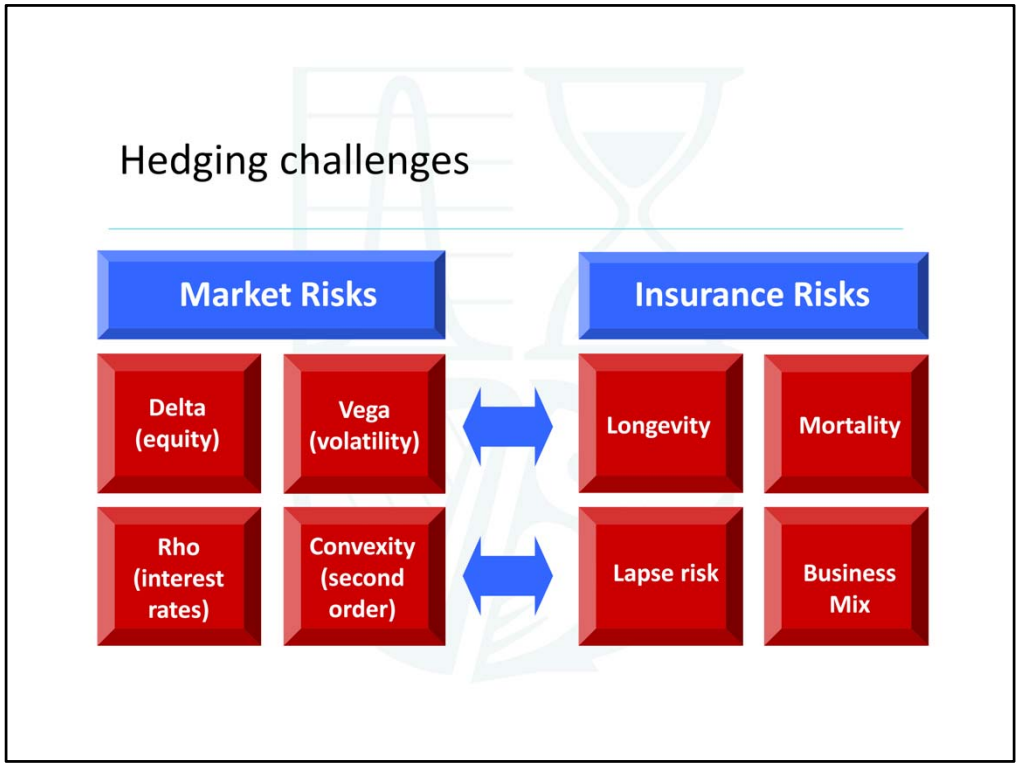


Figure 10.9.5(c). Delta rho vega hedged quarterly P&L distribution WB product (£)

Source: VA working party 2008

Thanks to VA working party 2008

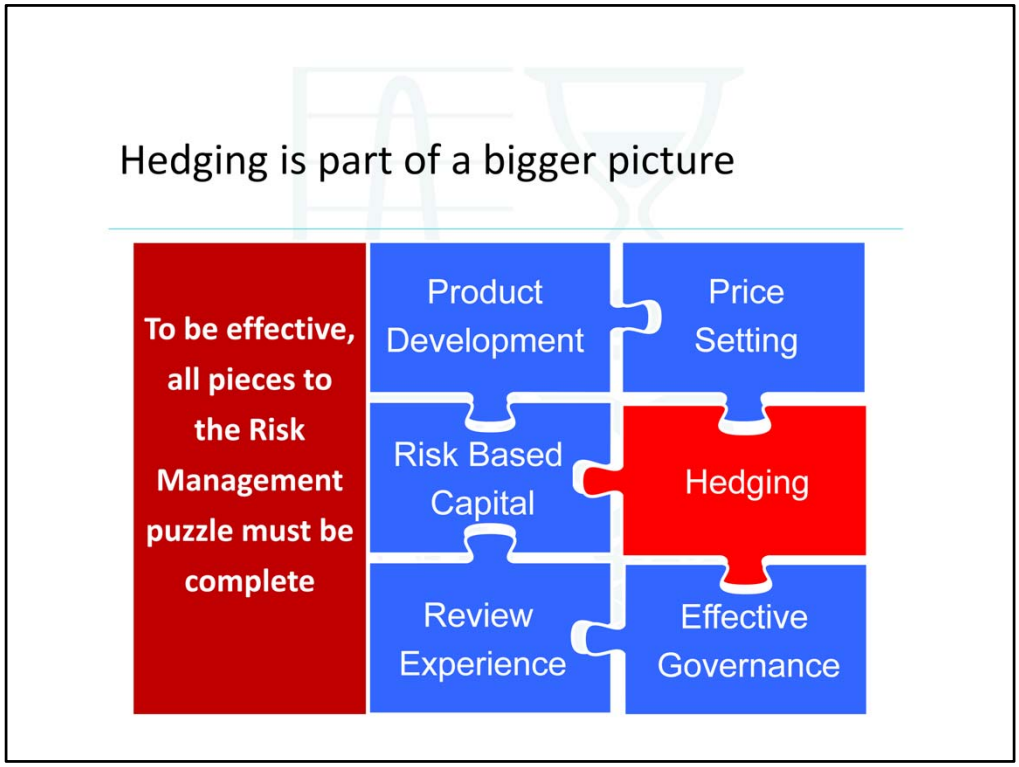


The more complicated the guarantee, the more market variables it is sensitive to, and the more exposed it is to demographic experience & policyholder behaviour, the more challenging it is to hedge. For example, applying a ratchet to the guarantee. Or investing the underlying fund in a mixture of equities, currencies, & bonds with different credit ratings. Or giving the customer multiple exercise dates or the option of switching from one fund to another while keeping the same guarantee.

Another challenge is deciding what to hedge: solvency, IFRS, economic capital, best estimate, &c.. It is usually not possible to hedge all accounting measures at the same time, so the insurer has to decide on the best trade-offs to make.

Other challenges can include the expenses of frequent trading and the level of infrastructure required.

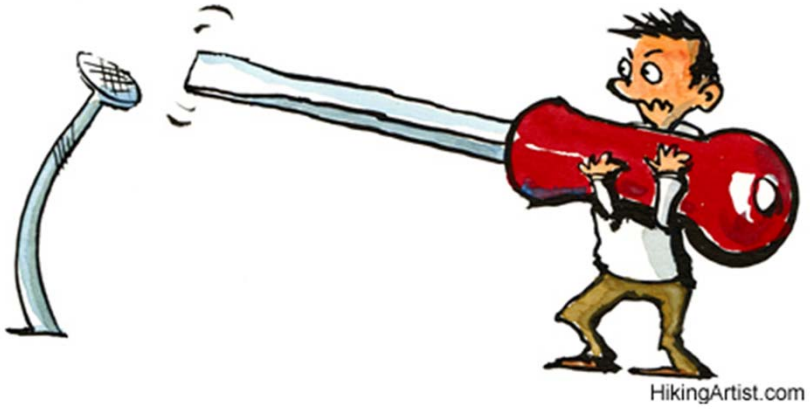
Apart from market and insurance risks, some other risks which may arise include basis risk, operation and modelling risks, reputational risk. These will each need to be considered in the trade-off of different approaches to managing the guarantee.



Thanks to Barry Cudmore of Aegon for this slide from 2008.
Hedging is required for any material option that the insurer isn't funding or hasn't sold, but it is not sufficient. The insurer should also have all the other pieces in place.

Case study

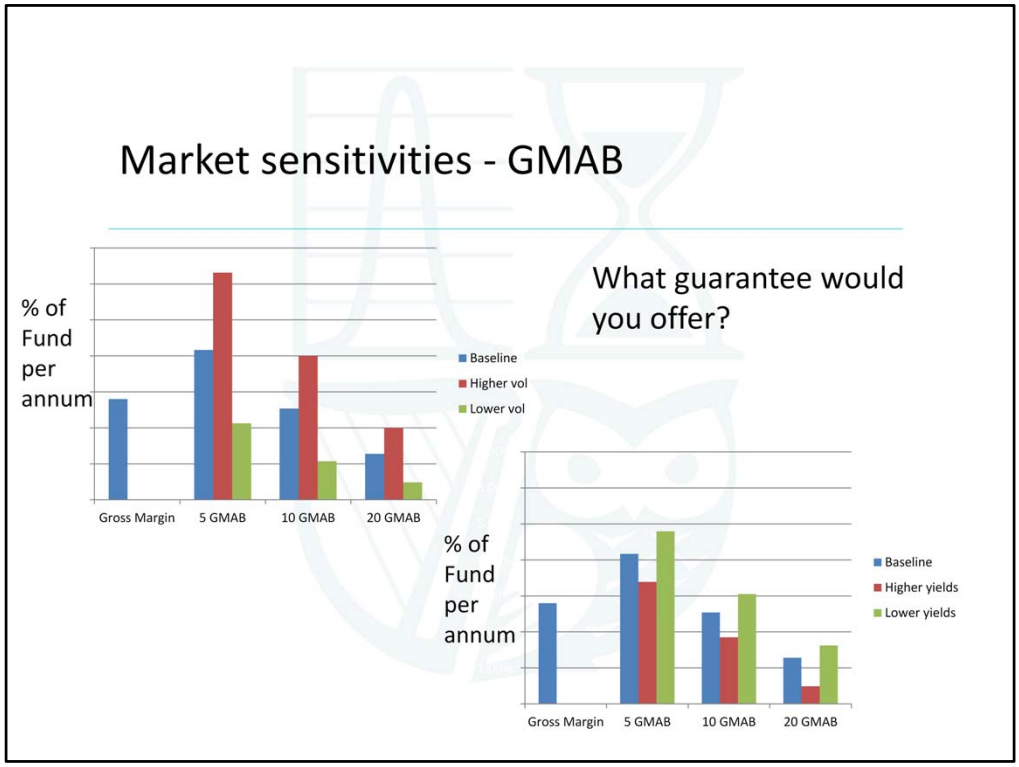
Theory and reality



Sample product (illustrative only)

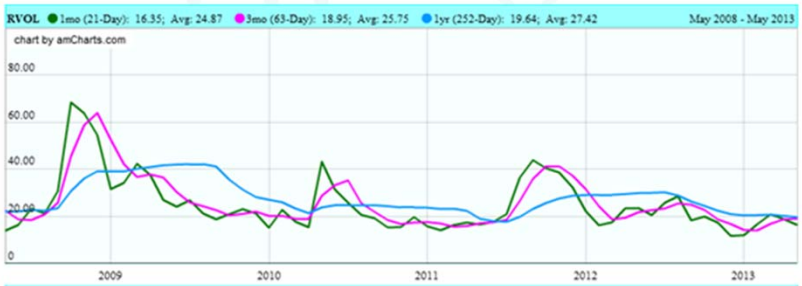
- Single Premium Bond
- 50% equity / 50% fixed interest bond
- Assume you have set a fixed AMC to cover all charges, commission and costs of guarantees
- Let's look at the various costs of GMAB versus GMWB

Assume 100% allocation, 2.8% AMC
GMAB with annual ratchet
… or 3.5% GMWB with annual ratchet
Equity vol 25%
Swap curve at 31 October 2013 (so low)

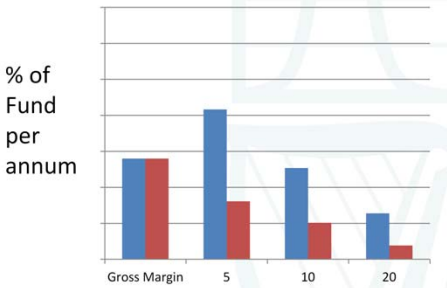


Blue bar – baseline (with assumed 2.8% total charge p.a.)
Note GMAB not affordable at 5 years
Vol baseline 25%, higher 40%, lower 10%
Yields +100bp and -100 bp

Realised Volatility EuroStoxx50 vs NASDAC



GMAB versus GMWB

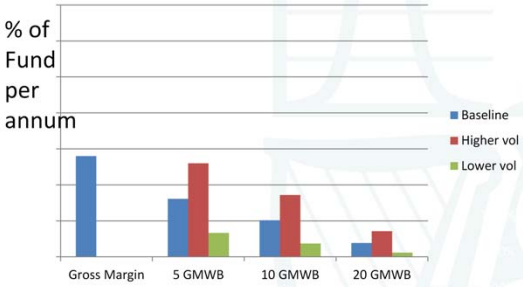


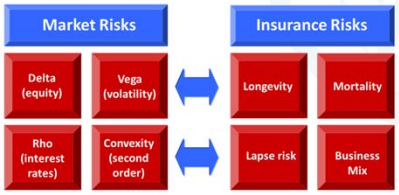
GMAB return of premium with annual ratchets

or

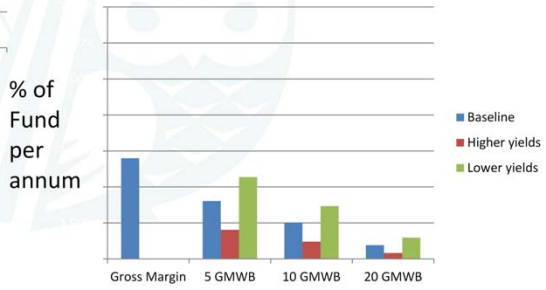
GMWB deferred for X years, with annual ratchets

So GMWB's must be lower risk?





But GMWB has longevity risk, and lapse risk, and "rationality" risk



A panel of guarantees (illustrative p.a.)

Product	Term	Deferral	Standard	Annual ratchet	Roll-up	Annual ratchet & roll-up
GMAB	5		3.3%	4.2%	4.4%	4.9%
GMAB	10		1.9%	2.5%	2.9%	3.2%
GMAB	20		0.9%	1.3%	1.7%	1.8%
GMDB	5		0.0%	0.0%	0.0%	0.0%
GMDB	10		0.1%	0.1%	0.1%	0.1%
GMDB	20		0.1%	0.2%	0.2%	0.2%
GMWB		0	2.0%	2.3%	2.1%	2.4%
GMWB		5	1.3%	1.6%	1.6%	1.8%
GMWB		10	0.8%	1.0%	1.2%	1.3%
GMWB		20	0.3%	0.4%	0.6%	0.6%

GMWB assumed 3.5% p.a.
Roll-up rate assumed 1.5% p.a.
Ratchet based on high water mark, annually
“Standard” assumes no roll-up or ratchet guarantee

Note GMDB’s are not “free”. Some products add these as a trivial rider.

Conclusions

What does all this mean?

VA pricing in current markets has driven product development

- Move back to more hedgeable funds
  - Equity index trackers
  - Limited volatility funds with internal rebalancing
  - Remove property, “active” management, alternative funds (and correlation argument for hedgeability no longer convinces)
- Remove “rich” guarantees, especially any that depend heavily on policyholder behaviours
- Be prepared to reprice and relaunch more frequently (are we moving to tranche products?)

Summary

- Investment guarantees are options
- Models and pricing methodologies exist
- Market and insurance risks need to be considered
- You need to consider pricing, risk management and risk mitigation, and reserving

Next steps

- Working Party to produce paper in 2014 (open to additional volunteers)
- Also plan to offer educational sessions (open to ideas)

Questions?