

Pensions conference 2011
Andy McAleese



How good a hedge is “good enough”?

Longevity Risk
Management

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Agenda

- **Options available to manage longevity risk**
- **Nature & impact of basis risk**
 - Key sources of basis risk
 - Scheme/portfolio characteristics
 - Sizing basis risk
- **Other aspects to consider**
 - Imperfect swaps
- **Questions**

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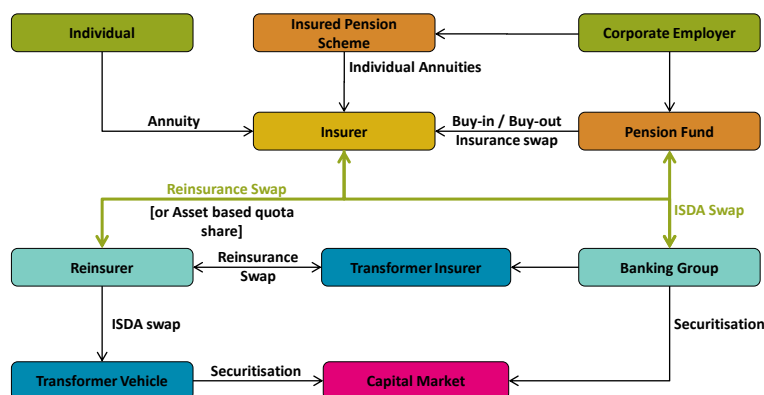
Options available to manage longevity risk

- **Bundled solutions transferring range of risks:**
 - pension buy-out / buy-in
 - asset-based quota share reinsurance
- **Pure longevity risk transfer:**
 - appetite to retain assets
 - may obtain better terms on each risk from specialist counterparties
 - first step to wider risk transfer
- **Consider two pure longevity risk transfer solutions:**
 - Portfolio Specific Hedges (“Longevity swaps”)
 - Index Based Hedges
 - generally capital markets instruments
- **Other options not currently in common use:**
 - Duration limitations
 - Non-proportional structures
 - First life only cover

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Options available to manage longevity risk



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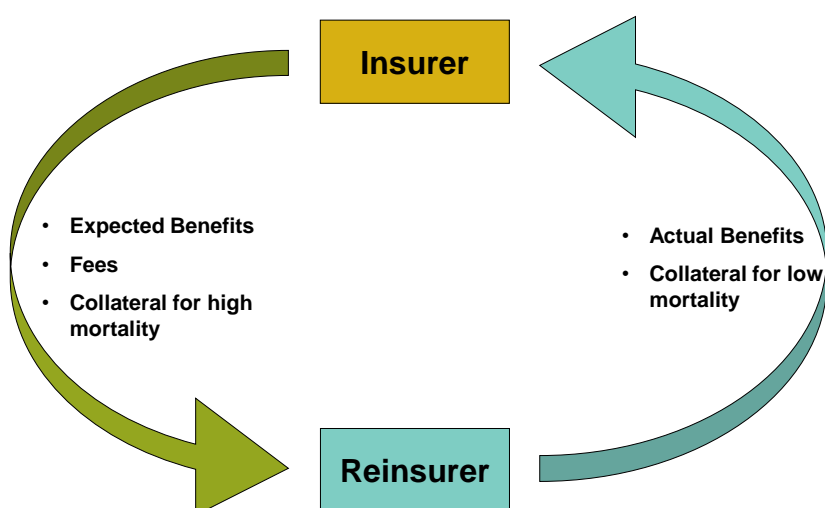
Longevity swap overview

- Scheme pays a fixed schedule of pension payments plus fees and receives floating payments based on actual scheme experience
- Term of cover tends to match the underlying benefits
- Transfers risk of spouses and financial dependents (age and existence) often overlooked and material risk
- Transactions structured in insurance, reinsurance or derivative formats
- Matches actual longevity risk on cashflow basis

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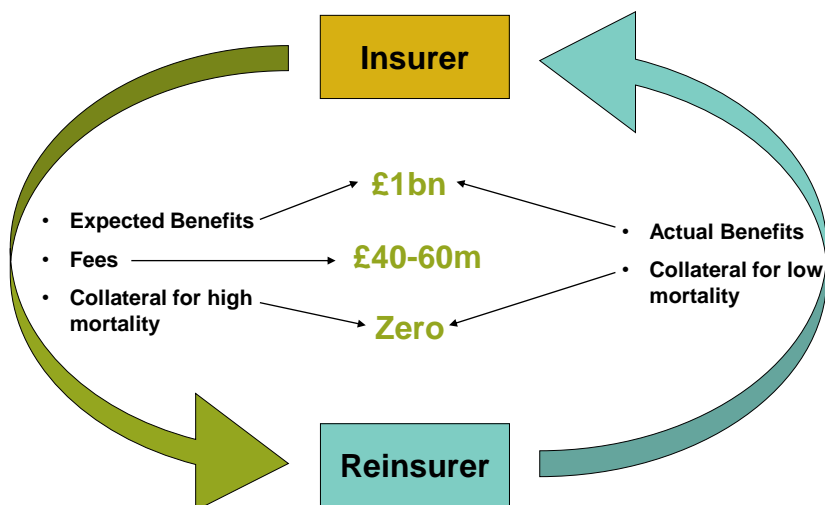
Longevity Swap Cash Flow Illustration



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Approximate present value of payments on a £1bn swap (if experience follows the swap basis)



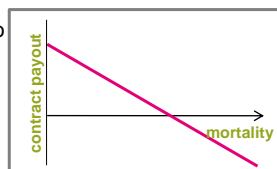
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Index based hedges

How index based hedging works for a portfolio

- **Asset of defined term**
- **Scheme pays fixed in exchange for floating based on realised population mortality at forward date:**
 - e.g. chosen index = E&W Males q_{70} based on observed crude data or graduated table
 - If realised mortality less than fixed scheme receives payment
 - Offset (to an extent) change in funding position
- **Structure and volume of index purchased set to best meet hedging objectives**
 - Range of gender/age-band specific indices available to cover portfolio
 - Impact on liquidity / capacity?
- **Nominal amounts purchased can be rebalanced in future (for uncertain additional cost)**



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Index based hedges

Available published indices

| <u>Company/Index</u> | <u>Reference population(s)</u> | <u>Date</u> | <u>In Force?</u> |
|------------------------|--|-------------|------------------|
| Credit Suisse | US | 2005 | Discontinued |
| LLMA (LifeMetrics) | US/E&W/Netherlands/Germany | 2007 | Yes |
| Deutsche Börse (Xpect) | E&W/Netherlands/Germany ¹ | 2008 | Yes |
| Goldman Sachs (QxX) | US impaired old age life settlement pool | 2009 | Discontinued |

Long-term availability of index?

LLMA consultation paper “Longevity Index Framework August 2010”

- Desirable features:
 - Tradability, Transparency, Robustness, Objectivity, Simplicity, Clear Governance, Timeliness, Continuity, Consistency, Universality

¹ socio-demographic customisation also possible

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Index based hedges

Actual activity to date

- Lucida (Jan 2008) annuity liability hedge**
 - LifeMetrics index (ONS England & Wales population mortality)
 - 10 year q-Forward standardised derivative contract hedging value of liabilities
 - Fully collateralised
- Pall (UK) Pension Fund (Feb 2011) £70m deferred pensioner liability hedge**
 - 10 year LifeMetrics derivative contract fully collateralised
- Capital market ILS mortality issues:**
 - Mostly focus on Catastrophe or pandemic risk (shock excess mortality)
 - Short term reflecting investor appetite
 - Novelty premium
 - but.....**huge potential capacity**

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Index basis risk

Overview

- **Index hedges may not match actual change in liabilities:**
 - Index population vs portfolio population:
 - Population and portfolio mortality trends may not be heavily correlated
 - Age, gender, socio-economics, geography, health, lifestyle, etc.
 - Statistical volatility:
 - number of lives
 - liabilities skewed to larger amounts
 - Base mortality assumptions uncertainty:
 - assessing level and shape against population
 - trade based around best estimate assumptions (potentially inaccurate)
 - aggregate experience contains shape “richness” by age, term, year, socio-demographics etc.
 - differentials emerge as divergent trends as portfolio ages
 - benefit structures (e.g. reversion/escalation) further shift exposure mix over time
 - adverse existence and age profile of dependants/joint lives
 - credibility and reliability of data sometimes limited

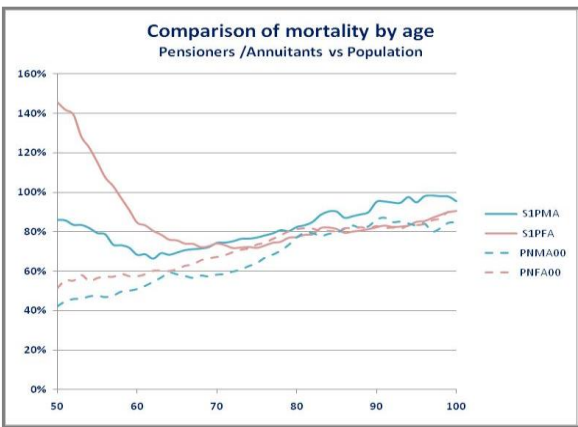
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Index reference

- Significant differences exist between current level and shape of wider population mortality and overall industry experience (pensioner or annuitant):



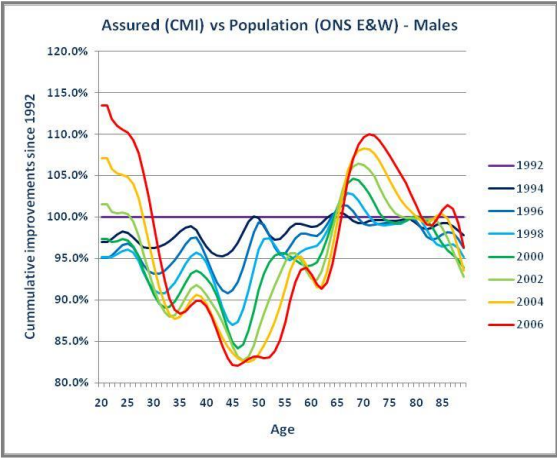
Ratio to E&W Population:
PNxA00 vs. ILT 99-01
S1PxA vs. ILT 02-04

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Index reference

- Over the longer term (despite broad consistency of overall rates of improvement) **divergent age patterns emerge:**



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Index reference

-longer term correlations much better but still not perfect:
- consider effect on own portfolio

| Period | Ratio of pension values at end of 10 year period ¹ | Difference ² | Implied difference in p.a. improvements within 10 year period |
|-----------|---|-------------------------|---|
| 1961-1971 | 97.7% | -2.3% | -0.5% |
| 1971-1981 | 100.5% | +0.5% | +0.1% |
| 1981-1991 | 96.8% | -3.2% | -0.7% |
| 1991-2001 | 99.4% | -0.6% | -0.1% |

¹ Source: JP Morgan LifeMetrics Technical Document

² Relative difference in residual annuity values based on

- single cohort of 65 year olds using observed improvements
- E&W population (ONS) data vs. Assured lives (CMI) data observed trends

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Statistical volatility

- **Impact of portfolio size and benefit distribution on results**
 - SAPS data 2001-08 Males:

| Benefit band pa | Mix by lives | Mix by amount | Average amount £k |
|-----------------|--------------|---------------|----------------------|
| £0 - £1500 | 19.8% | 2.3% | 0.8 |
| £1500 - £3000 | 19.3% | 6.3% | 2.2 |
| £3000 - £4500 | 14.4% | 7.9% | 3.7 |
| £4500 - £8500 | 21.1% | 19.4% | 6.2 |
| £8500 - £13000 | 11.8% | 18.2% | 10.5 |
| £13000 - £25000 | 10.3% | 26.5% | 17.4 |
| £25000 + | 3.3% | 19.3% | 39.6 |
| All | 100.0% | 100.0% | 6.8 |

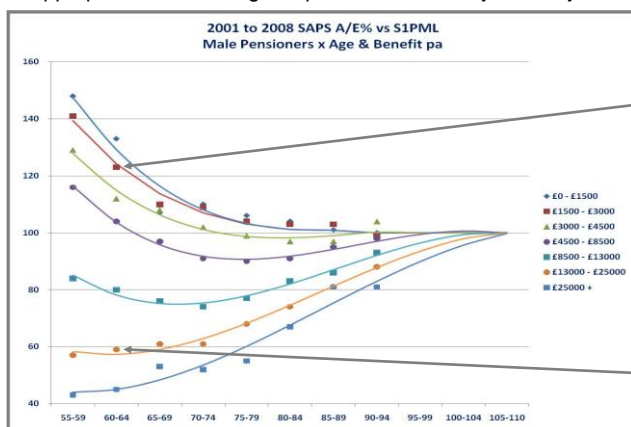
- How big does a scheme/portfolio need to be before this is not a significant factor?

Statistical volatility

- Crude stochastic model:
 - single cohort of 70 year old males
 - benefits escalate at 3% pa; valued at 4.5% pa (no reversion)
 - deterministic base mortality CMI p-spline improvements
 - separate band benefits assumed with binomial mortality for lives in each band
- 4 hypothetical schemes:
 - A: (small scheme) 500 lives all with same current annual benefit
 - B: (large scheme) as A except 5000 lives
 - C: (normal amounts spread) as B except average band amount & mix
 - D: (skewed benefits) as C except benefit in top band is £250,000 not £39,567 pa
- Results - 95th (99.5th) percentile liability value increases vs. best estimate:
 - A: +3.7% (5.8%)
 - B: +1.2% (1.7%)
 - C: +1.8% (2.7%)
 - D: +4.1% (6.0%)

Base mortality assumption

- Wide socio-demographic differentials for younger pensioners converge with increasing age
- Appropriate level and age slope of base mortality can vary materially by scheme:



Poor or job
hopping
executive?

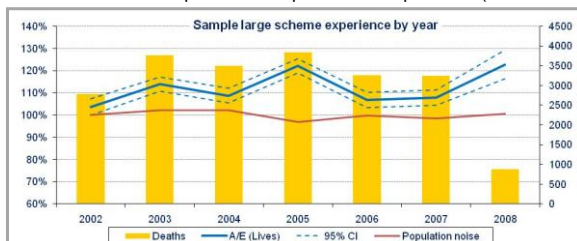
Wealthy or
long service
blue collar
worker?

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Other key assumptions

- **Dependant assumptions:**
 - Best estimate liabilities often reflect assumptions about proportion of lives with dependants and their age rather than using actual data
 - Liability values sensitive to these particularly for escalating benefits with high reversion factors:
 - +1.2% impact on from increasing married proportion by 10%
 - +1.9% impact on from decreasing the spouses age by 2 years
- **Scheme specific experience issues:**
 - Low credibility for smaller schemes increases base assumption uncertainty
 - It can be hard to interpret unusual patterns in experience (even for large schemes):



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Index basis risk

Conclusions

- Key reasons why an index hedge might not match the change in liabilities:

Potential range of mismatch impact¹

- **Index reference population inappropriate** **+/- 4 to 6%**
 - impact depends on assumed correlations/age mix,
 - affects all schemes
- **Statistical volatility** **+/- 1 to 6%**
 - impact depends on scheme size and benefit distribution
- **Base mortality assumptions and other assumptions** **+/- 2 to 5%**
 - impact depends on scheme experience credibility & reliability
 - married % and dependent age assumptions also important
 - highly subjective, especially where lives are heterogeneous or there are unexplained patterns in the observed experience

¹ crude estimates of 95th percentile increase in best estimate liabilities

Index basis risk

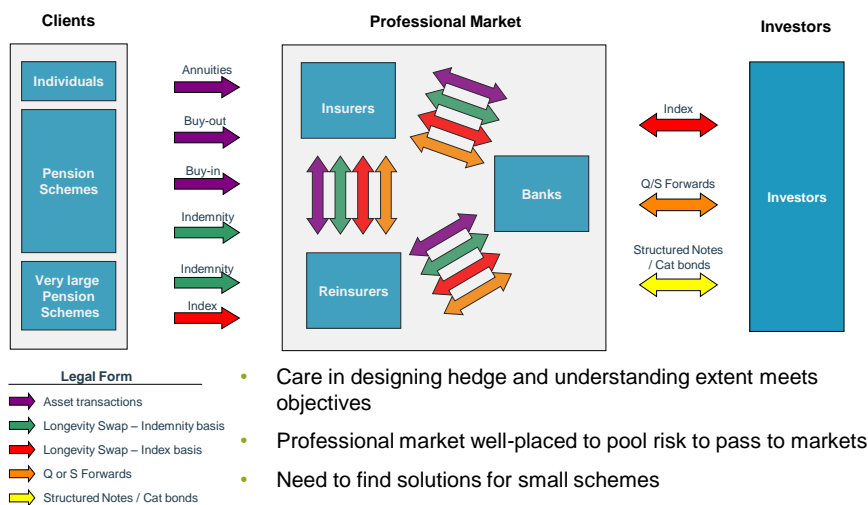
Conclusions

- Key reasons why an index hedge might not match the change in liabilities:

Potential range of mismatch impact

- **Index reference population inappropriate** **+/- 4 to 6%**
- **Statistical volatility** **+/- 1 to 6%**
- **Base mortality assumptions and other assumptions** **+/- 2 to 5%**
- **Contrast these figures with the expected variance in expected longevity trend:**
 - Most models will project a 99.5% scenario variance in longevity of between 6% and 10%
 - Assuming a normal distribution this suggests a 95th percentile variance of **between 4% and 6%**
- **At the 95th percentile event the volatility between the hedge result and actual mortality may be larger than the volatility between the expected mortality and actual mortality!**

Is there a place for index hedges?



- Care in designing hedge and understanding extent meets objectives
- Professional market well-placed to pool risk to pass to markets
- Need to find solutions for small schemes

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Longevity swaps

- **Can be constructed as an “indemnity” hedge which eliminates basis risk altogether however:**
 - Timing and definition of linked escalations (including GMP) can be complex to model
 - Legal and actuarial and on-going operational cost of defining/negotiation the “perfect hedge” may be greater than the risk associated with a nearly perfect hedge
 - Scheme data may not be perfect at inception but risk takers are unlikely to accept adjustment only to the floating vector
 - May be beneficial to assess cost vs benefit of insuring different benefits

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Longevity swaps

- **Base fixed and floating cashflows on “notional” benefits:**
 - Introduces very mild basis risk
 - Much easier to model and define contractually and administer
 - Can also be used to certain risks to improve terms, e.g. uncapped inflation or named spouse benefits
- **Key to ensure that fixed and floating cashflows move in parallel**
- **Over or under hedging by a few percent is a very second order risk that is generally worth the simplicity and cost savings**

Questions or comments?



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The views expressed in this presentation are those of the presenter.

