The Actuarial Profession
making financial sense of the future

MANAGING LONGEVITY AND MORTALITY RISK IN PENSION PLANS

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Longevity risk

"Certainty? In this world nothing is certain but death and taxes."

Benjamin Franklin

LONGEVITY RISK IN PENSION PLANS

LONGEVITY RISK MANAGEMENT

TOOLS FOR MANAGING LONGEVITY EXPOSURE

Longevity risk resides with organisations not equipped to manage it

- **Corporations, not insurance companies, have the largest exposure to longevity risk through defined benefit pension plans**
  - Estimated at over $20 trillion globally
  - It is not measured, let alone managed
  - Low visibility, poor transparency and perceived complexity

- **Changes in regulation and accounting have put longevity in the spotlight**
  - Greater scrutiny by management, members and shareholders

- **Hedging longevity risk can benefit members and sponsors**

A traded market would improve capital efficiency and risk management

Defined benefit pension plans faces several risks

Pension assets

- Equity risk
- Interest rate risk
- Other investment risks

Pension liabilities

- Interest rate risk
- Inflation risk
- Longevity risk
- Other demographic risks

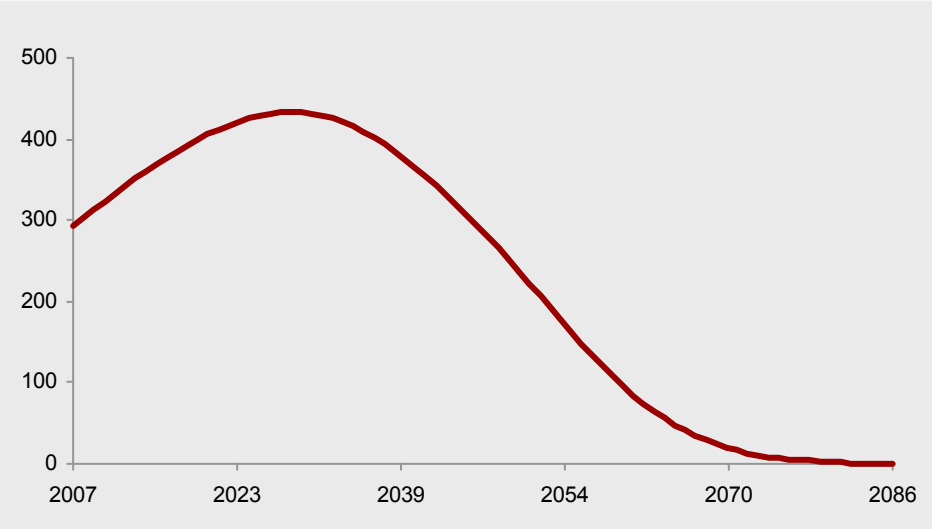
Risk to funding status

Potential for a growing deficit

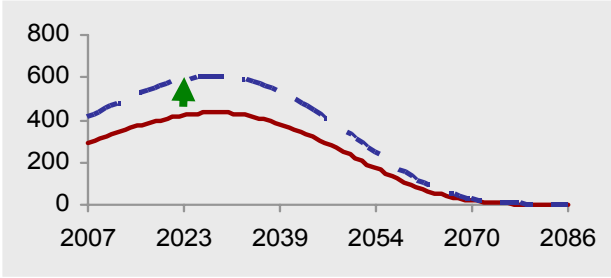
Longevity risk has moved firmly onto the risk management agenda

Longevity risk is similar to and very different from financial risks

Pension liability cash flows (£mm)

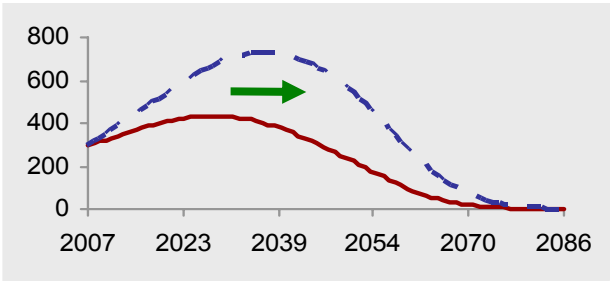


Inflation risk



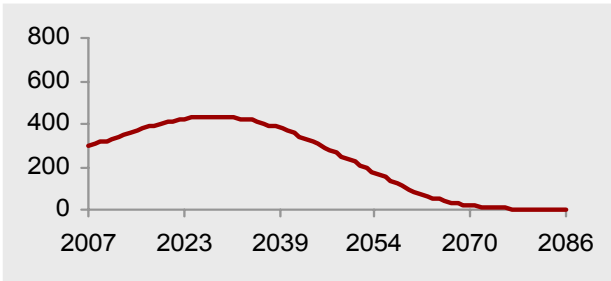
Impacts cash flow and value

Longevity risk



Impacts cash flow and value

Interest rate risk



Impacts value only

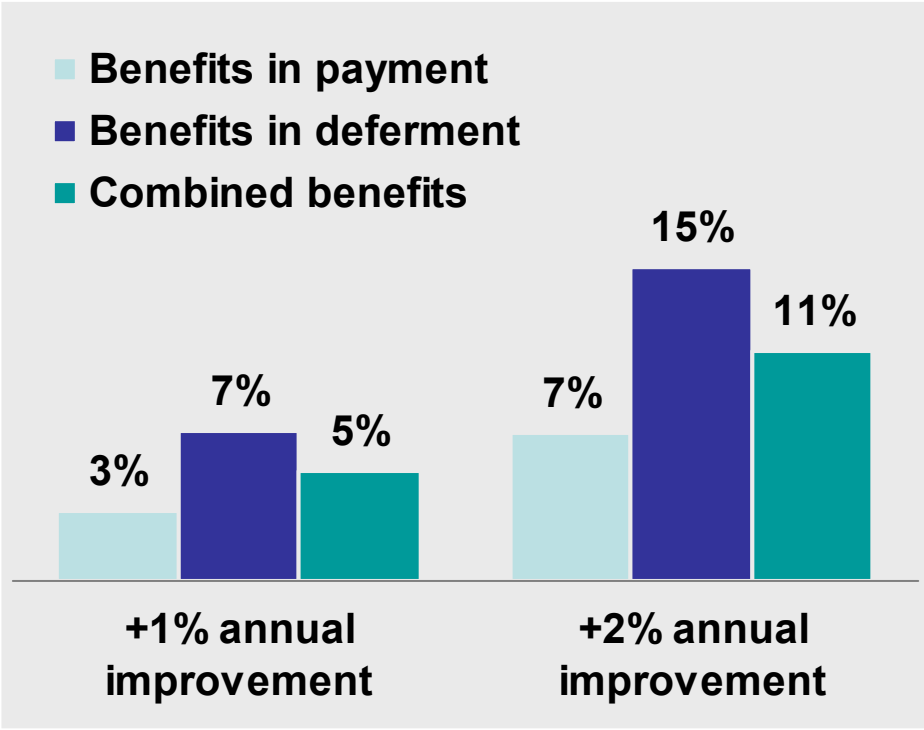
Longevity risk can have a material impact on pension plans

Longevity risk – a significant risk for pension plans

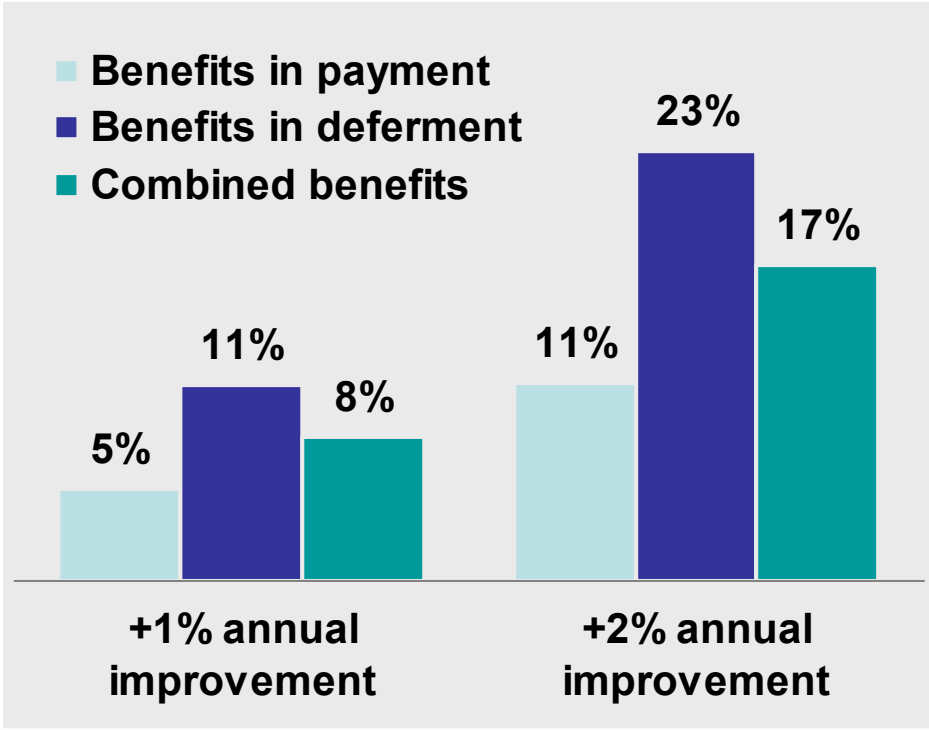
- Longevity risk is the potential for plan members living longer than expected
  - A longer period over which pensions must be paid
  - A higher valuation of pension liabilities and a larger deficit

Sensitivity of liabilities to mortality improvement

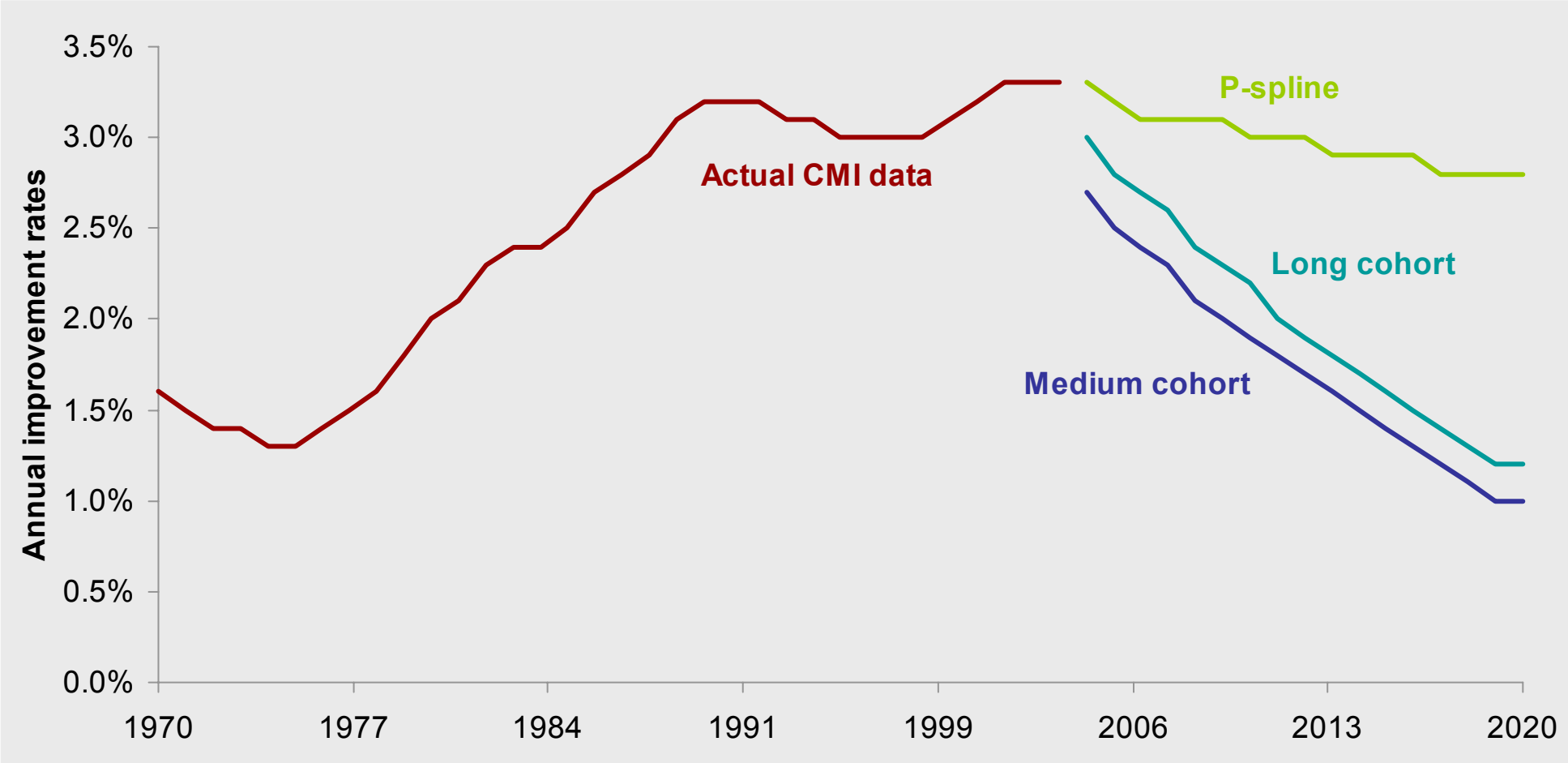
Fixed liabilities (%)



Inflation-linked liabilities (%)



Mortality improvements have been volatile and projections have been divergent



Mortality improvements for the 1935–1940 generation

LONGEVITY RISK IN PENSION PLANS

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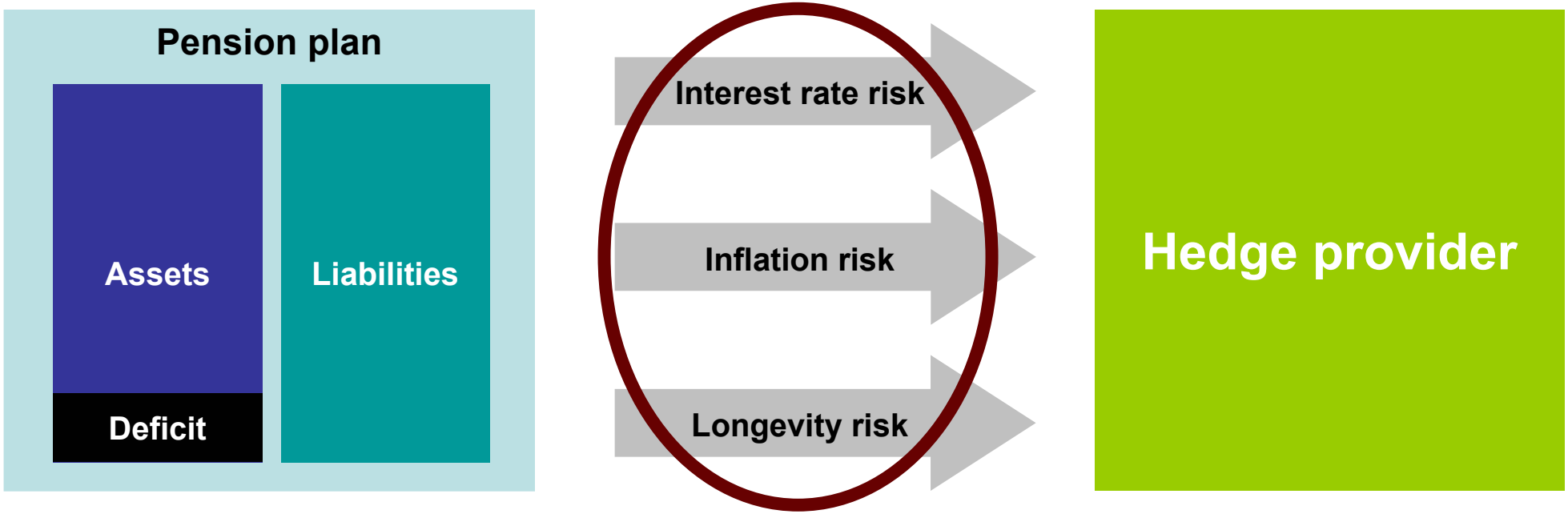
TOOLS FOR MANAGING LONGEVITY EXPOSURE

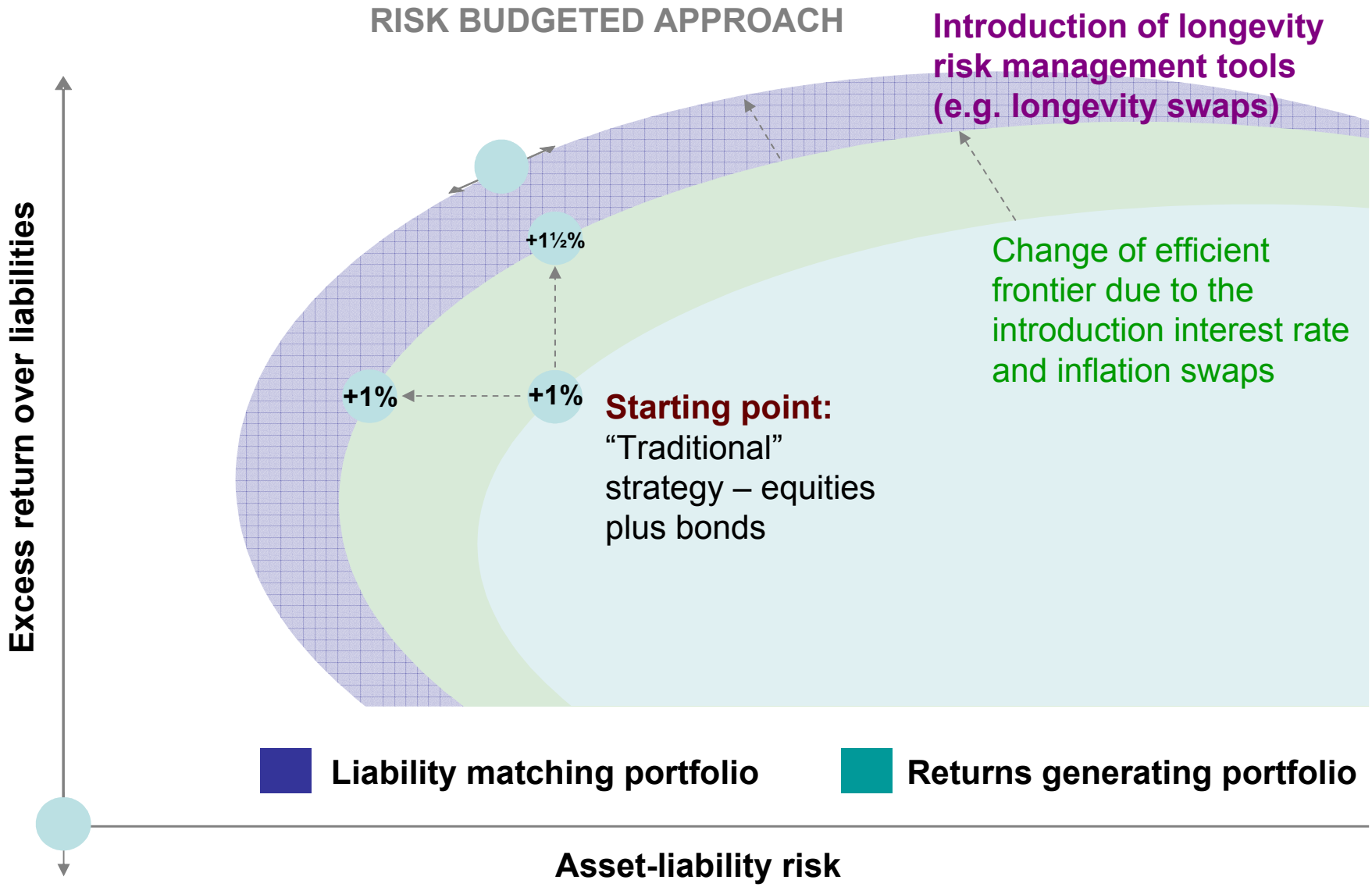
Hedging longevity is now possible – similar framework to interest rate and inflation hedging



- Interest rate, inflation and longevity risks – **largely unrewarded risks**
- Plan can implement a hedging programme to hedge interest rate and inflation risk
- HOWEVER, by ignoring longevity risk the effectiveness of this strategy greatly decreases!
- Longevity risk management is a natural extension of an LDI framework…

Longevity hedging is now possible

Longevity hedging offers the potential for better trade-off between risk and return



Alternative approaches to managing longevity risk

- **Retain Longevity Exposure**
  - Exposes plan to a potentially large unrewarded risk
  - Not consistent with a risk budgeting approach (removing unrewarded risks)
  - Not consistent with an LDI approach

- **Externalisation / Pension Buyout**
  - Eliminates the risk entirely, but also eliminates the pension plan
  - Crystallises the prevailing deficit, requiring a contribution from sponsor

- **Longevity Hedging**
  - Transfer longevity risk out of plan, but maintain plan
  - Consistent with risk budgeting approach and LDI approach

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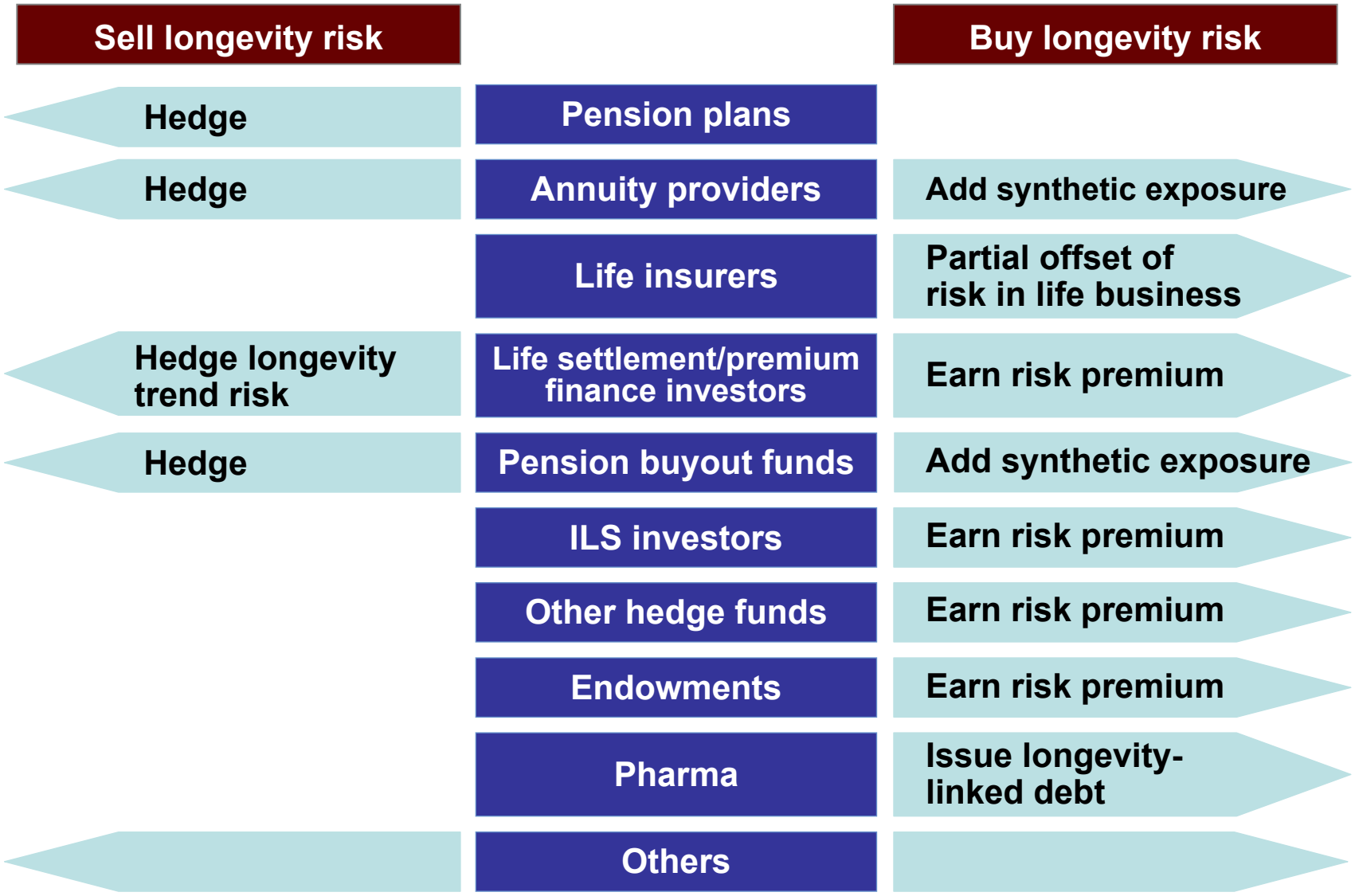
JPMorgan recently conducted an informal poll of CIOs of major US insurance companies

- **Hedging longevity**
  - **75%** see their company hedging with longevity derivatives
- **Investing in longevity**
  - **63%** would contemplate investing in longevity-linked assets
- **Size of the longevity derivative market in 5 years**
  - **70%** expect the market to be at least $100bn
  - **30%** expect the market to be at least $500bn

The time is right for the emergence of a traded market in longevity risk

A traded market in longevity risk is emerging with players seeking to deploy capital on both sides



There is capital seeking to be deployed on both sides of the market

Longevity risk sellers

- Pension plans and annuity providers
  - A number are already looking to hedge at least some part of their longevity exposure
- **Require customised hedges**

Longevity risk buyers

- Investors see longevity/mortality as a new asset class enabling them to
  - Earn a risk premium
  - Take positions based on views of future mortality/longevity
  - Gain exposure to an uncorrelated asset
- **Require standardised investments**

- The key task for any intermediary is to create risk transfer products that are
  - Sufficiently customised to provide effective hedges
  - Sufficiently standardised to provide liquidity

Risk must be repackaged to meet needs of buyers and sellers

“LifeMetrics” has been developed to promote effective management of longevity and mortality risk

What is LifeMetrics?	■ **A toolkit for measuring and managing longevity and mortality risk** ■ **Index** => longevity and mortality indices ■ **Framework** => methodologies and analytics ■ **Software** => tools for modelling/forecasting mortality
Strategic rationale	■ Assist pension funds in managing longevity risk ■ Educate investors to promote a market in longevity-linked assets ■ Provide hedging tools for insurers to complement existing toolkits
Features	■ Transparent, open, non-proprietary, freely-available ■ International ■ Comprehensive framework for longevity risk management ■ Building-block derivatives for hedging and risk transfer

Subject to two US patent applications

Key characteristics of LifeMetrics

- **Key advisors** – LifeMetrics has been developed with
  - Watson Wyatt (UK and US)
  - Pensions Institute at Cass Business School
- **International indices**
  - Based on official national population data
  - Initially US and England and Wales but other countries will be added
- **Transparency**
  - Methodology, algorithms and calculations are fully disclosed
- **Governance**
  - Advisory Committee to safeguard integrity of the LifeMetrics index
  - Independent calculation agent

LifeMetrics index data availability

Data type	Gender	Country	Ages	Period
m: Raw mortality rate	M/F	US	20 – 84	1968 – 2004
m: Raw mortality rate	M/F	E&W	20 – 89	1971 – 2005
m: Raw mortality rate	M/F	E&W	20 – 84	1961 – 1970
q: Mortality rate	M/F	US	20 – 90	1968 – 2004
q: Mortality rate	M/F	E&W	20 – 90	1961 – 2005
e: Life expectancy	M/F	US	20 – 80	1968 – 2004
e: Life expectancy	M/F	E&W	20 – 80	1961 – 2005

m = Crude central mortality rates
q = Graduated initial mortality rates
e = Period life expectancy

M = Male
F = Female

US = United States
E&W = England & Wales

www.jpmorgan.com/lifemetrics

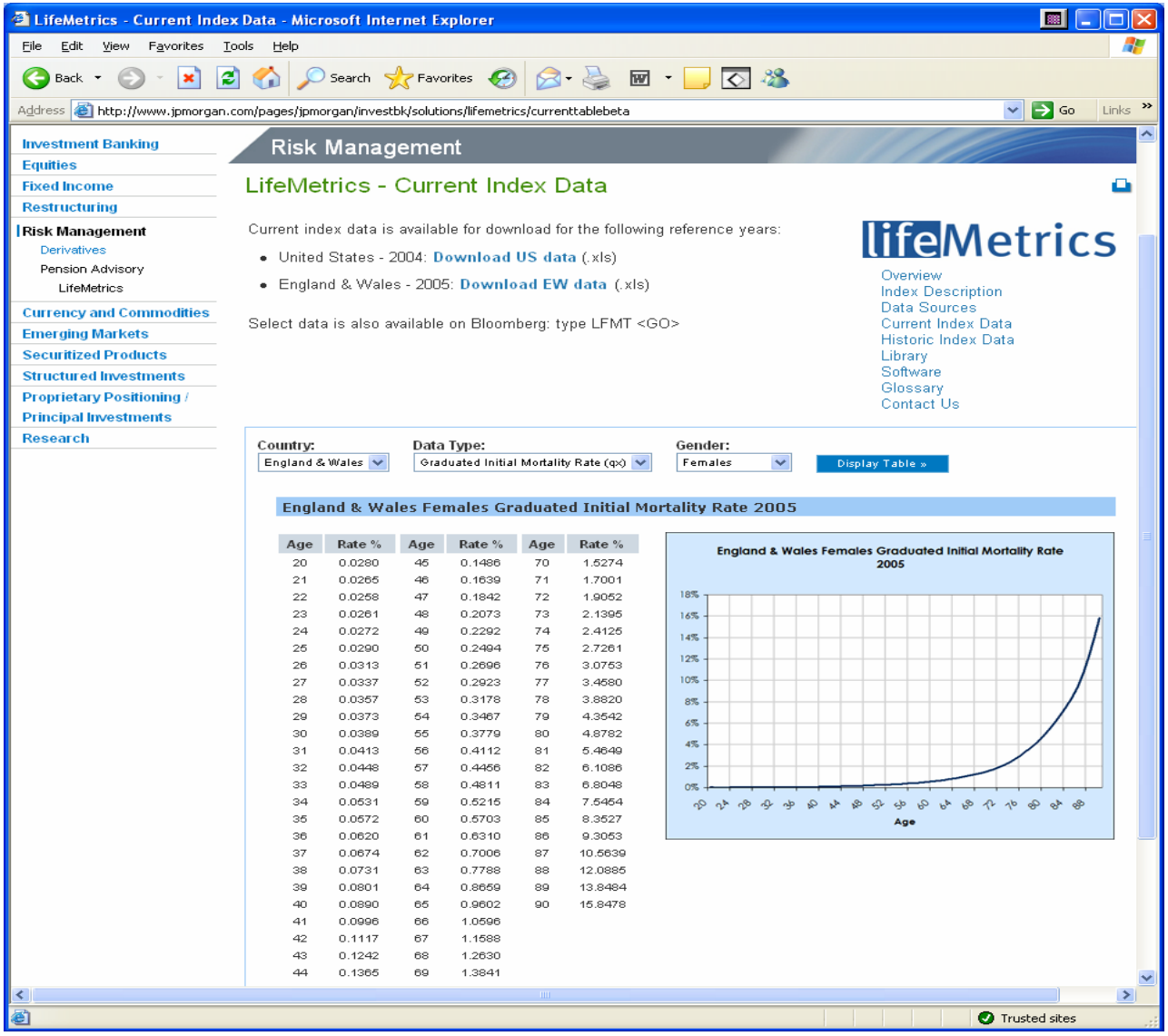
Bloomberg: LFMT <GO>

Additional data sets will be added

Current and historic data available on website and Bloomberg

www.lifemetrics.com

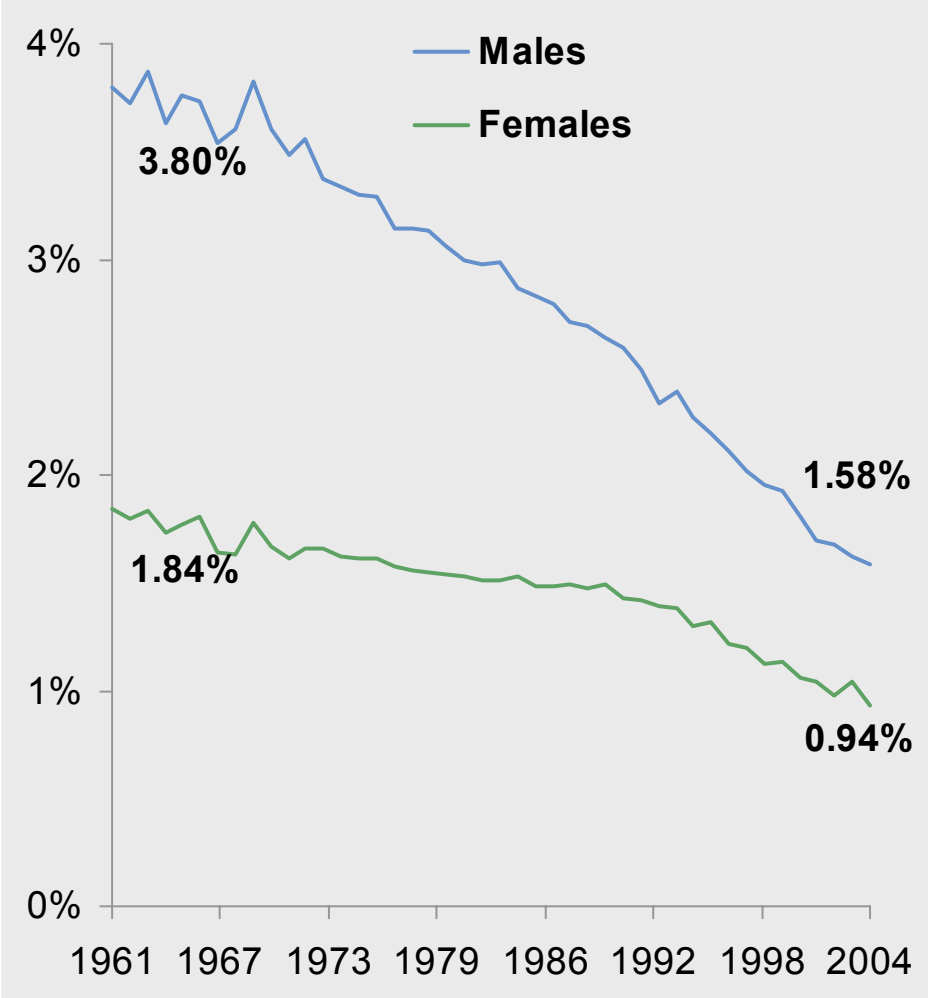
- Increase visibility of
  - Current mortality and longevity
  - Risk to future mortality and longevity
- Provides a reference for settling derivatives and securities



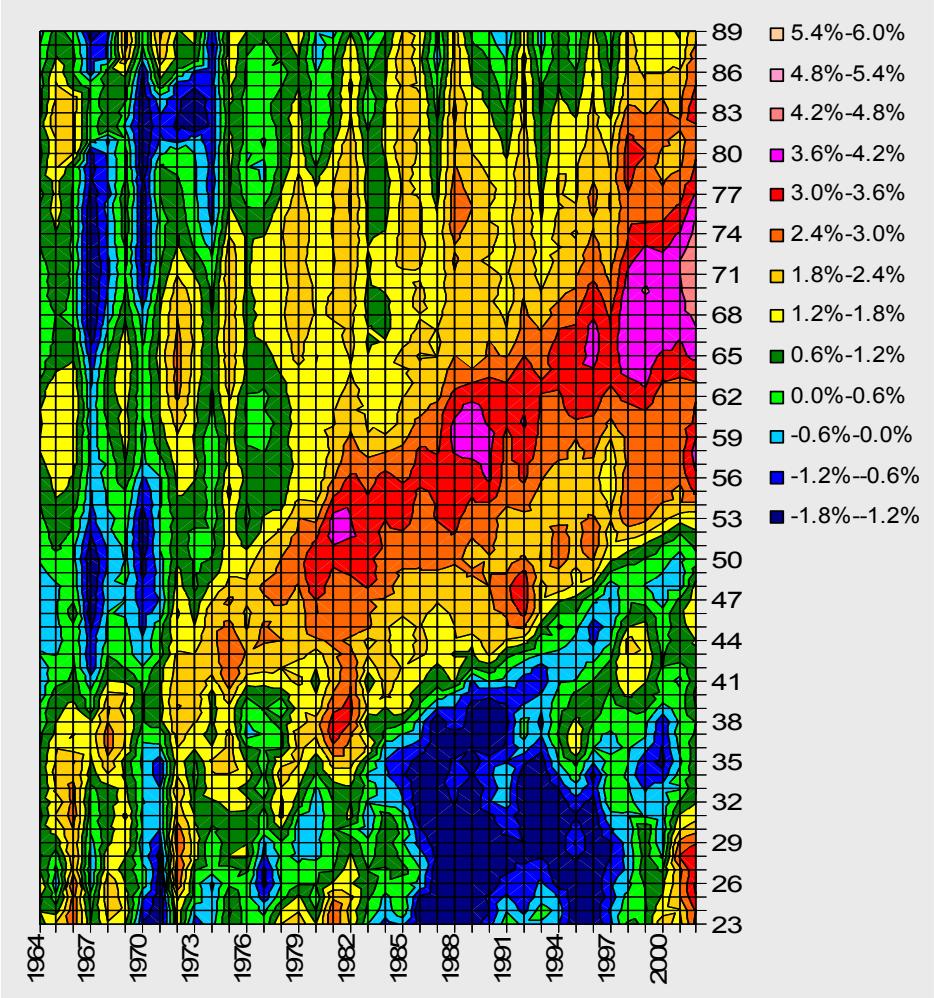
Age	Rate %	Age	Rate %	Age	Rate %
20	0.0280	45	0.1486	70	1.5274
21	0.0265	46	0.1639	71	1.7001
22	0.0258	47	0.1842	72	1.9052
23	0.0261	48	0.2073	73	2.1395
24	0.0272	49	0.2292	74	2.4125
25	0.0290	50	0.2494	75	2.7261
26	0.0313	51	0.2696	76	3.0753
27	0.0337	52	0.2923	77	3.4580
28	0.0357	53	0.3178	78	3.8820
29	0.0373	54	0.3467	79	4.3542
30	0.0389	55	0.3779	80	4.8782
31	0.0413	56	0.4112	81	5.4649
32	0.0448	57	0.4456	82	6.1086
33	0.0489	58	0.4811	83	6.8048
34	0.0531	59	0.5215	84	7.5454
35	0.0572	60	0.5703	85	8.3527
36	0.0620	61	0.6310	86	9.3053
37	0.0674	62	0.7006	87	10.5639
38	0.0731	63	0.7788	88	12.0885
39	0.0801	64	0.8659	89	13.8484
40	0.0890	65	0.9602	90	15.8478
41	0.0996	66	1.0596		
42	0.1117	67	1.1588		
43	0.1242	68	1.2630		
44	0.1365	69	1.3841		

Historical LifeMetrics data forms the basis of pricing, forecasting and risk management

England and Wales: 65-year old mortality rates



E&W Males: 1-year mortality improvements



Source: ONS and LifeMetrics

Framework for longevity/mortality risk management is fully documented

- **Technical document**
  - Transparent description of the LifeMetrics Index and how it is calculated
  - Details the approach to measuring and managing longevity/mortality risk
- **Research discussion paper**
  - Written in collaboration with academics
  - Evaluates and compares different models of mortality forecasting

Longevity risk and mortality risk are different from financial risks

- **Risk drivers**
  - Key determinants: **Population** size and **demographics**
  - Age, gender, marital status, socio-economic group, lifestyle, geography…

- **Types of longevity/mortality risk**
  - **Volatility**
  - **Sampling risk**
  - **Jump risk**
  - **Trend risk**

- **Hedging: Population basis risk**
  - Mismatch in systematic longevity risk between two populations

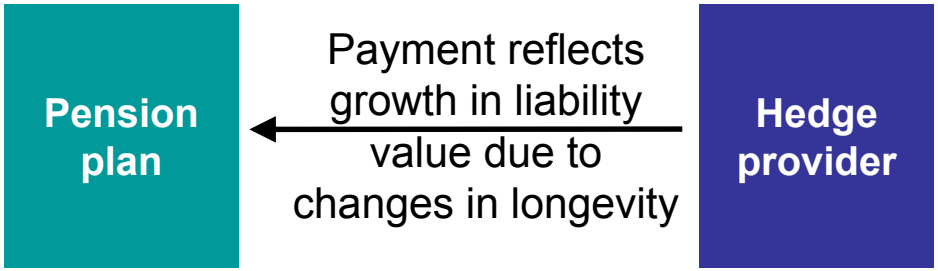
There are two broad categories of longevity hedge

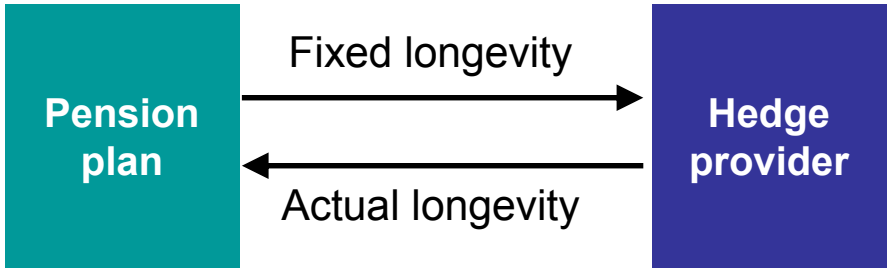
Standardised longevity hedge

- **Standardised** to reflect national population longevity experience
  - But calibrated to match mortality sensitivity of pension
- Structured as a **value hedge**
- Maturity of hedge
  - e.g. 10 years or 20 years

Customised longevity hedge

- **Tailored** to reflect actual longevity experience of the pension plan
- Structured as a **cash flow hedge**
- Maturity of hedge
  - Until the last member dies





Advantages and disadvantages of customised vs. standardised longevity hedges

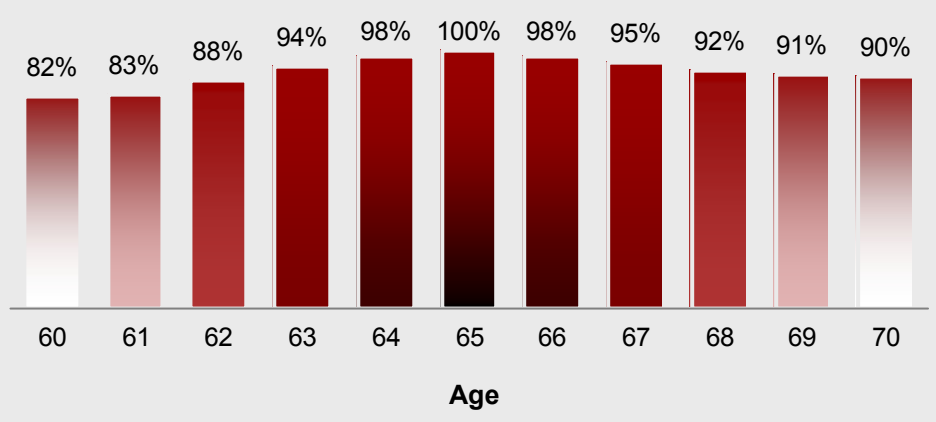
	Advantages	Disadvantages
Standardised hedge	✓ Cheaper than customised hedge ✓ Lower set-up/operational costs ✓ More liquid ✓ Shorter maturity so lower counterparty credit exposure	× Not a perfect hedge ■ Basis risk, roll risk
Customised hedge	✓ Exact hedge, no residual basis risk ✓ Set-and-forget hedge, requires minimal monitoring	× More expensive than standardised × Higher set-up/operational costs × Poor liquidity ■ Difficult to adjust or unwind × Longer maturity so larger counterparty credit exposure

Standardised hedges provide effective risk reduction with manageable basis risk

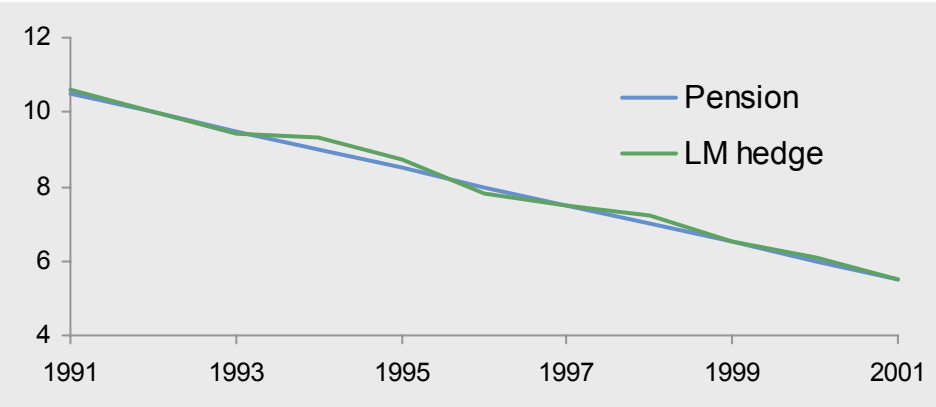
- **Basis risk by age** can be managed
  - Since mortality improvements are highly correlated across age

- **Basis risk by socio-economic group** can be managed
  - Since mortality movements associated with different groups are correlated over the long-term

Correlations in mortality improvements – Short-term correlations E&W males aged 65



Pension value for E&W males aged 65 – Pension vs. LifeMetrics standardised hedge



A market in traded longevity risk is developing

- **Involves the transfer of longevity risk to capital markets**
  - Includes securitisation, derivatives and direct solutions
  - There is capital seeking to take positions on both sides
- **Pension plans now have a viable means of hedging longevity risk**
  - Can be hedged **without** effecting a buyout
  - Residual risks can be minimised
  - Much cheaper than a buyout

Longevity risk can now be hedged