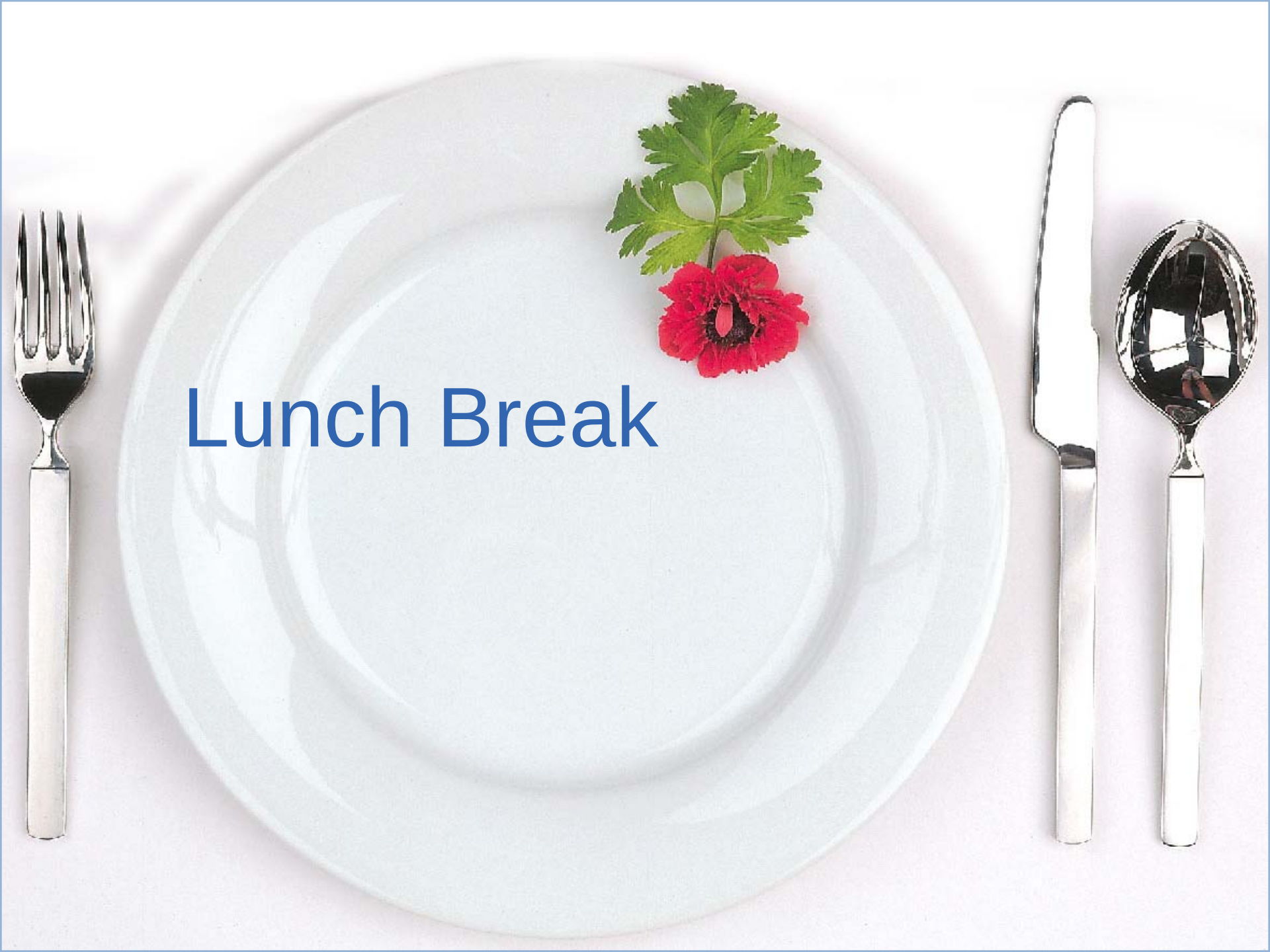
Lunch Break

## Breakout Session Topic 9:

# Asset / liability management


10 September 2009


# Dynamic asset liability management - a method for optimising investment strategy

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# Objective

How can we use modern actuarial modelling techniques to optimise the investment strategy of a life insurance company?

# Background

- Sophisticated actuarial models are built
- Investment strategy an input rather than an output
- Models little used to inform investment strategy

# Market value of liabilities

- AEC = MVA – MVL
- Under Solvency II:

  MVL = Best estimate of liabilities + risk margin

- Risk margin = cost of providing SCR, excluding hedgeable risks

# Market value of liabilities (2)

| | Hedgeable | Non-hedgeable |
|---|---|---|
| Financial | • 10-year USD, EUR or Yen cash flow or interest rate option<br>• 10-year equity option | • 60-year USD, EUR or Yen cash flow or interest rate option<br>• 15-year emerging markets cash flow<br>• 30-year equity option |
| Non-financial | • Screen- or exchange-traded CAT risks<br>• Actively traded securitised risks | • Most insurance risks, eg mortality, property, casualty<br>• Policyholder behaviour |

Source: “Market value of Liabilities for Insurance Firms” CRO Forum July 2008

# Market value of liabilities (3)

- Best estimate depends on investment strategy
- Risk margin depends on investment strategy in respect of non-hedgeable risks
- $MVL=BE(IS_{optimal}) + RM(IS_{optimal})$ ?

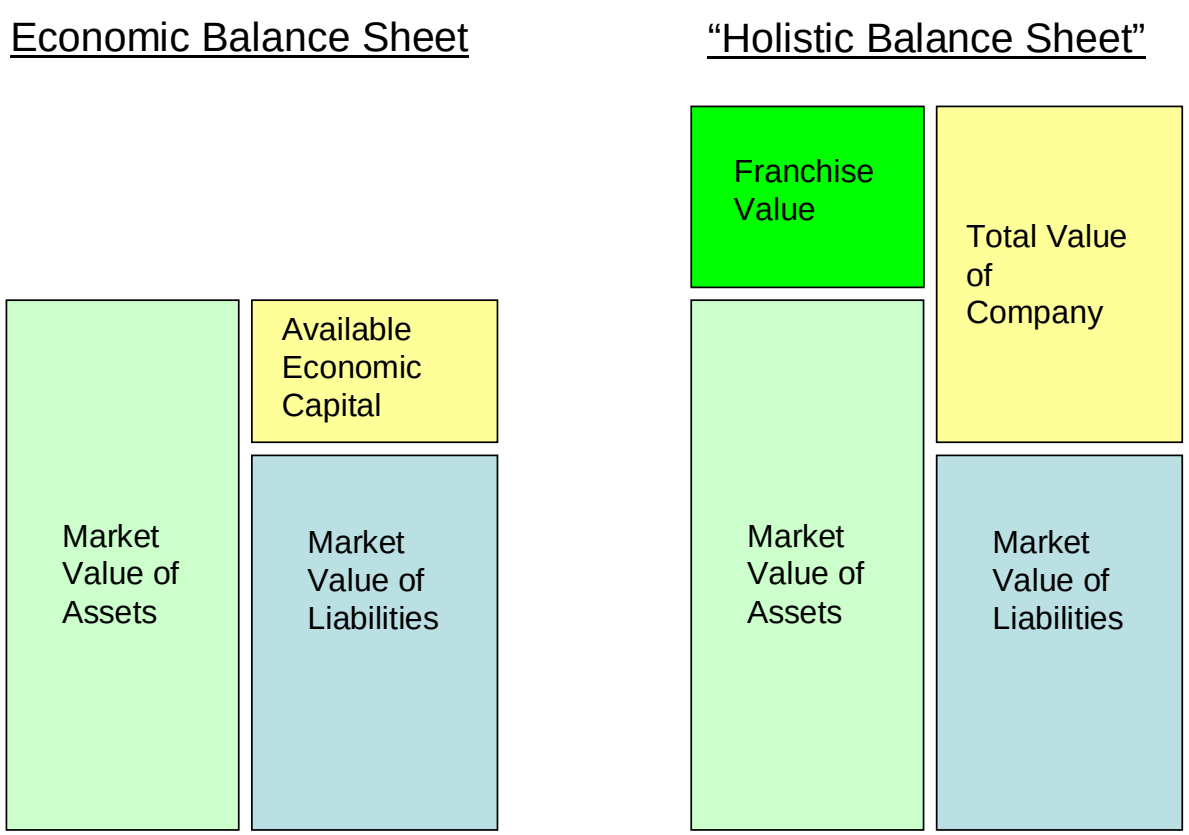
# Market value of liabilities (4)

- More correct: $MVL=BE(IS_{current}) + RM(IS_{current})$
- Cost of sub-optimal strategy: $MVL - MVL_{optimal}$

# Optimising the Economic Balance Sheet

- Optimise Available Economic Capital and Required Economic Capital
- VAR = Stochastic PVFP – 0.5$^{th}$ percentile worst PVFP
- Consider measure: X * stochastic PVFP – Y * VAR
- Iterative process

# Holistic Balance Sheet



# Modelling

- An ALM/stochastic model needs to reflect impact and interactions of:
  - Market and other external conditions
  - Policyholder actions
  - Management actions

# Modelling (2)

- Policyholder actions include:
  - Lapses
  - GAO take-up
  - New business
- Management actions include:
  - Investment strategies
  - Discretionary bonuses
  - MVA
  - New business

# Modelling (3)

- Management and policyholder actions can interact, eg:
  - Reduced bonus rates => higher lapses, lower new business
  - Increased lapses when interest rates have risen => negative feedback loop
  - New business added to existing fund when market yields have fallen dilutes policyholder returns => higher lapses, lower new business

# Modelling (4)

- Consider also:
  - Liquidity issues
  - Dealing costs

# Example Model – Basic Features (1)

- Two products, both whole of life, Italian profit participation business
- One with single and one with recurrent premiums
- Both contain an interest guarantee of 3% pa.
- The assets backing the policies are invested in a single “segregated fund”

# Example Model – Basic Features (2)

- Additional policyholder benefits ("profit sharing") can be added so that the annual return to policyholders is:

  $$\text{Max}(\text{MIN}(R * 80\%, R - 1\%), 3\%)$$

- % investment return R is based on investment income (coupons, dividends and interest), realised gains/losses on investments and amortisation of bonds

# Example Model – Basic Features (3)

- Asset values and economic conditions are at 31.3.09.
- Asset mix:

| | |
|---|---|
| CASH | 4% |
| FIXED RATE GOVERNMENT BONDS | 62% |
| FLOATING RATE GOVERNMENT BONDS | 31% |
| EQUITIES / FUNDS | 3% |
| **TOTAL** | 100% |

# Example Model – Basic Features (4)

- The model has a monthly interaction between assets and liabilities
- Assets are only bought/sold when there is a net positive/negative cash-flow

# Example Model – Basic Features (5)

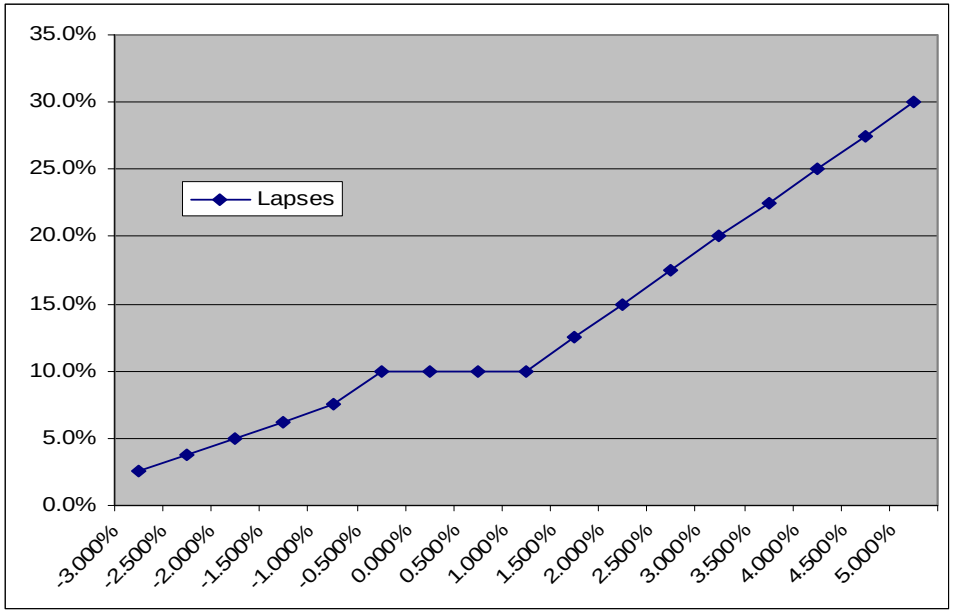
Dynamic policyholder behaviour rule:

- If market rate >= policyholder return + 1% then:

Lapse rate = base lapse rate*[1+50 * (market rate – (policyholder return+1%))]

- If market rate <= policyholder return – 1% then:

Lapse rate = base lapse rate*[1+25 * (market rate – (policyholder return-1%))]



# Example – Investment Strategies (1)

BASE STRATEGY

- Asset purchases:

  48% fixed rate government bonds, term 5 years

  48% floating rate government bonds, term 5 years

  4% equities

- Asset sales:

  - "Circulating bonds" sold first, starting with those with shortest duration

  - When all these are sold, "immobilised bonds" are sold, starting with those with shortest duration

- Cash maintained at between 1 and 3% of total assets

# Example – Investment Strategies (2)

ALTERNATIVE STRATEGY 1 – 'BUY SHORT'

Same as "base" except bonds purchased have a term of 1 year rather than 5 years.

ALTERNATIVE STRATEGY 2 – 'BUY LONG'

Same as "base" except bonds purchased have a term of 10 years rather than 5 years.

ALTERNATIVE STRATEGY 3 – 'DURATION MATCHING PURCHASE'

Same as "base" except assets purchased (as required by cash flows) are selected to try to bring duration of the assets in line with liabilities.

# Example – Investment Strategies (4)

ALTERNATIVE STRATEGY 4 – 'BUY FLOORS'

Same as "base" except that floors are bought:

- Nominal value EUR 2.5bn
- Maturity 5 years
- Strike rate 2.5%
- Index interest rate 5 year government bond yields
- The premium for the floor is EUR 23.8m spread over 5 years.

# Example – Investment Strategies (5)

ALTERNATIVE STRATEGY 5 – 'BUY CAPS'

Same as "base" except that caps are bought:

- Nominal value EUR 2.5bn
- Maturity 5 years
- Strike rate 4.5%
- Index interest rate 5 year government bond yields
- The premium for the floor is EUR 19.6m spread over 5 years.

# Example – Investment Strategies (6)

ALTERNATIVE STRATEGY 6 – 'BUY SWAPS'

Same as "base" except that a swap is entered into:

- Nominal value equivalent to nominal value of fixed rate bonds (1.6bn)
- 10 year term
- Company pays 3.37% (the 10 year swap rate) and receives 6 month government yields

# Example – Investment Strategies (7)

ALTERNATIVE STRATEGY 7 – '10% EQUITIES'

Same as "base" except:

- Equities are not sold, unless the total proportion of equities exceeds 10%
- When assets are purchased, 20% are in equities, until equities reach 10% of total assets

# Example - Results

COMBINED MEASURE = Stochastic PVFP – 20% * VAR

(This reflects the weight we choose to give to the importance of the “best estimate” and the “variability”)

| Strategy | Stochastic PVFP | VAR | Combined measure |
|---|---|---|---|
| **Base** | **95,612** | **253,299** | **44,952** |
| Buy short | 94,474 | 262,953 | 41,883 |
| Buy long | 85,979 | 258,148 | 34,349 |
| Duration matching purchase | 76,860 | 248,704 | 27,119 |
| Buy floors | 81,334 | 270,888 | 27,156 |
| **Buy caps** | **102,637** | **136,207** | **75,396** |
| Buy swaps | 69,918 | 320,511 | 5,816 |
| 10% equities | 87,037 | 271,379 | 32,761 |

Euros ‘000

# Example – Comments on Results (1)

In the base strategy the key risks are:

- A rise in interest rates in the early years, giving rise to losses on assets when they need to be sold.
- Lower interest rates in the later years, giving rise to lower reinvestment rates and hence a shortfall with respect to the guarantees in some years.

However, the impact of (a) is the more significant factor in the base strategy and it is this factor which drives the VAR result.

# Example - Comments on Results (2)

**'Optimal Strategy' is 'Buy caps'**

Provides the best result in terms of both Stochastic PVFP and VAR and hence the combined measure:

- Cap provides benefits in those scenarios which produce low fund yields in the early years (interest rates rise)
- VAR result is greatly reduced, as the scenario driving the VAR is one where interest rates have risen sharply in the early years.
- Therefore the benefit from the cap outweighs its cost.

# Example - Comments on Results (3)

## OTHER STRATEGIES – NON DERIVATIVES

- **'Buy short'** worse result than base since:
  increase in risk (b) outweighs reduction in risk (a)
- **'Buy long'** and **'Duration matching purchase'** worse results than base since:

  increase in risk (a) outweighs reduction in risk (b)
- **"10% equities"** worse result than base due to increased variability

  Of the strategies not involving derivative instruments tested so far, the 'base' strategy is the best.

# Example - Comments on Results (4)

- **OTHER STRATEGIES - DERIVATIVES**
- **'Buy floors'** worse result than base:
  - Falls in interest rates in the early years will increase investment returns and hence fund yields: much of this benefit will pass through to the policyholder, therefore the benefit derived from the floor is outweighed by its cost.
- **'Buy swaps'** produces worst results:
  - Negative impacts mostly borne by company
  - Much of positive impacts passed to policyholder

# Further Steps

## FURTHER ITERATIONS

After the first set of results, we can prepare a modified set of results, to see if can improve:

- **“Buy short – 3 year” strategy**

  Same as the “buy short” except that bonds purchased have a term of 3 years

- **“Buy caps – reduced amount” strategy**

  Same as “buy caps”, except that the nominal value of caps purchased is only EUR 1.6bn

# Further Steps (2)

- The results are shown below:

| EUR m | Stochastic PVFP | VAR | Combined measure |
|---|---|---|---|
| **Base** | **95,612** | **253,299** | **44,952** |
| Buy short - 3 year | 97,728 | 254,743 | 46,779 |
| Buy caps - reduced amount | 101,682 | 138,677 | 73,947 |

- "Buy caps" is still the best strategy, but "Buy short – 3 year" is now the best strategy which doesn't involve derivatives.

Further iterations of the model could be made to determine the optimal "shortness" of this strategy.

# Further Steps (3)

## INTERNAL DISCUSSIONS

The implications of the calculations should be discussed with relevant internal parties for example to check:

- whether there are any practical obstacles to implementing the identified optimal strategy;
- whether there are any risks which may not have been modelled in implementing the strategy
- whether there are any other strategies which should be considered

# Further Steps (4)

## OTHER INDICATORS – THE HOLISTIC BALANCE SHEET

- We can also use our model to calculate further measures such as the expected return for policyholders
- This can then be combined with an appropriate weighting to give a revised combined measure which we then try to optimise in the same way as above.
- The weighting would have to reflect the expected impact of this return in generating additional new business sales and hence adding additional franchise value to the company.

# Dashboard

**Measure Stoch PVFP**

| Eq mix | Bond purchase duration | Level of caps (bn) 0 | 0 |
|---|---|---|---|
| 0% | 1 | XX | XX |
| 0% | 3 | XX | XX |
| 0% | 5 | XX | XX |

**Measure Var**

| Eq mix | Bond purchase duration | Level of caps (bn) 0 | 0.5 | 1 | 1.5 |
|---|---|---|---|---|---|
| 0% | 1 | XX | XX | XX | XX |
| 0% | 3 | XX | XX | XX | XX |
| 0% | 5 | XX | XX | XX | XX |
| 0% | 10 | XX | XX | XX | XX |

**Measure PH return**

| Eq mix | Bond purchase duration | Level of caps (bn) 0 | 0.5 | 1 | 1.5 |
|---|---|---|---|---|---|
| 0% | 1 | XX | | | |
| 0% | 3 | XX | | | |
| 0% | 5 | XX | | | |
| 0% | 10 | XX | | | |
| 10% | 1 | XX | | | |
| 10% | 3 | XX | | | |
| 10% | 5 | XX | | | |
| 10% | 10 | XX | | | |
| 20% | 1 | XX | | | |
| 20% | 3 | XX | | | |
| 20% | 5 | XX | | | |
| 20% | 10 | XX | | | |

**Measure Combined**

| Eq mix | Bond purchase duration | Level of caps (bn) 0 | 0.5 | 1 | 1.5 |
|---|---|---|---|---|---|
| 0% | 1 | XX | XX | XX | XX |
| 0% | 3 | XX | XX | XX | XX |
| 0% | 5 | XX | XX | XX | XX |
| 0% | 10 | XX | XX | XX | XX |
| 10% | 1 | XX | XX | XX | XX |
| 10% | 3 | XX | XX | XX | XX |
| 10% | 5 | XX | XX | XX | XX |
| 10% | 10 | XX | XX | XX | XX |
| 20% | 1 | XX | XX | XX | XX |
| 20% | 3 | XX | XX | XX | XX |
| 20% | 5 | XX | XX | XX | XX |
| 20% | 10 | XX | XX | XX | XX |

# Conclusions

- Techniques considered can:
  - help to understand how different measures are influenced by investment strategy
  - help to inform investment management decisions to identify best strategies
  - improve ERM
  - play a part in “use test” for Solvency II internal model approval

# Dynamic asset liability management - a method for optimising investment strategy

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