UNDERSTANDING AND MANAGING PENSION RISKS WITH A FOCUS ON LONGEVITY RISK

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Plan

- Background and Liability Driven Investment
- Measurement and management of longevity risk
  - models
  - risk management options
  - why size matters

Defined Benefit Pension Plan Risks

Liability cashflows:

- price inflation
- salary inflation
- longevity and other demographic risks

Liability values:

- Nominal and real interest rates

Assets:

- Equity-type returns
- Nominal and real bond returns

Why pension plan risk matters

Company (*)	Market cap. (GBP bn)	Pension Liabilities (GBP bn)	Plan Deficit (GBP bn)
Br. Airways	2.8	12.8	0.6
BT	9.6	33.4	4.0
Invensys	2.7	4.7	0.2
BAE Systems	13.1	20.4	5.3
RBS	25.6	30.7	2.9

(*) at 31 March 2010

Liability Driven Investment (LDI) (DB Plans)

$\Rightarrow$ hedging in part or in whole a pension plan's exposure to interest-rate and inflation risk

- Traditional: Bonds (fixed-income + index-linked)
- Less capital intensive:
  - Interest-rate swaps
  - Other OTC derivatives
  - e.g. CPI, LPI swaps (LPI= CPI with cap and floor)

ALM + LDI

- Holistic approach
- Reflects good risk management
- Asset mix reflects a clearly defined risk appetite and set of risk tolerances

ALM + LDI: e.g. modified Portfolio Theory

- Surplus, $S(t)$ = Assets(t) − Liabilities(t)
- Portfolio theory $\Rightarrow$ tradeoff between

  Expected Surplus *versus* Risk in Surplus
- Given risk appetite $\Rightarrow$
  - *some* hedging of liability risk
  - some risk taking on asset side

Longevity Risk

- Most significant risk after interest rate and inflation hedging
- Unlike interest rates/inflation, longevity shocks persist
- Before 2005:
  - no securities/derivatives to hedge longevity risk
  - poor understanding of quantity of risk

    $\Rightarrow$ need for better modelling and education

Recent developments

- Significant advances in modelling and measurement
- Financial innovation
- Widespread closure of DB plans
- Alternatives to final salary plans
- *Riots and strikes ...*

Modelling and Measurement of Longevity Risk

- Growing range of models
- Wide range of model selection criteria, including
  - statistical quality of fit
  - robustness
  - are forecasts plausible? (Not always!)
- Recent work on modelling and understanding

  basis risk

Measurement of Longevity Risk: Examples of magnitude

Assuming longevity risk only (no interest-rate/inflation risk)

- Cohort currently aged 65: payment of future pensions

  95% Value-at-Risk $\sim$ 5% to 10% on top of basic liability

- Cohort currently aged 55: cost of annuity purchase at age 65

  95% Value-at-Risk $\sim$ 5% to 10% on top of basic liability

  Younger cohorts $\Rightarrow$ bigger risks

  CPI/LPI linked pensions $\Rightarrow$ bigger risks

Management: UK final salary plans

- Future service accrual:
  - many final salary plans replaced by DC
  - BUT there are alternatives
- Past service:
  - Very difficult to scale back benefits
  - Legacy assets and liabilities need careful risk management

Financial innovation

- Customised hedges:
  - tailored to requirements of hedger
  - potentially expensive
  - 100% risk reduction
- Index hedges
  - standardised contracts
  - cheaper
  - BUT $< 100\%$ risk reduction (basis risk)

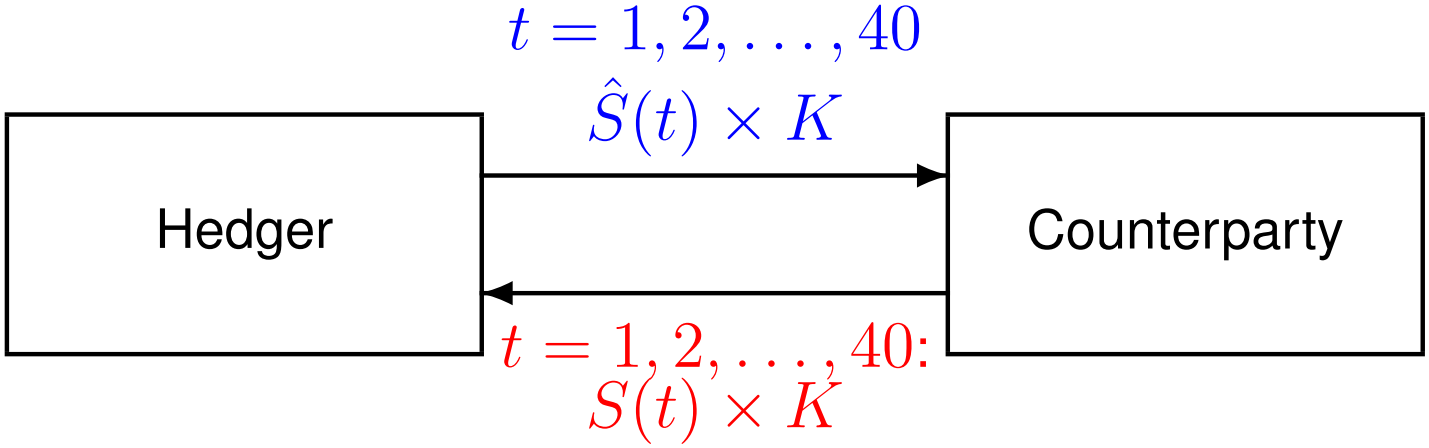
Customised hedges

- Buy-outs; Buy-ins; Longevity swaps:
- Buy-outs
  - Pension Plan transfers responsibility for pensions in payment to a specialist insurer
  - Not normally possible for active members and (??) deferred pensions
  - Relatively expensive???

Customised hedges

- Buy-ins
  - Purchase of bulk annuities, but Plan retains responsibility
  - Can include active members and deferred pensions: expensive $+$ only partial risk reduction
  - Contractual differences: Buy-in $\longleftrightarrow$ Buy-out

Customised Longevity Swaps: simplified example

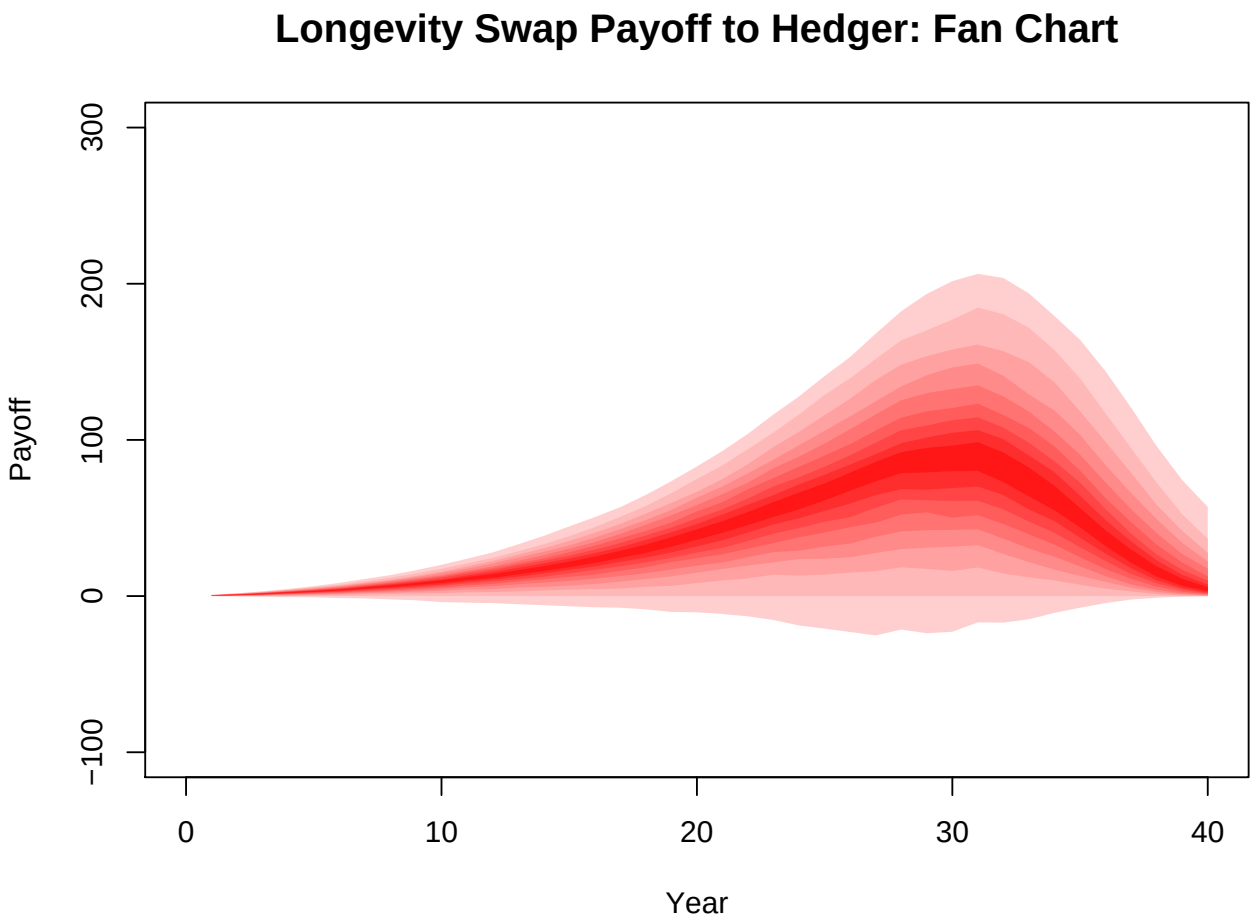


$S(t)$ = proportion still alive at t out of

males aged 65 at time 0 $\Rightarrow$ floating leg

$\hat{S}(t)$ = Fixed leg, set at time 0

K = Notional



- $\hat{S}(t) =$ 10% quantile of $S(t)$
- $K = 1000$

- Customised longevity swap
  - Plan retains responsibility
  - Low initial capital outlay (0 (??) $+$ collateral)
  - Longevity $+$ inflation risk
  - Up to 100% risk reduction

Index-based longevity instruments

- Life and Longevity Markets Association (LLMA)
- Typical contracts:
  - q-forwards

    swap fixed for floating future mortality rates

    (JPMorgan $\leftrightarrow$ Lucida, 2007)
  - S-forwards

    swap fixed for floating survivorship ($\hat{S}(t) \leftrightarrow S(t)$)

    (*longevity swap* $=$ *collection of S-forwards*)

Index-based longevity instruments

- e.g. linked to national mortality
- Cheaper than customised hedges
- Accessible to medium sized Plans
- Risk reduction NOT indemnification

  i.e. Basis risk

Which option?

- Risk appetite $\Rightarrow$ de-risk ???
- Customised longevity swap
  - Only available to large Pension Plans
- Bulk Buy-outs
  - Good option for medium and large Plans
  - Expensive (??) for small Plans

- Buy-ins
  - More generally available
  - More expensive
  - Capital intensive
- Index-based hedges
  - Less capital intensive
  - Good alternative option for medium Plans

Basis risk in index-based hedges

- Key risks:

  population basis risk; small population sampling variation

- Modelling $\Rightarrow$ risk is small for large Plans

  (correlations of 90% to 95%)

Basis risk in index-based hedges

Choice between customised hedge and index-based hedge

- *Everything else being equal:*

  large Plan more likely to favour index-hedge

  (smaller plans $\Rightarrow$ more sampling variation $\Rightarrow$ customised better)

- BUT: customised longevity swaps not available to medium Plans

  $\Rightarrow$ might favour index-based hedges

- Small Plans:

  too much basis risk to be a viable option for *pensions in payment*

  BUT possible use for index-based instruments to hedge future annuity purchase for *active* members at retirement

- Price of each option influences outcome

- Expensive $\Rightarrow$??? *partial* or no hedging

Future service: longer term options

Under DB:

- Final salary $\longrightarrow$ Career average salary ... X (for longevity)
- Longevity risk sharing: ....✓
  - Systematic increases in the retirement age
  - Life Expectancy Adjustment Factor (John Lewis shops)
  - Pension increases linked to longevity experience

Conclusions

- Index-linked longevity market still in its infancy

  (pension plans and advisers lack confidence over basis risk???)

- Target groups:
  - medium sized pension plans ???
  - plans seeking to hedge longevity risk for current employees
- Index-based solutions might not be the right choice
- Companies with a commitment to quality DB plans

  $\Rightarrow$ need to develop longevity risk sharing benefits

Discussion

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