



The Actuarial Profession

making financial sense of the future

Life expectancy: how certain are we
about future trends and what is driving
them?

Chris Shaw

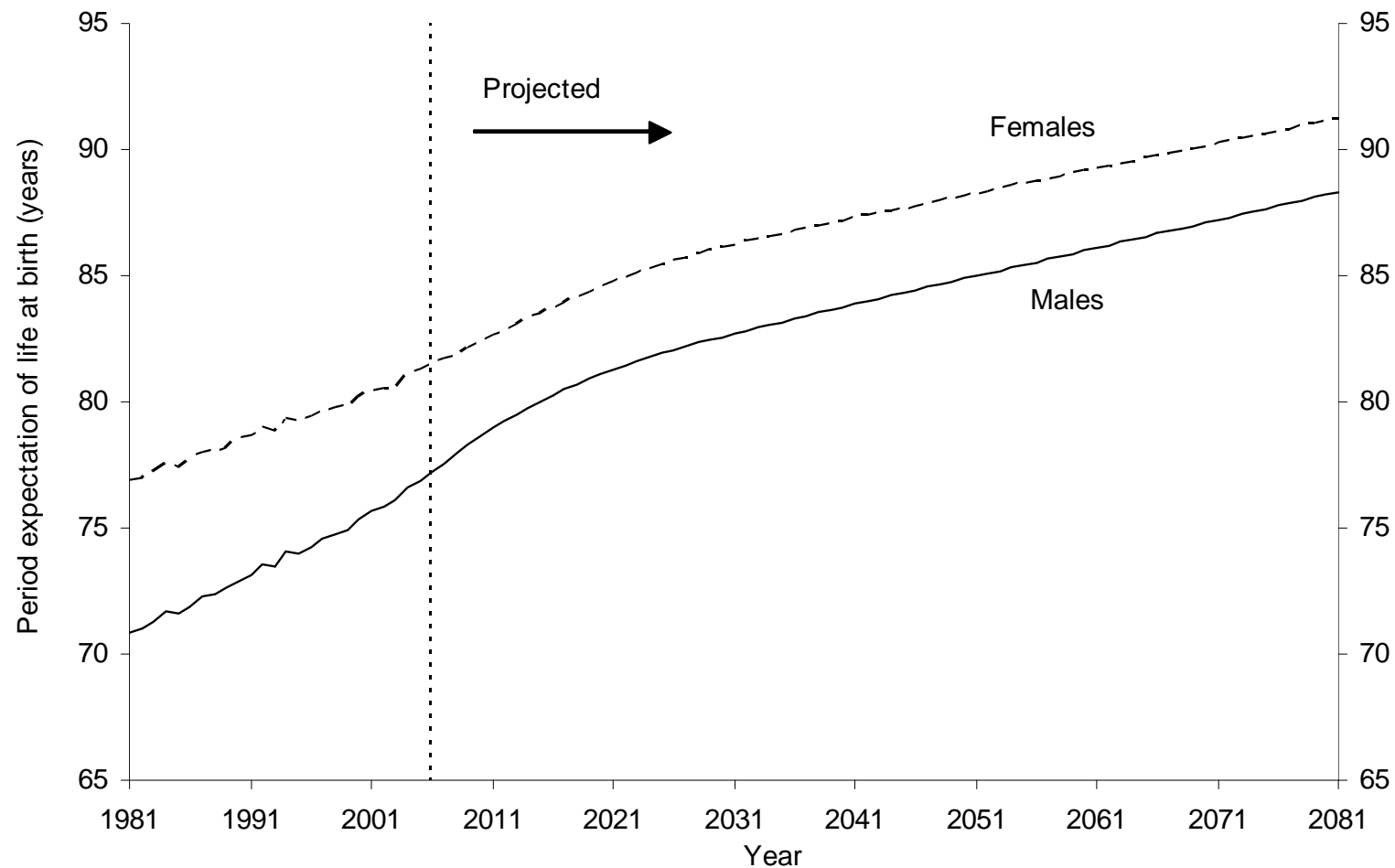
Office for National Statistics

Overview

- Latest projections
- Past accuracy
- Measures of uncertainty
 - Traditional variants
 - Stochastic forecasts
- What is driving trends?

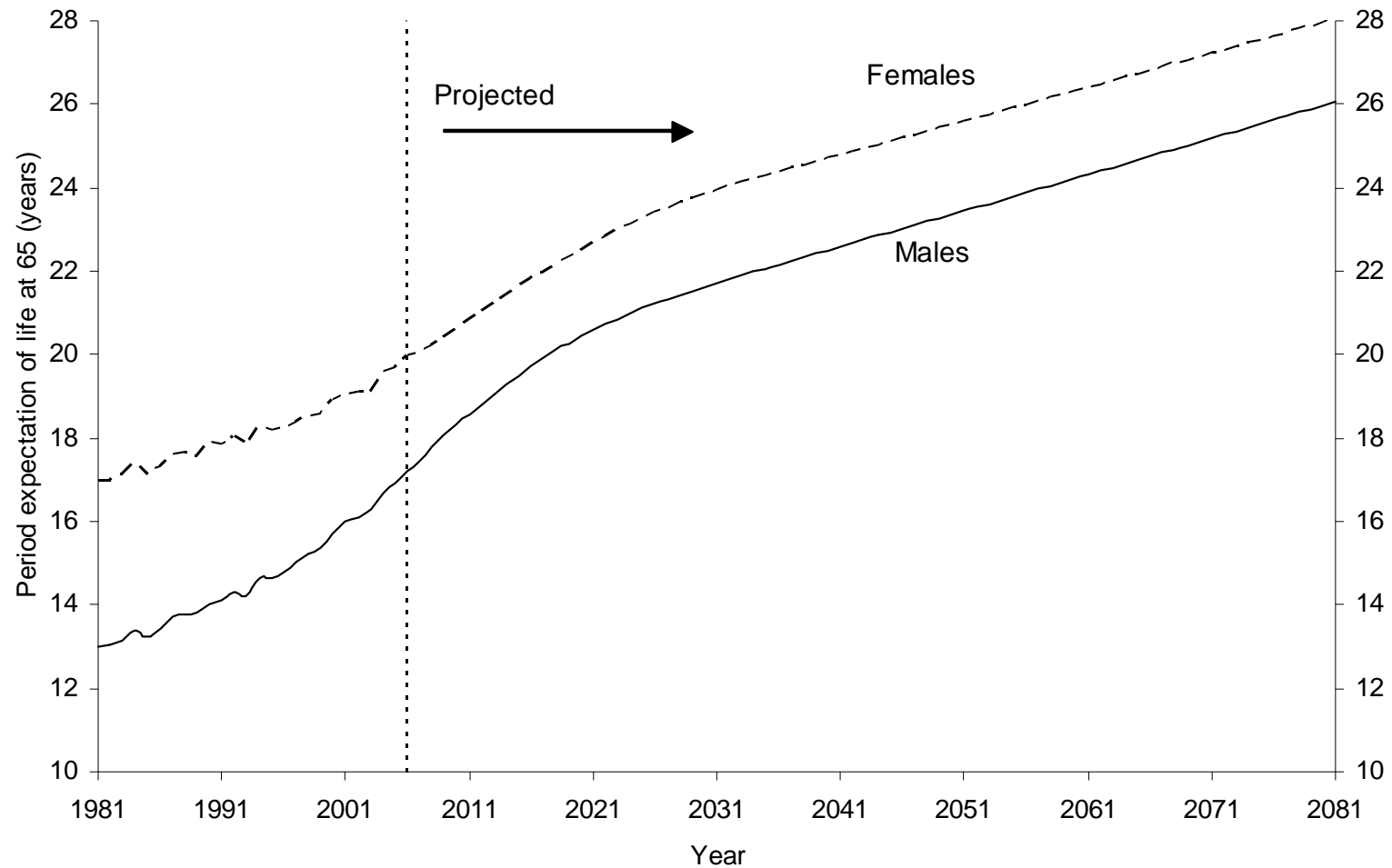
Period life expectancy at birth, UK 1981-2081

Actual & 2006-based principal projections

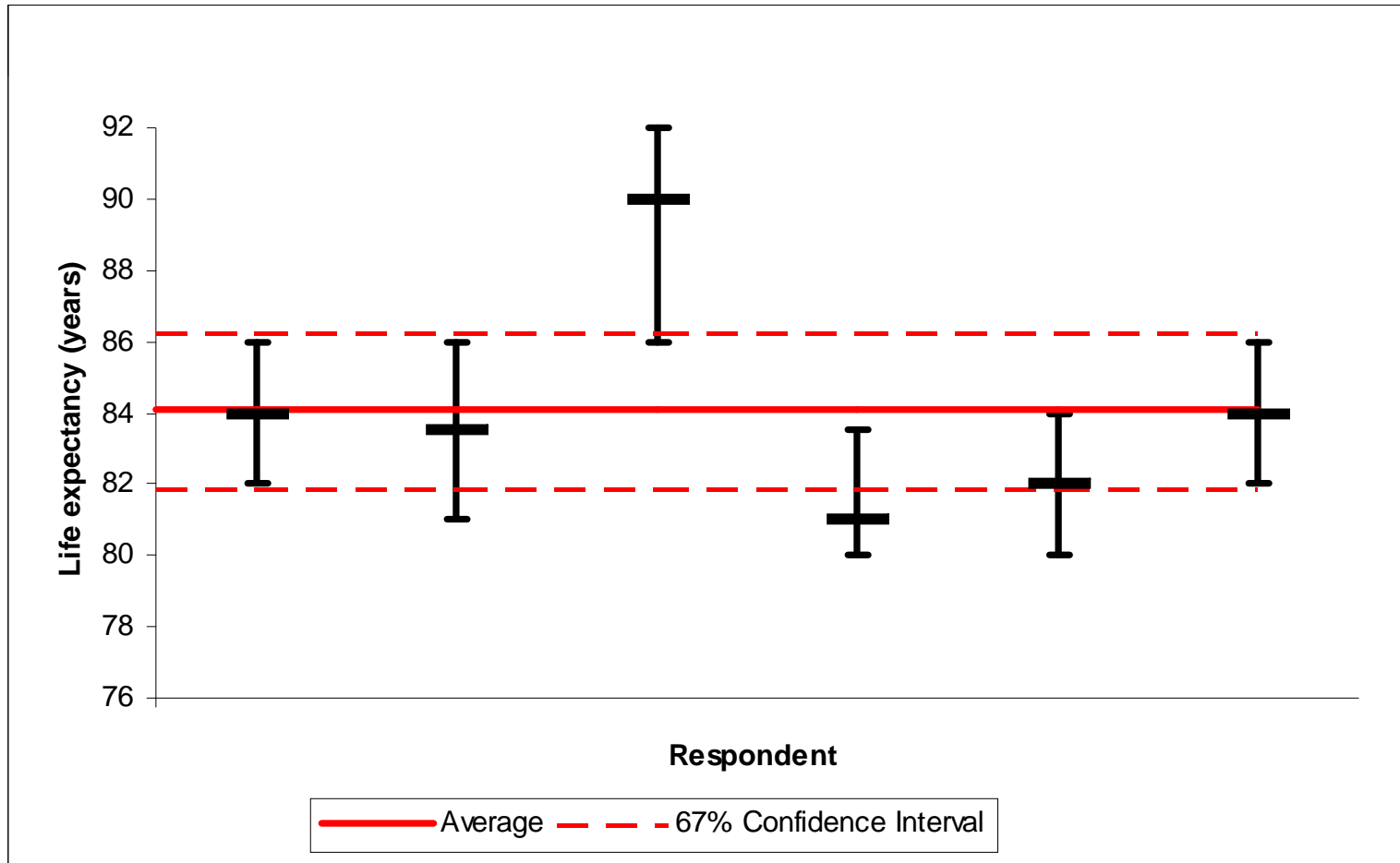


Period life expectancy at age 65, UK 1981-2081

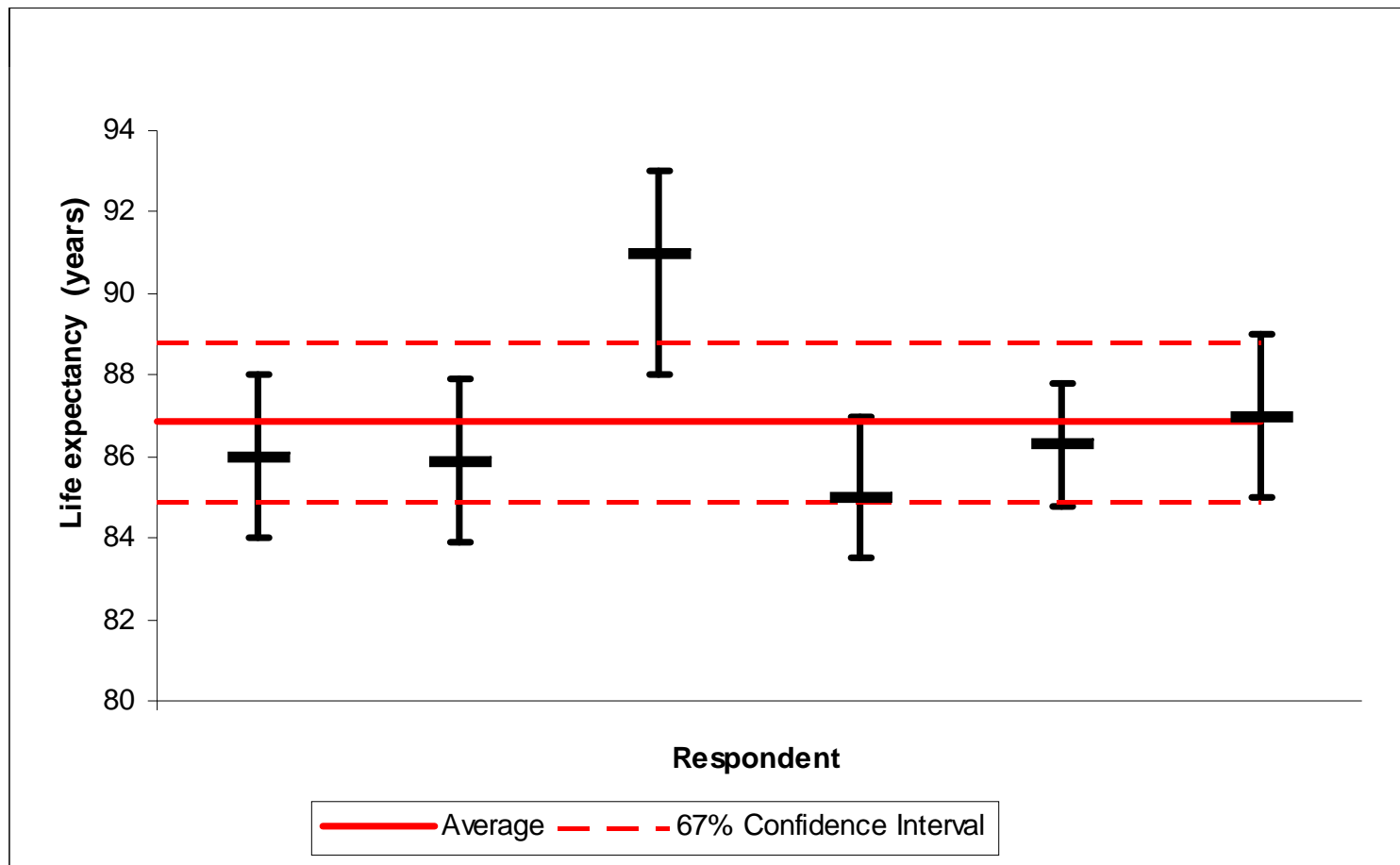
Actual & 2006-based principal projections



Expert Panel estimates of male period life expectancy at birth at 2030



Expert Panel estimates of female period life expectancy at birth at 2030

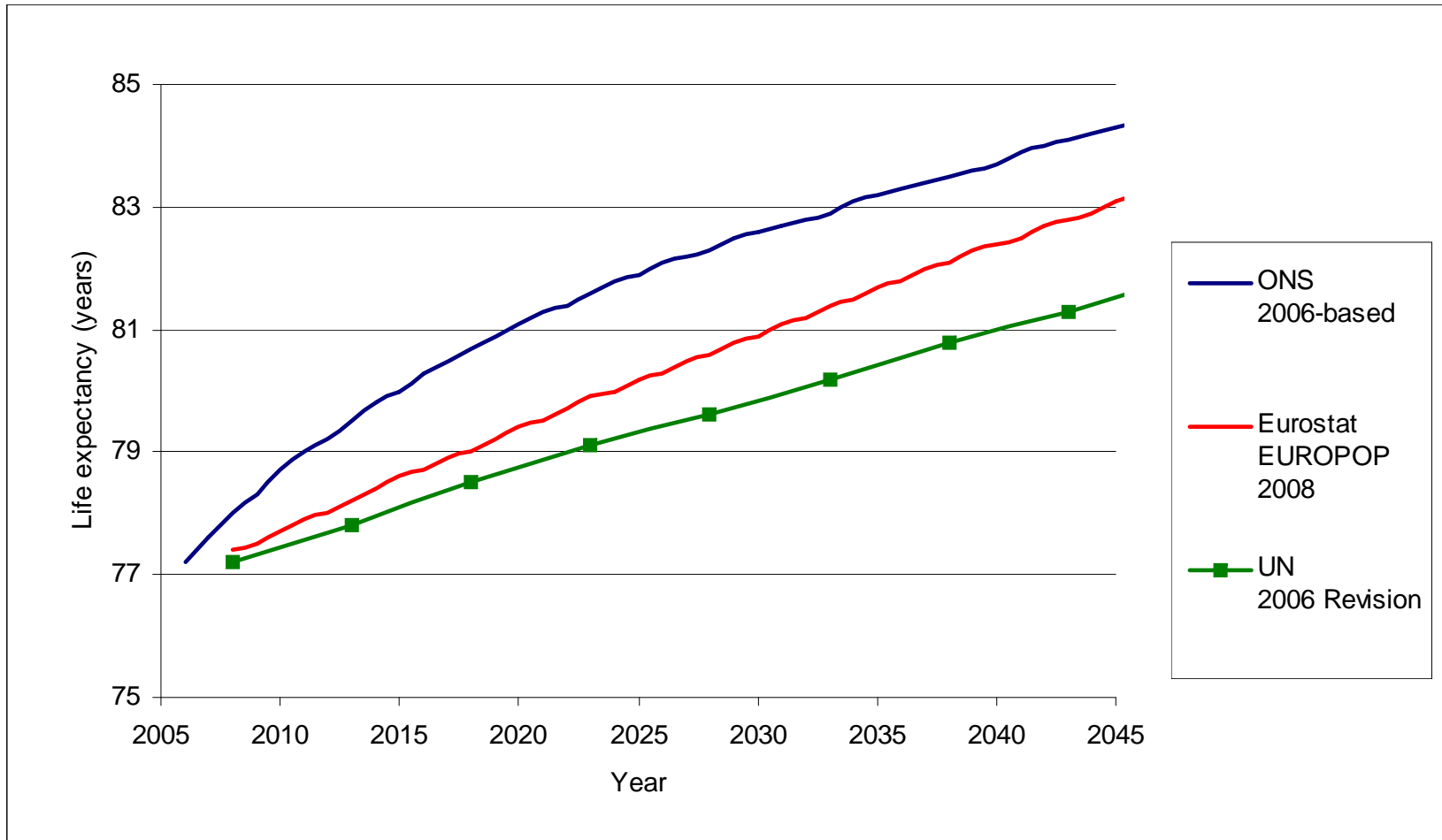


NPP v Expert Panel: Key indicators at 2030

	ONS 2006-based principal	Expert panel average
TFR	1.84	1.78
Male period life expectancy at birth	82.6	82.9
Female period life expectancy at birth	86.1	86.0
Annual net migration	+190,000	+199,000

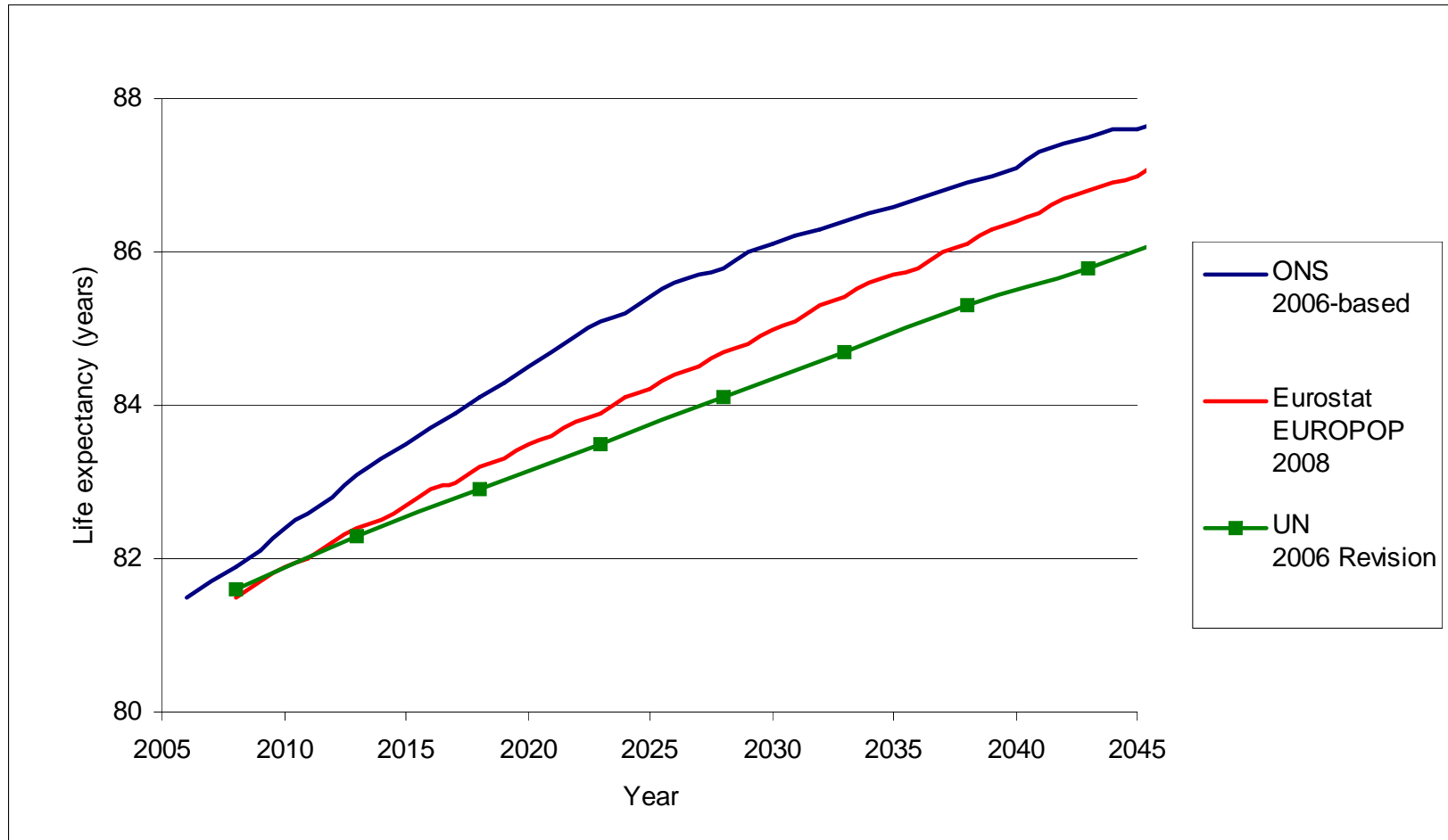
UK male period life expectancy at birth

Latest ONS, Eurostat & UN assumptions

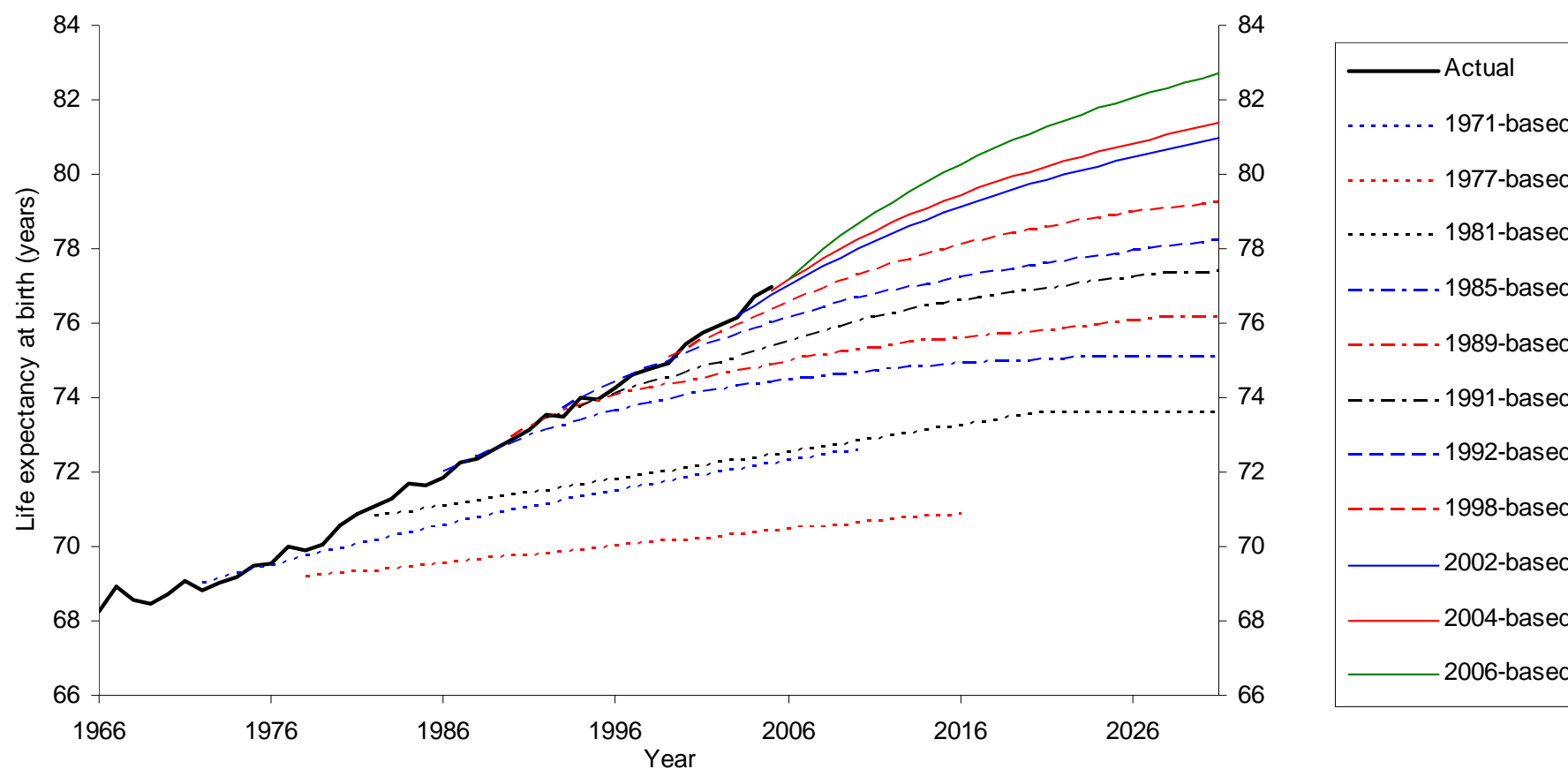


UK female period life expectancy at birth

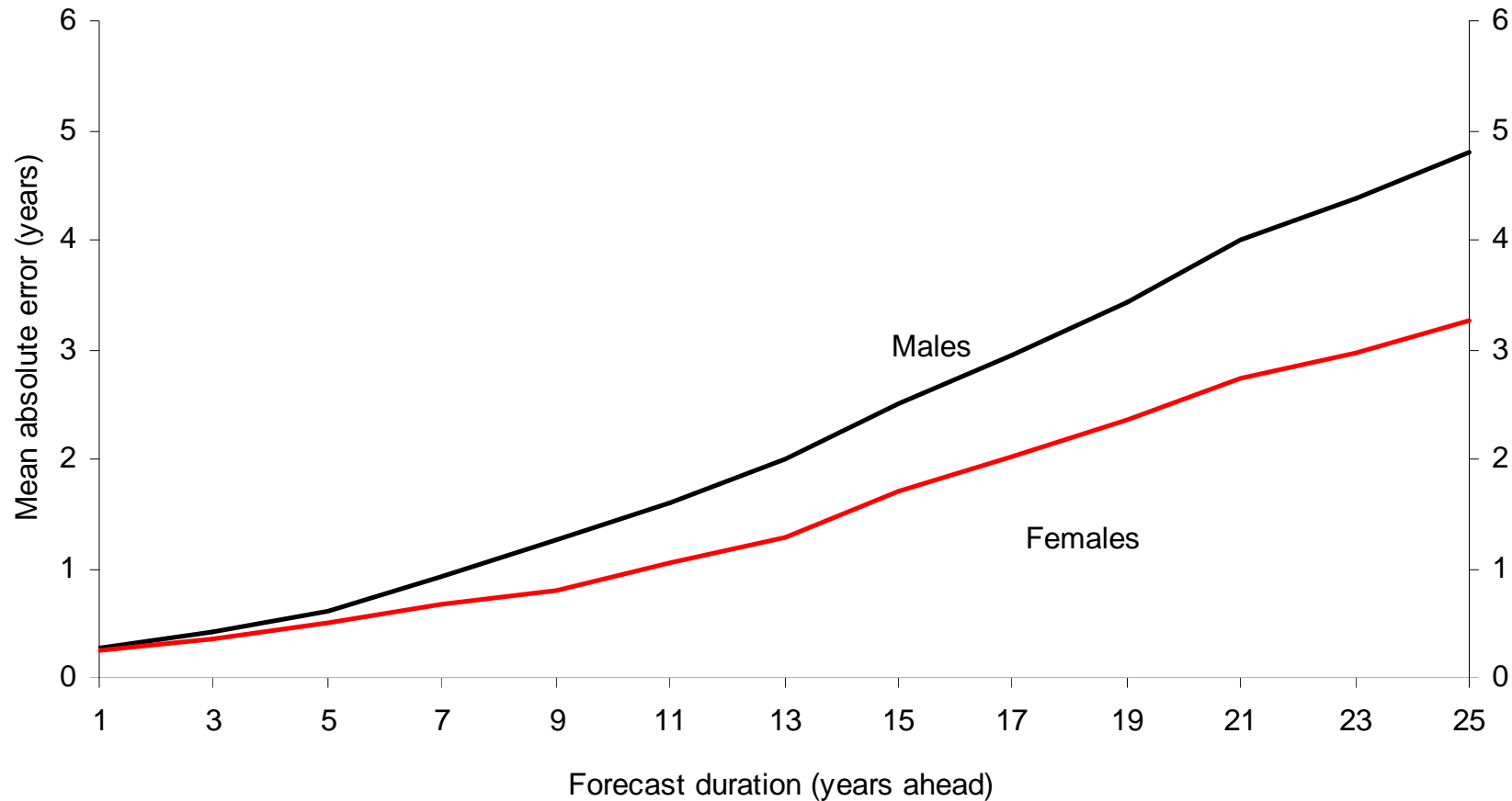
Latest ONS, Eurostat & UN assumptions



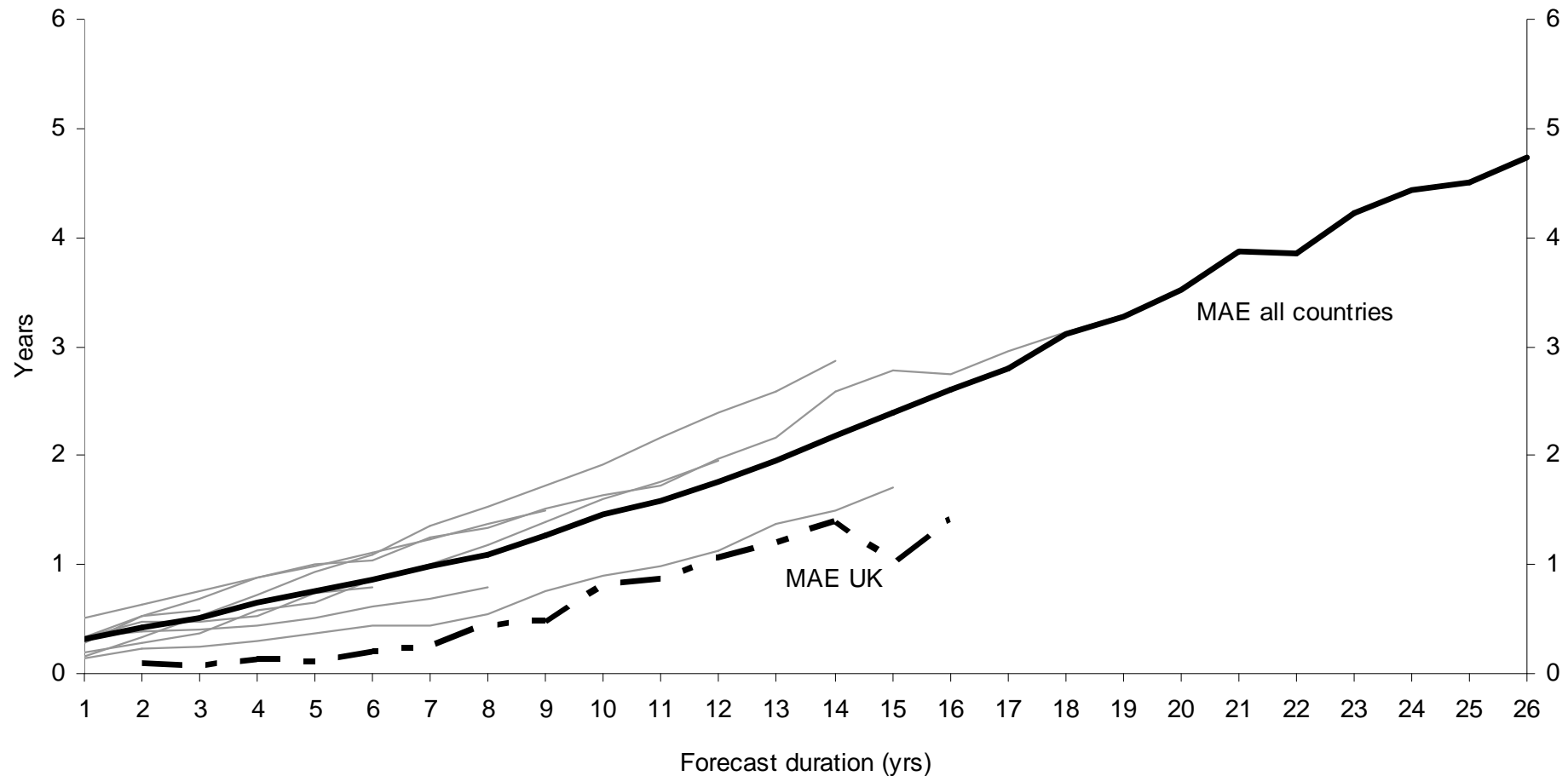
Actual and projected male period life expectancy at birth, UK, 1966-2031



Mean absolute error: period life expectancy at birth, 1971-based to 2004-based projections

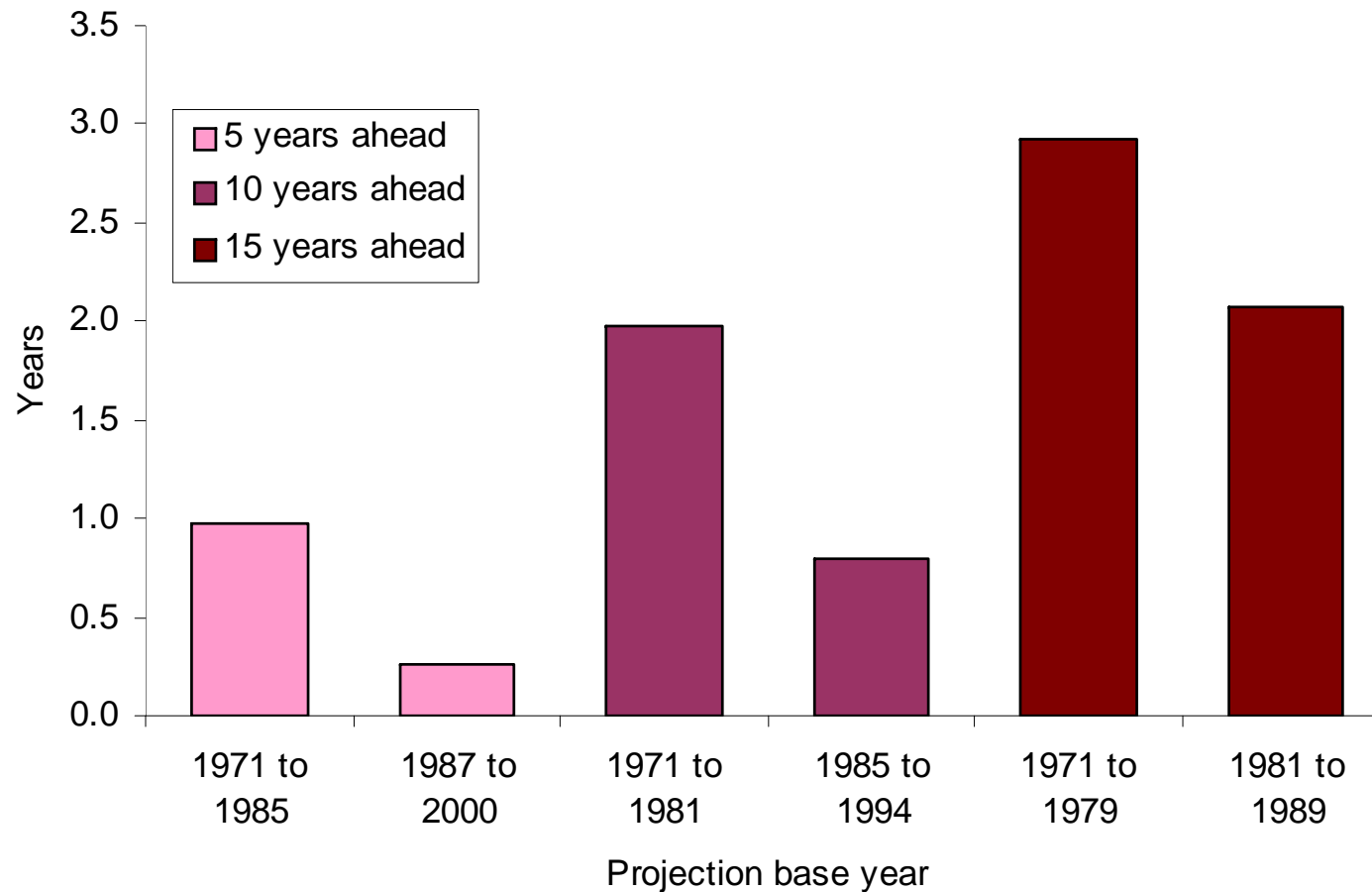


Observed mean absolute error for period life expectancy at birth for men in 14 European countries



Each unlabelled line represents one country. Data only shown where there are ten or more observations

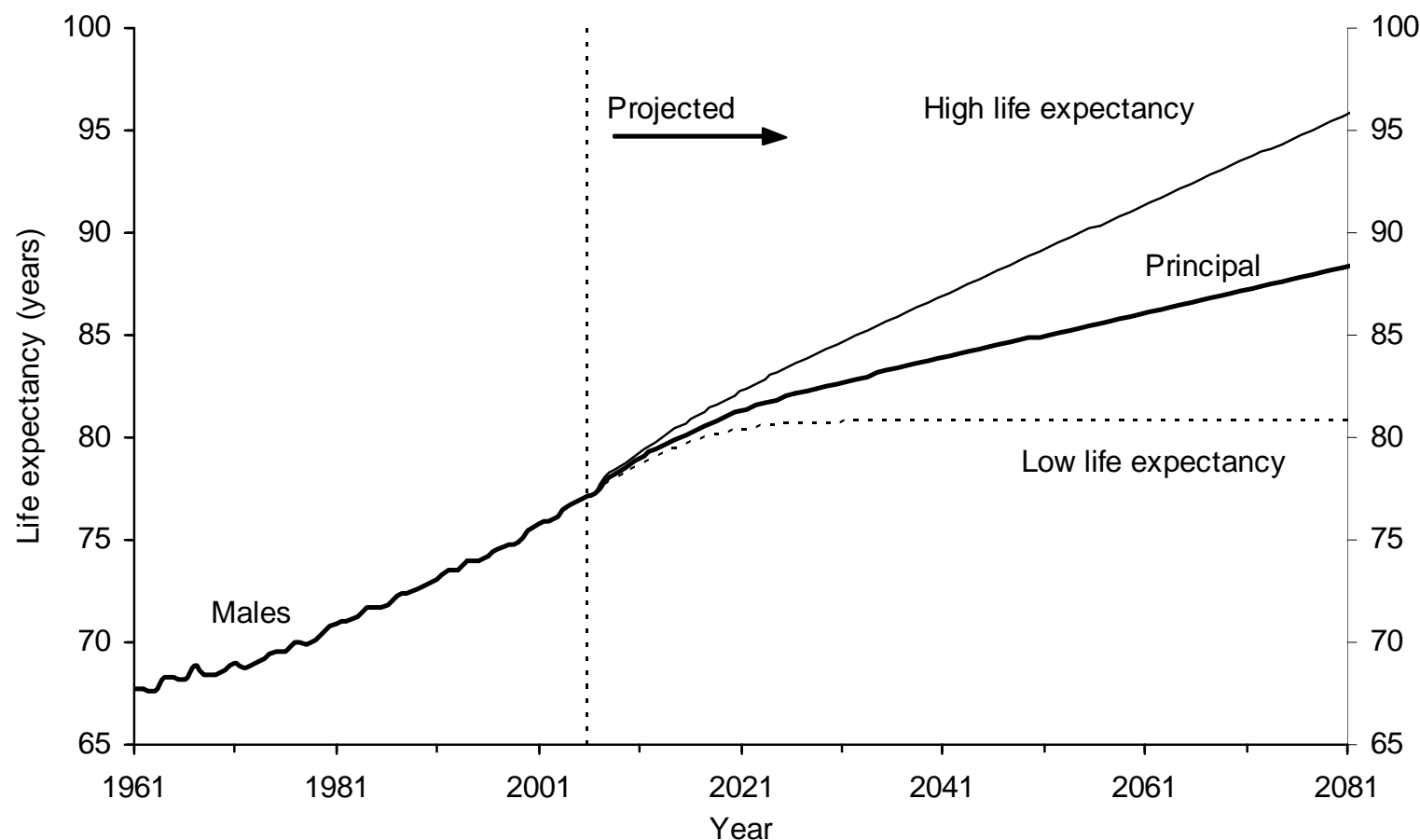
Older v Newer projections: Average absolute error in male period life expectancy at birth



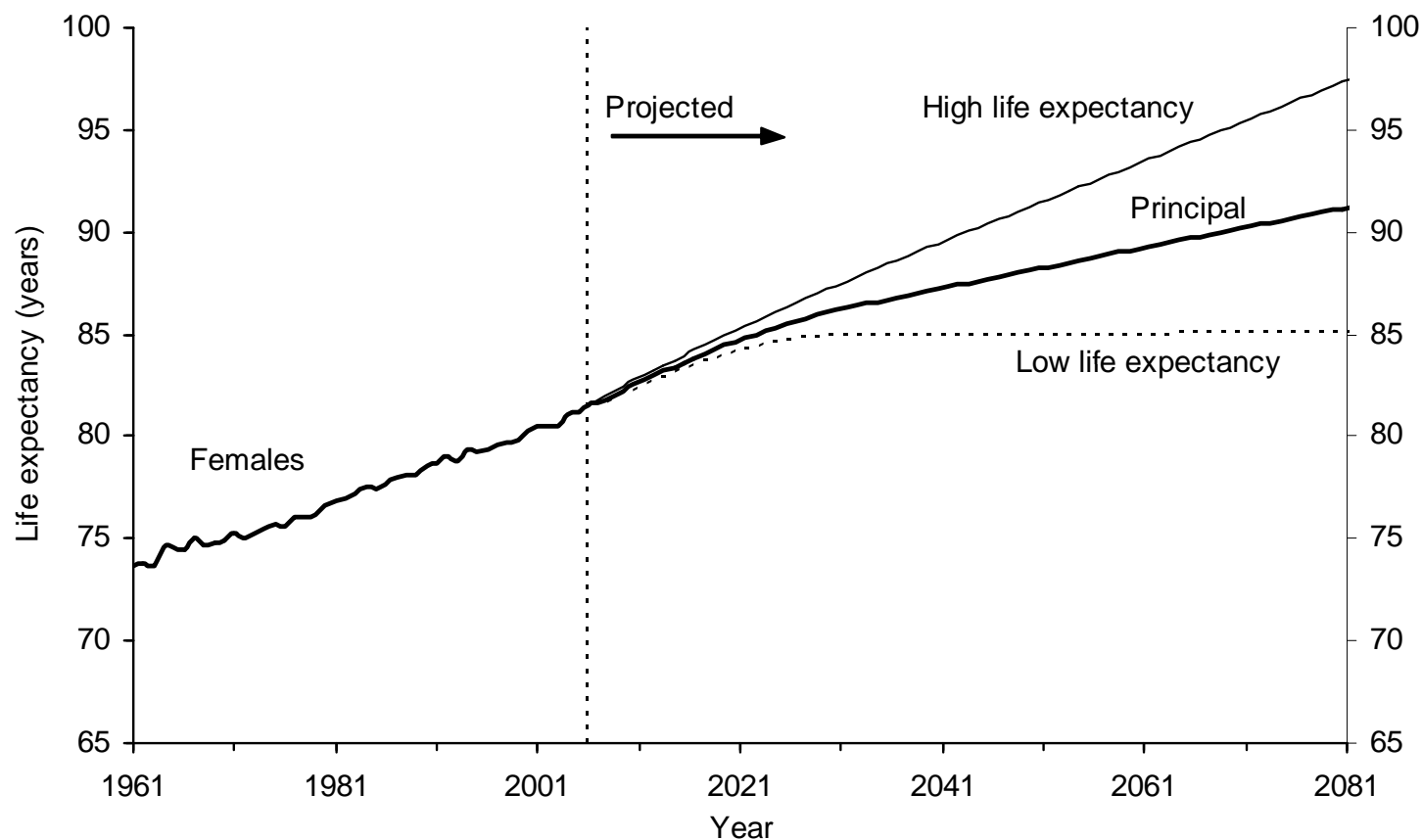
Actual and assumed overall average annual rates of mortality improvement

England & Wales		Per cent		
	Males		Females	
	Past (actual)	Future (assumed)	Past (actual)	Future (assumed)
Last/next 24 years	2.13	2.12	1.47	2.15
Last/next 44 years	1.54	1.62	1.33	1.64
Last/next 74 years	1.23	1.37	1.27	1.38

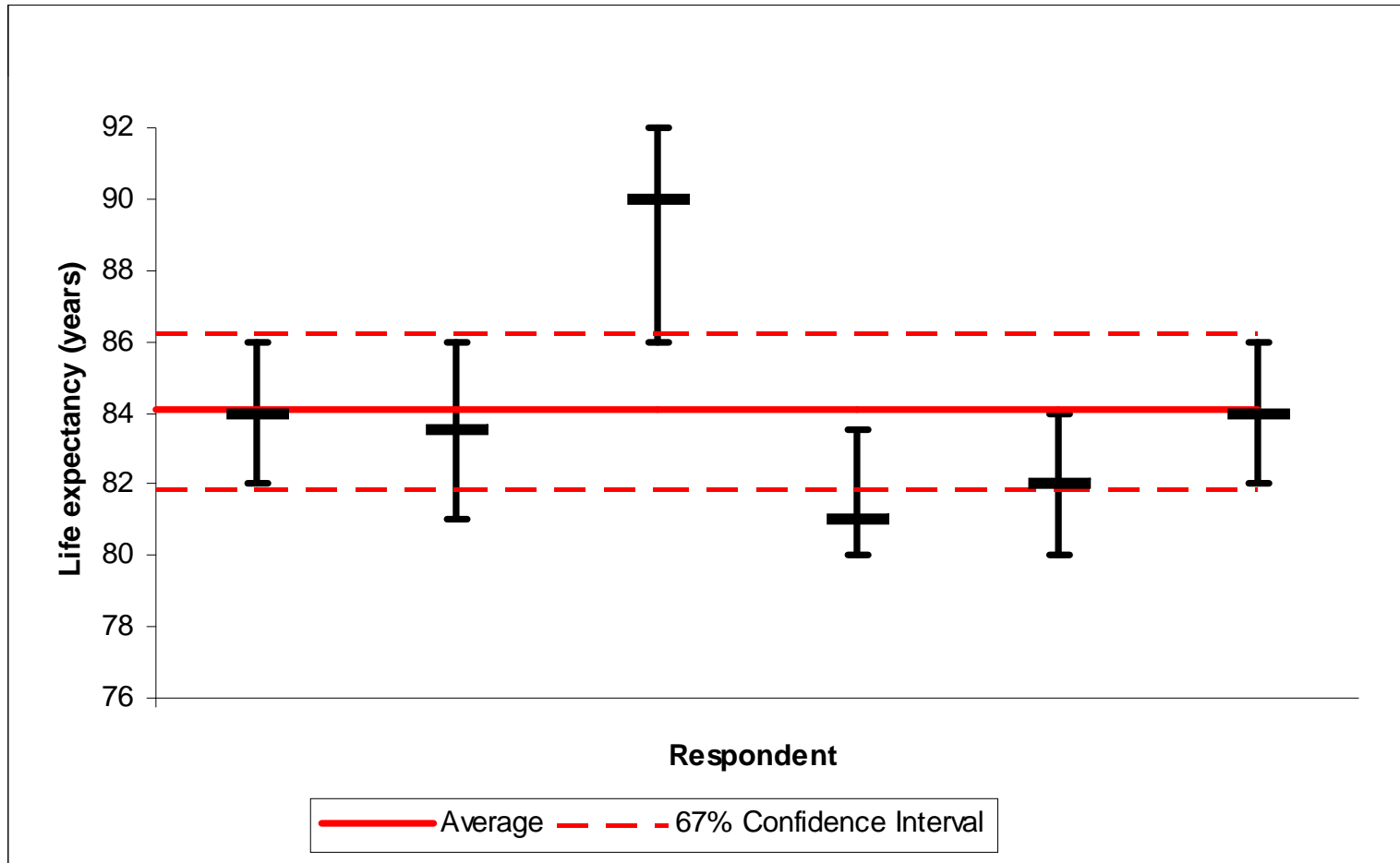
Actual and projected male period life expectancy at birth, UK, 1961-2081



Actual and projected female period life expectancy at birth, UK, 1961-2081



Expert Panel estimates of male period life expectancy at birth at 2030



NPP v Expert Panel: Uncertainty at 2030

	ONS assumptions (High variant – low variant)	Expert panel average (Width of 67% confidence interval)
TFR	0.40	0.50
Male period life expectancy at birth	3.7	4.1
Female period life expectancy at birth	2.4	3.7
Annual net migration	120,000	165,000

ONS Stochastic forecasting project

- Aim
 - To develop a model that will enable the degree of uncertainty in UK national population projections to be specified
 - Approach
 - Express fertility, mortality and migration assumptions in terms of probability distributions
 - Generate random values from these probability distributions to produce predictive distributions for any projection result
-

Probability distributions

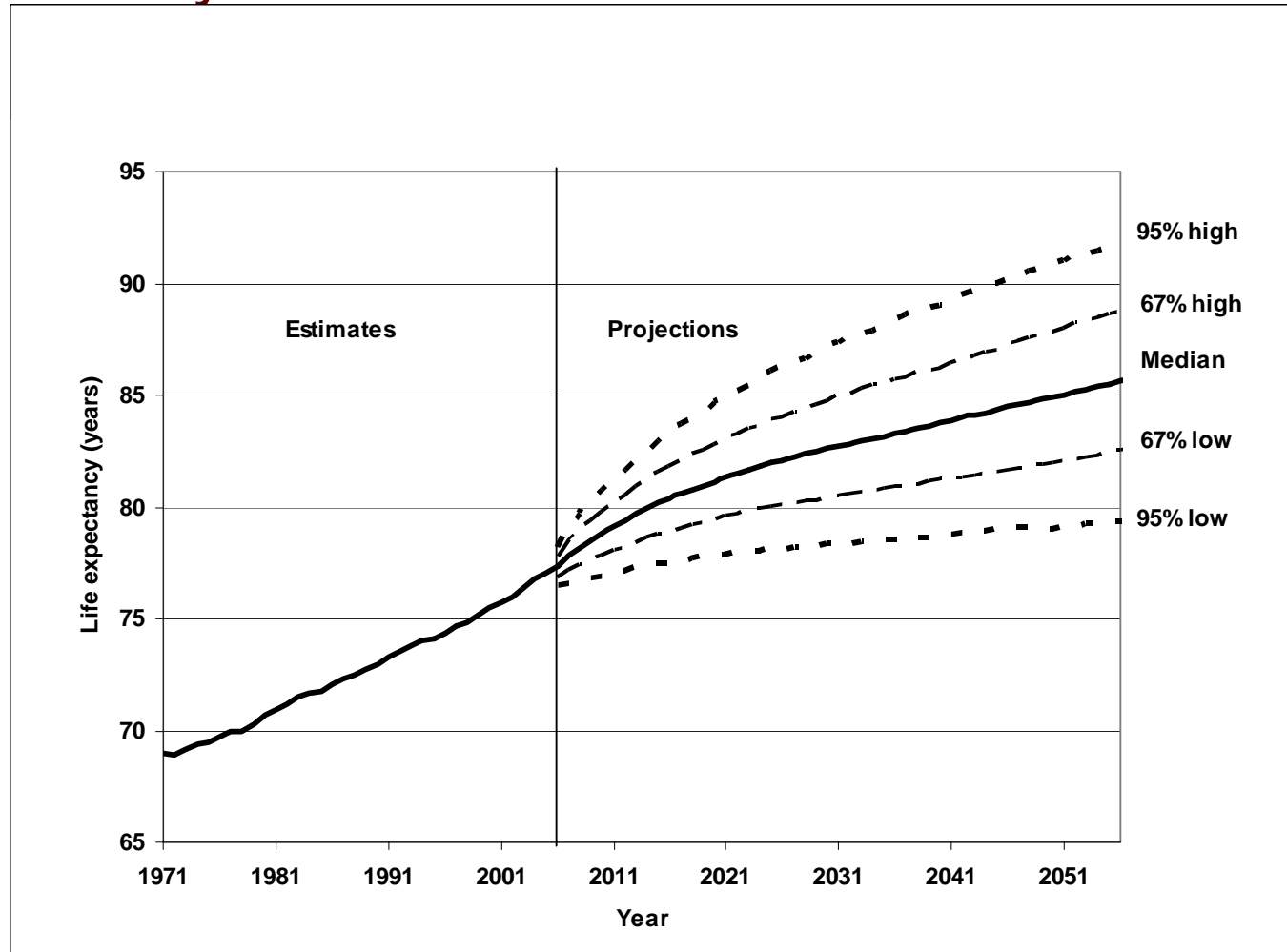
- How can we estimate future probability distributions?
- Three approaches:
 - Analysis of accuracy of past projections
 - Expert opinion
 - Time series analysis
- No 'right' answer – subjective judgement

Comparative measures of uncertainty for five years ahead

	TFR (number of children)	Male e0 (years)	Female e0 (years)	Net mig (000s)
Experts: Standard deviation	0.15	0.63	0.79	51.3
Past accuracy: RMSE	0.20	0.78	0.66	58.6

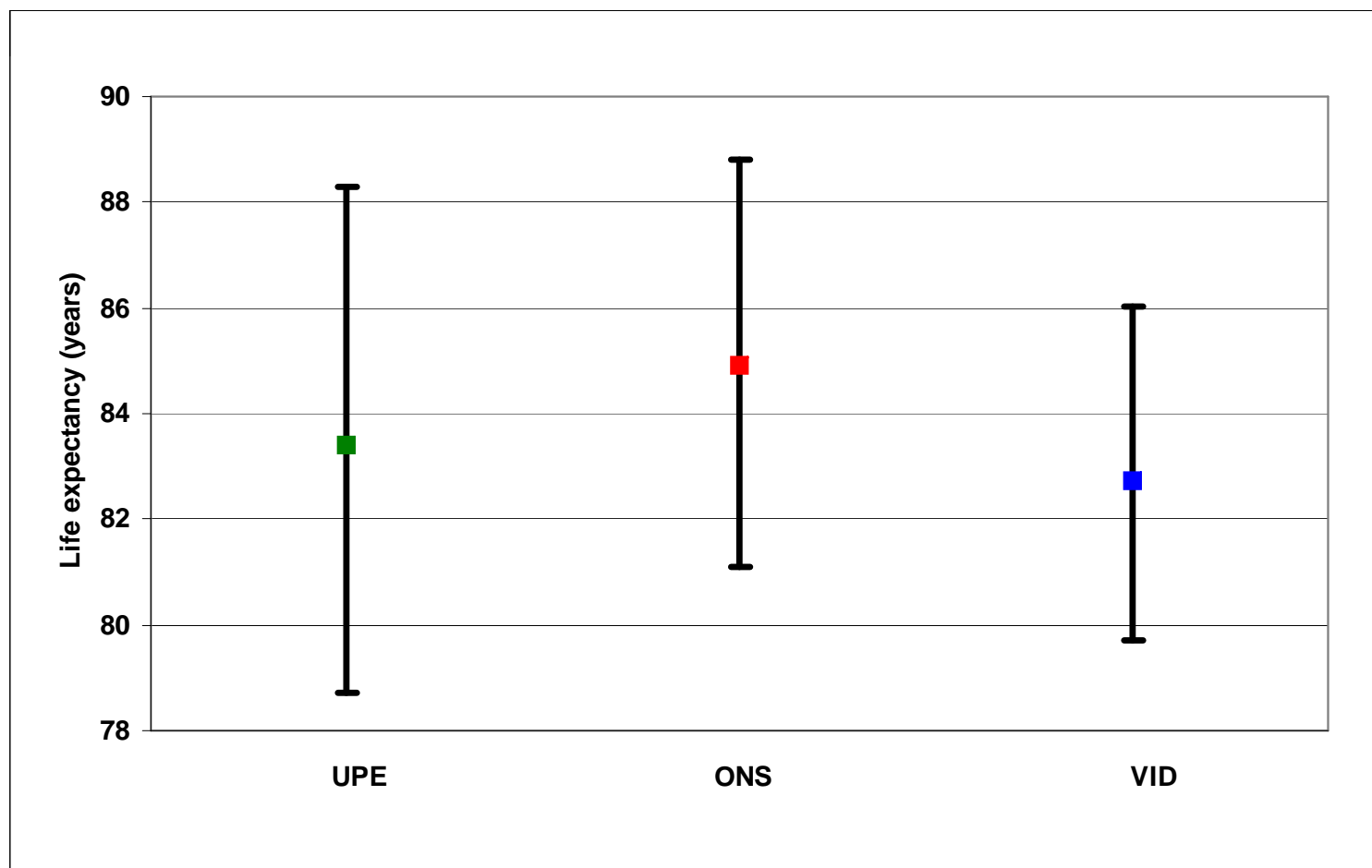
UK male period life expectancy at birth

Probability distribution



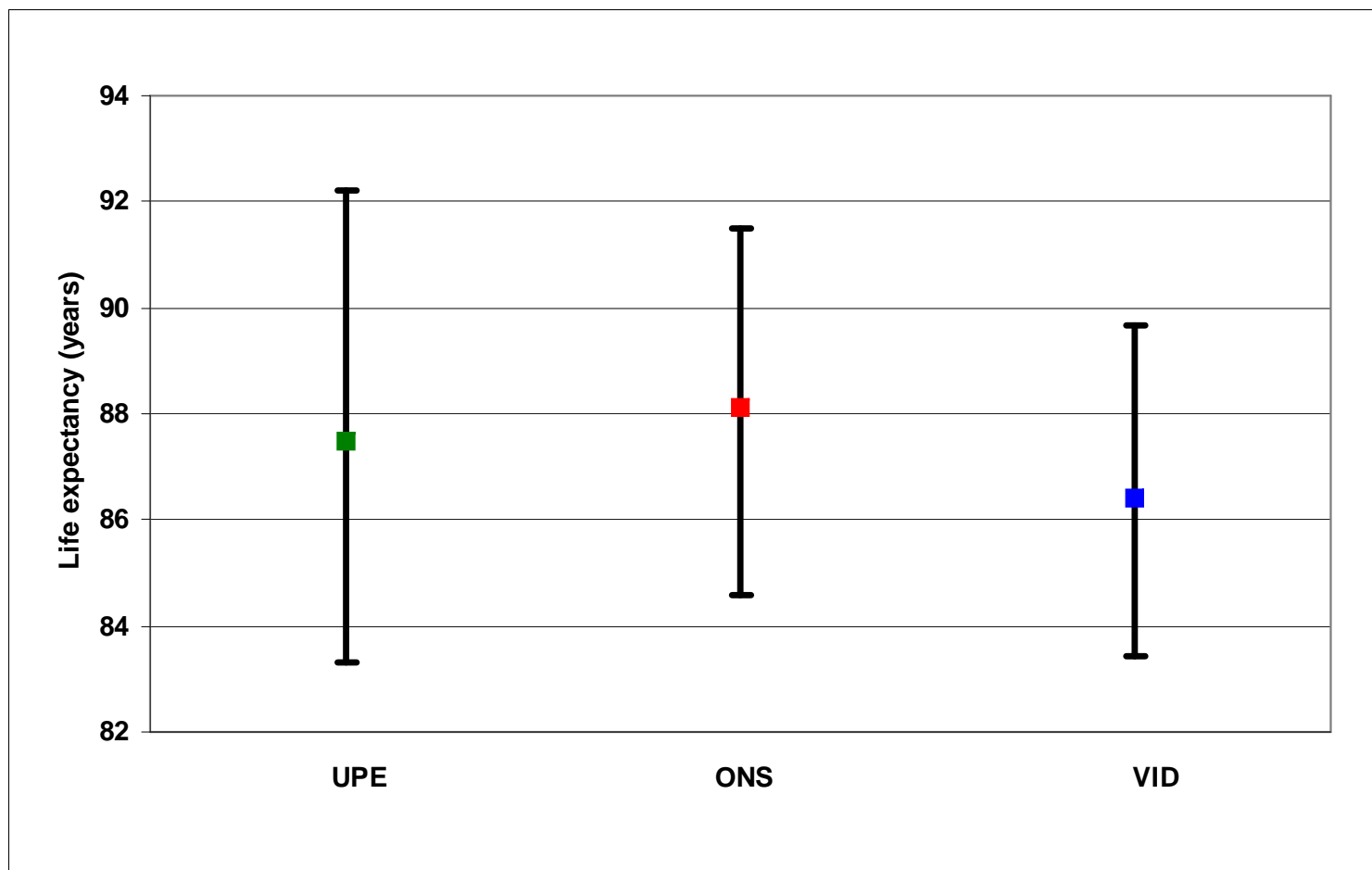
Estimates of period life expectancy at birth in 2049/2050, UK males

Median and 80% confidence intervals



Estimates of period life expectancy at birth in 2049/2050, UK females

Median and 80% confidence intervals



Expert Group Questionnaire

- Given to our Expert Advisory Panel in 2007
- Developed by International Institute for Applied Systems Analysis (IIASA) in Vienna and adapted by ONS for use in UK
- Collected views on a large range of factors which might influence future fertility, mortality and migration
- Article will appear in Population Trends in December

Forces and arguments

- Force: Changes in bio-medical technology
- Arguments:
 - Increased understanding of bio-medical ageing processes will allow us to develop effective anti-ageing strategies.
 - Breakthroughs in the understanding of carcinogenic processes will lead to substantial reductions in mortality from cancers.
 - Innovative medication will make hitherto life threatening diseases containable.
 - Improvements in surgery including transplants and implants will enhance longevity.
 - Unintended adverse consequences of new bio-medical technologies will outweigh their benefit

Major forces shaping mortality

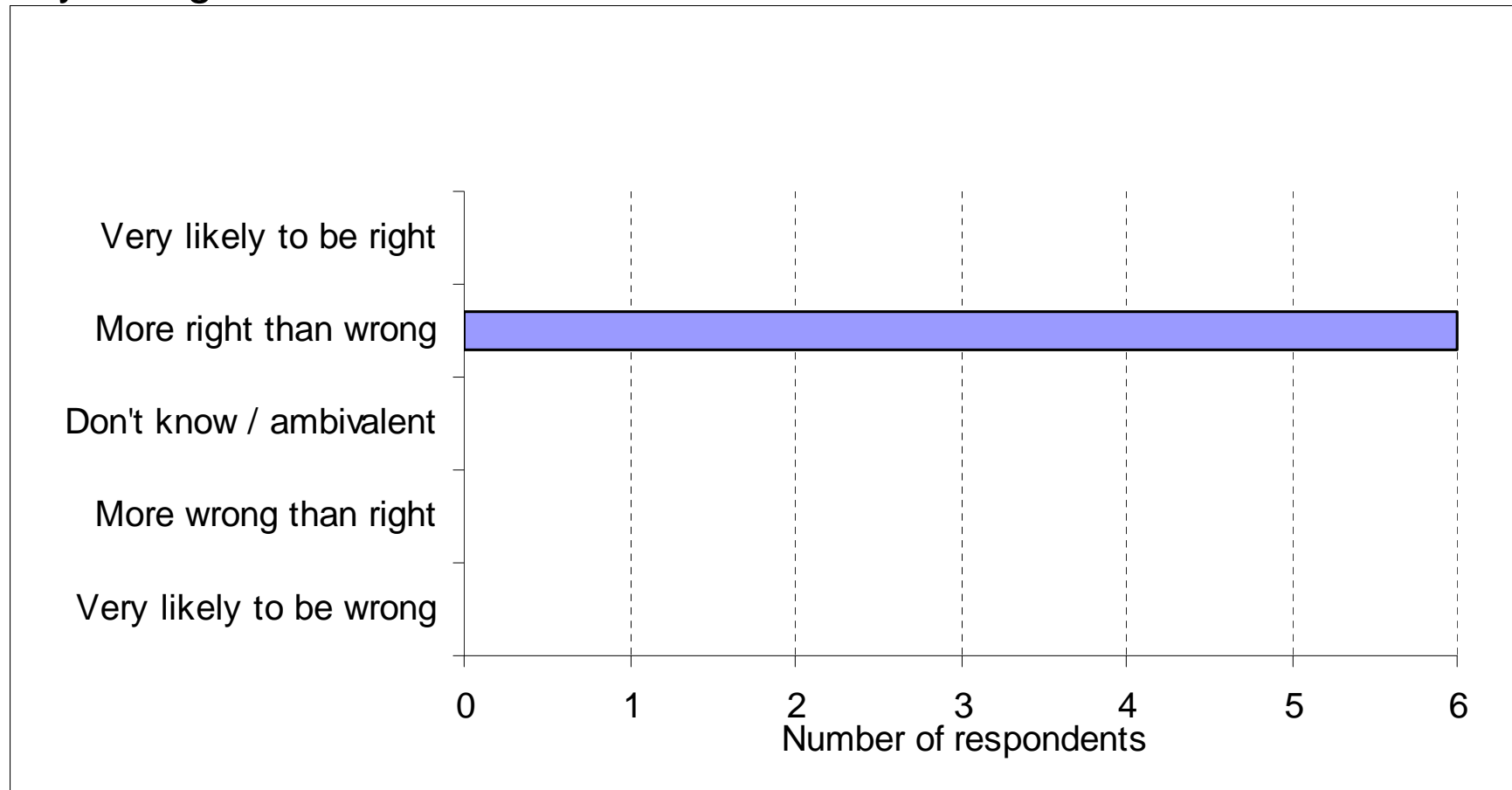
	% weighting	<i>Min</i>	<i>Max</i>
Bio-medical technology	28	15	50
Health care systems	17	10	30
Behavioural changes	28	10	53
New/resurgent diseases	9	5	15
Environmental changes	8	5	15
Population composition	9	0	20
	100		

Major forces shaping mortality

	UK Panel	IIASA (18 world experts)
Bio-medical technology	28	25
Health care systems	17	24
Behavioural changes	28	25
New/resurgent diseases	9	7
Environmental changes	8	8
Population composition	9	11
	100	100

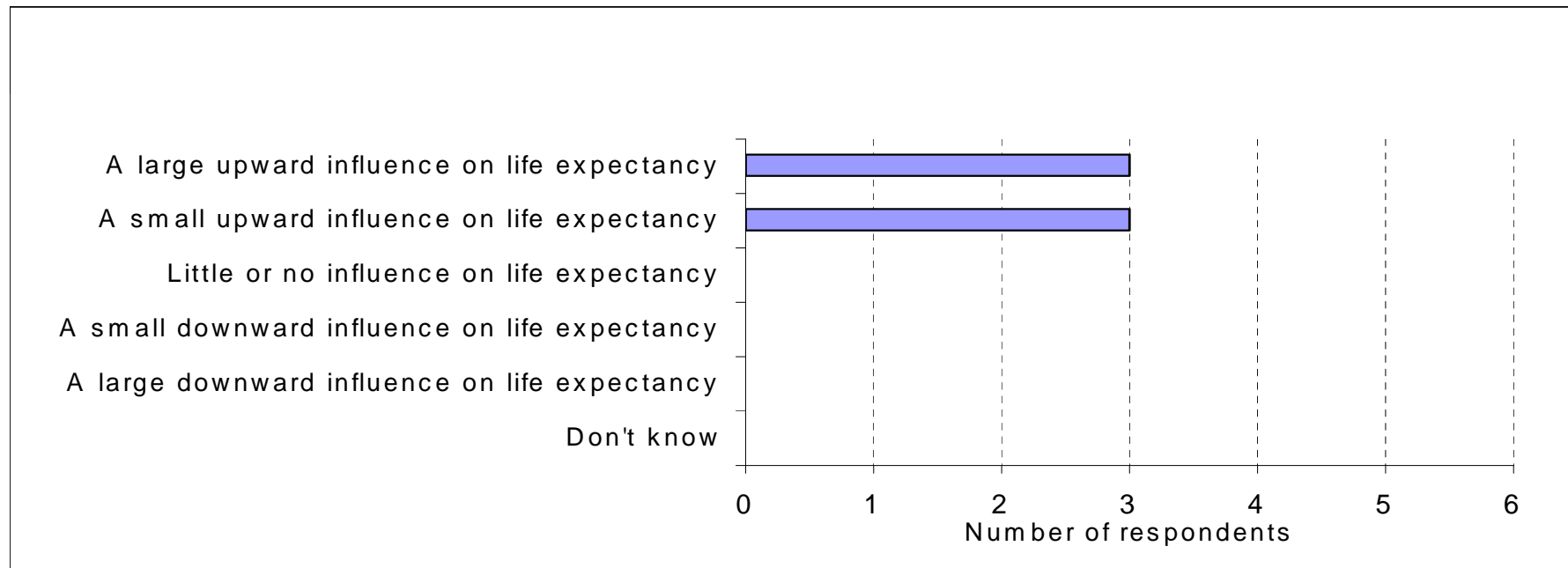
Increased understanding of bio-medical ageing processes will allow us to develop effective anti-ageing strategies.

Validity of argument



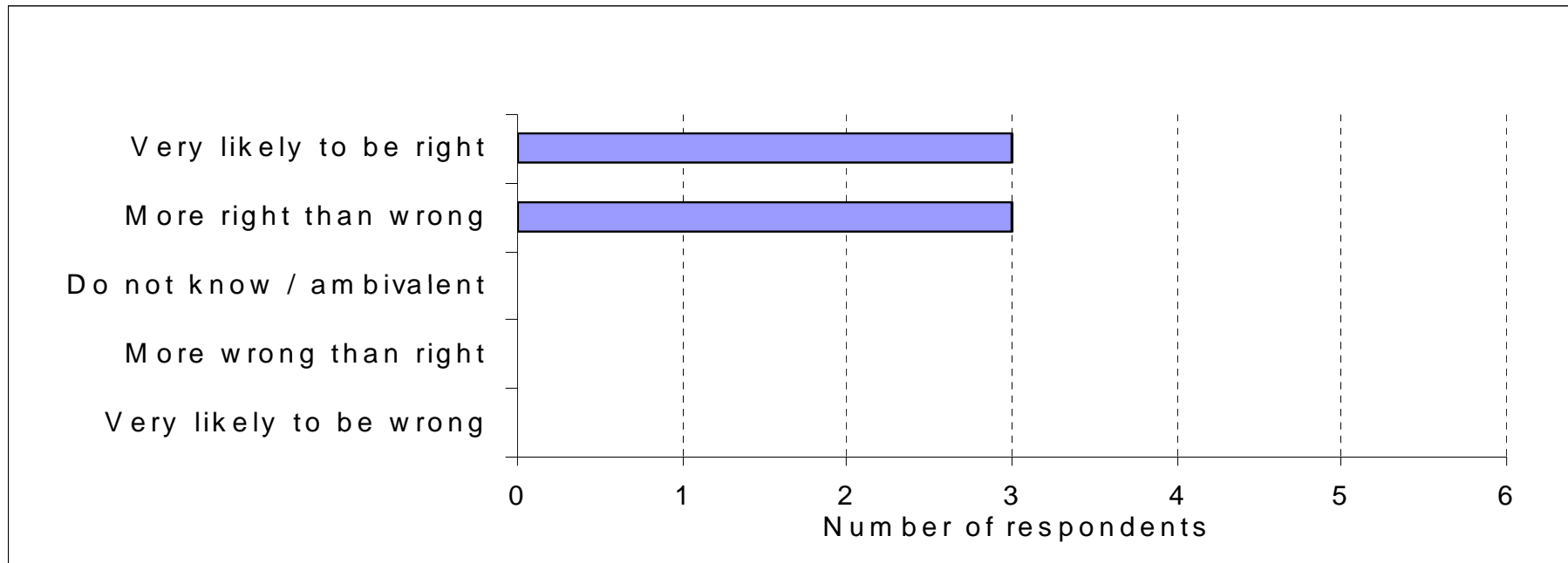
Increased understanding of bio-medical ageing processes will allow us to develop effective anti-ageing strategies.

Importance of argument



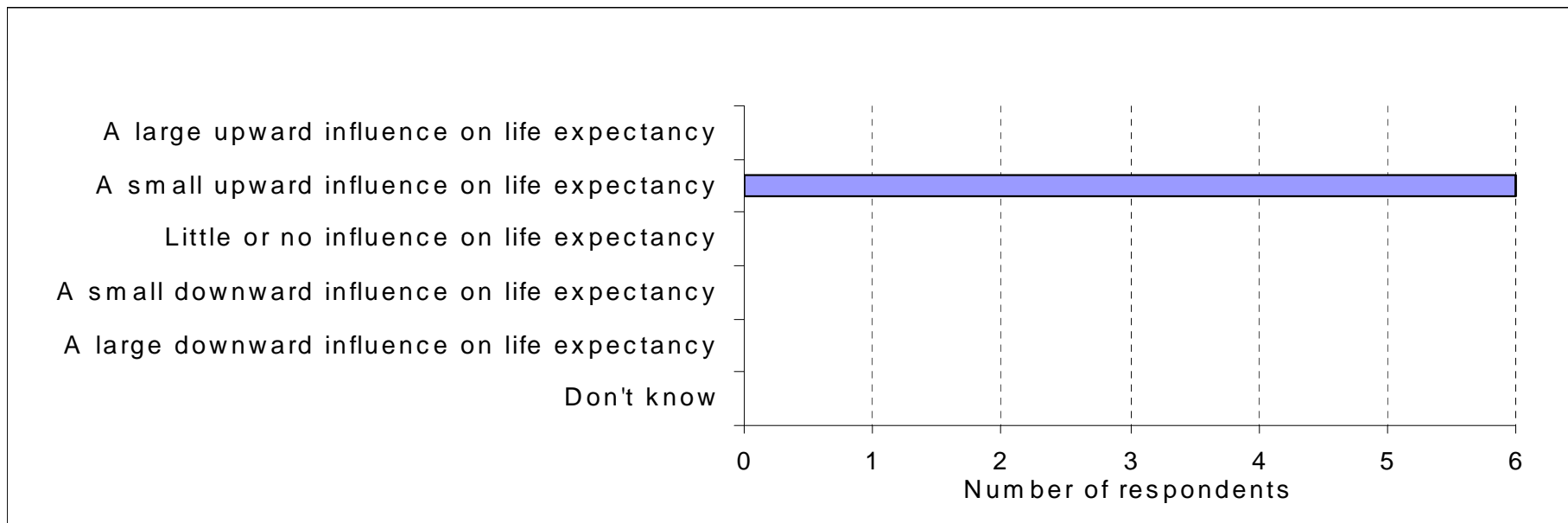
Smoking prevalence will continue to decline.

Validity of argument



Smoking prevalence will continue to decline.

Importance of argument



Factors considered to be valid by the majority of the panel *and* considered to have the potential to impact on future levels.

Factors that could have an *upwards* impact on life expectancy:

- Greater understanding of bio-medical ageing processes leading to the development of effective anti-ageing strategies.
- Breakthroughs in the understanding of carcinogenic processes leading to reduced mortality from cancer.
- Medical advances leading to previously life-threatening diseases becoming containable.
- Progress in preventive medicine.
- Better information about health.
- A continued decrease in smoking prevalence.
- Increasing mental and social activities at old age.
- Effective and easily affordable new technologies.

Factors considered to be valid by the majority of the panel *and* considered to have the potential to impact on future levels.

Factors that could *diminish or reverse* increases in life expectancy:

- Increasing drug resistance to known infectious diseases.
- Negative impact on health of increased stress levels.
- Majority of immigration will be from countries with higher mortality than UK.

References

- 2006-based national projections, Chapter 7 (Mortality)
<http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=4611>
- Accuracy of past UK projections, Population Trends 128
- Accuracy of past European projections, Population Trends 129 (Part 2)
- Results from Expert Panel questionnaire, Population Trends 134 (to be published in December 2008)
<http://www.statistics.gov.uk/statbase/Product.asp?vlnk=6303>