Westminster and City Annuities Conference

Pricing longevity risk

Stephen Richards
1st December 2005

About the author

- 1990 — graduated Heriot-Watt
- 1994 — qualified F.F.A.
- 1995 — consulting in Germany
- 1997 — joined Standard Life
- 2003 — Head of Mortality Risk at Prudential
- 2005 — independent consultant on longevity risk

Pricing longevity risk — plan of talk

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- What's new

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- What's new
- What investors need to know

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- Restructuring longevity risk

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- What investors need to know
- Restructuring longevity risk
- Summary and questions

What's new on longevity risk in 2005?

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- New proposed standard tables from CMIB.

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- New actuarial paper on cohort effect.
- New projection methodologies and software from CMIB.
- Some big new bets placed on longevity risk in 2005.

Restructuring longevity risk

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Restructuring longevity risk

- H1 2005—XL Re 'closed a U.K. annuity reinsurance transaction which contributed US$1.8 billion of premium'[1].
- May 2005—Canada Life reinsured annuity liabilities held by Phoenix Life & Pensions Limited and London Assurance Limited. The backing assets were around £2.2bn (US$3.9bn)[2].
- June 2005–Prudential plc reinsured the annuity liabilities held by Phoenix Life & Pensions Limited. The backing assets were around £1.5bn (US$2.7bn)[3].

Source: Richards Consulting survey of annuity reinsurance, incorporating [1] XL Capital Ltd press release, July 27th 2005; [2] Canada Life press release, May 2005; [3] Prudential press release, June 2005.

Restructuring longevity risk

- The insurers are restructuring...

Restructuring longevity risk

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- ...but the big business lies in restructuring pension schemes.

Spot the insurance company

Company	Longevity liability
Standard Life	£12.7bn[1]

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Spot the insurance company

Company	Longevity liability
Standard Life	£12.7bn[1]
British Airways	£12.6bn[2]
Prudential	£20.7bn[3]
British Telecom	£34.3bn[4]

Source: [1] Valuation annuity reserves, Standard Life FSA Returns to 31 December 2004; [2] Present value of pension liabilities, British Airways Annual Report and Accounts to 31 March 2005, section 32, page 57; [3] Valuation annuity reserves for PAL and PRIL, FSA Returns to 31 December 2004; [4] Present value of pension liabilities for BTPS on FRS17 basis as at 31 March 2005.

Spot the insurance company: General Motors

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- $98.0bn total liability.

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Spot the insurance company: General Motors

- $98.0bn total liability.
- $60.2bn funded.
- $37.8bn unfunded.

Source: Value of off-balance-sheet pension liabilities in 2004 according to company data and CSFB.

What investors in longevity risk need to know

Annuity business is highly leveraged

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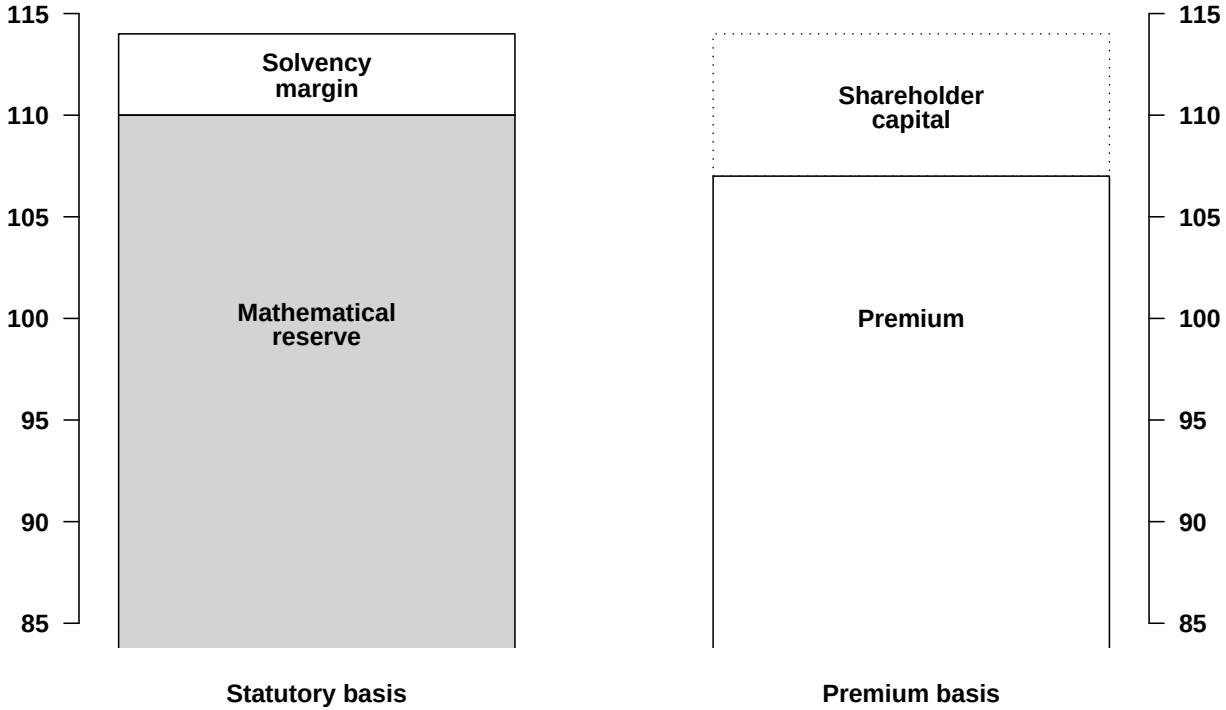

Source: Richards Consulting

What investors want to know

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- When will I get it back?

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What investors want to know

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- When will I get it back?
- What return on my capital will I get?
- What volatility does this return have?
- APs and EVs don't answer these questions.

Pricing and return on capital (IRR)

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Age at outset (years)	IRR (% per annum) Males	Females
55	27	32
60	22	25
65	20	21
70	20	20
75	22	21
80	26	23

Source: Richards Consulting report on Pricing and Capital Management for Annuity Portfolios. Level annuity payable continuously to a single life. Pricing and assumed actual experience: (i) 4.50% annual interest rate, earned continuously; (ii) 100% of μ_x according to PMA92/PFA92, with no mortality improvements; (iii) 75bps margin offset to annual interest rate. Statutory reserving basis: (i) 40bps offset to realistic interest rate; (ii) 10% deduction from mortality table percentage; (iii) 5% EU solvency margin.

Reduced average IRR achieved if mortality experience is 10% lighter

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Age at outset (years)	IRR (% per annum) Males	IRR (% per annum) Females	Change in IRR (% per annum) Males	Change in IRR (% per annum) Females
55	25	30	-2.3	-2.1
60	19	22	-3.6	-3.2
65	15	17	-5.3	-4.5
70	13	14	-7.2	-6.0
75	12	13	-9.8	-7.9
80	13	12	-13.2	-10.3

Source: Richards Consulting report on Pricing and Capital Management for Annuity Portfolios. Level annuity payable continuously to a single life. Pricing: (i) 4.50% annual interest rate, earned continuously; (ii) 100% of μ_x according to PMA92/PFA92, with no mortality improvements; (iii) 75bps margin offset to annual interest rate. Statutory reserving basis: (i) 40bps offset to realistic interest rate; (ii) 10% deduction from mortality table percentage; (iii) 5% EU solvency margin. Actual mortality experience is assumed to be 90% of pricing level.

New proposed standard tables v. old

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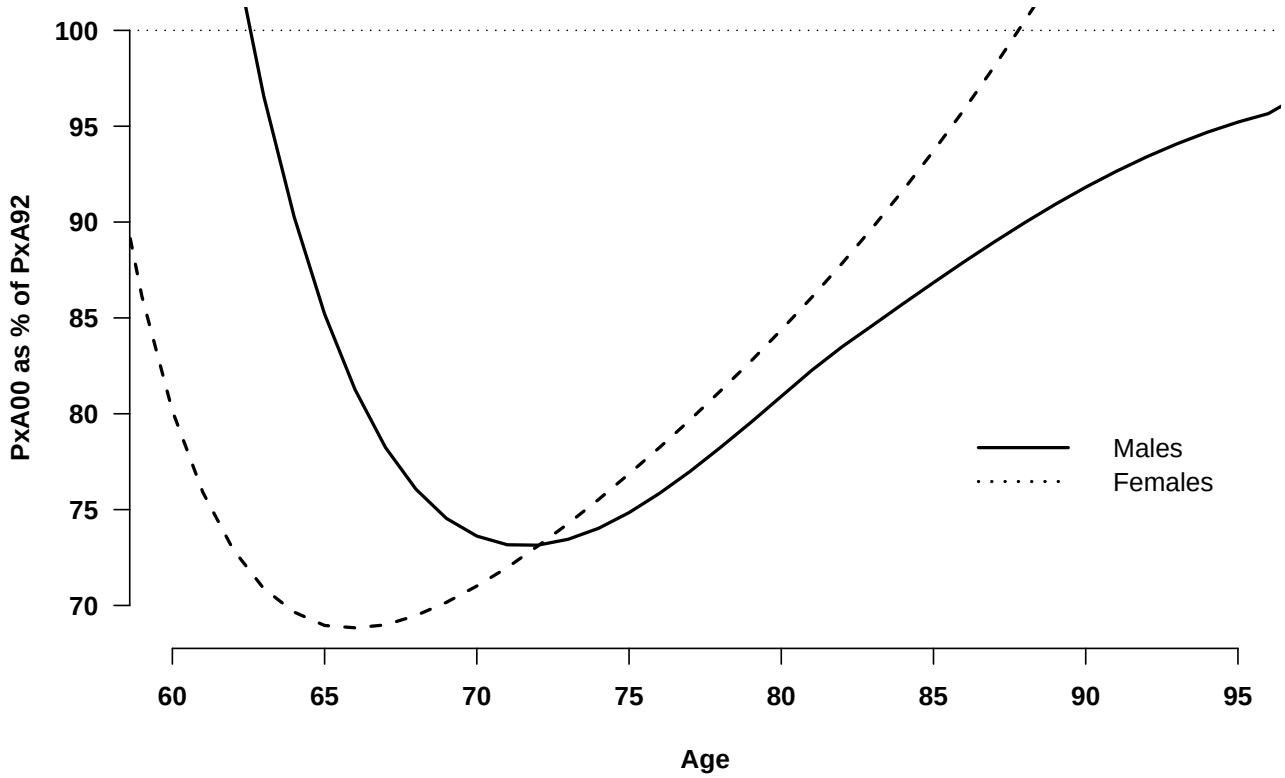

Source: Richards Consulting calculations comparing PMA00 with PMA92 and PFA00 with PFA92.

Improvements 1992-2000 implied by new tables

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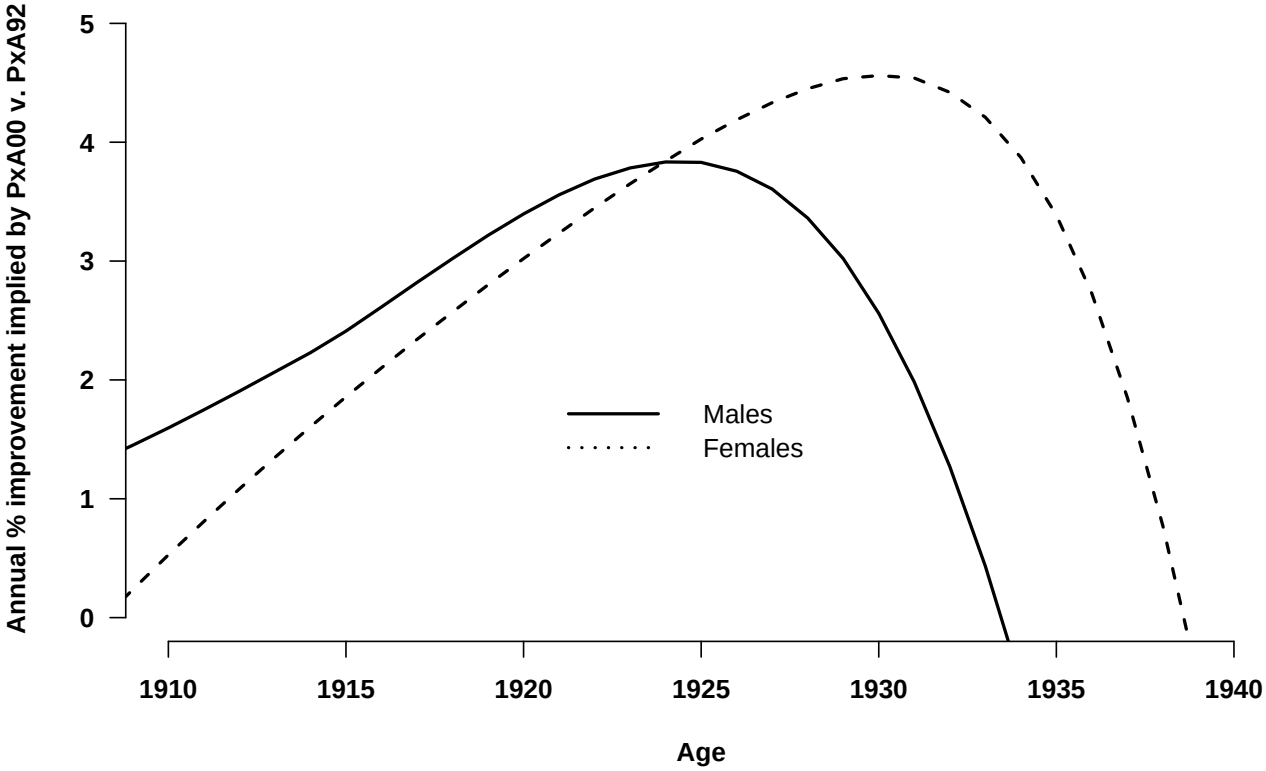

Source: Richards Consulting calculations of improvements implied by PMA00 v. PMA92 and PFA00 v. PFA92.

Impact of new tables on life expectancy

Impact of new tables on life expectancy

	92 Series:		00 Series:		Increase:	
Age	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
55	25.2	28.2	26.4	29.5	4.5%	4.4%
60	20.7	23.7	22.2	25.0	7.3%	5.4%
65	16.4	19.4	18.0	20.5	9.7%	5.8%
70	12.7	15.5	14.1	16.3	11.3%	5.4%
75	9.5	12.1	10.6	12.5	11.6%	3.8%

Source: Richards Consulting calculations using CMIB data. Life expectancies at current rates, i.e. with no allowance for any likely future improvements in mortality and life expectancy.

Impact of new tables on annuity factors

Impact of new tables on annuity factors

	92 Series:		00 Series:		Increase:	
Age	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
55	15.25	16.08	15.51	16.51	1.7%	2.7%
60	13.59	14.60	14.14	15.16	4.1%	3.8%
65	11.76	12.96	12.50	13.54	6.3%	4.5%
70	9.87	11.22	10.65	11.73	8.0%	4.5%
75	8.04	9.48	8.73	9.83	8.5%	3.7%

Source: Richards Consulting calculations. Immediate level annuities paid annually in advance to single lives, discounted at 4.5% interest per annum.

Impact of new tables on pension liabilities

Impact of new tables on pension liabilities

	92 Series:		00 Series:		Increase:	
Age	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
55	20.14	21.79	20.74	22.56	3.0%	3.5%
60	17.30	19.11	18.24	19.98	5.5%	4.6%
65	14.44	16.37	15.56	17.21	7.8%	5.1%
70	11.70	13.00	12.79	14.37	9.3%	4.9%
75	9.24	11.21	10.12	11.62	9.5%	3.6%

Source: Richards Consulting calculations. Pensions in payment paid annually in advance to single lives, escalating at 2.5% per annum and discounted at 4.5% interest per annum.

New paper on cohort effect and improvements

Mortality improvements by year of birth

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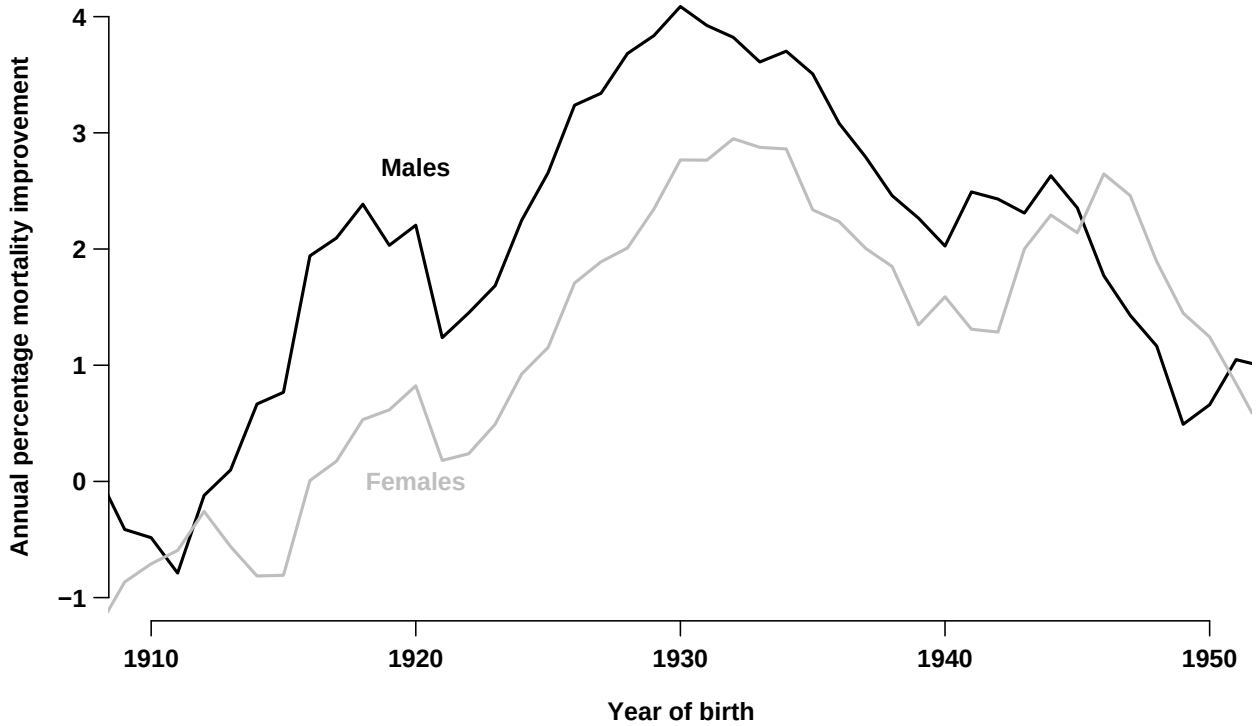
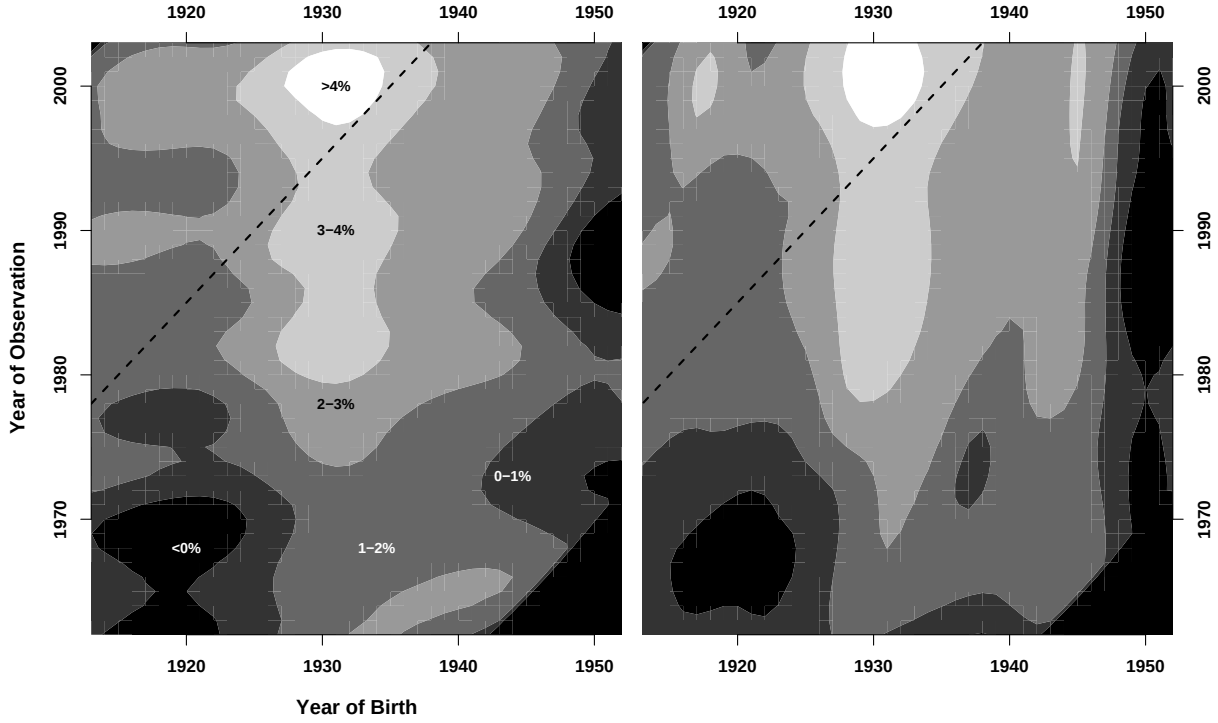


Source: Own calculations with GAD interim life tables for 2000–2002 and 2001–2003.

Mortality improvements

Mortality improvements



Source: Richards, Kirkby and Currie (2005). Male mortality improvements after smoothing mortality rates in two dimensions using penalised splines.

Mortality improvements

Mortality improvements

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- Do the peak improvements really lie in the past?
- Will improvements really tail off to zero in ten years?

Future retirement generations turning 65

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- 2021 — First generation born after Clean Air Act took effect in 1956.

Future retirement generations turning 65

- 2012 — First generation with NHS services from birth onwards.
- 2021 — First generation born after Clean Air Act took effect in 1956.
- 2026 — First generation to see health warnings on cigarette packets.

Uncertainty of projecting future mortality

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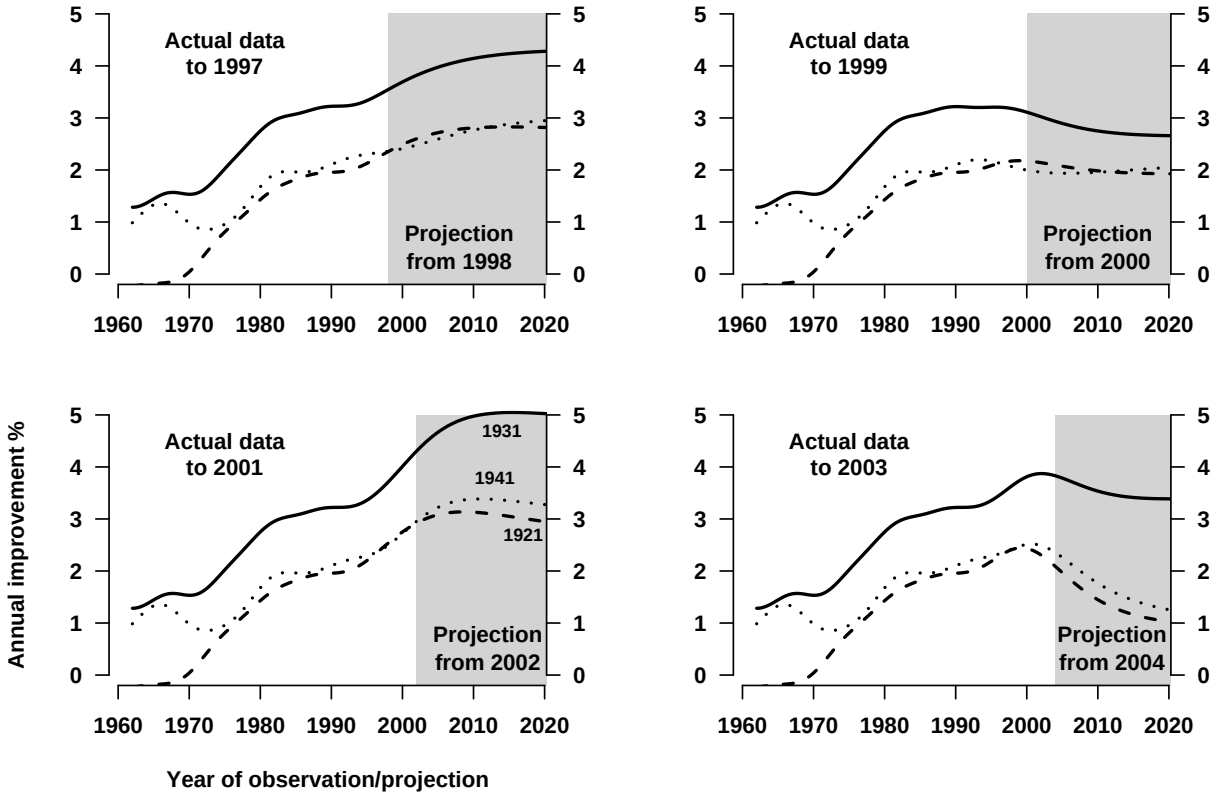

Source: Richards, Kirkby and Currie (2005).

Cost of uncertainty of projecting future mortality

Cost of uncertainty of projecting future mortality

Interest rate p.a.	Projection from: 1998	2000	2002	2004
0%	2.8%	3.9%	2.5%	3.5%
3%	2.6%	3.5%	2.2%	3.1%
6%	2.3%	3.1%	2.0%	2.7%
9%	2.0%	2.8%	1.8%	2.4%

Source: Richards, Kirkby and Currie (2005). Increase in temporary annuity factor over basis without future mortality improvements. Male single-life temporary annuities for sixteen years from age 74, population mortality of 2003.

Mortality improvements v. differentials

Retirement life expectancy by socio-economic group

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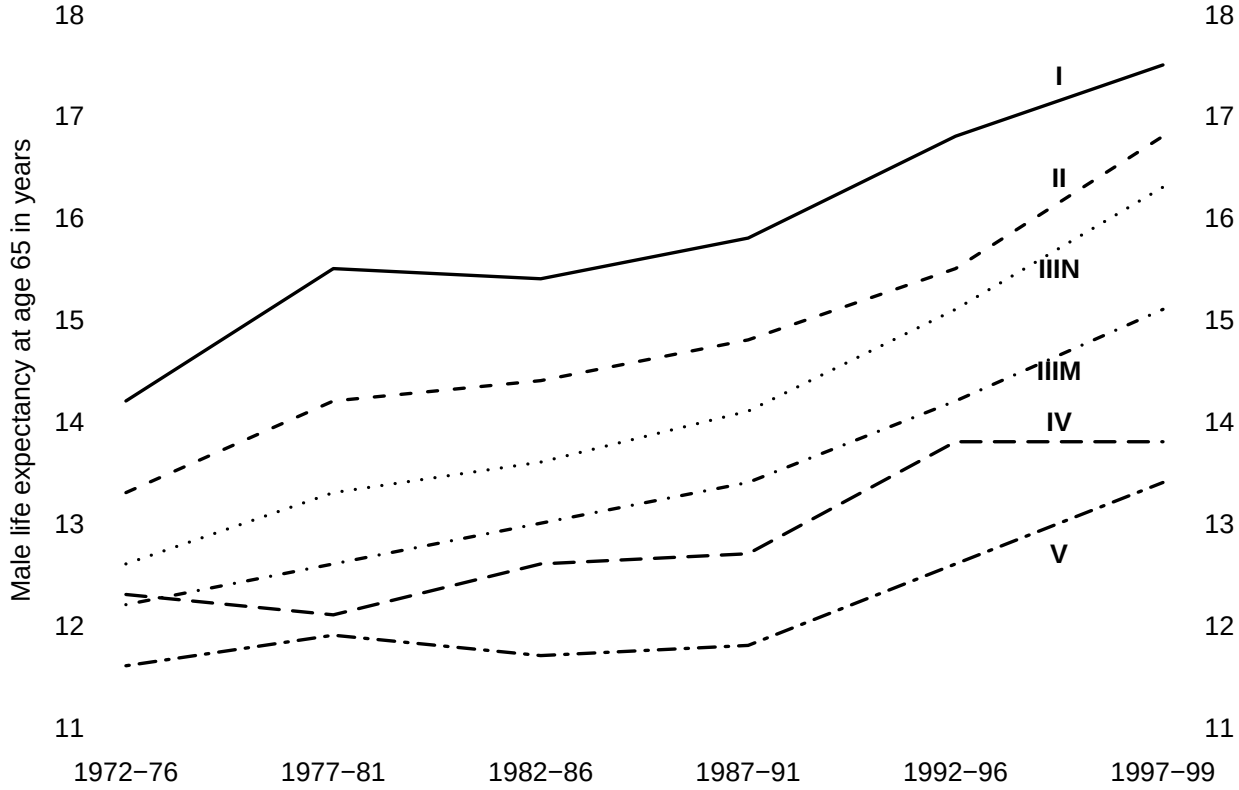

Source: ONS Longitudinal Survey.

Relative strength of rating factors

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Factor	Strength
Age	2,095
Gender	100

Relative strength of rating factors

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Age	2,095
Gender	100
Lifestyle	51

Relative strength of rating factors

Factor	Strength
Age	2,095
Gender	100
Lifestyle	51
Duration	25

Relative strength of rating factors

Factor	Strength
Age	2,095
Gender	100
Lifestyle	51
Duration	25
Amount	8
Region	8

Source: Richards and Jones (2004), page 37.

Financial impact of mortality rating factors

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Factor	Step change	Annuity	Price change
Base case	-	13.39	-

Financial impact of mortality rating factors

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Base case	-	13.39	-
Gender	Female-male	12.14	-9.3%

Financial impact of mortality rating factors

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Base case	-	13.39	-
Gender	Female-male	12.14	-9.3%
Lifestyle	Top-bottom	10.94	-9.9%

Financial impact of mortality rating factors

Factor	Step change	Annuity	Price change
Base case	-	13.39	-
Gender	Female-male	12.14	-9.3%
Lifestyle	Top-bottom	10.94	-9.9%
Duration	Short-long	9.88	-9.7%

Financial impact of mortality rating factors

Factor	Step change	Annuity	Price change
Base case	-	13.39	-
Gender	Female-male	12.14	-9.3%
Lifestyle	Top-bottom	10.94	-9.9%
Duration	Short-long	9.88	-9.7%
Pension size	Large-small	9.36	-5.2%
Region	South-North	8.90	-4.9%
Overall	-	-	-33.6%

Source: Richards and Jones (2004), page 39.

Summary and questions

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- Mortality improvement have accelerated over past 40 years.
- Likely strengthening of reserves for some.
- Likely hardening of pricing of longevity risk.
- Reprints of papers available at the front and back.

References

Richards, S. J. and Jones, G. L. **2004** *Financial aspects of longevity risk*, SIAS

Richards, S. J., Kirkby, J. G. and Currie, I. D. **2005** *The Importance of Year of Birth in Two-Dimensional Mortality Data*, Presented to Institute of Actuaries