



Discussion points

Focus on mortality – level and trends – at older ages (85+)

1. Setting the scene – longevity swaps
2. Sensitivity of liabilities to older age assumptions
3. Data sources for older age assumptions
4. Level of mortality at the older ages
5. Mortality trends at the older ages
6. Summary

Discussion points

1. **Setting the scene – longevity swaps**
2. Sensitivity of liabilities to older age assumptions
3. Data sources for older age assumptions
4. Level of mortality at the older ages
5. Mortality trends at the older ages
6. Summary

© 2012 The Actuarial Profession • www.actuaries.org.uk

2

1. Setting the scene – Longevity swaps

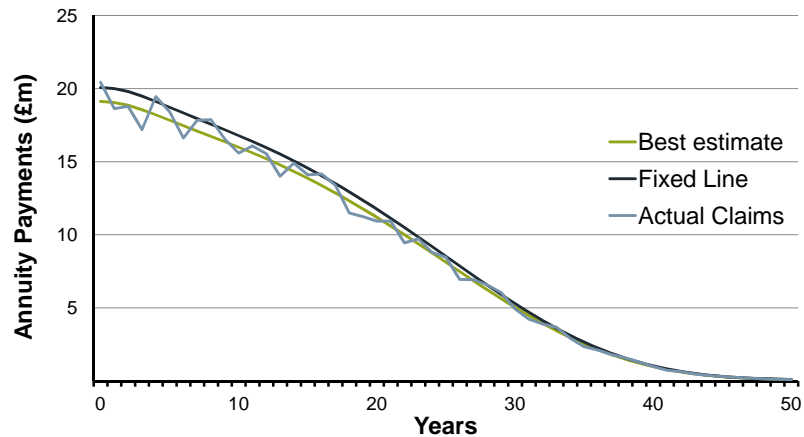
- Longevity swaps now common place in the UK market
- Majority of reinsurers offer this product
- Swaps the uncertain benefit payment of a pension scheme for a fixed schedule of premiums to the provider of the swap

© 2012 The Actuarial Profession • www.actuaries.org.uk

3

1. Setting the scene – Longevity swaps

Longevity swap example:



© 2012 The Actuarial Profession • www.actuaries.org.uk

4

1. Setting the scene – Longevity swaps

There have been a number of high-profile deals in the last couple of years



© 2012 The Actuarial Profession • www.actuaries.org.uk

5

1. Setting the scene – Longevity swaps

Longevity swap characteristics:

- Large
- Often mature pension schemes => higher average age
- Low margins
- Often provide credible scheme data (but not at older ages)

=> Need to be confident about view of older age assumptions

© 2012 The Actuarial Profession • www.actuaries.org.uk

6

Discussion points

1. Setting the scene – longevity swaps
2. **Sensitivity of liabilities to older age assumptions**
3. Data sources for older age assumptions
4. Level of mortality at the older ages
5. Mortality trends at the older ages
6. Summary

© 2012 The Actuarial Profession • www.actuaries.org.uk

7

2. Sensitivity to older age assumptions

Base mortality

Impact of changes in base mortality to annuity values

	Life Age 65				Life Age 75			
	Males		Females		Males		Females	
	Level	Esc	Level	Esc	Level	Esc	Level	Esc
<i>Mortality Level (Phased Approach)</i>								
100% at 80, increasing to 110% for 90+	-0.7%	-1.1%	-0.7%	-1.1%	-1.5%	-2.1%	-1.5%	-2.0%
100% at 80, decreasing to 90% for 90+	0.8%	1.3%	0.8%	1.3%	1.7%	2.3%	1.7%	2.3%
<i>Mortality Level (Step Change)</i>								
90% of B.E. from age 85	0.8%	1.3%	0.8%	1.3%	1.8%	2.4%	1.7%	2.4%
90% of B.E. from age 90	0.4%	0.8%	0.5%	0.8%	0.9%	1.3%	1.0%	1.4%
90% of B.E. from age 100	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%

Assumptions:

- Starting level: 100% PCxA00 with actual rates of mortality improvement as per CMI Model from 2000 to 2008
- Improvements: CMI Model 'core' default with long-term rate of 1.5%
- Yield curve: UK government gilts as at 30/6/2012; escalating benefits are at 2.5% p.a.

© 2012 The Actuarial Profession • www.actuaries.org.uk

8

2. Sensitivity to older age assumptions

Mortality improvements

Assumed mortality improvements in 2009

Base Assumptions (2009)			Base * 75%		Difference	
Age	M	F	M	F	M	F
85	1.9%	2.0%	1.4%	1.5%	-0.5%	-0.5%
90	1.7%	1.2%	1.3%	0.9%	-0.4%	-0.3%
95	1.3%	0.8%	1.0%	0.6%	-0.3%	-0.2%
100	0.8%	0.6%	0.6%	0.4%	-0.2%	-0.1%

© 2012 The Actuarial Profession • www.actuaries.org.uk

9

2. Sensitivity to older age assumptions

Mortality improvements

Impact of changes in mortality improvements to annuity values

	Life Age 65				Life Age 75			
	Males		Females		Males		Females	
	Level	Esc	Level	Esc	Level	Esc	Level	Esc
<i>Mortality Improvement (Multiplicative)</i>								
x110% at Age 85+	0.5%	0.8%	0.4%	0.7%	0.9%	1.2%	0.7%	1.0%
x125% at Age 85+	1.2%	2.0%	1.1%	1.8%	2.1%	2.9%	1.8%	2.5%
x150% at Age 85+	2.4%	4.0%	2.2%	3.6%	4.3%	5.9%	3.6%	4.9%
x90% at Age 85+	-0.5%	-0.8%	-0.4%	-0.7%	-0.8%	-1.1%	-0.7%	-1.0%
x75% at Age 85+	-1.2%	-1.9%	-1.1%	-1.8%	-2.1%	-2.8%	-1.8%	-2.4%
x50% at Age 85+	-2.4%	-3.8%	-2.2%	-3.5%	-4.2%	-5.5%	-3.6%	-4.8%

© 2012 The Actuarial Profession • www.actuaries.org.uk

10

Discussion points

1. Setting the scene – longevity swaps
2. Sensitivity of liabilities to older age assumptions
3. **Data sources for older age assumptions**
4. Level of mortality at the older ages
5. Mortality trends at the older ages
6. Summary

© 2012 The Actuarial Profession • www.actuaries.org.uk

11

3. Data sources for older age assumptions

- We normally prefer to use portfolio-specific data
 - To reflect mortality for the characteristics of the portfolio
- But:
 - Portfolio-specific data lacks credibility at high ages
- So consider alternative information sources
 - Pooled insurance or pension scheme data
 - Population data

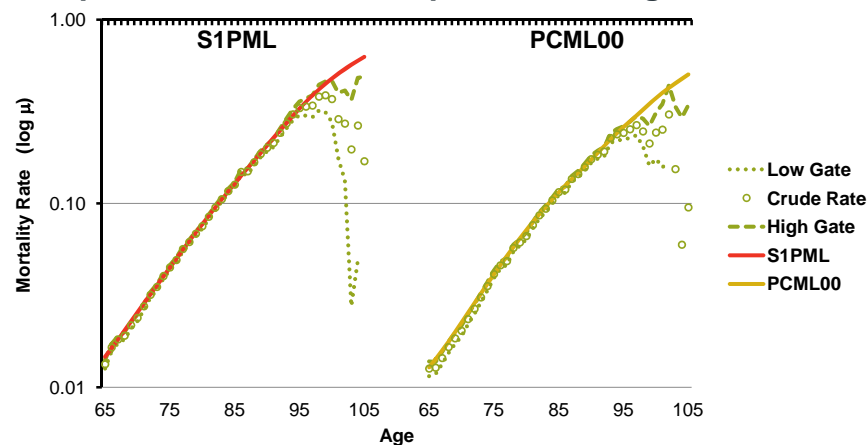
© 2012 The Actuarial Profession • www.actuaries.org.uk

12

3. Data sources for older age assumptions

Unreliability of insured and pensioner data at older ages

Comparison of observed experience with graduations



Source: CMI Working Paper 35 (for S1PML) and CMI Report 23 (for PCML00).

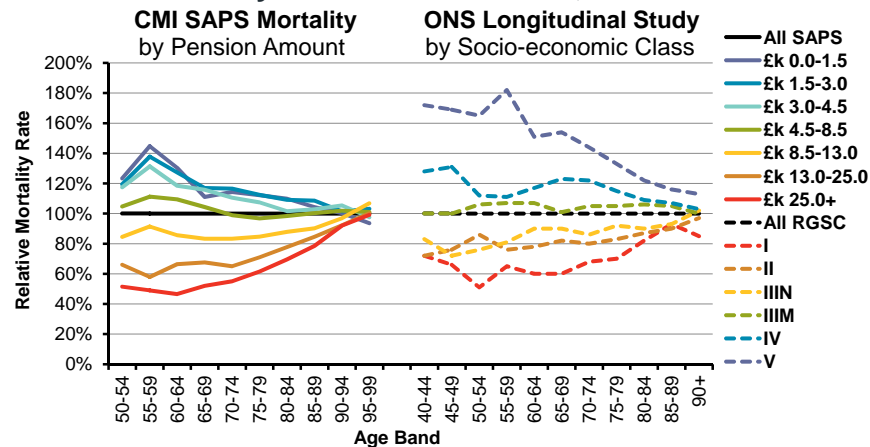
© 2012 The Actuarial Profession • www.actuaries.org.uk

13

3. Data sources for older age assumptions

Convergence of subset mortality rates at older ages

Relative mortality for subsets of lives; males



Source: CMI Working Paper 62 (for SAPS), 2003-10; ONS Longitudinal Study, 1987-2005.

© 2012 The Actuarial Profession • www.actuaries.org.uk

14

3. Data sources for older age assumptions

Why use population mortality data?

- We normally prefer portfolio-specific data
 - To reflect mortality for the characteristics of the portfolio
- But:
 - Portfolio-specific data lacks credibility at older ages
 - Pooled insurance or pension scheme data lacks reliability at older ages
 - Mortality differentials for population subsets narrow significantly (in % terms) at older ages
- So examine population data for use at older ages
 - Relevant ✓ ; credible ✓ ; reliable ?

© 2012 The Actuarial Profession • www.actuaries.org.uk

15

3. Data sources for older age assumptions

Calculating population mortality rates

- Mortality rate = Deaths ÷ Exposure
 - Death registrations data is considered highly accurate
 - Use mid-year population as estimate of exposure
- Derivation of population estimates
 - Underpinned by decennial Census
 - Roll forward year-by-year
 - Cohort component method allowing for:
 - Natural change: Ageing, births and deaths
 - Migration
 - Review when next Census is reached
 - Investigate differences; revise intercensal estimates

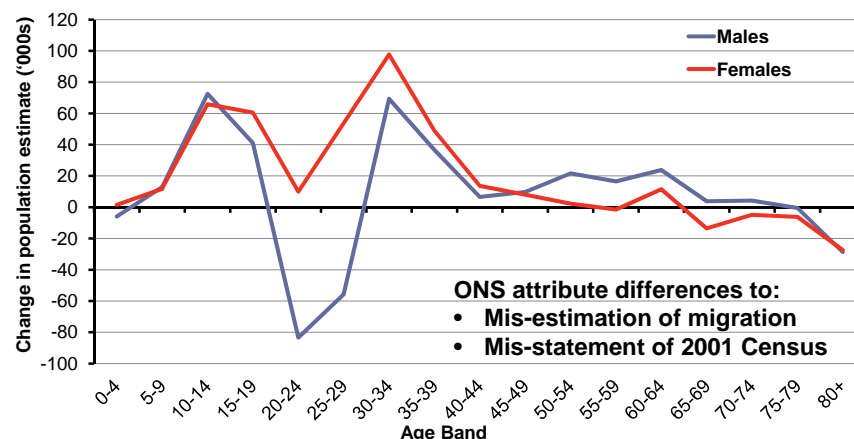
© 2012 The Actuarial Profession • www.actuaries.org.uk

16

3. Data sources for older age assumptions

Comparison of population estimates

2011 Census count compared with roll-forward estimate



Source: ONS; estimates as at Census day 27/03/11; roll-forward estimate underpinned by 2001 Census.

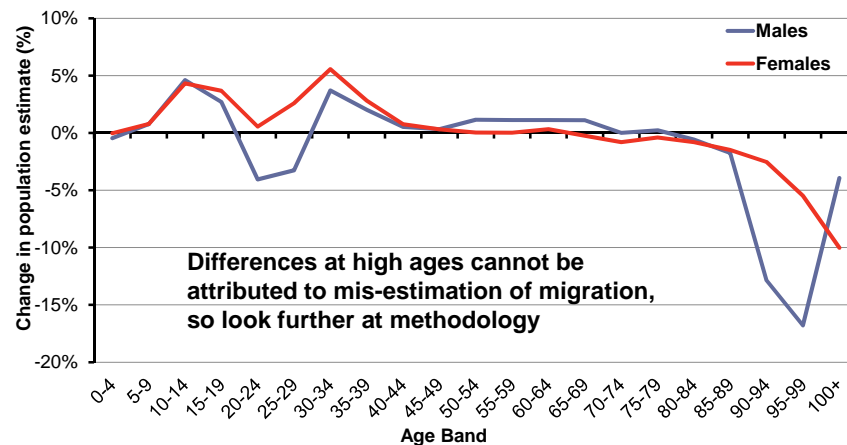
© 2012 The Actuarial Profession • www.actuaries.org.uk

17

3. Data sources for older age assumptions

Comparison of population estimates

2011 Census count compared with roll-forward estimate



Source: ONS supplemented by own calculations for ages 90+; estimates as at mid-2011

© 2012 The Actuarial Profession • www.actuaries.org.uk

18

3. Data sources for older age assumptions

Deriving population estimates for the older ages

- Kannisto-Thatcher (K-T) / Survivor Ratio method
- Method uses data on deaths only; assume no migration
- Extinct cohorts
 - Reconstruct population working back along cohort's path, starting from last survivor and adding back deaths
- Non-extinct cohorts
 - Estimate current population using survivor ratio
 - $\text{Survivor ratio} = \text{Survivors} \div \text{deaths in cohort in last 5 years}$
 - Assume stability or predictability of survivor ratio across cohorts
 - Then work back along cohort's path as above

© 2012 The Actuarial Profession • www.actuaries.org.uk

19

3. Data sources for older age assumptions

Deriving population estimates for the older ages

- Alternative applications of K-T methodology
- ONS
 - Use Census roll-forward method to estimate population at individual ages to age 89, plus a total for ages 90+
 - Use Kannisto-Thatcher method to allocate 90+ total to individual ages
 - Survivor ratios modified to fit constraint on total for 90+
- Alternative (described as 'BW' - Barnett Waddingham)
 - Apply K-T methodology without constraint to 90+ total
 - Use simple linear projection of observed survivor ratios

© 2012 The Actuarial Profession • www.actuaries.org.uk

20

Discussion points

1. Setting the scene – longevity swaps
2. Sensitivity of liabilities to older age assumptions
3. Data sources for older age assumptions
4. **Level of mortality at the older ages**
5. Mortality trends at the older ages
6. Summary

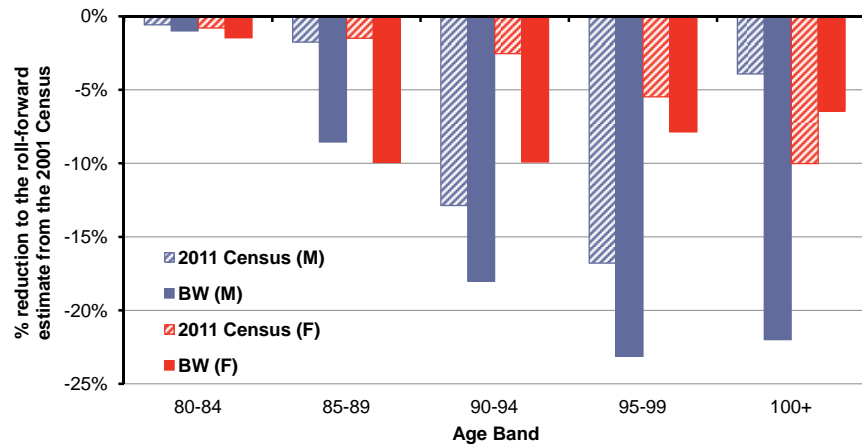
© 2012 The Actuarial Profession • www.actuaries.org.uk

21

4. Level of mortality at the older ages

Comparison of estimates of mid-2011 population for E&W

Alternative estimates compared with roll-forward estimate



Source: BW calculations using population estimates and death registrations data published by ONS.

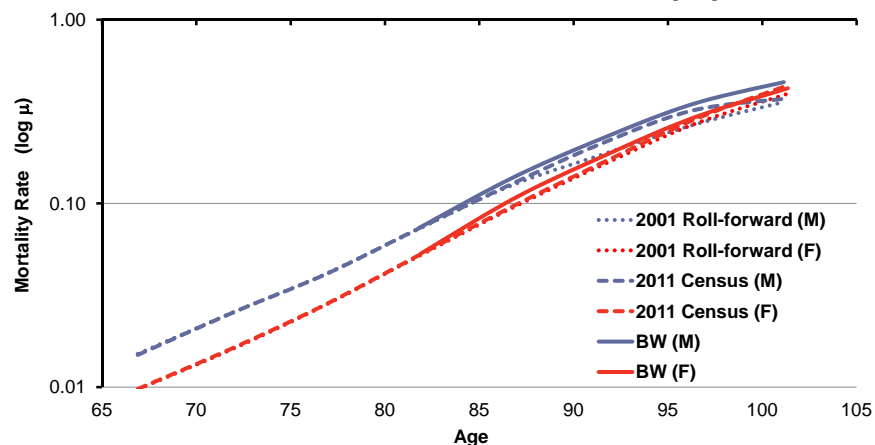
© 2012 The Actuarial Profession • www.actuaries.org.uk

22

4. Level of mortality at the older ages

Comparison of mortality rate estimates

Alternative estimates for mid-2011 for E&W population



Source: BW calculations using population estimates and death registrations data published by ONS.

© 2012 The Actuarial Profession • www.actuaries.org.uk

23

Discussion points

1. Setting the scene – longevity swaps
2. Sensitivity of liabilities to older age assumptions
3. Data sources for older age assumptions
4. Level of mortality at the older ages
- 5. Mortality trends at the older ages**
6. Summary

© 2012 The Actuarial Profession • www.actuaries.org.uk

24

5. Mortality trends at the older ages

- Impact of 2011 Census and alternative population estimates data on mortality trends for older ages
- Considerations for older age mortality trend assumptions:
 - Tapering
 - 1919 cohort
 - How do the 2011 Census and alternative population estimates affect these issues?

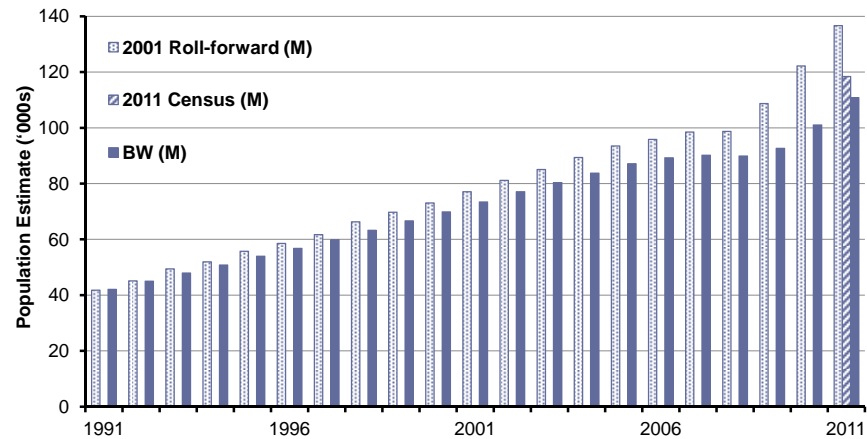
© 2012 The Actuarial Profession • www.actuaries.org.uk

25

5. Mortality trends at the older ages

Comparison of population estimates for 1991 – 2011

Alternative estimates of population – Males, 90+, E&W



Source: ONS population estimates plus BW calculations using death registrations data

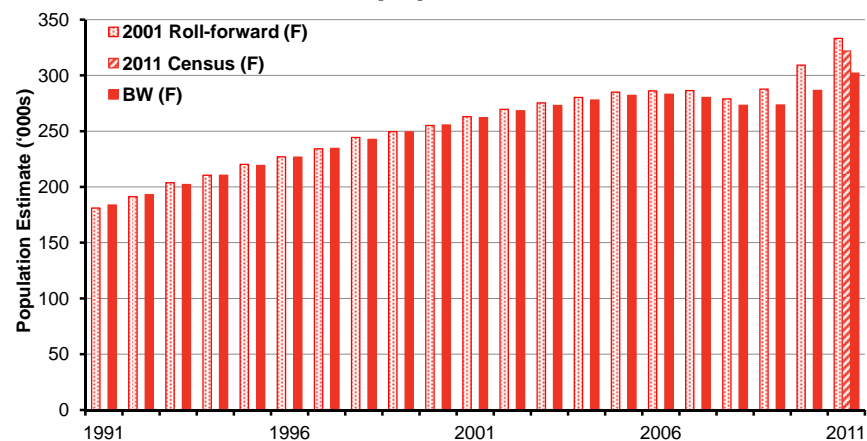
© 2012 The Actuarial Profession • www.actuaries.org.uk

26

5. Mortality trends at the older ages

Comparison of population estimates for 1991 – 2011

Alternative estimates of population – Females, 90+, E&W



Source: ONS population estimates plus BW calculations using death registrations data.

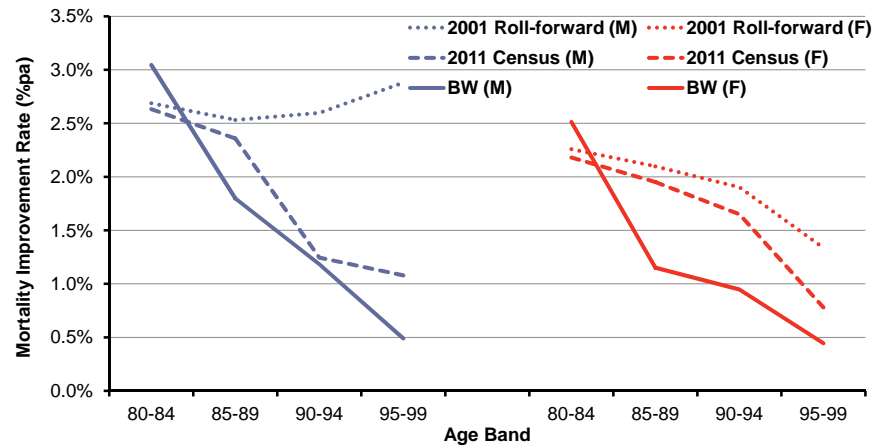
© 2012 The Actuarial Profession • www.actuaries.org.uk

27

5. Mortality trends at the older ages

Comparison of mortality improvement rates 2001 - 2011

Rates derived from alternative estimates of population



Source: Derived from ONS population estimates plus BW calculations using death registrations data.

© 2012 The Actuarial Profession • www.actuaries.org.uk

28

5. Mortality trends at the older ages

Tapering

- What is tapering?
- Does it exist? If so,
 - What age should it start?
 - Speed of the taper
 - Minimum ultimate improvement rate
 - The age at which the minimum is reached

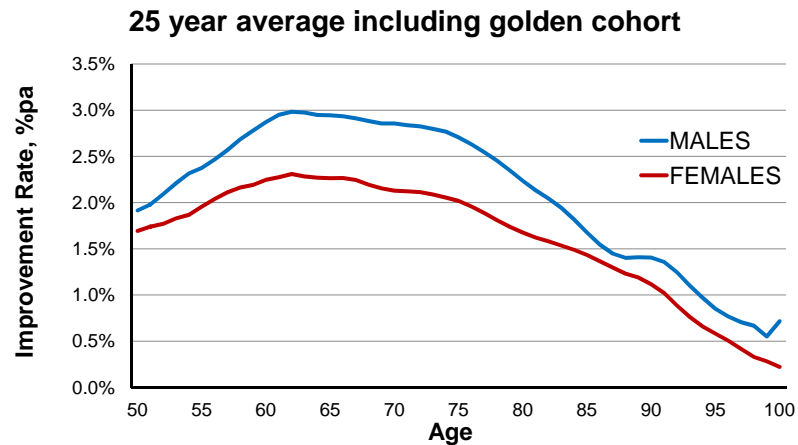
=> May materially impact on the values of older liabilities

© 2012 The Actuarial Profession • www.actuaries.org.uk

29

5. Mortality trends at the older ages

Historic evidence for tapering (1)



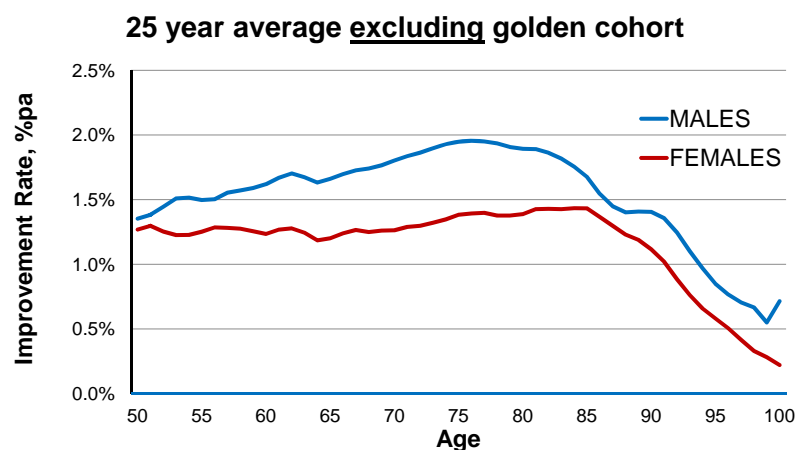
Source: ONS, England & Wales population data

© 2012 The Actuarial Profession • www.actuaries.org.uk

30

5. Mortality trends at the older ages

Historic evidence for tapering (2)



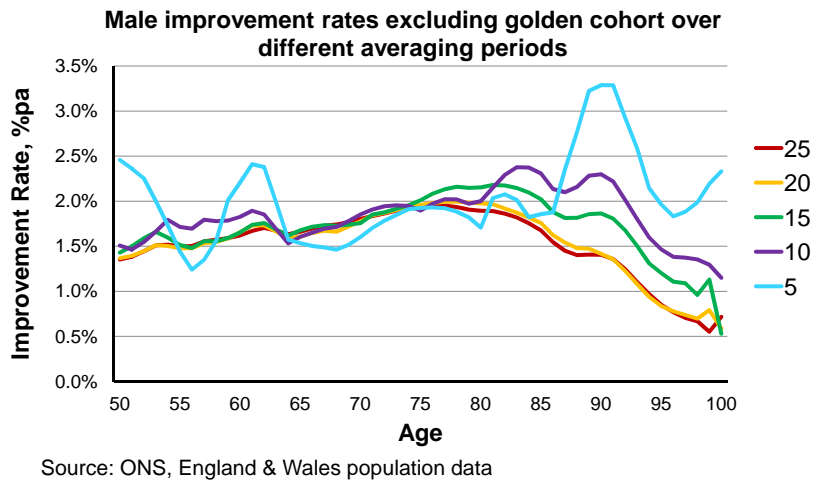
Source: ONS, England & Wales population data and own calculations

© 2012 The Actuarial Profession • www.actuaries.org.uk

31

5. Mortality trends at the older ages

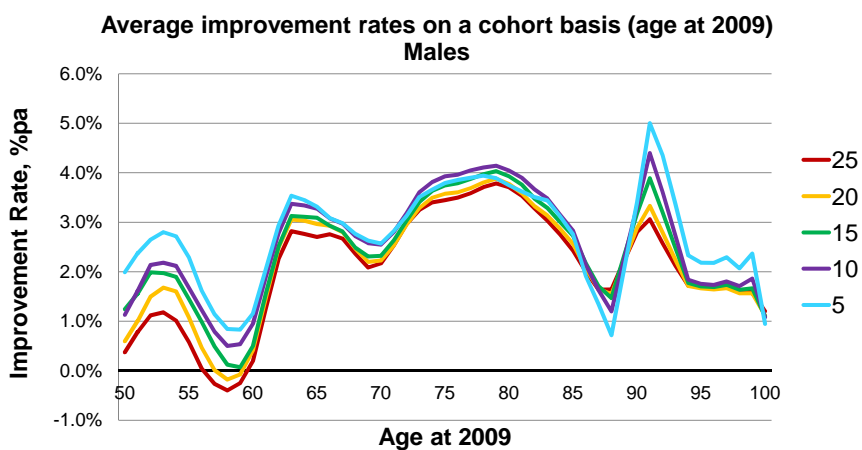
Evidence for tapering – different averaging periods



32

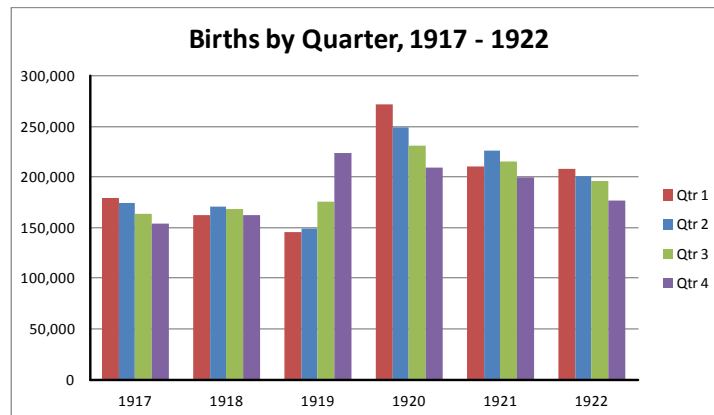
5. Mortality trends at the older ages

Tapering – 1919 Cohort Issue



33

5. Mortality trends at the older ages Tapering – 1919 Cohort Issue

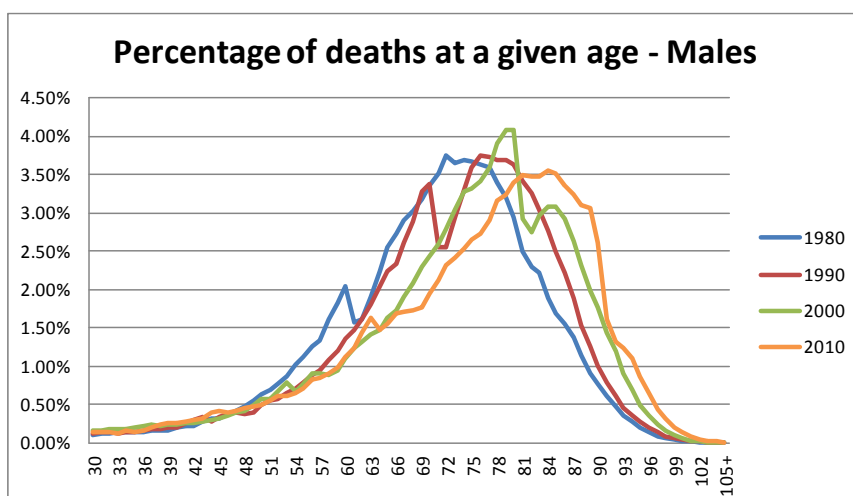


Source: ONS, England & Wales population data

© 2012 The Actuarial Profession • www.actuaries.org.uk

34

5. Mortality trends at the older ages Tapering – Ageing the taper age



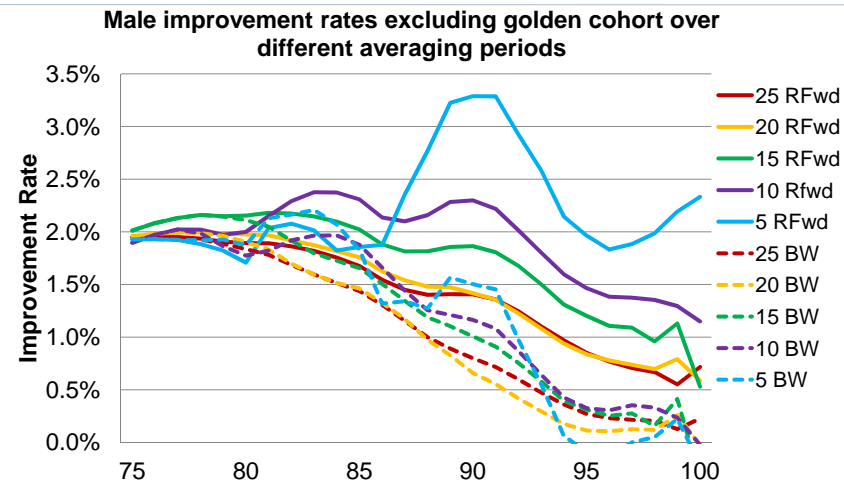
Source: ONS, England & Wales population data

© 2012 The Actuarial Profession • www.actuaries.org.uk

35

5. Mortality trends at the older ages

Tapering – Impact of using BW derived exposures



36

Discussion points

1. Setting the scene – longevity swaps
2. Sensitivity of liabilities to older age assumptions
3. Data sources for older age assumptions
4. Level of mortality at the older ages
5. Mortality trends at the older ages
6. **Summary**

© 2012 The Actuarial Profession • www.actuaries.org.uk

37

6. Summary

Combined impact of population estimate update

Impact of combined changes to annuity values

Life Age 65				Life Age 75			
Males		Females		Males		Females	
Level	Esc	Level	Esc	Level	Esc	Level	Esc
Census data update				-1.5%	-2.5%	-0.5%	-0.8%
BW Methodology				-1.8%	-3.0%	-1.7%	-2.7%

Annuitant age determines whether the change in base level or improvement is the more dominant factor.

For older ages the change to the base assumption represents 2/3rds of the impact.

© 2012 The Actuarial Profession • www.actuaries.org.uk

38

6. Summary

- Materiality of mortality assumptions for the older ages
- Relevance of population data for older age assumptions
- Level of uncertainty in population exposure measures
 - Impact of 2011 Census results
 - Alternative methods for estimating older age population
- Significant revision needed for mortality rates at older ages
 - Material increase in mortality rates for ages 90+
 - Marked reduction in mortality trend for ages 90+
- Impact on the tapering assumption

© 2012 The Actuarial Profession • www.actuaries.org.uk

39

Questions or comments?

Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

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

scourquin@munichre.com

Neil.Robjohns@Barnett-Waddingham.co.uk

