Office for National Statistics

Compendium

National Population Projections: 2014-based reference volume, series PP2

National population projections provide an indication of the future size and age structure of the UK and its constituent countries based on a set of assumptions of future fertility, mortality and migration, including a number of variant projections based on alternative scenarios.

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Chapters in this compendium

Compendium

An executive summary, 2014-based national population projections reference volume

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1 . Introduction

This publication presents the results of the 2014-based population projections produced by the Office for National Statistics (ONS) for the UK and its constituent countries. These results were previously published in statistical releases 2014-based Statistical Bulletin on 29 October 2015 and 2014-based extra variants report on 26 November 2015. This volume is the latest in a regular series, which started in 1970, and brings together a summary of the results and details of the methodology into one compendium.

This volume includes some alternative summary charts and tables to those published previously. It also provides further detail of the projections methodology, some discussion around the trends which informed the assumptions and a range of related references for further background reading.

The following chapters are included:

- Chapter 1 - Background and methodology
- Chapter 2 - Summary results
- Chapter 3 - Fertility assumptions
- Chapter 4 - Mortality assumptions
- Chapter 5 - Migration assumptions
- Chapter 6 - Variants

Main points

At mid-2014 the estimated population of the UK was about 86,000 higher than that projected for mid-2014 in the 2012-based projections. This was predominantly due to higher levels of net migration observed in 2013 to 2014 than assumed in the 2012-based projections. More information comparing the 2014-based and 2012-based projections is available in the Summary Results chapter of the 2014-based national population projections release.

The main points of the 2014-based population projections are:

- the UK population is projected to increase by 9.7 million over the next 25 years, from an estimated 64.6 million in mid-2014 to 74.3 million in mid-2039
- the UK population is projected to reach 70 million by mid-2027
- over the 10 year period to mid-2024, the UK population is projected to increase by 4.4 million to 69.0 million - this is 249,000 higher than the previous (2012-based) projection for that year
- assumed net migration accounts for 51% of the projected increase over the next 25 years, with natural increase (more births than deaths) accounting for the remaining 49% of growth

2 . Projected UK population change

The projection has the following features:

- the population is projected to continue ageing, with the average (median) age rising from 40.0 years in mid-2014 to 40.9 years in mid-2024 and 42.9 by mid-2039
- by mid-2039, more than 1 in 12 of the population is projected to be aged 80 or over.
- the number of children (those aged 0 to 15) is projected to grow by 8.8% between mid-2014 and mid-2039
- the number of people of working age (those aged between 16 and State Pension Age) is projected to rise by 11.4%, from 40.0 million in mid-2014 to 44.6 million by mid-2039
- the number of people of pensionable age for every thousand people of working age is projected to fall from 310 in mid-2014 to 284 in mid-2020 as a result of changes in the State Pension Age, but then rise to 370 in mid-2039 - this rise means that the projections show more people of pensionable age relative to the number of people of working age in mid-2039 than in mid-2014

The change in the age distribution between mid-2014 and mid-2039 is shown in Figure 0.1.

Figure 0.1: Estimated and projected age structure of UK population, mid-2014 and mid-2039

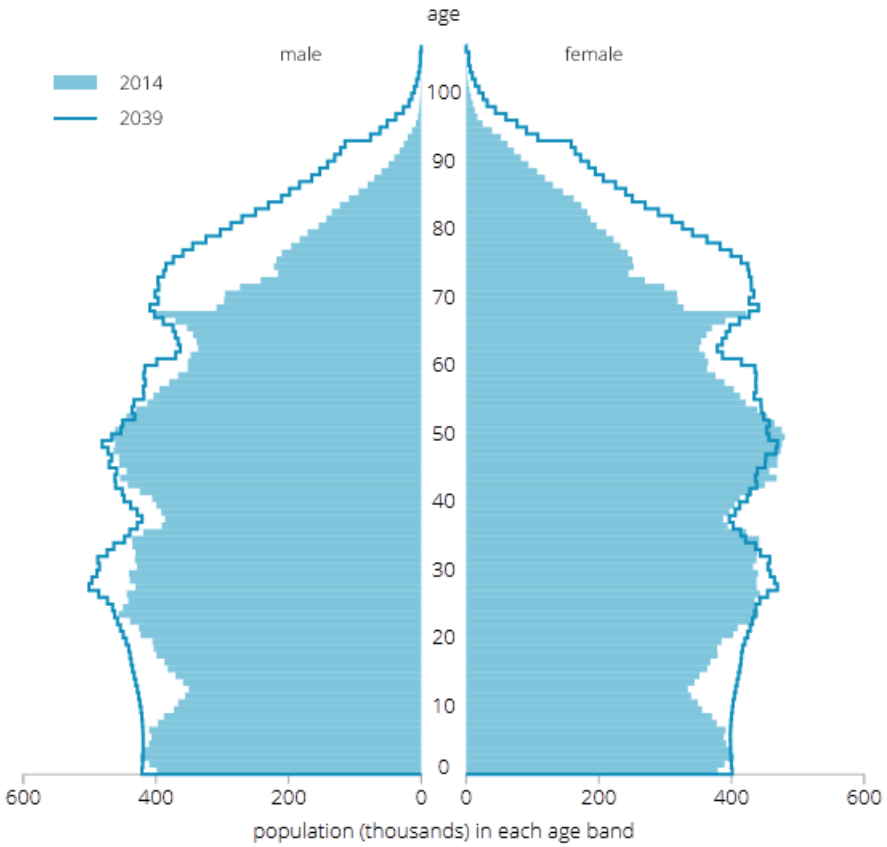

Table 0.1: Estimated and projected population by age, UK, mid-1981 to mid-2089

thousands

Year	All ages	Under 16	16-64	65 & over	(80 & over)
Estimates					
1981	56,357	12,543	35,339	8,476	1,572
1991	57,439	11,685	36,695	9,059	2,126
2001	59,113	11,863	37,877	9,373	2,459
2011	63,285	11,883	40,944	10,458	2,915
2014	64,597	12,153	41,037	11,407	3,071
Projections					
2019	66,928	12,741	41,718	12,468	3,433
2024	69,036	13,105	42,206	13,725	3,962
2034	72,721	13,188	42,558	16,974	5,614
2039	74,284	13,219	43,013	18,053	6,259
Longer-term projections					
2044	75,766	13,380	43,842	18,544	7,137
2054	78,510	13,942	44,644	19,924	8,458
2064	80,992	14,198	45,606	21,188	8,908
2074	83,670	14,428	47,142	22,101	10,060
2084	86,546	14,836	47,990	23,720	10,690
2089	87,984	15,010	48,438	24,536	11,189

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

Due to differences in past and present demographic patterns, and those assumed for the future, projected trends differ for the 4 countries of the UK (see Table 0.2).

The population of England is projected to increase by 16.5%, Wales by 6.1%, Scotland by 6.6% and Northern Ireland by 9.8% over the 25 year period to mid-2039.

Table 0.2: Estimated and projected population of the UK by constituent country, mid-1981 to mid-2064

thousands

Year	UK	England	Wales	Scotland	Northern Ireland
Estimates					
1981	56,357	46,821	2,813	5,180	1,543
1991	57,439	47,875	2,873	5,083	1,607
2001	59,113	49,450	2,910	5,064	1,689
2011	63,285	53,107	3,064	5,300	1,814
2014	64,597	54,317	3,092	5,348	1,840
Projections					
2019	66,928	56,466	3,139	5,428	1,894
2024	69,036	58,396	3,187	5,514	1,939
2034	72,721	61,800	3,262	5,659	2,000
2039	74,284	63,282	3,280	5,701	2,021
Longer-term projections					
2044	75,766	64,702	3,294	5,732	2,039
2054	78,510	67,373	3,314	5,767	2,057
2064	80,992	69,801	3,338	5,798	2,055

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

3 . Underlying assumptions

The national population projections are based on the latest available mid-year population estimates and a set of demographic assumptions about future fertility, mortality and migration based on analysis of trends and expert advice. The main assumptions for the UK as a whole are set out below.

Average completed family size, which has been falling from a peak of nearly 2.5 children per woman for women born in the mid-1930s, is assumed to level off at 1.89 children for women born after 2010. This is the same assumption as the 2012-based projection. It is projected that this assumption will hold true for women born after 2015.

Expectation of life at birth, based on mortality rates for the year in question, is projected to increase from 78.9 years in mid-2015 to 84.1 years in mid-2039 for males, and from 82.5 years in mid-2015 to 86.9 years in mid-2039 for females. In mid-2039, period expectation of life at birth for the UK is around 0.2 years lower for males and 0.6 years lower for females compared with the previous projections. These projected life expectancies are lower as a result of recent mortality rates. After 2039, the life expectancies continue to diverge from those in the 2012-based projections to approximately 0.6 years lower for males and 1.0 years lower for females by the end of the 100 year projection period.

The long-term assumption for net migration to the UK is +185,000 each year, compared with +165,000 per year in the 2012-based projections. This change reflects the most recent trends in international migration available at the time the projections were produced. A new method for setting and applying the cross-border (intra-UK) migration assumptions as rates rather than fixed numbers of migrants was introduced and applied for the 2014-based projections (see Chapter 5).

4. Background notes

1. The 2014-based Population Projections for the United Kingdom and constituent countries were published 29 October 2015. Available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/compendium/nationalpopulationprojections/2015-10-29 (main release) and 26 November 2015, available at http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/articles/nationalpopulationprojections/2014basedextravariantsreport (extra variants).

2. These National Statistics are produced to high professional standards and released according to the arrangements approved by the UK Statistics Authority.

Compendium

Background and methodology, 2014-based national population projections reference volume

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Table of contents

1 . Introduction

The 2014-based national population projections for the UK and its constituent countries were produced by the Office for National Statistics (ONS) on behalf of the National Statistician and the Registrars General of Scotland and Northern Ireland.

This chapter provides the background to the national population projections, including their history, purpose and availability. It describes the methodology used to produce the projections and provides an outline of the related projections available.

2 . Background

Purpose

Projections relate to the usually resident population of the UK and its constituent countries. The population includes all usually resident persons, whatever their nationality. The usually resident population includes all long-term international migrants (people changing their country of usual residence for at least one year) but excludes short-term migrants who come to or leave the UK for less than one year.

The projections are based on the population estimates as at 30 June 2014 and a set of underlying demographic assumptions regarding future fertility, mortality and migration. The assumptions were based on the best statistical evidence available at the time and were agreed in liaison with the devolved administrations – Welsh Government, National Records of Scotland (NRS) and Northern Ireland Statistics and Research Agency (NISRA) – following consultation with the main users of projections in each country and advice from an expert academic advisory panel.

The primary purpose of the national population projections is to provide an estimate of the future population of the UK and its constituent countries which is used as a common framework for national planning in a number of different fields. They are also used as the base for other official population projections such as subnational projections, household projections and in the calculation of life tables. These official sets of projections ensure that the many users of projections can work on consistent assumptions.

The projections are the outcome of a calculation showing what happens if particular assumptions are made. As a forecast of the future population they would inevitably be proved wrong, to a greater or lesser extent. As well as not taking into account future government policies, there is uncertainty in the underlying data – for example, estimates of the current population or of past migration flows – on which the projections are based. In addition, there is inevitable uncertainty in the assumptions reflecting the inherent unpredictability of demographic behaviour. The latter reason means that projections become increasingly uncertain the further they are carried forward into the future. To give users of the projections an indication of this uncertainty, in addition to the principal (main or central) projection, a number of variant population projections have also been produced based on alternative assumptions of future levels of fertility, mortality and migration. These are discussed in the variants chapter.

We published the 2014-based principal and key variant projections on 29 October 2015, with additional variants released on 26 November 2015[1].

Projections history

The first projections of the population of the UK were made by the Government Actuary's Department (GAD) in the 1920s. One of the main uses of these earliest projections was in connection with long-term financial estimates under the Contributory Pensions Acts and other schemes of social insurance. Projections made since the war, however, have been increasingly used in all areas of government planning. New projections were produced each year from 1955 to 1979 and then every second year until 1991. There was then a 1992-based set and since then projections have resumed to being produced every second year.

Additional "interim" projections are occasionally produced. The 2001-based projections were published following the 2001 Census and an additional set were produced based on the 2003 estimates to incorporate revisions to the population estimates for England and Wales. Responsibility for the production of national population projections transferred to ONS on 31 January 2006.

Publications

This volume, the latest in a regular series which started in 1970, gives details of the 2014-based national population projections produced by ONS (based on the estimated population of mid-2014). These replace the 2012-based projections published on 6 November 2013.

Expert advisory panel

As part of the production process for the 2004-based projections round, an expert academic panel was convened in 2005 to advise us on current and emerging demographic trends and their possible implications for the national population projections. An expert panel has met to discuss appropriate assumptions for each subsequent round of projections. The panel's role is to advise only. Responsibility for final decisions on the assumptions remains with ONS and the statistical offices of the devolved administrations.

A note of the 2015 meeting of the expert panel is included in the 2014-based projections October release, in Appendix A of the Background and Methodology paper.

3 . Base population and projection period

Population estimates

The projections for England and Wales are based on the mid-2014 population estimates[2] that were published on 25 June 2015. The projections for Scotland are based on the mid-2014 population estimates published by National Records Scotland (NRS) on 30 April 2015 and likewise the projections for Northern Ireland are based on the mid-2014 estimates published by Northern Ireland Statistics and Research Agency (NISRA) on 4 June 2015. These estimates are based upon 2011 Census results with allowance for subsequent births, deaths, migration and ageing of the population. The population includes all persons resident, or intending to stay, for 12 months or more. Members of HM armed forces in the UK are included, as are foreign armed forces stationed in the UK. Members of HM armed forces and their families who are abroad are excluded from the population estimates and are treated as migrants when they return home.

In October 2015, National Records of Scotland announced small errors in the mid-year population estimates (MYE) for areas in Scotland. Whilst these errors do not affect the total population of Scotland, or other parts of the UK, they do have a small effect on the age and sex distribution of the population. The impact of these errors is much smaller than the uncertainty around the estimates due to sampling error from the census. NRS will publish corrected MYEs in April 2016.

The 2014-based national population projections are based on the original release of the Scottish MYE in April 2015 and thus do not reflect the correction to the MYE for Scotland used as the base population for the projection. The errors will also have a small effect on the projected age distribution of cross-border migration flows from Scotland to England and Wales. These effects are very small compared to other sources of uncertainty in the projections.

Table 1.1 shows the estimates of the population at mid-2014 upon which the 2014 projections are based.

Table 1.1: Base population estimates for 2014-based projections

Constituent countries of the UK	thousands
England	54,317
Wales	3,092
Scotland	5,348
Northern Ireland	1,840
UK	64,597

Source: Office for National Statistics

Estimates of the population aged 90 and over

Official mid-year population estimates produced by the Office for National Statistics (ONS), NRS and NISRA are prepared by individual age to the age of 89, with an upper age band for all those aged 90 and over. Estimates of the population aged 90 to 104 by single year of age and for the 105 and over age group are prepared using the Kannisto Thatcher survivor ratio method[3], with the results controlled to agree with the official estimates of all those aged 90 and over. Estimates of the very old[4] are published for England and Wales on an annual basis. Scotland has published population estimates of people aged 90 and over[5] by single year of age to 105 and over. Northern Ireland has published estimates of the population aged 85 and over[6] by single year of age to 105 and over.

Projections period

The main focus of the 2014-based projections is on the next 25 years up to mid-2039, though longer-term projections to mid-2114 are also produced. Long-term figures should be treated with great caution since population projections become increasingly uncertain the further they are carried forward, particularly so for smaller geographical areas and age-sex breakdowns.

For more information on how our population projections meet user needs, along with information on their fitness for purpose, including strengths and limitations, please see the report on quality and methodology[7].

4 . Methodology

The cohort component method

The projections are made for successive years running from one mid-year to the next using the cohort component method.[8] The starting population, taking into account net migration less the number of deaths, produces the number in the population, one year older, at the end of the year. Age is defined as completed years at the last birthday. To this has to be added survivors of those born during the year.

Migration is assumed to occur evenly throughout the year. For computing purposes, this is equivalent to assuming that half the migrants in a given year at a given age migrate at the beginning of the year and half at the end of the year. Therefore, the number of net migrants to be added to obtain the population aged x+1 at the end of the projection year consists of half of those migrating during the year at age x and half of those migrating during the year at age x+1.

The number of deaths in a year is obtained by adding half of the net inward migrants at each age to the number in the population at the beginning of the year and applying the mortality rate q_x. The mortality rates (q_x) used in the projections represent the probabilities of death between one mid-year and the next, according to a person's age last birthday at the beginning of the period. The appropriate rate of "infant mortality", that is, the probability of a new-born child not surviving until the following mid-year is also given. This is about 85% of the full, first year of life infant mortality rate used in official statistics.

The number of births in the year is calculated by multiplying the average number of women at each single year of age during the year (taken as the mean of the populations at that age at the beginning and end of the year) by the fertility rate applicable to them during that year. The total number of births in a year is assumed to be divided between the sexes in the ratio of 105 males to 100 females, in line with recent experience. The number of infants aged 0 at the end of the year is calculated by taking the projected number of births, deducting the number of deaths (found by applying the infant mortality rate to the projected number of births) and adding half the number of net migrants aged 0 last birthday.

The principal projections are computed for each of the constituent countries of the UK and the results are added together to produce projections for England and Wales, Great Britain and the UK.

The fertility and mortality assumptions have been set using rates based on a consistent series of population estimates which reflect the results of the 2011 Census.

In the 2014-based projections, the method of projecting "cross-border flows" of migration between countries of the UK has changed from being based on assumed absolute levels to being calculated from assumed rates of migration based on an average of estimates for the previous 5 years. This change in methodology is described in full in Chapter 5. International migration assumptions continue to be set as a fixed number of migrants based on historical trends.

Lexis diagram

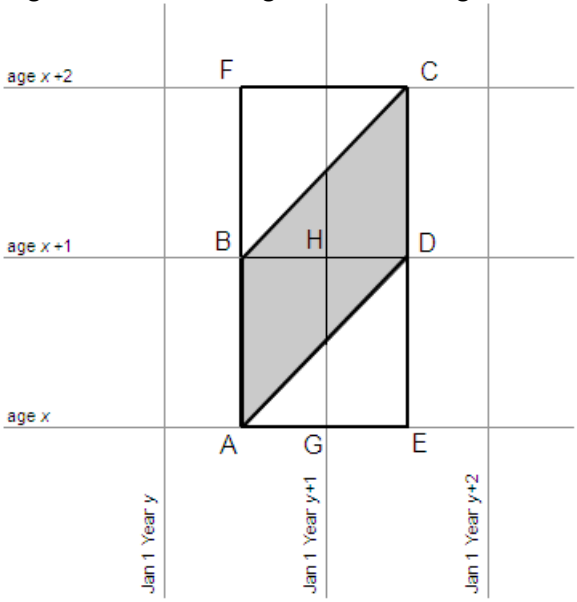
The projection process can be illustrated by means of a Lexis diagram (see Figure 1.1) where age is represented on the vertical axis and time on the horizontal axis. The life of an individual (or of a birth cohort), is represented by a diagonal line (or parallelogram) running from bottom left to top right.

The line AB represents the population aged x at mid-year y. The size of this cohort one year ahead, that is, aged x+1 at mid-year y+1, is represented by the line DC. To calculate this population one year ahead (for x greater than or equal to 0), it is necessary to project deaths and net migration occurring to this cohort between mid-year y and mid-year y+1. The relevant interval of time for this cohort is represented by the shaded parallelogram ABCD.

The net number of migrants aged x between mid-year y and mid-year y+1 is represented by the square ABDE in the Lexis diagram. Similarly, the net number of migrants aged x+1 between mid-year y and mid-year y+1 is represented by the square BFCD.

As noted above, it can be assumed that half the migrants in a given year at a given age migrate at the beginning of the year and half at the end of the year. Thus, of net migrants aged x between mid-year y and mid-year y+1, it can be assumed that half add to the population represented by the line AB in the diagram and the other half to the population represented by the line ED. Similarly, of the migrants aged x+1 in this period, half can be added to the population denoted by the line BF and half to the population represented by the line DC. Net migration in the parallelogram ABCD is therefore obtained by adding half of the net migrants aged x (that is, those adding to the population AB) and half of those aged x+1 (that is, those adding to the population DC) in this interval.

Figure 1.1: Lexis diagram illustrating the calculation of population projections



The number of deaths in a year is obtained by adding half of the net inward migrants at each age to the number in the population at the beginning of the year and applying the mortality rate q_x. This produces the number of deaths in the parallelogram ABCD. Finally, there is the special case of projecting the number of infants aged 0 at mid-year y+1 as described above. So if x=0, the required population is represented by the line ED and it is therefore necessary to project births, deaths and net migration in the triangle represented by ADE.

The relationship between m_x and q_x

The mortality rates (q_x) are given, for each individual age, in the data tables available on our website. However, in other statistical publications, and in the mortality chapter, mortality rates are often shown as central death rates (m_x). These are obtained by dividing the number of deaths during a year at a given age by the average population at that age during the year (usually taken to be the population at the midpoint of the year). The relationship between q_x and m_x is shown by the following equation:

m_x and q_x mortality rates

$$q_x \cong \frac{m_x}{1+0.5m_x}$$

Note that this equation is an approximation as it assumes deaths occur evenly between exact age x and exact age x+1. It does not hold for infant mortality, as infant deaths are concentrated in the first few months of life.

The q_x rates used in the projections are the results of 2 interpolations. The first interpolation takes place between the q_x rates for adjacent calendar years and produces rates on a mid-year to mid-year basis. The second interpolation is between adjacent ages and gives a set of q_x rates that, in life table terms, relate to exact age x+½ on a mid-year basis. These are assumed to be applicable to the mid-year population at age last birthday.

5 . Related projections

Subnational population projections

Subnational population projections are the responsibility of the statistical offices of the constituent countries of the UK. The latest set of subnational population projections are available on the release pages of the Office for National Statistics (ONS[9]), Welsh Government[10], National Records of Scotland[11] and Northern Ireland Statistics and Research Agency[12] websites.

Other related projections

A number of more specialised projections, all consistent with the national projections, are also prepared by government. Marital status projections[13], consistent with the 2008-based national projections, were published on 24 June 2010. These are produced on an ad hoc basis. There are currently no plans to produce marital status projections using the 2014-based national projections.

The Department for Communities and Local Government (DCLG)[14] published 2012-based interim household projections for England on 27 February 2015.

We no longer produce labour force projections, however, the Office for Budget Responsibility (OBR) now produces regular forecasts independent of government, which include labour force projections. The latest available are for the period to 2020 to 2021 which were published on 25 November 2015 in the Economic and Fiscal Outlook publication.[15]

Population projections for other countries, carried out on a comparable basis, are produced by organisations such as Eurostat[16] and the United Nations[17].

6 . Data availability

Website

Detailed results of the 2014-based national population projections for the UK and its constituent countries are available from our website. The results include the principal and variant projections for each country and a summary of the assumptions upon which they are based.

For each projection, the following datasets can be downloaded in Microsoft Excel format:

- components of change, summary age distributions and dependency ratios
- population in 5 year age groups

The projected population numbers are shown in thousands but stored to 3 decimal places (that is, to unit level). This does not imply that the projections are accurate to that level of detail. Results should always be presented in thousands.

In addition a number of open datasets are available in XML format. These have been published as part of the government's open data agenda, mainly for modelling purposes. An open dataset is available for each country and variant combination and contains the underlying assumptions and projected figures for the 2014-based national population projections. Each file contains:

- population by single year of age (0 to 104), age groups (105 to 109, 110 and over) and sex
- fertility assumptions by single year of age (15 to 46)
- mortality assumptions by single year of age (0 to 125) and sex
- cross-border rates for each country flow by single year of age (0 to 125) and sex
- births by single year of age of mother (15 to 46)
- deaths by single year of age (0 to 105 and over) and sex
- in, out and net cross-border migration by single year of age (0 to 105 and over) and sex
- in, out and net international migration by single year of age (0 to 105 and over) and sex
- in, out and net total migration by single year of age (0 to 105 and over) and sex

For the principal projection, figures cover the period mid-2014 to mid-2114. For the variant projections, files contain projected figures to mid-2039. Variant projections up to 100 years ahead can be requested from the Population Projections Unit.

The interactive population pyramids[18] allow you to analyse the age structure of the population more easily. By animating the graph, you can compare the alternative projections and show how the population structure is projected to change over time.

An interactive article[19] "How big will the UK population be in 25 years time?", allows you to view trends in the principal and variant projections graphically to mid-2039.

Period and cohort life expectancy data[20] derived from historic mortality rates (from 1981 to 2014) and assumed calendar year mortality rates from the 2014-based national population projections are also available on our website.

Further information

Further information about the national population projections may be obtained from the Office for National Statistics, Population Projections Unit, Population Statistics Division, Segensworth Road, Titchfield, Fareham, Hampshire PO15 5RR.

Telephone: +44 (0) 1329 444652

E-mail: projections@ons.gsi.gov.uk

7. References

1. Full results of the 2014-based principal and variant projections can be found at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29/relateddata?page=1
2. Mid-2014 estimates for each constituent country of the UK are available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/2015-06-25

3. Thatcher AR, Kannisto V and Andreev K (2002). The survivor ratio method for estimating numbers at high ages. Demography 6. Available at: http://www.demographic-research.org/volumes/vol6/1/

4. Mid-2014 estimates of the very elderly (including centenarians) for England, Wales and the UK are available at: http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/ageing/bulletins/estimatesoftheveryoldincludingcentenarians/2015-09-30

5. Population estimates for Scottish Centenarians are available at: http://www.gro-scotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates/estimates-of-special-populations/population-estimates-for-scottish-centenarians

6. Population estimates of those aged 85 and over in Northern Ireland are available at: http://www.nisra.gov.uk/demography/default.asp134.htm

7. ONS national population projections quality and methodology report available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/qmis/nationalpopulationprojectionsqmi

8. For a good introduction to projections methodology see Chapters 16 to 18 of Hinde A Demographic Methods. Arnold. (1998)

9. Subnational population projections (England) are available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/subnationalpopulationprojectionsforengland/2014-05-29

10. Subnational population projections (Wales) are available at: http://gov.wales/statistics-and-research/local-authority-population-projections/

11. Subnational population projections (Scotland) are available at: http://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-projections/sub-national-population-projections

12. Subnational population projections (Northern Ireland) are available at: http://www.nisra.gov.uk/demography/default.asp47.htm

13. 2008-based marital status projections for England and Wales. Available at: http://webarchive.nationalarchives.gov.uk/20100910180945/http://statistics.gov.uk/STATBASE/Product.asp?vlnk=14491

14. Department for Communities and Local Government household projections for England are available at: https://www.gov.uk/government/collections/household-projections

15. See: http://budgetresponsibility.org.uk/economic-fiscal-outlook-november-2015/

16. Regional population projections produced by Eurostat are available at: http://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-data

17. World Population Prospects are available at: http://esa.un.org/wpp/unpp/panel_population.htm

18. Interactive population pyramid: http://www.neighbourhood.statistics.gov.uk/HTMLDocs/dvc219/pyramids/index.html

19. The national population projections interactive article is available at: http://visual.ons.gov.uk/how-big-will-the-UK-population-be-in-25-years-time/

20. Period and cohort life expectancy data: http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/bulletins/pastandprojecteddatafromtheperiodandcohortlifetables/2014baseduk1981to2064

8. Background notes

1. These National Statistics are produced to high professional standards and released according to the arrangements approved by the UK Statistics Authority.

Compendium

Results, 2014-based national population projections reference volume

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1 . Introduction

This chapter presents the main findings from the 2014-based national population projections for the UK. Included are sections on:

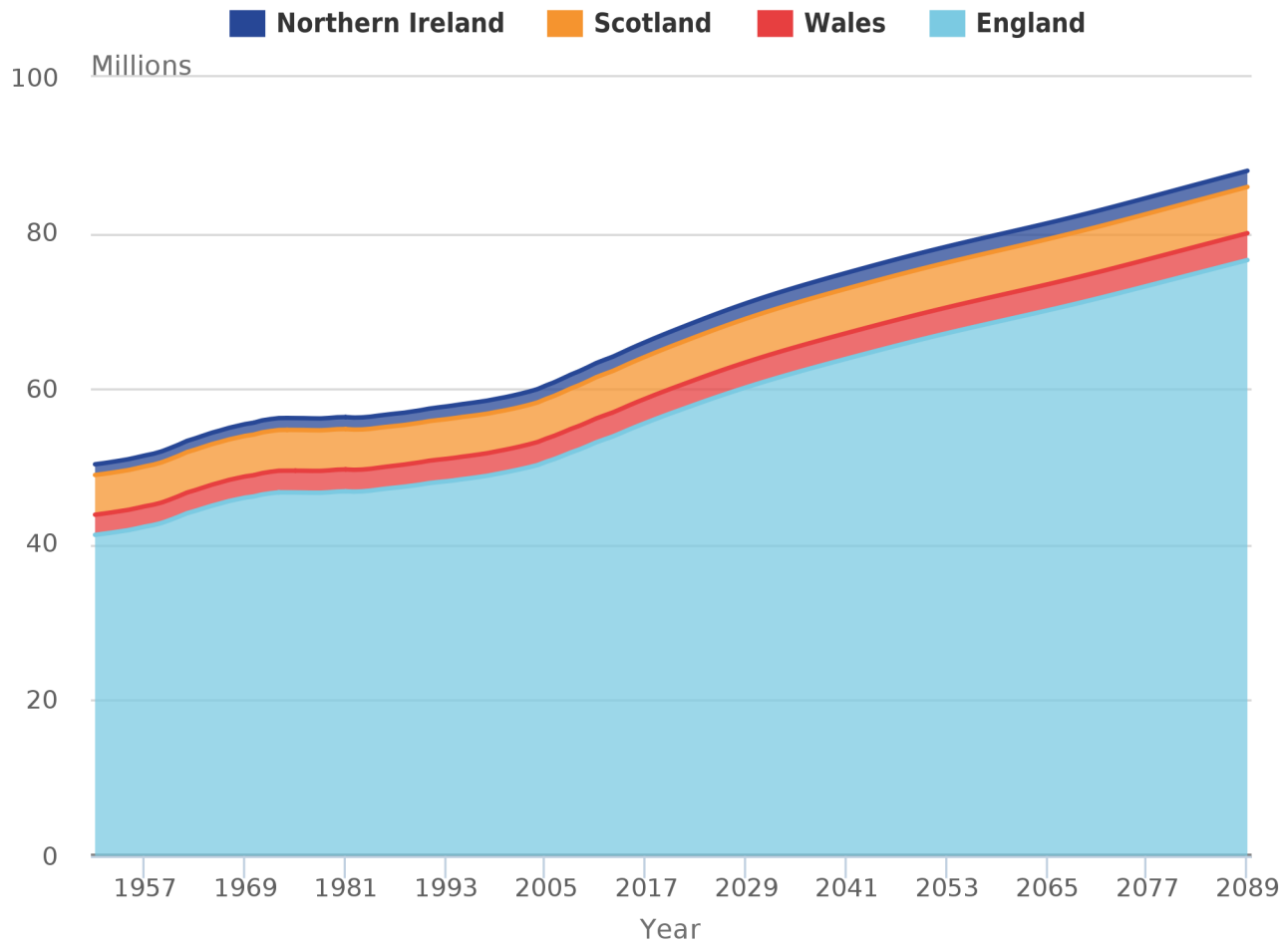
- future size of the population
- age structure
- comparison with the 2012-based population projections

Discussion of the results of the variant projections can be found in Chapter 6.

2 . Future size of the population

The UK population is projected to increase by 9.7 million (15%) over the next 25 years, from an estimated 64.6 million in mid-2014 to 74.3 million in mid-2039. Longer-term projections suggest that the population will continue rising beyond mid-2039, reaching 88.0 million by mid-2089. Figure 2.1 shows the estimated and projected population of the UK and its constituent countries between mid-1951 and mid-2089.

Figure 2.1: Estimated and projected population, UK and its constituent countries, mid-1951 to mid-2089



Source: Office for National Statistics, NRS, NISRA

The population of England is projected to increase by 17% by mid-2039. The population of other UK countries are also projected to increase, but at a slower rate. Northern Ireland is projected to increase by 10%, Scotland by 7% and Wales by 6% over the 25 year period to mid-2039. Beyond mid-2039, the populations of all 4 constituent countries are projected to rise; however, Northern Ireland projects very small year-on-year decreases in the late 2050s and 2060s before increasing to its peak in the longer-term. These small decreases in population are a result of the age and sex structure of the population of Northern Ireland leading to a slightly increased number of deaths, lower number of births and higher net out migration to other countries of the UK during this period.

3 . Births, deaths and migration

Of the 9.7 million projected increase in the population by mid-2039, 4.7 million (49%) is due to projected natural increase (more births than deaths) and 5.0 million (51%) is due to assumed net migration. Table 2.1 contains a breakdown of the components of population change of the UK population projections for the 5 year periods between mid-2014 and mid-2039.

The projected number of births and deaths are themselves partly dependent on the assumed level of net migration. As migration is concentrated at young adult ages, the assumed level of net migration affects the projected number of women of childbearing age and hence the projected number of births. Thus, about 68% of the projected increase in the population over the period mid-2014 to mid-2039 is either directly attributable to future migration (51% of projected growth), or indirectly attributable to future migration through its effect on births and deaths (17% of projected growth).

Table 2.1: Projected components of change, UK, mid-2014 to mid-2039

millions

		2014 to 2019	2019 to 2024	2024 to 2029	2029 to 2034	2034 to 2039
Population at start		64.6	66.9	69.0	71.0	72.7
	Births	3.9	4.0	4.0	4.0	4.1
	Deaths	2.9	2.9	3.0	3.2	3.4
	Natural change	1.1	1.2	1.0	0.8	0.6
	Net migration	1.2	0.9	0.9	0.9	0.9
	Total change	2.3	2.1	2.0	1.7	1.6
Population at end		66.9	69.0	71.0	72.7	74.3

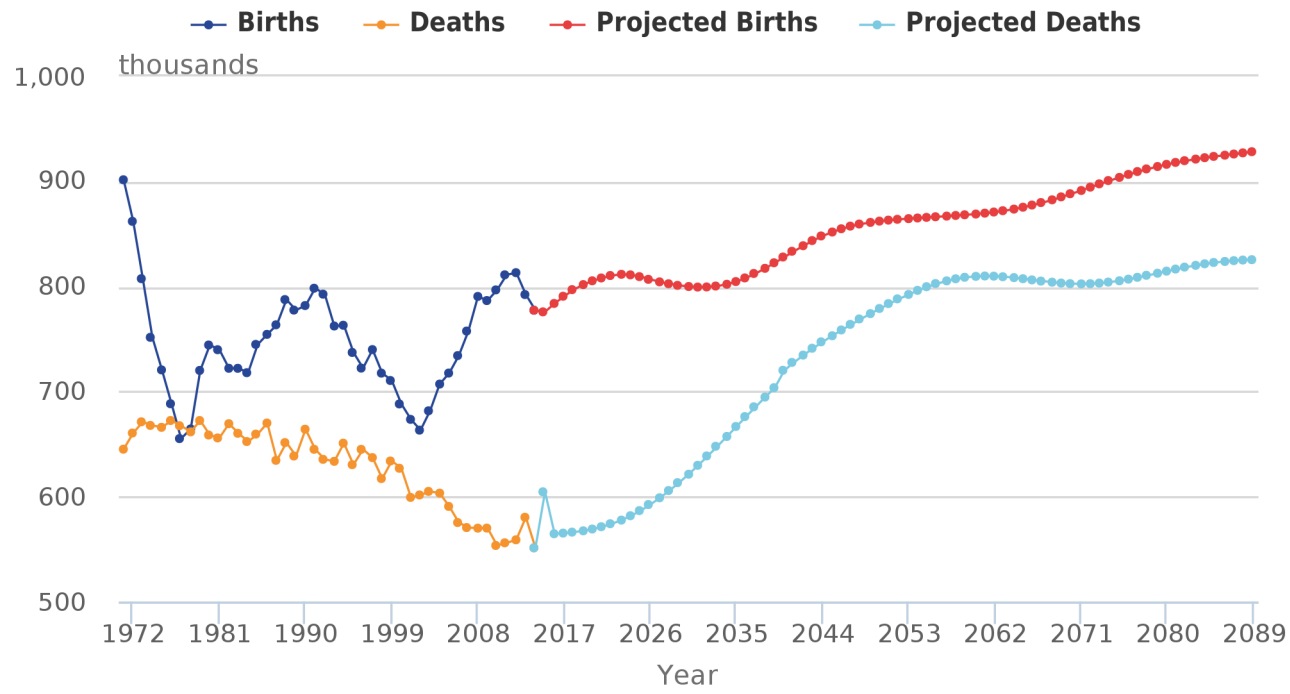
Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

With the single exception of the year ending mid-1977, the UK gained population through natural increase every year throughout the 20th century. Figure 2.2 shows the estimated and projected number of births and deaths in the UK since the year ending mid-1971.

Figure 2.2: Estimated and projected births and deaths, UK, year ending mid-1971 to year ending mid-2089



Source: Office for National Statistics

The equivalent charts for the constituent countries of the UK can be found in appendices A to D of the Results report published on 29 October 2015.

The total fertility rate[1] for the UK in the first year of the projection takes into account the provisional estimate of the number of births, leading to a slight decrease in the total fertility rate compared with the previous year. The total fertility rate assumption then increases to 1.89 in the long-term. Figure 2.2 shows that after the initial dip in the year ending mid-2015, births are projected to rise until mid-2023, before declining slightly, then rising again from mid-2032.

The annual number of deaths tends to vary year-on-year but has generally been declining in the last few years. The projected number of deaths in the first year of the projection reflects the provisional estimate of deaths in the year to mid-2015 where a higher than expected number of deaths was recorded, particularly in the first quarter (January to March) of 2015[2,3,4]. The mortality assumption in the year to mid-2016 has been set more in line with previous rates. Thereafter, the number of deaths is projected to rise with the steep increase reflecting deaths to the large cohorts born after the Second World War and those born during the 1960s “baby boom”.

It is assumed that annual net inward migration into the UK will be 185,000 persons per year from the year ending mid-2021 onwards. In the short-term, figures have been formulated to represent a transition from the last year of actual data to the long-term assumption. A short-term armed forces flow has been included to account for the planned return of home armed forces personnel and their dependants from Germany. International migration figures for the first year of the projection were set at a level higher than the mid-2014 estimate as published migration estimates for the first 3 quarters of the year to mid-2015 indicated a likely increase.

4 . Age structure

The age structure of the population is projected to change in future years as a result of past and projected changes in births, deaths and net migration. The main effects are summarised in Table 2.2 and Figure 2.3.

Table 2.2: Projected population by age, UK, mid-2014 to mid-2039

millions

Ages	2014	2019	2024	2029	2034	2039
0-14	11.4	12.0	12.3	12.3	12.3	12.4
15-29	12.6	12.4	12.3	12.6	13.2	13.5
30-44	12.7	12.9	13.6	13.7	13.3	13.2
45-59	13.0	13.4	12.9	12.6	12.7	13.4
60-74	9.7	10.4	11.1	12.0	12.4	12.0
75 and over	5.2	5.8	7.0	7.8	8.7	9.9
75-84	3.7	4.1	4.9	5.4	5.6	6.3
85 & over	1.5	1.7	2.0	2.4	3.2	3.6
All ages	64.6	66.9	69.0	71.0	72.7	74.3
Median age (years)	40.0	40.2	40.9	41.6	42.3	42.9
Under 16	12.2	12.7	13.1	13.1	13.2	13.2
Working age[1]	40.0	42.0	43.0	44.2	44.3	44.6
Pensionable age[1]	12.4	12.2	13.0	13.6	15.2	16.5

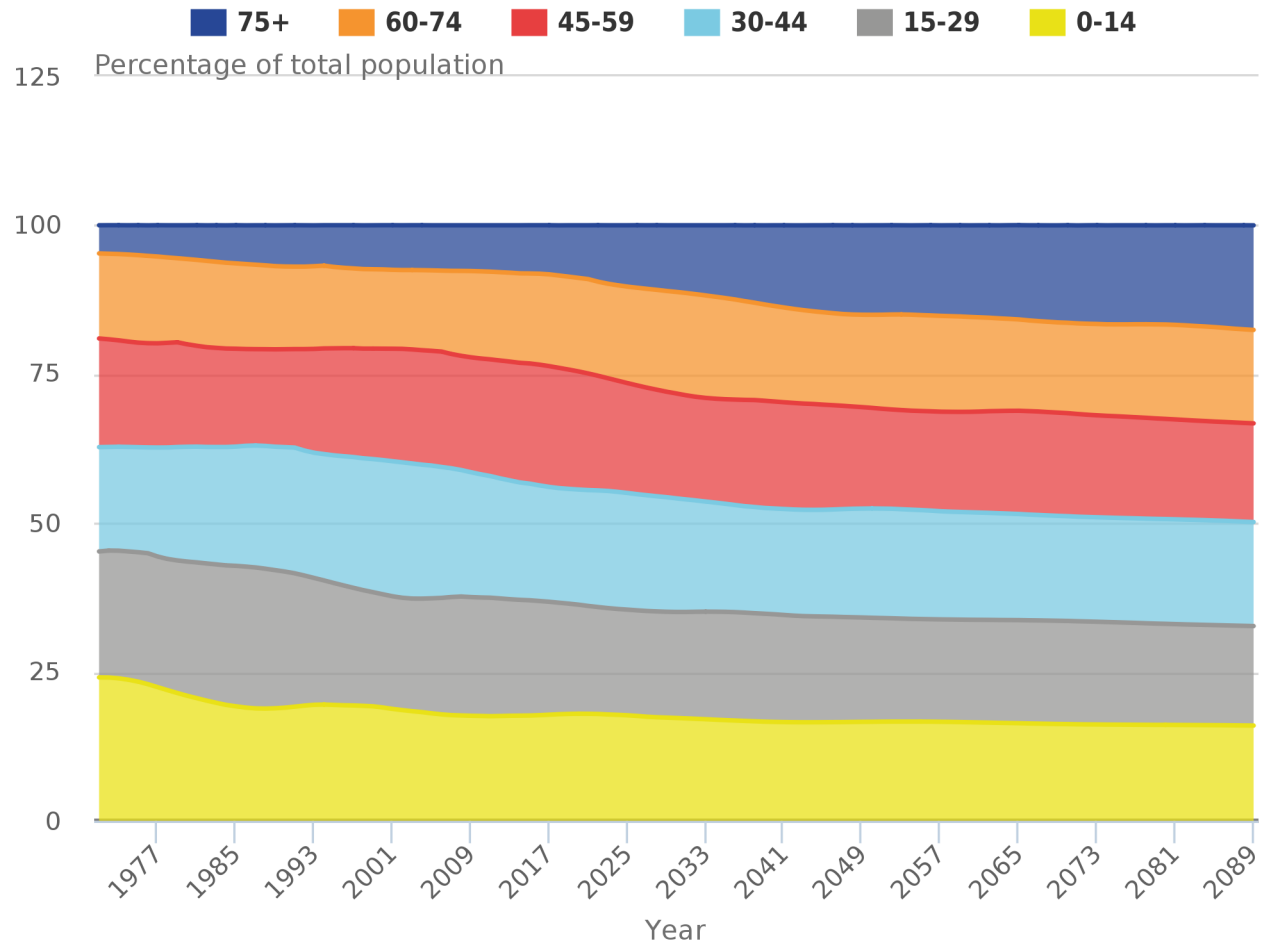
Source: Office for National Statistics

Notes:

1. Working age and pensionable age populations based on State Pension age for given year. Between 2012 and 2018, State Pension age will change from 65 years for men and 61 years for women, to 65 years for both sexes. Between 2019 and 2020, State Pension age will change from 65 years to 66 years for both men and women. Between 2026 and 2027 SPA will increase to 67 years and between 2044 and 2046 to 68 years for both sexes. This is based on SPA under the 2014 Pensions Act

2. Figures may not sum due to rounding

Figure 2.3: Percentage age distribution, UK, mid-1971 to mid-2089



Source: Office for National Statistics

The equivalent charts for the constituent countries of the UK can be found in appendices A to D of the Results report published on 29 October 2015.

The age structure is projected to become gradually older, with the median age of the population increasing from 40.0 years in mid-2014 to 42.9 years in mid-2039. Longer-term projections show continuing ageing, with the median age reaching 44.8 years by mid-2089.

Particularly notable is the projected increase in the population at older ages. By mid-2039, 13% of the population of the UK is projected to be aged 75 and over, compared with 8% in mid-2014. By mid-2089, this figure is projected to increase to 18%. The number of people aged 85 and over is projected to more than double by mid-2039, and the number of centenarians is projected to rise from 14,000 in mid-2014 to 83,000 in mid-2039 – nearly a 6 fold increase. The increase in the number of older people means that by mid-2039, 1 in 12 of the population is projected to be aged 80 or over.

Children and the population of working and pensionable ages

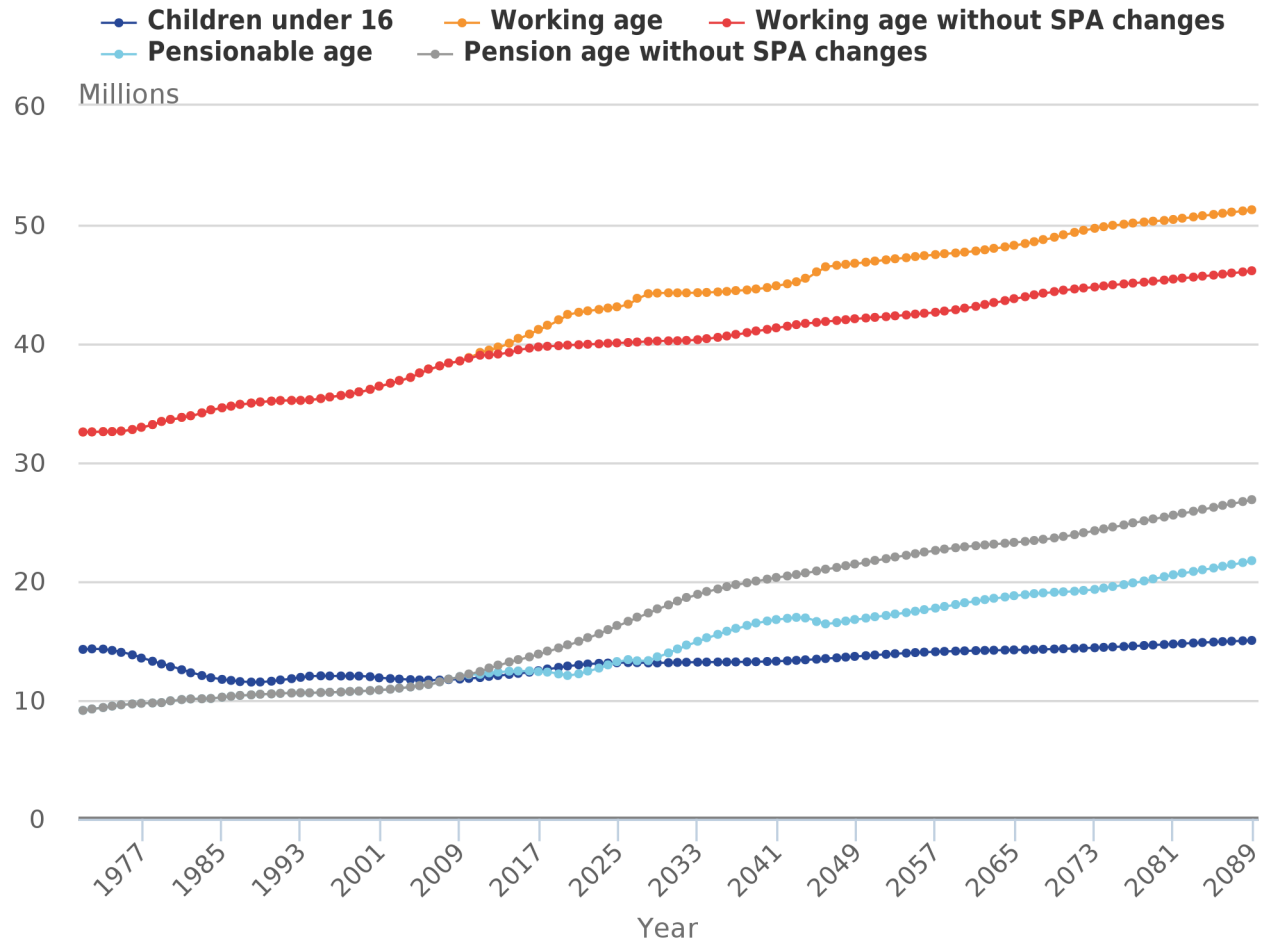
Under legislation introduced by the Pensions Act 1995, women's State Pension age was due to be equalised with men's, rising from 60 years in 2010 to 65 years by 2020. Following this, both women's and men's State Pension age would have increased to 66 years by 2026 under the Pensions Act 2007 and would then rise to 67 years by 2036 and to 68 years by 2046.

Under the provisions of the Pensions Act 2011, this timetable was amended. The State Pension age will change from 65 years for men and 60 years for women to 66 years for both sexes between 2018 and 2020. To enable the increase to 66 to be implemented from 2018, the Act also amended the timetable for equalising women's State Pension age with men's so that women's State Pension age rises more quickly from 2016 to reach 65 by 2018. There will then follow an increase in 2 stages to 68 years for both sexes between 2034 and 2046.

The Pensions Act 2014[5] brought the increase in the State Pension age from 66 to 67 forward by 8 years. The State Pension age for men and women will now increase to 67 between 2026 and 2028.

The 2014-based projections presented in this report and on our website incorporate these changed definitions to State Pension age as they occur during the projection period.

Figure 2.4: Estimated and projected number of children and populations of working and pensionable ages, UK, mid-1971 to mid-2089



Source: Office for National Statistics

Notes:

1. Working age and pensionable age populations based on State Pension age (SPA) for given year. Between 2012 and 2018, State Pension age will change from 65 years for men and 61 years for women, to 65 years for both sexes. Between 2019 and 2020, State Pension age will change from 65 years to 66 years for both men and women. Between 2026 and 2027, State Pension age will increase to 67 years and between 2044 and 2046 to 68 years for both sexes

The definition of the working age population used in this report is people aged between 16 and State Pension age. The size of the working population is affected by a number of different factors. This includes the level of net migration (much of which is young adults), the survivors of births 16 years earlier who enter the working age population and the size of the cohort about to leave the working age population and reach State Pension age.

The working age population is projected to rise by 11.4% from 40.0 million in mid-2014 to 44.6 million by mid-2039 and then reach 51.2 million by mid-2089. If State Pension age had remained at 65 years for men and 60 years for women, the population of working age would have been projected to rise from 39.2 million in mid-2014 to 41.1 million in mid-2039 and 46.1 million by mid-2089.

Despite increases in State Pension age, the population of pensionable age is projected to increase by 32.7% from 12.4 million in mid-2014 to 16.5 million by mid-2039. This increase is projected to continue in the long-term, reaching 21.7 million by mid-2089. Assuming State Pension age remained at 65 years for men and 60 years for women, the population of those of a State Pension age would have been projected to rise from 13.2 million in mid-2014 to 20.0 million by mid-2039, and to 26.9 million by mid-2089 (3.5 and 5.2 million higher, respectively, than with the current changes).

The number of children under the age of 16 is projected to rise by 8.8% between 2014 and 2039, from 12.2 million in mid-2014 to 13.2 million in mid-2039. The number is projected to increase to 15.0 million by mid-2089.

Dependency ratios

Changes to the age structure will over time affect the proportion of dependants in the population. The dependency ratio is the number of children aged under 16 or the number of people of pensionable age (or the sum of the 2) per 1,000 people of working age. These figures provide an indication only of dependency, as in reality, full-time education ends and retirement starts at a range of ages. Research has shown that labour market changes have in the past been a more important factor than demographic trends in influencing real (economic) dependency[6]. Table 2.3 and Figure 2.5 show the estimated and projected dependency ratios for the UK

Table 2.3: Projected dependants per thousand persons of working age, UK, mid-2014 to mid-2039

dependants per thousand of working age

Ages	2014	2019	2024	2029	2034	2039
Under 16	304	303	305	297	298	296
Pensionable age[1]	310	290	301	308	344	370
Total	614	594	606	605	642	666

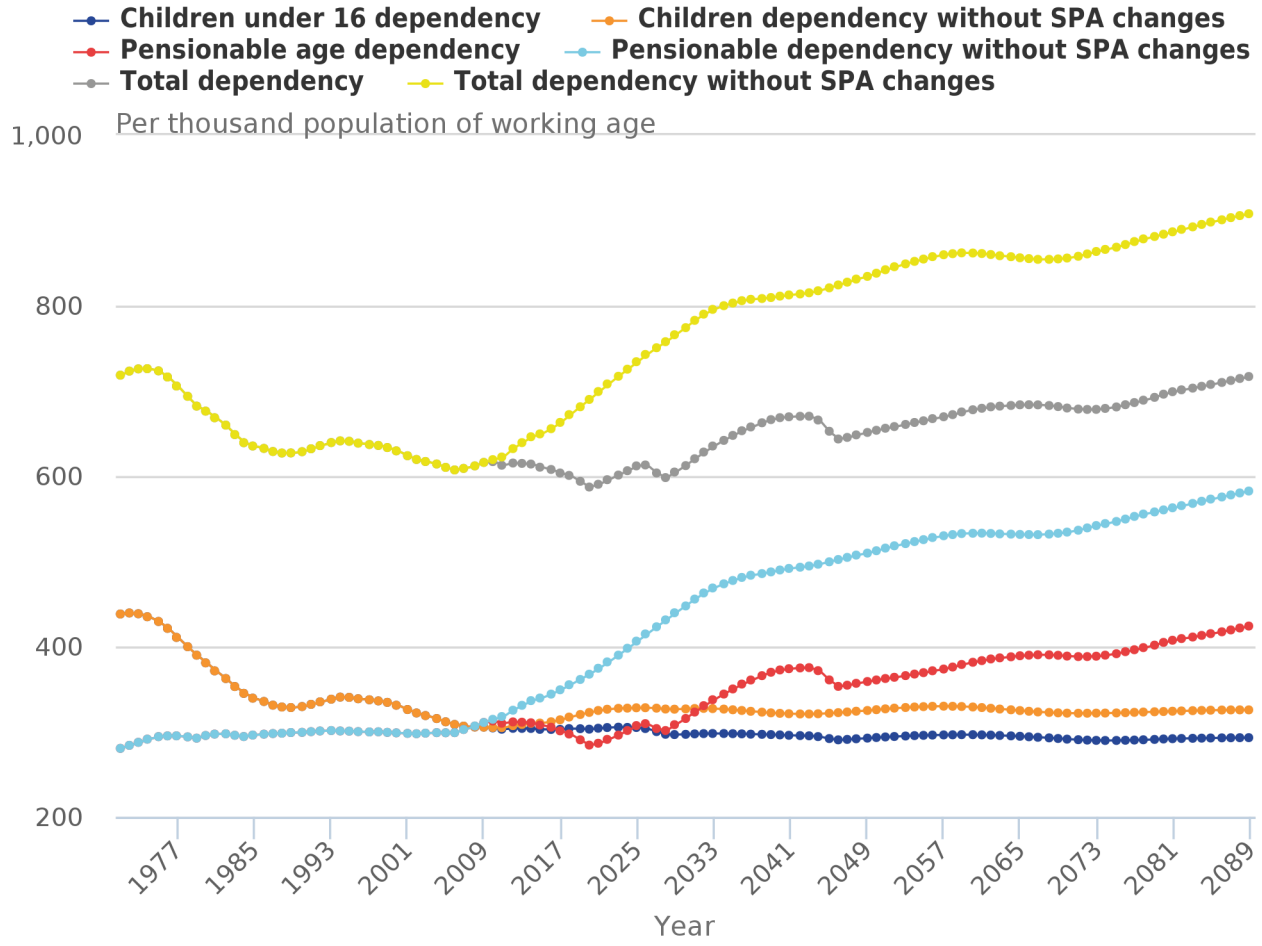
Source: Office for National Statistics

Notes:

1. Working age and pensionable age populations based on State Pension age for given year. Between 2012 and 2018, State Pension age will change from 65 years for men and 61 years for women, o 65 years for both sexes. Between 2019 and 2020, State Pension age will change from 65 years to 66 years for both men and women. Between 2026 and 2027 SPA will increase to 67 years and between 2044 and 2046 to 68 years for both sexes. This is based on SPA under the 2014 Pensions Act

2. Figures may not sum due to rounding

Figure 2.5: Estimated and projected dependency ratios, total, children and pensionable ages, UK, mid-1971 to mid-2089



Source: Office for National Statistics

Notes:

1. Working age and pensionable age populations based on State Pension age (SPA) for given year. Between 2012 and 2018, State Pension age will change from 65 years for men and 61 years for women, to 65 years for both sexes. Between 2019 and 2020, State Pension age will change from 65 years to 66 years for both men and women. Between 2026 and 2027, State Pension age will increase to 67 years and between 2044 and 2046 to 68 years for both sexes

The total dependency ratio (the number of dependants aged under 16 or of pensionable age per 1,000 of the working age population) for the UK was 614 in mid-2014. Over the period until mid-2020 when the State Pension age is set to rise to 66 years for both sexes, the total dependency ratio is projected to decline. The total dependency ratio then rises year-on-year with the exception of the timeframes when State Pension age rises to 67 and 68 years.

The longer-term projections suggest a total dependency ratio of 717 dependants per 1,000 persons of working age by mid-2089, which is similar to the ratios observed in the early 1970s. In the 1970s the majority of dependants were children, whereas longer-term projections comprise more dependants of pensionable age than those aged under 16. Research suggests that the cost of supporting a person aged 65 and over is, on average, greater than the cost of supporting a child[7].

Without the changes to State Pension age, the total dependency ratio would be projected to increase to a much higher level, with 725 dependants per 1,000 people of working age by mid-2024, 809 by mid-2039 and 908 by mid-2089.

The child dependency ratio (the number of children aged under 16 per 1,000 people of working age) declined markedly in the 1970s and 1980s. After some increases observed in the 1990s, it continued to decline to a ratio of 304 children per 1,000 people of working age in mid-2014. The child dependency ratio is projected to fluctuate over the next 75 years, but remain within a relatively narrow range. The highest expected ratio during the projection period (305 children per 1,000 people of working age) is expected in mid-2023, whilst the lowest ratio (290 children) is expected around mid-2074. The changes to State Pension age results in an increase to the working age population. Without these changes, the child dependency ratio would be slightly higher.

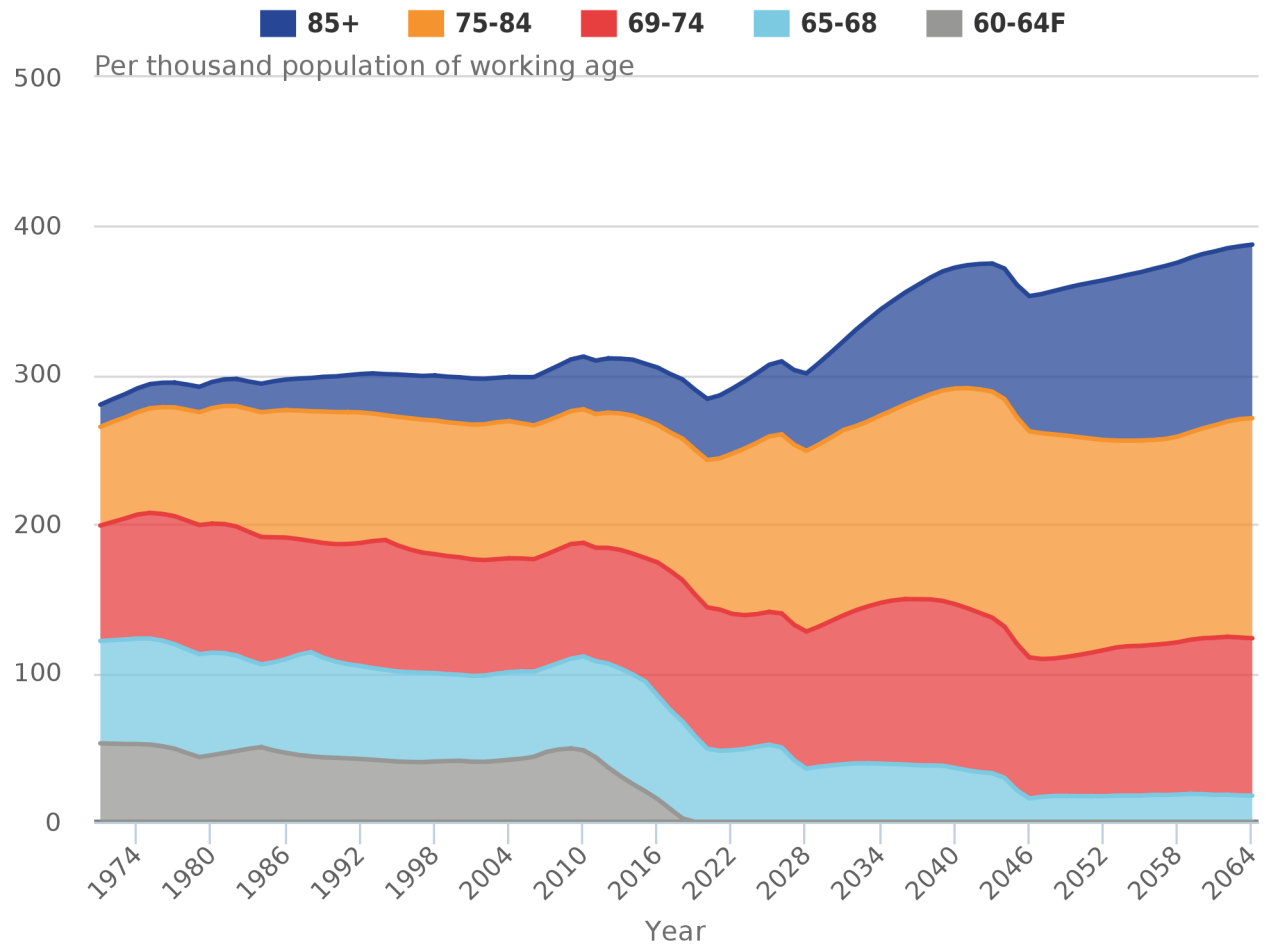
The pensionable age dependency ratio (the number of people of State Pension age per 1,000 people of working age) is affected more by the changes to the State Pension age and shows a very similar pattern to that of the total dependency ratio. The pensionable age dependency ratio is projected to fall from 310 per 1,000 persons of working age in mid-2014 to 284 by mid-2020. It then fluctuates before reaching a ratio of 424 pensioners per 1,000 persons of working age in mid-2089.

Without the changes in State Pension age, the pensionable age dependency ratio would have steadily risen over the projection period, reaching 398 pensioners per 1,000 persons of working age in mid-2024, 487 by mid-2039 and 582 by mid-2089. This is compared to 301, 370 and 424, respectively, based on the projections including the changes made to the State Pension age.

Figure 2.6 splits the pensionable age dependency ratio into 5 age bands (60 to 64 (females only), 65 to 68, 69 to 74, 75 to 84 and 85 and over). The first 2 bands represent the age groups which become part of the working age population by 2046. In mid-2014, persons aged 75 and over represented 42% of the population of pensionable age. This is projected to increase to 60% in mid-2039 and 68% by mid-2064.

Population ageing will be experienced to a greater or lesser extent in all Western countries. A report by Eurostat [8] based on the population projections in 2010 show that the UK will have proportionately fewer older people than most other EU countries over the coming decades.

Figure 2.6: Estimated and projected pensionable age dependency ratio, by age of dependant, UK, mid-1971 to mid-2064



Source: Office for National Statistics

Notes:

1. Working age and pensionable age populations based on State Pension age (SPA) for given year. Between 2012 and 2018, State Pension age will change from 65 years for men and 61 years for women, to 65 years for both sexes. Between 2019 and 2020, State Pension age will change from 65 years to 66 years for both men and women. Between 2026 and 2027, State Pension age will increase to 67 years and between 2044 and 2046 to 68 years for both sexes

5 . Long-term projections to mid-2089

The main focus of the projections is on the period to mid-2039. Longer-term projections have been discussed where appropriate. However, projections become increasingly uncertain the further they are carried forward into the future, as demographic trends change from those being assumed.

The annual number of births is projected to still be increasing in the long-term, reaching around 928,000 by mid-2089. The annual number of deaths is projected to reach around 825,000 by mid-2089. The excess of births over deaths (or “natural change”) is projected to reach a peak of 237,000 in mid-2021, before reducing to a difference of 60,000 in mid-2060. After this point, the excess of births over deaths is projected to rise again on an annual basis to 104,000 in mid-2080, followed by fluctuation further into the projections. In the year ending mid-2089 the excess of births over deaths is projected to be 103,000. These patterns are mainly the result of the current age structure of the UK. The excess of births over deaths, combined with the assumed level of net inward migration, means that the UK population is projected to continue to rise strongly throughout the projection period, reaching 88.0 million by mid-2089.

Population increases are greatest at the older ages. The number of people aged 60 and over is projected to rise throughout the projection period, with nearly twice the number of people aged 60 and over by mid-2089 (29.3 million), compared with mid-2014 (14.9 million). However, the number of persons aged 80 and over is projected to rise even faster, doubling by mid-2039 and increasing to more than 3.5 times the mid-2014 estimate by mid-2089. This will have implications for health and social care resource.

Although these very long-term figures are subject to great uncertainty, they show the consequences that would follow if the long-term assumptions of fertility, mortality and migration were to be realised in practice.

Longer-term projections to mid-2114 are available for the principal projection released on 29 October 2015.

6 . Comparisons with 2012-based projections

The 2014-based population projections are different to the 2012-based projections as the 2014-based figures use the latest available population estimates (mid-2014) as the base year. Further to this, the underlying assumptions about fertility, mortality and migration have been reviewed. Revised assumptions have been adopted for the 2014-based projections.

Changes in assumptions

Table 2.4 shows the long-term fertility, mortality and migration assumptions used in the 2014-based projections compared with those used for the 2012-based projections.

Table 2.4: Long-term principal assumptions for the UK 2014-based national population projections compared with assumptions for the 2012-based projections

	United Kingdom	England	Wales	Scotland	Northern Ireland
Fertility – Long-term average number of children per woman					
2014-based	1.89	1.90	1.90	1.70	2.00
2012-based	1.89	1.90	1.90	1.75	2.00
Mortality - Expectation of life at birth in 2039[1]					
Males 2014-based	84.1	84.3	83.4	82.3	83.3
Males 2012-based	84.3	84.5	83.8	82.2	83.5
Females 2014-based	86.9	87.1	86.4	85.0	86.5
Females 2012-based	87.5	87.8	87.1	85.7	87.0
Net migration[2] – Annual long-term assumption					
2014-based	+185,000	+170,500	+4,000	+9,500	+1,000
2012-based	+165,000	+150,000	+3,000	+12,000	0

Source: Office for National Statistics

Notes:

1. Expectations of life for 25 years ahead given as example year. Note these are period expectations of life based on the mid-year mortality rates assumed for the year 2039 and do not take account of the continuing improvement in mortality projected beyond 2039

2. Net migration includes international migration and cross-border migration between the countries of the UK

Fertility

The long-term assumptions of completed family size for the UK and constituent countries remain the same as the 2012-based projections, except for Scotland where the completed family size is 0.5 children lower in the 2014-based projections compared with the 2012-based projections.

Mortality

The 2014-based projections assume that rates of improvement will converge to 1.2% for most ages in mid-2039 and remain at 1.2% each year thereafter. Those born between 1925 and 1938 are assumed to experience higher rates of improvement than 1.2% in mid-2039, while those born before 1922 are assumed to experience annual rates of improvement below 1.2%. These are the same assumptions for the rates of mortality improvement in the target year as those used in the 2012-based projections (where the target year was mid-2037). The projected period life expectancy at birth for mid-2039 are around 0.2 years lower than in previous projections for males and 0.6 years lower for females. This is because higher mortality rates have been assumed at nearly all ages and lower rates of mortality improvement at most ages over 65 in 2014 compared with those projected for 2014 in the 2012-based projections.

Migration

The long-term assumption for net migration to the UK is +185,000 each year, +20,000 higher than the figure of +165,000 a year projected in the 2012-based projections.

The assumed level of annual net international migration to England is +170,500, which is 20,500 higher than for the 2012-based projections. For Wales and Northern Ireland, it is 1,000 higher at +4,000 and +1,000 a year respectively. The assumption for Scotland is 2,500 lower than in the 2012-based projections at +9,500. These changes reflect the most recent trends in international migration and advice from an expert academic advisory panel.

In the 2014-based projections, the methodology for setting assumptions for the flows between the countries of the UK was changed to using rates rather than a fixed number of migrants. These cross-border rates were applied to the population by age and sex each year taking into account the population size of both the origin and destination country. Using a rates-based method results in the projected number of migrants moving between countries of the UK varying year-on-year. For the 2012-based projections, the movement of people between countries of the UK was assumed to be constant in the long-term.

For the year ending mid-2039, England and Northern Ireland had a projected net outflow of migrants to other countries of the UK of -6,000 and -800 respectively (compared with long-term assumptions of -6,500 and 0 respectively in the 2012-based projections). Whereas Scotland had a projected net inflow of 5,500 and Wales a projected net inflow of 1,300 from other countries of the UK (compared with the 2012-based long-term assumptions of 3,500 and 3,000 respectively).

Base population

Table 2.5 shows the estimated population change between mid-2012 and mid-2014 compared with the projected change from the 2012-based projections. At mid-2014, the estimated population of the UK was 86,000 higher than the projections for mid-2014 in the 2012-based projections.

Table 2.5: Population change, mid-2012 to mid-2014: estimated change compared with 2012-based projected change, UK

thousands

	Mid-year estimates	2012-based projections	Difference	Percentage difference
Population at mid-2012	63,705	63,705	0	0.0
Components of change (2012 to 2014)				
Births	1,570	1,606	-36	-2
Deaths	1,131	1,130	1	0
Natural change	438	476	-38	-
Net migration and other changes[1]	453	330	123	-
Total change	892	806	86	-
Population at mid-2014	64,597	64,511	86	0
England	54,317	54,228	89	0
Wales	3,092	3,095	-3	-0
Scotland	5,348	5,346	1	0
Northern Ireland	1,840	1,842	-1	-0

Source: Office for National Statistics

Notes:

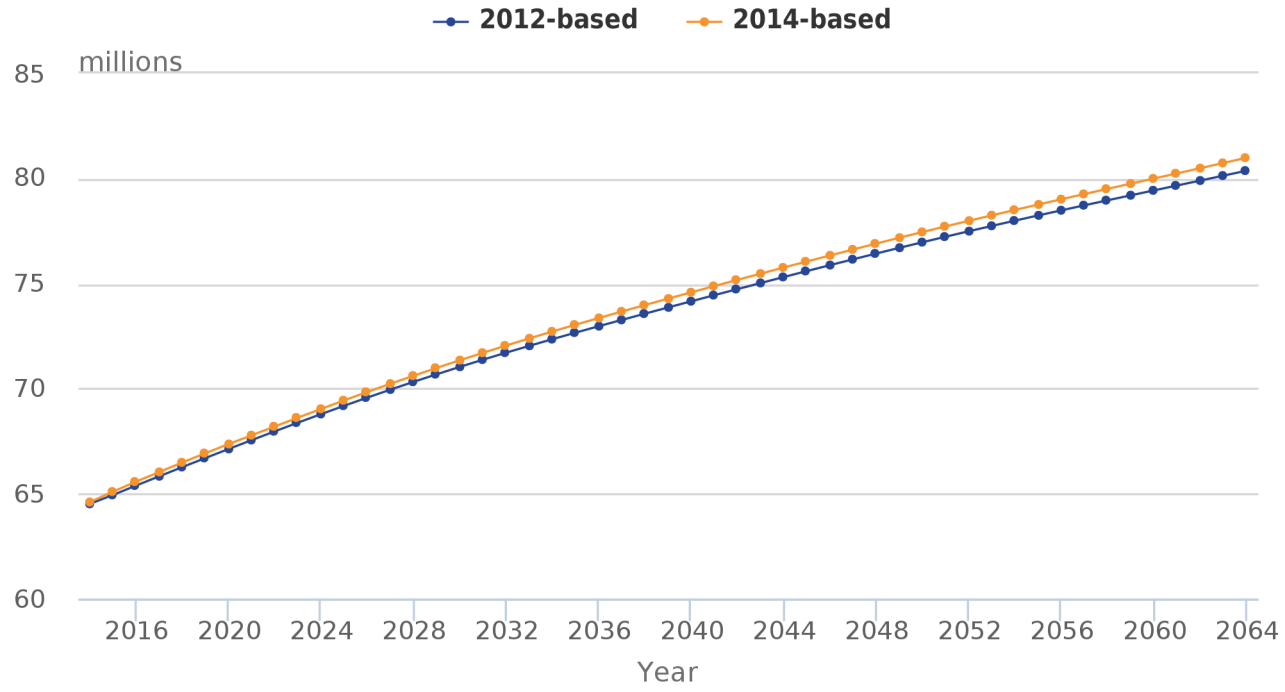
1. Including net movements of Armed Forces and other small changes

2. Figures may not sum due to rounding

Total UK population

The 2014-based population projection for the UK is higher than in the 2012-based projections (Figure 2.7). This is partly attributable to the base 2014 population estimate being 86,000 higher in the 2014-based projection than in the 2012 projections. The remainder of the difference reflects changes in the age structure of the base population (which affects the numbers of projected births and deaths) and changes in assumptions made in the 2014 projections as described previously.

Figure 2.7: 2012-based and 2014-based population projections, UK, mid-2014 to mid-2064



Source: Office for National Statistics

Table 2.6 breaks down the change in the projected population between the 2014-based and 2012-based projections to differences in base population, births, deaths and net migration. Figures are shown 1 year, 10 years and 25 years into the projection.

For the UK, the changed assumptions result in there being around 141,000 fewer births, 198,000 more deaths and 502,000 more net migrants projected over the decade to mid-2024.

Table 2.6: Change in UK projected population compared with 2012-based projections

thousands

				Change due to difference in:		
	2014-based projection	2012-based projection	Total change	Base population	Projected births	Projected deaths	Projected migrants
Population at mid-2015							
England	54,780	54,613	166	89	-30	-47	154
Wales	3,101	3,107	-6	-3	-2	-4	3
Scotland	5,365	5,365	-1	1	-2	-5	5
Northern Ireland	1,851	1,852	-0	-1	-0	-1	3
United Kingdom	65,097	64,938	160	86	-34	-57	165
Population at mid-2024							
England	58,396	58,073	324	89	-93	-165	493
Wales	3,187	3,216	-29	-3	-13	-13	-0
Scotland	5,514	5,564	-49	1	-34	-15	-2
Northern Ireland	1,939	1,935	4	-1	-1	-4	11
United Kingdom	69,036	68,788	249	86	-141	-198	502
Population at mid-2039							
England	63,282	62,718	563	89	-26	-303	803
Wales	3,280	3,332	-52	-3	-17	-25	-7
Scotland	5,701	5,804	-102	1	-73	-24	-7
Northern Ireland	2,021	2,011	10	-1	6	-8	13
United Kingdom	74,284	73,865	419	86	-109	-359	802

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

Table 2.6 shows that in England, the projected population is higher than in the 2012-based projections for all 3 years, but for Wales and Scotland, the projected population is lower than the 2012-based projections for all 3 years. The Northern Ireland 2014-based projection is higher than the 2012-based projection in mid-2024 and mid-2039 and is more or less the same at mid-2015. The largest relative difference is at mid-2039 for Scotland, where the 2014-based population projection is 1.8% lower than the 2012-based projection.

There has been a decrease in projected deaths across years for all countries and an increase in net migration for most countries. There has generally been a decrease in births projected in all countries with the exception of Northern Ireland, where projected births over the 25 years to mid-2039 are higher than the 2012-based projections.

Distribution by age and sex

The change in the projected size of the UK population for selected age groups is shown in Table 2.7. Compared with the 2012-based projections, the projected UK population at mid-2039 in the 2014-based projections is higher for those in the age groups between 0 to 74 mainly reflecting the higher net international migration assumptions in the 2014-based projections. For the older population aged 75 and over, the UK population at mid-2039 is lower in the 2014-based projections than the 2012-based projections, reflecting the lower rates of mortality improvement at most ages over 65 and subsequently lower projected period life expectancy at birth.

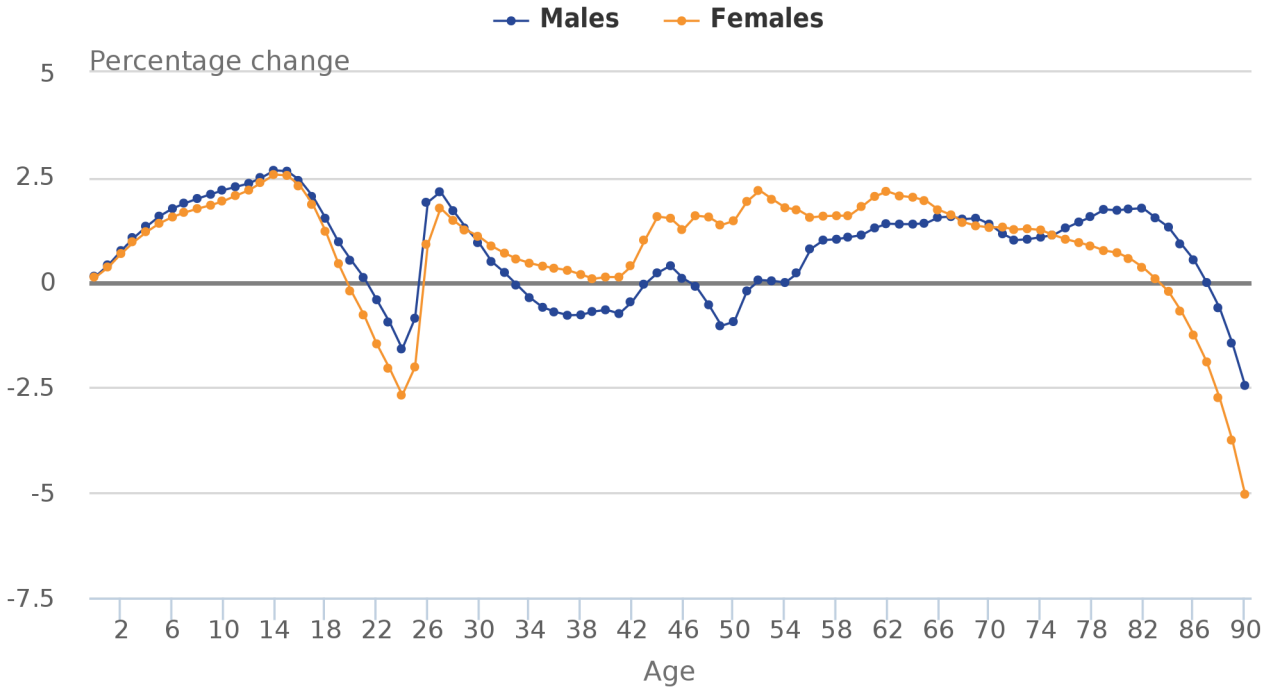
Table 2.7: Change in projected population by age group, UK, 2014-based projections compared with 2012-based projections

	mid-2014		mid-2024		mid-2034		mid-2039	
Age	Thousands	%	Thousands	%	Thousands	%	Thousands	%
Under 16	53	0.4	35	0.3	173	1.3	216	1.7
16-29	-44	-0.4	94	0.8	68	0.6	57	0.5
30-44	29	0.2	65	0.5	15	0.1	19	0.1
45-59	33	0.3	118	0.9	131	1.0	116	0.9
60-74	19	0.2	86	0.8	145	1.2	175	1.5
75 and over	-4	-0.1	-149	-2.1	-166	-1.9	-164	-1.6
All ages	86	0.1	249	0.4	366	0.5	419	0.6

Source: Office for National Statistics

Figure 2.8 shows the changes by individual age and sex. Overall, the male and female projected UK populations are both 0.6% higher than the 2012-based projections.

Figure 2.8: Change in projected population at mid-2039 by age and sex compared with the 2012-based projections, UK



Source: Office for National Statistics

Notes:

1. Where the percentage change is greater than 0, the 2014-based projection is greater than the 2012-based projection

2. Where the percentage change is less than 0, the 2014-based projection is less than the 2012-based projection

The differences observed for particular ages reflect the differences between the base population and underlying assumptions between the 2012-based and 2014-based projections. For example, the reduction in males and females in their early 20s is due to the lower short-term fertility assumptions in the 2014-based projections, leading to a lower number of births to the cohorts reaching their early 20s in mid-2039.

7. References

1. The total fertility rate is a summary of fertility and is defined as the average number of children that would be born per woman if all women lived to the end of their childbearing years and experienced the exact current age-specific fertility rates throughout their lifetime.

2. Excess winter mortality in England and Wales available at: http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/previousReleases

3. Excess winter mortality in Scotland available at: http://www.gro-scotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/vital-events/deaths/winter-mortality

4. Excess winter mortality in Northern Ireland available at: http://www.nisra.gov.uk/demography/default.asp32.htm

5. Pensions Act 2014: http://www.legislation.gov.uk/ukpga/2014/19/contents

6. Johnson P. and Falkingham J. Ageing and economic welfare. Sage publications (1992).

7. Replacement migration: is it a solution to declining and ageing populations? United Nations (2000).

8. Eurostat Statistical Focus: 'The greying of the baby boomers – A century long view of ageing in European populations', May 2011, available at: http://ec.europa.eu/eurostat/en/web/products-statistics-in-focus/-/KS-SF-11-023

8. Background notes

1. The 2014-based Population Projections for the UK and constituent countries were published 29 October 2015 (main release) and the extra variants were published 26 November 2015.

2. These National Statistics are produced to high professional standards and released according to the arrangements approved by the UK Statistics Authority.

Compendium

Fertility, 2014-based national population projections reference volume

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1 . Introduction

For the UK as a whole, the main measure used in setting the fertility assumptions in the national projections is average completed family size; the average number of live-born children per woman which a group of women born in the same year have had by the end of their childbearing years. This has been falling from a peak of nearly 2.5 children per woman for women born in the mid-1930s and the projections assume that this will level off at 1.89 children per woman for women born in 2015 and later. This long-term assumption is unchanged from the 2012-based projections at the UK level.

The assumptions made about completed family size, which underlie this projection round, are based on an analysis of recent trends in fertility and an assessment of their implications for future completed family sizes, together with other relevant information such as the views of the expert advisory panel. These assumptions about future levels of fertility are set for each of the UK's constituent countries separately and then combined to obtain the assumption for the UK as a whole.

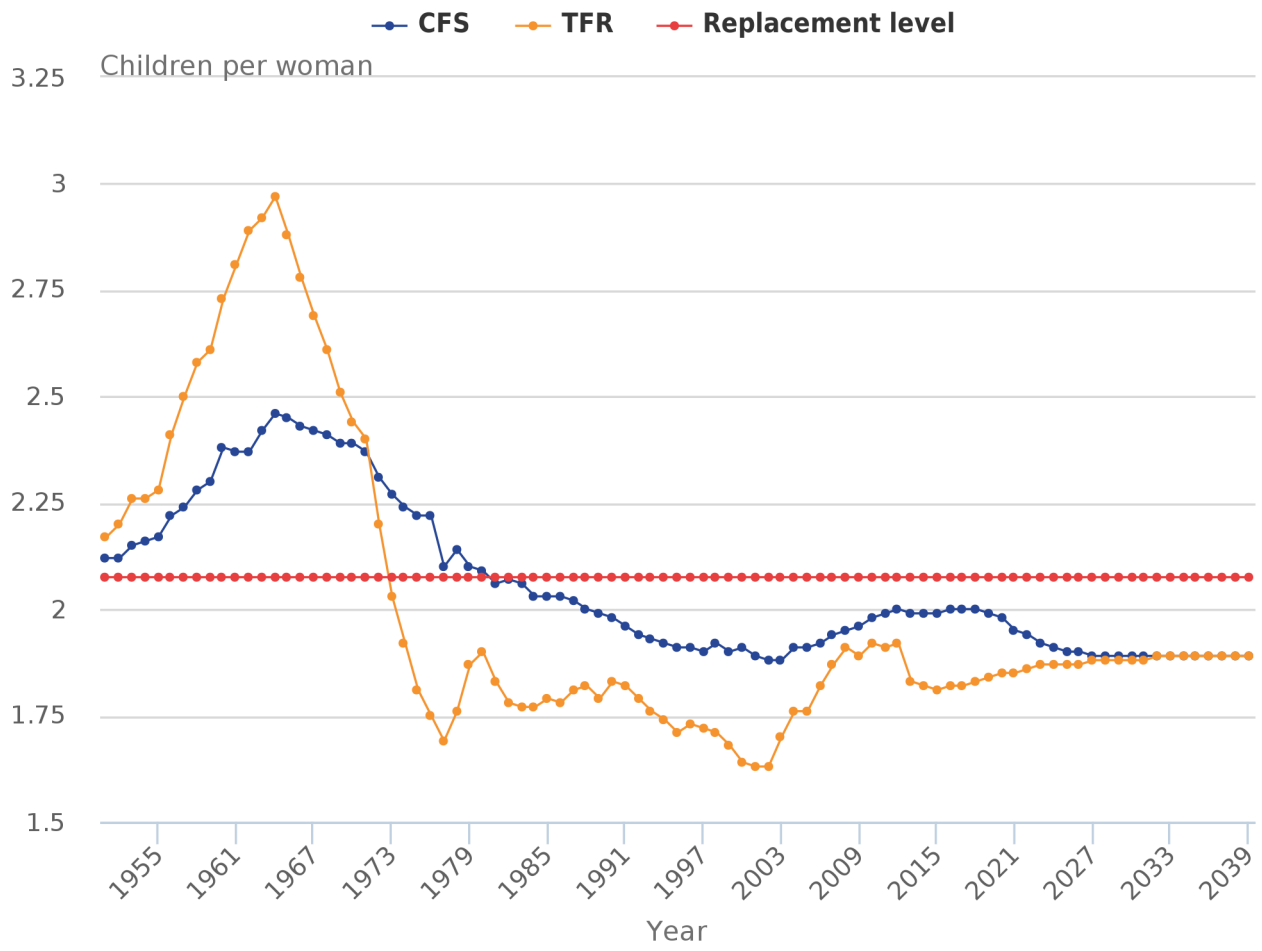
This chapter discusses past trends in fertility and summarises the resulting assumptions adopted for the 2014-based projections.

2 . Recent trends in fertility

Fertility assumptions are formulated in terms of completed family size. As Figure 3.1 shows, the cohort measure of fertility is more stable than the total fertility rate (TFR), which is based on the calendar year (period measure). This is because the completed family size is affected only by changes in the total number of children women have and not by the timing of births within women's lives. The TFR, in contrast, may rise or fall if births are brought forward or delayed for any reason[1]. The TFR measures the average number of children that a group of women would have if they were to experience the age-specific fertility rates of the year in question throughout their childbearing lives.

The completed family size is plotted against the year in which women were, or will be, aged 30 (the approximate mid-point of childbearing ages). Average completed family size reached around 2.45 children per woman among those born in the mid-1930s, who would have been in their peak childbearing ages in the early to mid-1960s. Since then, the completed family size in the UK has fallen steadily, with women born in 1969 – the most recent cohort for whom there are data up to exact age 45 – having an average of 1.90 children.

Figure 3.1: Estimated and assumed total fertility rate (TFR) and average completed family size (CFS), UK, 1951 to 2039



Source: Office for National Statistics

Notes:

1. Completed family size relates to cohort born 30 years earlier – 30 years being the approximate mid-point of the childbearing ages. Projected completed family size is given for cohorts who have not yet completed childbearing

2. All fertility data are displayed on a calendar year basis

3. Replacement fertility is the level of fertility required for the population to replace itself in size in the long-term. In the UK, women would need to have, on average, 2.075 children to ensure long-term "natural" replacement of the population

Fertility rates in the UK fell sharply from the “baby boom” peak in the TFR of just under 3 children per woman in 1964 to a trough of 1.69 in 1977. During the 1980s, the TFR stayed relatively stable at around 1.80 children and then fell to around 1.70 in the second half of the 1990s. In recent years the UK has generally seen increases in the TFR, from 1.63, the lowest point ever recorded in 2001, to 1.92 in 2010 and 2012, the highest since 1974. However, in 2013 there was a substantial drop in the UK TFR from 1.92 to 1.83 (the largest single year change since 1975).

Fertility rates among women in their 30s and 40s in the UK have continued to rise at a fast pace since the turn of the century, reaching levels last seen during the 1960s “baby boom”. This increasing fertility among older women continued until 2012 despite the TFR drop in 2009. Since 2002, there have also been smaller increases in fertility among women in their late 20s and stabilisation among women in their early 20s, following declining fertility in this age group during the 1990s. Fertility rates for women aged under 20 have been declining since their peak in the late 1960s. The combination of trends in these age groups has led to the rise in overall fertility over the decade, as well as further small increases in the average age at childbirth. The drop in fertility in 2013 was experienced by all age groups with the exception of women aged 40 and over, who experienced a small increase in fertility compared with 2012.

Apart from the recuperation in fertility at older ages by women born in the late 1960s and 1970s, other factors that could be associated with recent increases in period fertility include the increasing proportion of women of childbearing age born outside the UK (who have above UK-born average fertility) and the possible role of changes relating to support for families (such as tax credits or maternity and paternity leave) – see references [2,3,4,5,6,7] for further discussion of these factors.

The 1965, 1970 and 1975 cohorts have had steadily fewer children by the ages of 25 and 30 than earlier cohorts and this trend continues with the data now available for the 1980 and 1985 cohorts. The exception is a rise in the average achieved family size, at the age of 30, between the 1975 and 1980 cohorts (Table 3.1). This is due to a growth in the number of children achieved between the exact ages of 25 and 30. The 1975 cohort achieved 0.47 children, whereas the 1980 cohort achieved 0.50 children. This reflects the increases in the period fertility of 25 to 29 year olds from 2002 to 2008.

Table 3.2 shows women have been increasingly “catching up” in their 30s. For example, women born in 1980, on average, achieved 0.56 children between their 30th and 35th birthdays compared with 0.47 for women born 10 years earlier.

Table 3.1: Average achieved family size by age (exact years) and year of birth woman, UK, women born 1950 to 1995

	Age						
Cohort born	20	25	30	35	40	45	Final
1950	0.23	0.93	1.56	1.93	2.06	2.09	2.09
1955	0.22	0.78	1.43	1.84	2.00	2.03	2.03
1960	0.16	0.68	1.31	1.75	1.94	1.98	1.98
1965	0.13	0.59	1.18	1.64	1.85	1.91	1.91
1970	0.15	0.57	1.09	1.56	1.83	1.90	1.91
1975	0.15	0.51	0.98	1.51	1.83	…	…
1980	0.15	0.50	1.00	1.55	…	…	…
1985	0.14	0.49	1.01	…	…	…	…
1990	0.13	0.47	…	…	…	…	…
1995	0.09	…	…	…	…	…	…

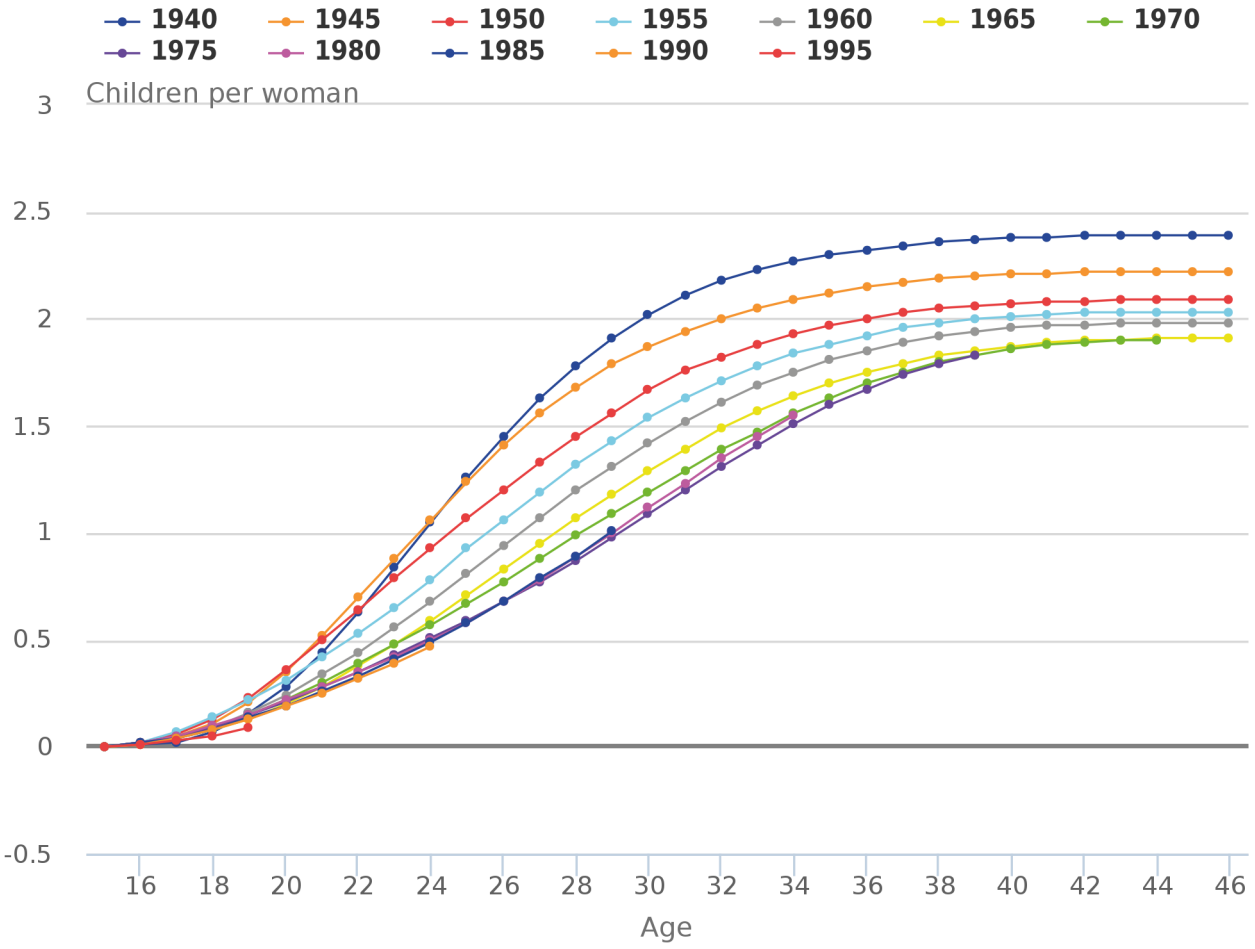
Source: Office for National Statistics

3 . Fertility assumptions for the UK

In the 2014-based projections, the long-term completed family size is assumed to be 1.89 children per woman. This is the same as the level assumed in the 2012-based projections, but is below the “replacement level”. The “replacement level” family size of 2.075 represents the approximate number of children per woman needed for the population to replace itself in the long-term (in the absence of migration) [8]. The total fertility rate (TFR) in the UK has been below replacement level since the early 1970s and the completed family size assumed for the long-term falls around 9% below replacement level.

Table 3.1 and Figure 3.2 show the achieved family sizes of selected cohorts at successive ages. From 1950, for those aged 25, 40 and 45, each subsequent cohort has had fewer children by each age than earlier cohorts. For those in their 30s, the most recent data show a slight increase on previous cohorts. Over time there have been some fluctuations in the achieved family size for those aged 20 but a downwards trend for successive cohorts born since 1980.

Figure 3.2: Average achieved family size by age and year of birth of woman, UK, women born 1940 to 1995



Source: Office for National Statistics

There is also evidence of strong recuperation at older ages for women born between 1960 and 1970. These cohorts delayed their fertility at younger ages but have been experiencing relatively high rates at older ages compared with earlier cohorts. For example, Table 3.2 shows that women born in 1965 had, on average, 0.22 children between the ages 35 to 39, compared with 0.16 children for the 1955 cohort for this age group. Thus, the completed family sizes of more recent cohorts will not be as low as they would have been had their fertility at older ages stayed at levels experienced by earlier cohorts.

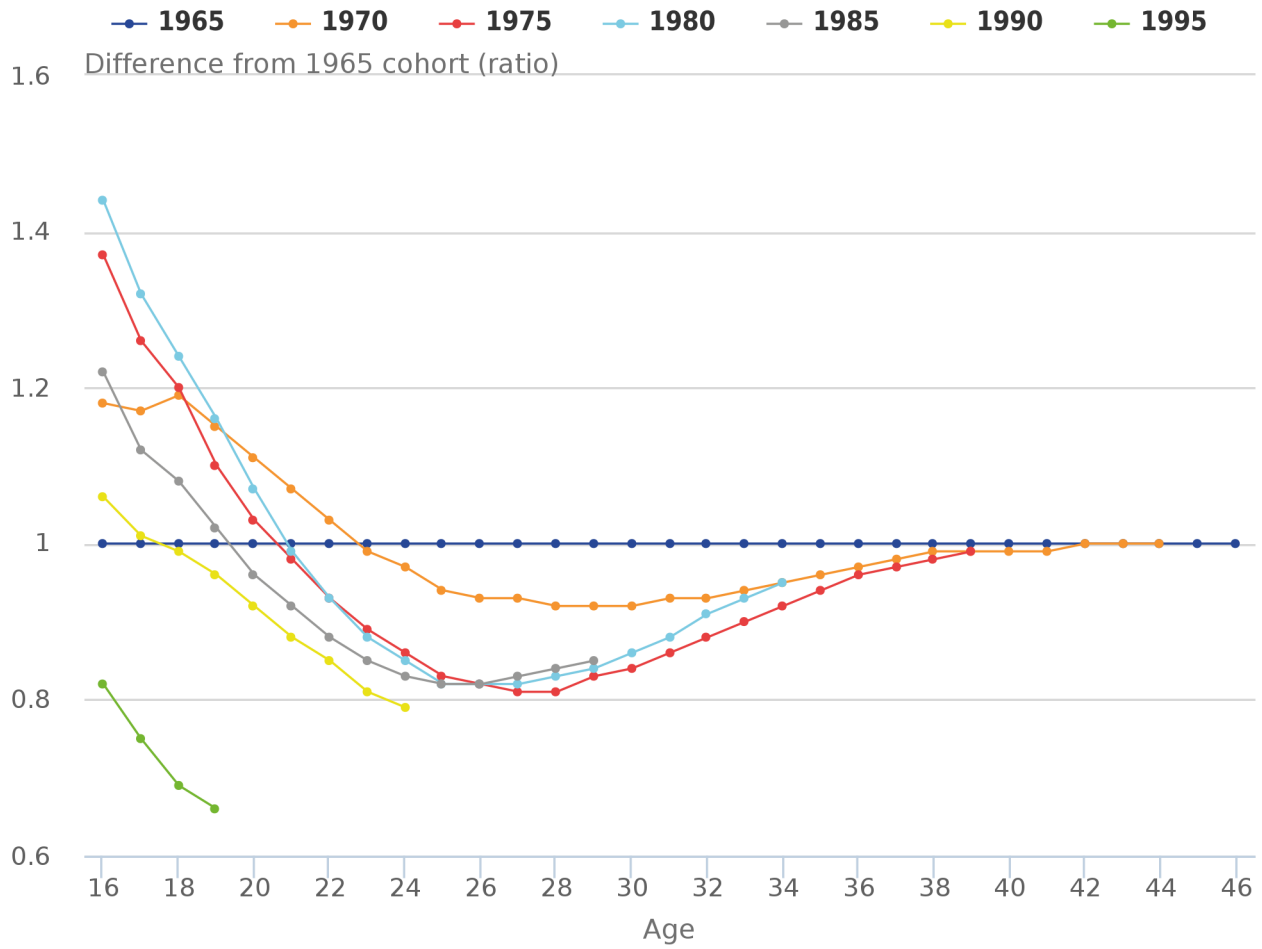
Table 3.2: Average number of children between given ages by year of birth of woman, UK, women born 1950 to 1995

	Age						
Cohort born	Under 20	20–24	25–29	30–34	35–39	40–44	45 and over
1950	0.23	0.70	0.63	0.36	0.13	0.03	0.00
1955	0.22	0.56	0.65	0.40	0.16	0.03	0.00
1960	0.16	0.53	0.63	0.44	0.19	0.04	0.00
1965	0.13	0.46	0.59	0.45	0.22	0.05	0.00
1970	0.15	0.42	0.52	0.47	0.28	0.07	…
1975	0.15	0.36	0.47	0.53	0.32	…	…
1980	0.15	0.35	0.50	0.56	…	…	…
1985	0.14	0.36	0.51	…	…	…	…
1990	0.13	0.34	…	…	…	…	…
1995	0.09	…	…	…	…	…	…

Source: Office for National Statistics

Figure 3.3 also shows this recuperation in terms of differences in selected cohorts relative to the 1965 cohort, who completed their fertility with an average of 1.91 children per woman. Although the 1970, 1975 and 1980 cohorts fell increasingly behind the 1965 cohort during their 20s, the curves for these cohorts after around age 28 rose steeply towards the 1965 level due to higher fertility at older ages, with the 1970s cohorts set to catch up with the completed family size of the 1965 cohort.

Figure 3.3: Difference between average achieved family size by age and year of birth of woman, UK, 1965 cohort compared with women born 1970 to 1995



Source: Office for National Statistics

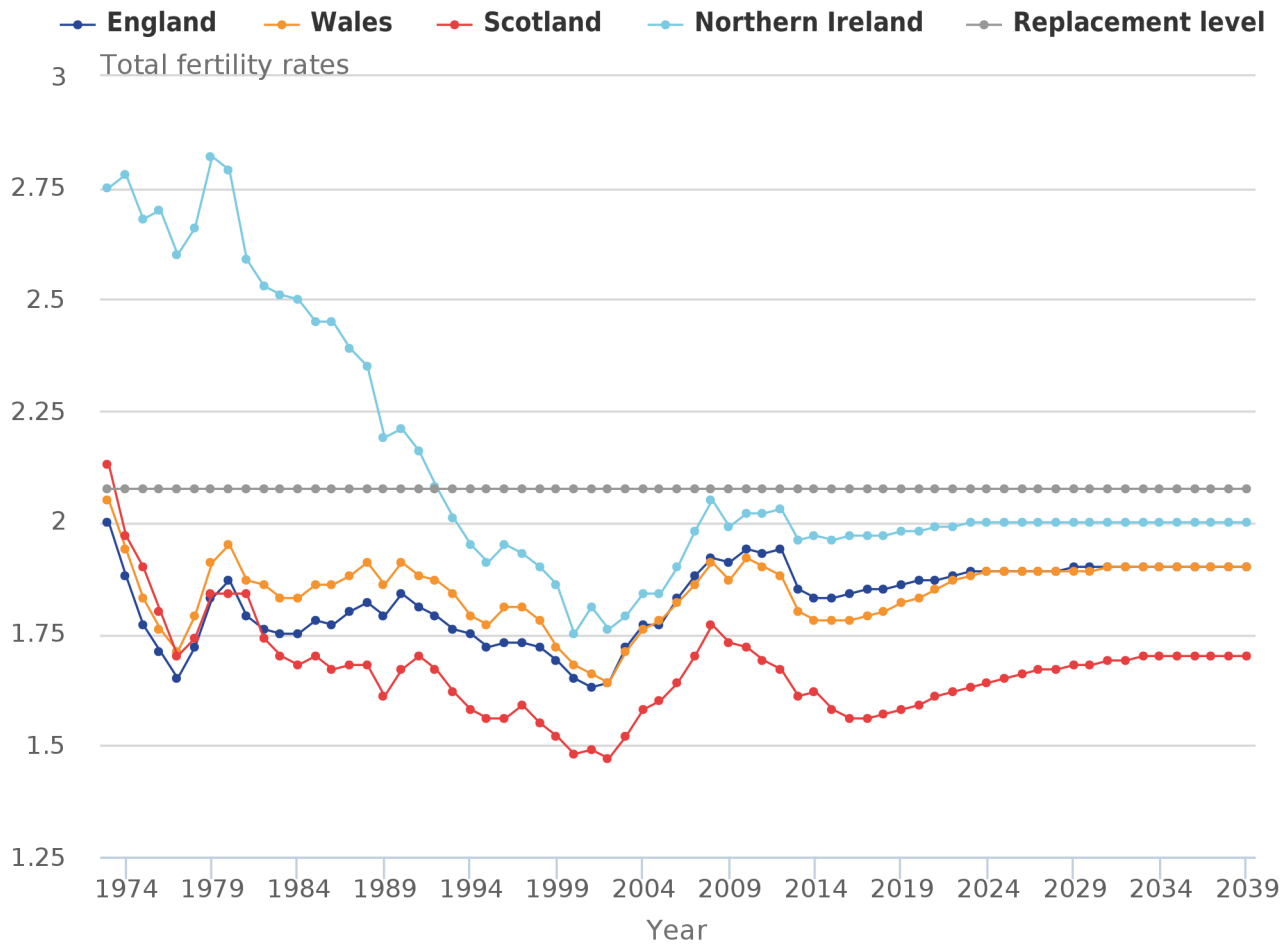
Women born in 1980 have followed a very similar fertility trajectory to the 1975 cohort up to age 25, but are showing higher fertility from age 27 onwards. This represents a marked difference from the previous pattern where successive cohorts born between the 1940s and the 1960s achieved lower fertility by each age than their predecessors, and suggests that falls in cohort fertility are bottoming out. However, women born in the late 1980s onwards have experienced slightly lower teenage fertility than those born in the 1970s and early 1980s, so they will have further to catch up at older ages if they are to match the achieved family sizes of their predecessors.

4 . Fertility assumptions for the constituent countries

Figure 3.4 and Figure 3.5 show the estimated and assumed trends in the total fertility rate (TFR) and completed family size for the constituent countries of the UK. All 4 countries show a similar trajectory over time, though Scotland's TFR declined from 2008 onwards compared with the roughly stable TFRs that England, Wales and Northern Ireland had between 2008 and 2012. In 2013, the TFR fell in all 4 countries of the UK (Figure 3.4). In 2014, the TFRs for England and Wales were 1.83 and 1.78 children per woman, respectively. Northern Ireland has historically had higher fertility than the rest of the UK and in 2014 its TFR was 1.97. Scotland has had lower fertility than England since the early 1980s and in 2014 its TFR was 1.62.

Recent trends do not provide any strong evidence of convergence in the overall levels of fertility between the individual countries, so current differentials are reflected in the completed family sizes assumed for the long-term (Figure 3.5).

Figure 3.4: Estimated and assumed total fertility rates, constituent countries of the UK, 1973 to 2039



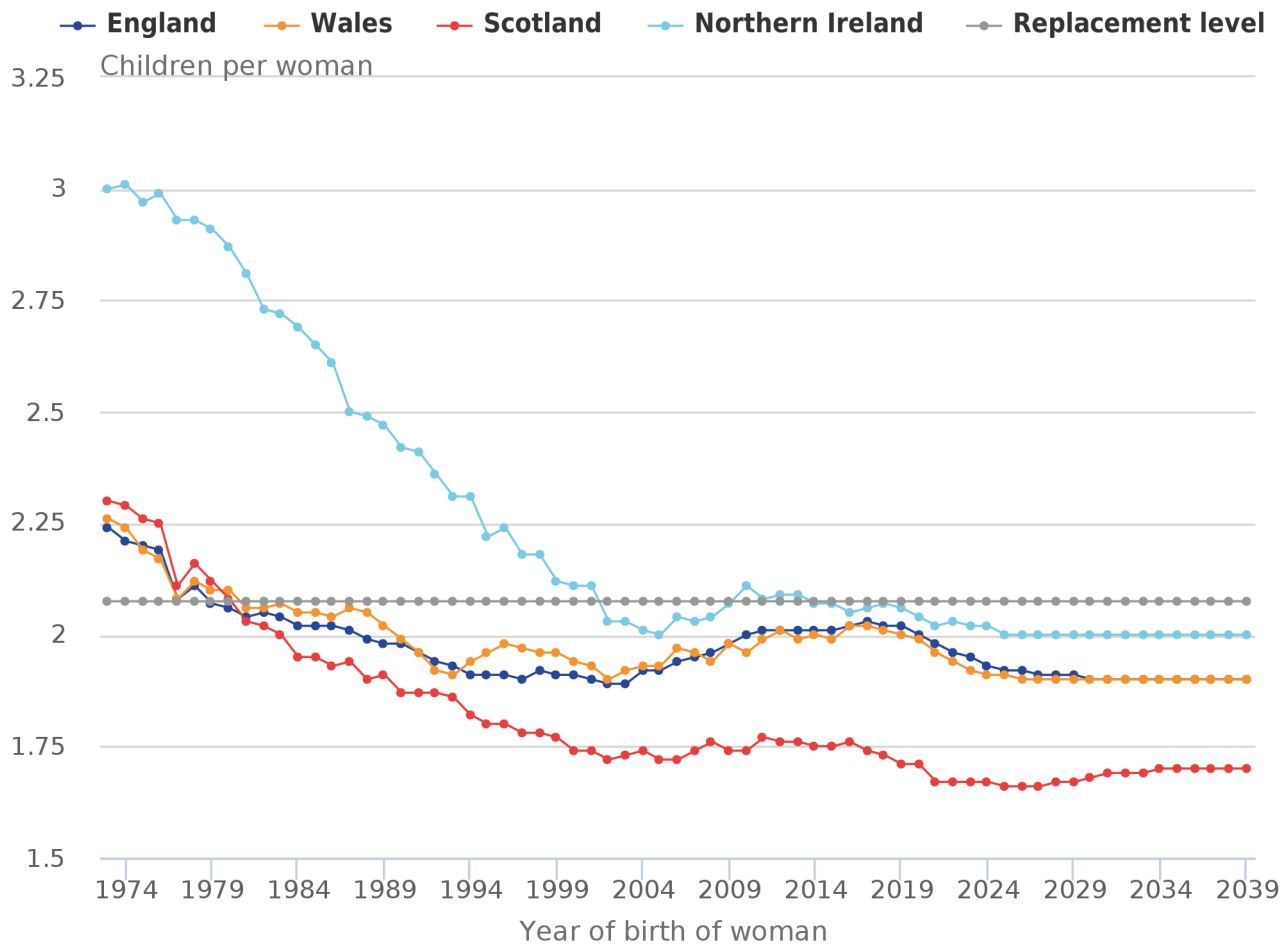
Source: Office for National Statistics, NRS, NISRA

Notes:

1. All fertility data are displayed on a calendar year basis

2. Replacement fertility is the level of fertility required for the population to replace itself in size in the long-term. In the UK, women would need to have, on average, 2.075 children to ensure long-term "natural" replacement of the population

Figure 3.5: Estimated and assumed completed family size, constituent countries of the UK, women born 1943 to 2009



Source: Office for National Statistics, NRS, NISRA

Notes:

1. All fertility data are displayed on a calendar year basis

2. Replacement fertility is the level of fertility required for the population to replace itself in size in the long-term. In the UK, women would need to have, on average, 2.075 children to ensure long-term "natural" replacement of the population

The achieved family sizes to date for the individual countries of the UK for selected cohorts are shown in Table 3.3. For the 1964 and 1969 cohorts – who can now be effectively regarded as having completed their childbearing – average family sizes were lowest in Scotland and highest in Northern Ireland. In the 1964 cohort, Wales had a larger completed family size than England and this pattern continues to the 1969 cohort; the most recent cohort to complete childbearing. While the 1964 and 1969 completed family size (CFS) for England are similar, there were declines for UK, Scotland and Northern Ireland, and an increase for Wales between these cohorts. The relative achieved family sizes across the countries of the UK for the 1974 and 1979 cohorts are similar to the 1969 cohort. For younger cohorts, the achieved family size for Northern Ireland is lower than for England and Wales and, for the 1994 cohort, is lower than England, Wales and Scotland. This reflects the older age pattern of child bearing in Northern Ireland.

For the 2014-based projections, the long-term fertility assumptions for England, Wales, Northern Ireland and Scotland have been slightly raised when compared with the 2010-based projections. The assumptions for England, Wales and Northern Ireland are the same as the 2012-based projections whereas the long-term assumption for Scotland has been set slightly lower. The assumed long-term completed family size is 1.90 children per woman for England and for Wales, 2.00 for Northern Ireland and 1.70 in Scotland. Table 3.4 illustrates, for each constituent country of the UK, the assumed progression in completed family size from cohorts who have recently finished childbearing to those who have not yet started. The CFS is assumed to rise slightly for the cohorts between 1975 and 1985, before declining back down to the long-term trend.

Table 3.3: Achieved family size attained by 2014 for the constituent countries of the UK, women born 1954 to 1994

Cohort born	Achieved to age	UK	England	Wales	Scotland	Northern Ireland
1954	Complete	2.03	2.02	2.05	1.95	2.69
1959	Complete	1.99	1.98	2.02	1.91	2.47
1964	Complete	1.92	1.91	1.94	1.82	2.31
1969	Complete	1.90	1.91	1.96	1.77	2.12
1974	Age 40	1.86	1.86	1.89	1.70	1.97
1979	Age 35	1.63	1.64	1.70	1.48	1.75
1984	Age 30	1.12	1.13	1.23	1.00	1.13
1989	Age 25	0.59	0.59	0.66	0.53	0.53
1994	Age 20	0.19	0.19	0.22	0.18	0.17

Source: Office for National Statistics

Table 3.4: Estimated and assumed average completed family size for the constituent countries of the UK, women born 1950 to 2010

Cohort born	UK	England	Wales	Scotland	Northern Ireland
1950	2.09	2.06	2.10	2.08	2.87
1955	2.03	2.02	2.05	1.95	2.65
1960	1.98	1.98	1.99	1.87	2.42
1965	1.91	1.91	1.96	1.80	2.22
1970	1.91	1.91	1.94	1.74	2.11
1975	1.91	1.92	1.93	1.72	2.00
1980	1.98	2.00	1.96	1.74	2.11
1985	1.99	2.01	1.99	1.75	2.07
1990	1.98	2.00	1.99	1.71	2.04
1995	1.90	1.92	1.91	1.66	2.00
2000	1.89	1.90	1.90	1.68	2.00
2005	1.89	1.90	1.90	1.70	2.00
2010 and later	1.89	1.90	1.90	1.70	2.00

Source: Office for National Statistics

Notes:

1. For cohorts born in 1970 and onwards figures are partly projected

Between 2002 and 2008, total fertility rates increased in all constituent countries of the UK, followed by a dip in 2009. All countries except Scotland then showed a recovery in 2010, followed by a fluctuating pattern in TFR in the short-term. This is reflected in the latest projections, as the total fertility rate for the UK also fluctuates in the short-term and levels off at the long-term assumption of 1.89 by 2032.

5 . Fertility assumptions age and sex distribution

Assumed age pattern of fertility

Table 3.5 summarises assumed fertility rates for the UK by 5 year age groups. The age pattern is projected to change slightly over the projection period, with fertility rates for women aged 40 and over increasing and rates for women aged under 20 decreasing slightly. Fertility rates for women in their 20s are also assumed to decrease slightly and this is offset by slight increases for women in their 30s.

The mean age at motherhood for the UK is assumed to rise gradually from 28.4 years for the 1965 cohort to its long-term level of 30.6 years for those born from 2005 onwards. Among the constituent countries of the UK, the mean age at motherhood assumed for the long-term varies from 29.9 years in Wales to 30.3 years in Scotland, 30.6 in England and 30.4 years in Northern Ireland.

Table 3.5: Estimated and assumed births per 1,000 women by age and year of birth of woman, UK, women born 1950 to 2010

	Age							
Cohort born	Under 20	20–24	25–29	30–34	35–39	40 and over	Average completed family size (number of children)	Mean age at motherhood (years)
1950	231	699	634	365	132	28	2.09	26.4
1955	221	561	650	403	163	36	2.03	27.1
1960	156	527	630	438	190	43	1.98	27.8
1965	133	457	594	454	216	57	1.91	28.4
1970	152	418	522	466	276	71 †	1.91 †	28.9 †
1975	147	361	469	533	316	80 †	1.91 †	29.5 †
1980	154	346	498	556	338 †	88 †	1.98 †	29.7 †
1985	135	357	513	549 †	348 †	90 †	1.99 †	29.7 †
1990	127	338	504 †	564 †	354 †	91 †	1.98 †	29.9 †
1995	88	284 †	507 †	572 †	360 †	91 †	1.90 †	30.4 †
2000	73 †	283 †	508 †	574 †	361 †	92 †	1.89 †	30.5 †
2005	72 †	281 †	509 †	574 †	361 †	92 †	1.89 †	30.6 †
2010 and later	71 †	281 †	509 †	575 †	361 †	92 †	1.89 †	30.6 †

Source: Office for National Statistics

Notes:

1. † Figures are partly or wholly projected

Assumed sex ratio at birth

It is assumed that there will be 105 boys for every 100 girls. This is in line with the estimated sex ratios recorded in the UK since the 1987-based projections. The UK sex ratio fluctuates each year with no clear trend over time and these annual fluctuations are relatively larger in Wales, Scotland and Northern Ireland compared with England; therefore it was decided during the 2004-based round not to use different sex ratios for the 4 countries of the UK.

6 . Distribution of completed family size

The assumptions for these projections have been informed by the use of a birth order probability model for England and Wales as a whole, maintained by the Office for National Statistics (ONS) [9,10,11]. This model also provides details of a distribution of women by number of children that is consistent with the fertility assumptions used for the 2014-based projections.

Table 3.6 shows that the proportion of women who remain childless by age 45, in England and Wales as a whole, has been increasing in recent years, from an estimated 14% of the 1950 cohort to 20% of women born in 1965. The rise in childlessness was the main factor in the reduction in completed family size for cohorts born in the 1950s through to the early 1960s, since the average number of children for women who were not childless remained fairly stable for these cohorts at around 2.4.

In the long-term, for cohorts born from the mid-1990s, it is assumed that 18% of women will remain childless. The fall in completed family size, from 1.98 for the 1960 cohort to the 1.90 assumed for those born from the mid-2000s onwards, is consistent with a decrease in the average complete family size of women who have children from 2.45 to 2.33. The family size distribution consistent with the 2014-based projections is similar to the distribution produced alongside the 2012-based projections.

Table 3.6: Estimated and assumed distribution of women by number of children and year of birth of woman. England and Wales, women born 1950 to 2010

			Number of children (percentages)				
Cohort born	Average family size	Average family size of women who have children	0	1	2	3	4 or more
1950	2.07	2.39	14	13	44	20	10
1955	2.02	2.41	16	13	41	19	11
1960	1.98	2.45	19	12	38	20	11
1965	1.91	2.39	20	13	38	19	10
1970	1.91	2.31	17	18	37	17	10
1975	1.92	2.35	18	17	37	17	11
1980	2.00	2.37	16	17	38	18	11
1985	2.01	2.40	16	16	37	19	12
1990	2.00	2.41	17	16	37	18	12
1995	1.92	2.34	18	17	37	17	11
2000	1.91	2.33	18	18	37	17	10
2005	1.90	2.33	18	18	37	17	10
2010 & later	1.90	2.33	18	18	37	17	10

Source: Office for National Statistics

Notes:

1. Figures for 1950 to 1965 (incl) are estimated, 2000 onwards are wholly assumed and between 1970 and 1995 (incl) are based on partly estimated and partly assumed data

2. Comparable figures for Scotland and Northern Ireland are not available

7 . Future fertility levels

For the 2006-based projections, the fertility assumptions were raised for the first time since the 1960s, with the long-term level of completed family size for the UK increasing from 1.74 to 1.84 children per woman. For the 2008-based projections, the long-term assumptions remained unchanged following a review of the available evidence, except in Scotland where the assumption was raised slightly. In 2010, the assumptions were maintained at the 2008-based levels. In 2012, the long-term fertility assumptions in the individual countries were increased from the 2006, 2008 and 2010 based rounds.

Our review prior to the 2014-based projections proposed maintaining the assumptions in line with the following arguments:

- the expert panel cautioned against frequent changes of long-term assumption, stating that stability is desired by users
- four (of nine) of the expert panel predicted a long-term total fertility rate (TFR) of between 1.90 and 1.93.
- both Eurostat and the UN assume higher TFRs for the UK than the Office for National Statistics (ONS); decreasing the assumption will increase this gap
- the current achieved family sizes for the 1970 to 1985 cohorts suggests that they are catching up with the achieved family sizes of the 1968 cohorts and may exceed the completed fertility of the 1968 cohort by the time they have finished childbearing, if the projected rises in older age fertility rates occur; the completed family size (CFS) for the 1968 cohort was 1.91, near to the 2012-based long-term projected TFR, so this supports maintaining the assumption
- net migration levels remain high despite political will to decrease them, and women born outside the UK tend to have higher fertility levels than UK-born women

8. References

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11. Since May 2012, information on previous children has been collected from all women at birth registration, so from 2013 onwards, birth order is no longer estimated from the General Lifestyle Survey for births outside marriage.

9. Background notes

1. The 2014-based Population Projections for the UK and constituent countries were published 29 October 2015 (main release) and the extra variants were published 26 November 2015.

2. These National Statistics are produced to high professional standards and released according to the arrangements approved by the UK Statistics Authority.

Compendium

Mortality, 2014-based national population projections reference volume

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1 . Introduction

Throughout the 20th century and into this century, the UK has experienced a continuation of the pattern of falling mortality rates that began in the 19th century. During this time there has been a change from a pattern of high infant and child mortality caused by the prevalence of acute and infectious diseases, to a new pattern in which adult mortality predominates and chronic and degenerative diseases are the most common causes of death. [1] The pattern has been broadly similar in England, Scotland, Wales and Northern Ireland. [2,3,4]

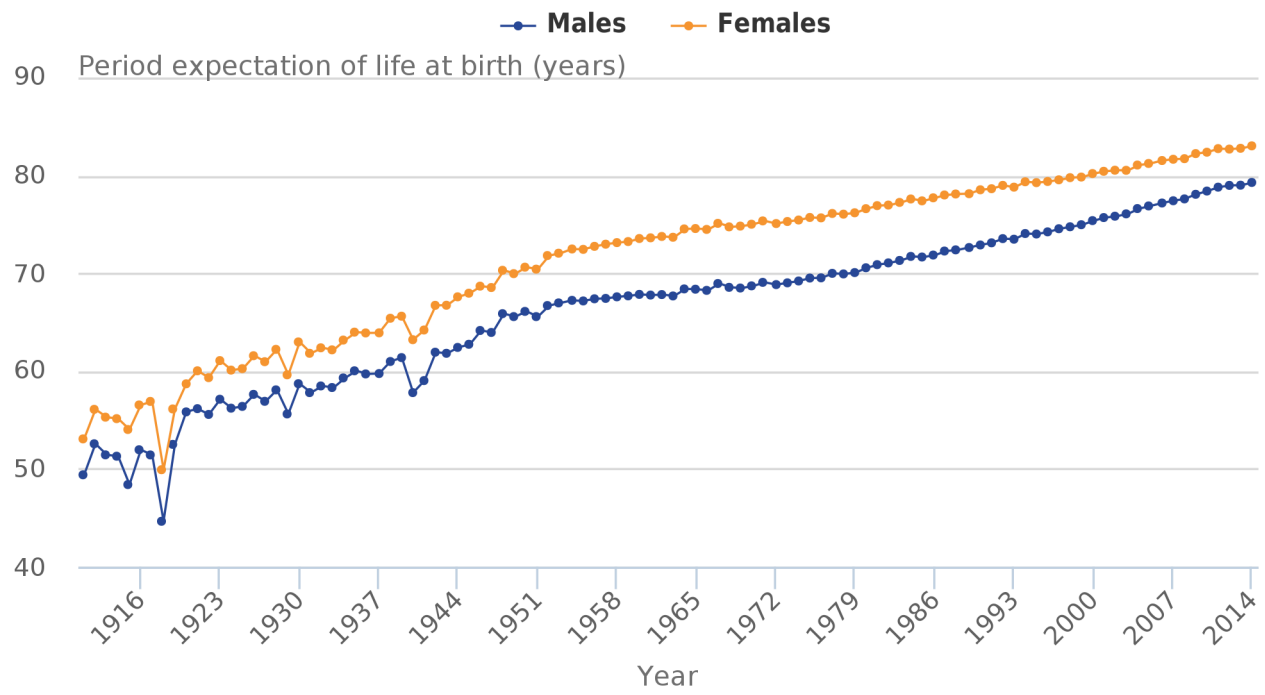
The 2014-based principal projection assumes that mortality rates will continue to improve into the future to an annual target rate of improvement from 2039 of 1.2% for most ages. This target rate was based on the examination of past rates of improvement and expert advice. The average annual rate of improvement over the last hundred years was around 1.2% for both males and females.

This chapter summarises past trends in mortality and life expectancy and discusses the assumptions about future mortality made for the 2014-based population projections.

2 . Past trends in life expectancy

One measure of the mortality rates in a particular year is the period expectation of life at birth, which is the average number of years a new-born baby would live for, based on the mortality rates for the given year. Figure 4.1 shows that there was a relatively rapid increase in this measure throughout the first half of the 20th century and then a slower, steady year on year increase continuing into the 21st century.

Figure 4.1: Period expectation of life at birth according to mortality rates experienced in given years, UK [1], 1912 to 2014



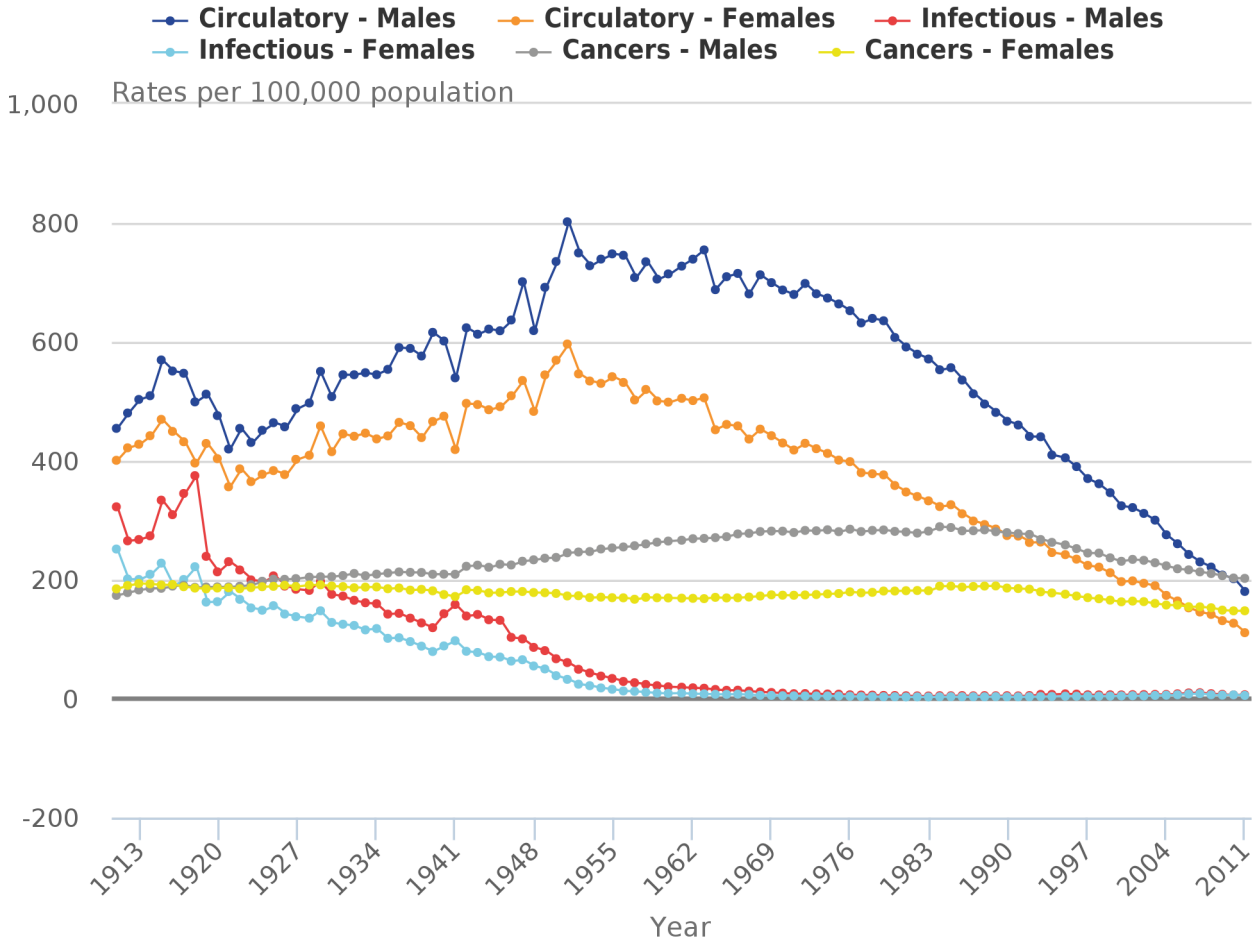
Source: Office for National Statistics

Notes:

1. Figures for 1912 to 1950 relate to England and Wales and figures for 1951 to 2014 are for the UK

Much of the increase in the period expectation of life at birth in the first half of the 20th century can be attributed to the reduction of infant and child mortality to very low levels by about 1950. Infant and child mortality rates have now fallen to such low levels that further reductions can have little effect on the expectation of life at birth, which has thus come closer to being a measure of the normal life span. Since about 1940, the increasing control of infectious diseases, has considerably reduced the number of early adult deaths and there has recently been a reduction in the number of those dying early from circulatory diseases (Figure 4.2). [2,3,4] The greatest decline in mortality rates at advanced ages has occurred since the 1970s. However, in general, mortality rates at the oldest ages declined less over the 20th century in relative terms than those at younger ages.

Figure 4.2: Age-standardised mortality rates by major cause, England and Wales, 1911 to 2011



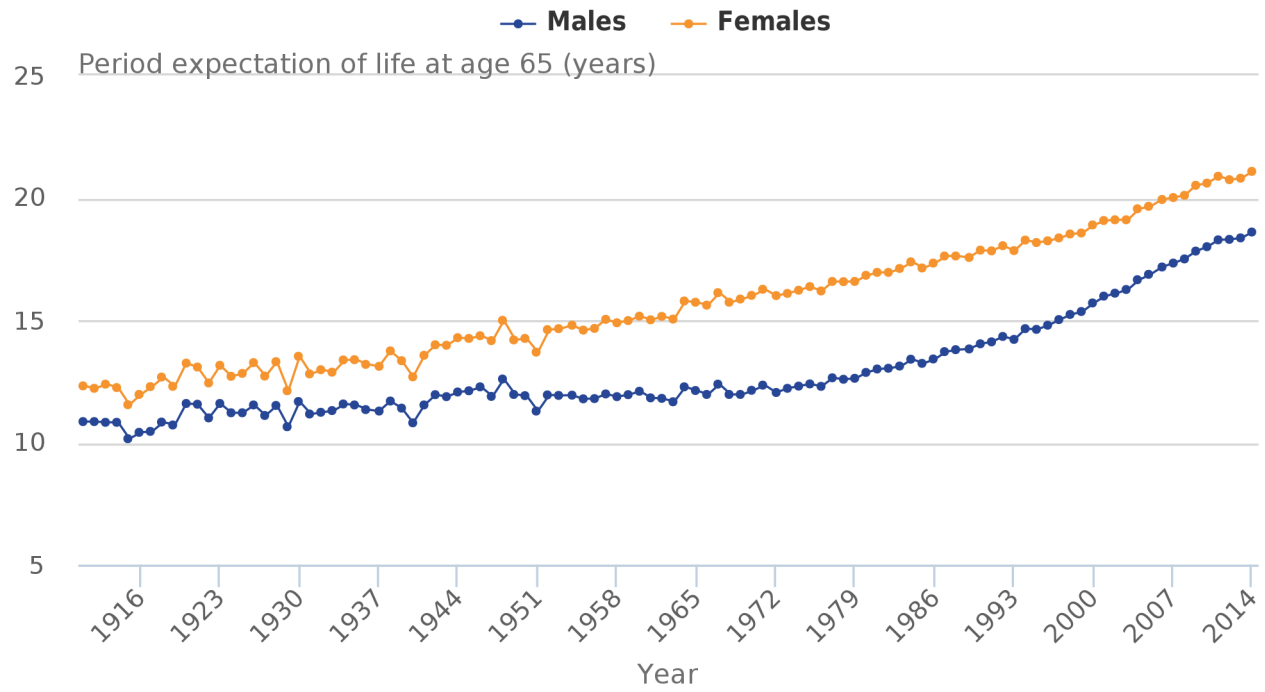
Source: Office for National Statistics

Notes:

1. Mortality rates are not available for the UK before 1951; for long historic trends England and Wales data are used

Figure 4.3 shows that period life expectancy at age 65 has also risen during the 20th century and continues to rise in the 21st century. For females, the annual increase was relatively constant over this period whereas for males, after an initial period of increasing longevity, period life expectancy at 65 remained almost constant between 1940 and 1970. Since 1970, there has been a rapid decline in mortality rates at advanced ages, particularly for males for whom mortality is currently improving more rapidly than female mortality. As a result, the age differential in period life expectancy at age 65 between males and females has reduced from around 4.0 years during the 1970s and early 1980s to 2.5 years in 2014. A partial explanation for this may be the different historical patterns in cigarette smoking between men and women, with a higher proportion of males smoking in the past than females and the peak consumption for males being earlier (1940 to 1960) than for females (around 1960).[5,6] This might suggest that the rate of increase in female expectation of life at 65 will continue to be slower than for males over the next few years.

Figure 4.3: Period expectation of life at age 65 according to mortality rates experienced in given years, UK [1], 1912 to 2014



Source: Office for National Statistics

Notes:

1. Figures for 1921 to 1950 relate to England and Wales and figures for 1951 to 2014 are for the UK

A number of publications provide reviews of long-term mortality trends in the UK. [1,2,3,4,7,8,9]

3 . Future prospects for life expectancy

Since the 1980s, the period expectation of life at birth in the UK for females has increased by about 1.9 years per decade, while male life expectancy has increased by around 2.6 years per decade. The period expectation of life at birth in the UK in 2014 was about 83.0 years for females and 79.3 years for males. However, there are diverse opinions amongst demographers as to the level of longevity that might reasonably be expected in the future. [9,10,11,12]

Internationally, there are examples of countries with higher period expectations of life at birth. For example in Japan, the period expectation of life at birth in 2014 was about 86.8 years for females and 80.5 years for males. [13] Other countries in Europe, such as Italy, Norway, Sweden and Switzerland also currently have higher period expectations of life at birth than the UK for both males and females. [14]

There is also the possibility of lower incidences of cancer, heart disease and strokes through changes in lifestyle and, through medical advances, greater control of these when they do occur. In particular, mortality rates for heart disease and strokes have fallen quite rapidly and steadily over the 1990s for males and females aged 40 to 64 and to a lesser extent for older men and women. [15] Since 2000, the falls in mortality rates from these causes have continued at around the same pace for the 40 to 64 age-group and have accelerated for older men and women (aged 65 and over). Mortality rates from circulatory diseases had fallen to similar levels as the all cancers mortality rate by 2008. In the future changes in mortality rates from causes other than circulatory diseases will have an increasingly greater effect on the rates of future mortality improvements.

On the other hand, some demographers believe that, despite the possibility of advances in medical practices and of encouraging healthy lifestyles, a law of diminishing returns will apply to mortality rate reductions at advanced ages, partly because no more than a minority of the population will adopt truly healthy lifestyles. It is also possible that new diseases, or the re-emergence of existing diseases such as tuberculosis, may serve to temper future improvements in mortality.

4 . Methodology and derivation of UK base mortality rates

When formulating the mortality assumptions for population projections the focus is on mortality rates and annual percentage change in the mortality rates by age and year rather than life expectancy. The annual percentage changes are also referred to as rates of improvement in mortality (or mortality improvements) because at most ages in most years mortality rates have improved. In this chapter, the assumptions for the projections are given in the form of central mortality rates (m_x). The difference between these and the probabilities of dying (q_x) used to carry out the actual projections is described in Chapter 1. The latter figures can be accessed via the 2014-based national population projections open datasets.

Age-specific mortality rates were calculated for each year using deaths data and mid-year population estimates for 1961 to 2013 (deaths data for 2014 did not become available until after the mortality assumptions for these projections were finalised). Population estimates by age for those aged 90 and over from 1979 onwards (and retrospective estimates for earlier years, back to when these persons were aged 80) were calculated using the Kannisto-Thatcher survivor ratio method which is a modified form of the method of extinct generations.[16] The retrospective estimates to age 80 have been found to give more reliable results than using the official population estimates made at the time.

A p-spline model was then applied to the resulting crude mortality rates to produce a fitted, smoothed surface of mortality rates to the historical data for each sex.[17] A review of the methodology to be used for projecting mortality is currently being undertaken and the initial results were incorporated into the current methodology. As a result, a modification to the smoothing method used has been made to account for possible presence of overdispersion in the data. Mortality data often present overdispersion (or heterogeneity) that is, the presence of greater variability in a data set than would be expected based on a given statistical model.

Comparisons of the annual percentage change in the smoothed mortality rates using different ranges of calendar years and ages found that improvements calculated for the final and penultimate years of the data range tend to be altered more than those in the preceding years when an extra year's data are added; those calculated for earlier years are usually not altered to a significant degree. The tests also suggested that using data for ages 0 to 100 for males and 0 to 105 for females produced reasonable results.

As a result of these analyses, smoothed mortality rates were calculated using data for years 1961 to 2013 and age ranges 0 to100 for males and 0 to 105 for females. Percentage changes in mortality were then calculated by age for the year 2011 using the smoothed mortality rates for 2010 and 2011. These rates of percentage change for 2011 were then projected forward to 2014 by assuming that the same rates of change applied in 2012, 2013 and 2014. This projection was carried out by year of age (period) for those born in 1960 and later and by year of birth (cohort) for those born before 1960. Improvement rates (percentage change) in 2014 for ages where this methodology did not give an assumed rate were obtained by interpolation between the nearest ages where there were assumed rates.

Assumed age-specific base mortality rates for 2014 were obtained by applying the resulting assumed rates of improvement for 2012, 2013 and 2014 successively to the smoothed age-specific mortality rates produced for 2011.

The rates of improvement derived for 2014 are then projected into the future, and are assumed to converge to the target rates of improvement by age and sex in 2039. The resulting projected rates of improvement are then applied successively to the assumed rates of mortality by age and sex for the base year 2014 to provide projected age- and sex-specific mortality rates in each future year of the projection period. Further adjustments are made to ensure that the projected curves of mortality rates appear reasonable and that male mortality rates do not generally fall below those for females for the same age and year.

5 . Base year mortality rates for individual countries

Mortality rates for the base year 2014 were initially calculated for the UK, as described above. Mortality rates for 2014 for the 4 individual countries of the UK were then obtained by adjusting the UK mortality rates at each age in proportion to the particular country's mortality experience relative to the UK mortality experience at that age for the 3 years 2011 to 2013. The resulting base year mortality rates for individual countries are shown for selected ages in Table 4.1. The country-specific mortality improvement rates described later in this chapter were then applied to the projected base mortality rates for 2014 for each country to obtain the projected mortality rates for future years.

Table 4.1: Assumed base year mortality rates (m_x) per 100,000 population, by selected ages, UK, 2014

	Males				Females			
Age	England	Wales	Scotland	Northern Ireland	England	Wales	Scotland	Northern Ireland
0	440	410	397	436	353	345	334	352
2	17	16	16	17	16	15	15	14
12	9	10	10	15	8	9	8	5
22	51	64	77	87	22	26	28	27
32	77	109	152	111	41	61	59	41
42	166	222	251	189	99	113	134	112
52	355	389	459	400	241	276	320	276
62	891	953	1,119	971	589	648	736	624
72	2,303	2,518	2,928	2,518	1,512	1,664	1,989	1,617
82	6,900	7,391	7,977	7,391	5,027	5,355	6,044	5,487
92	21,774	22,910	22,910	22,664	17,862	18,453	19,445	19,047
102	55,646	55,646	55,646	55,646	46,108	46,336	48,640	47,483

Source: Office for National Statistics

6 . Trends in mortality by age

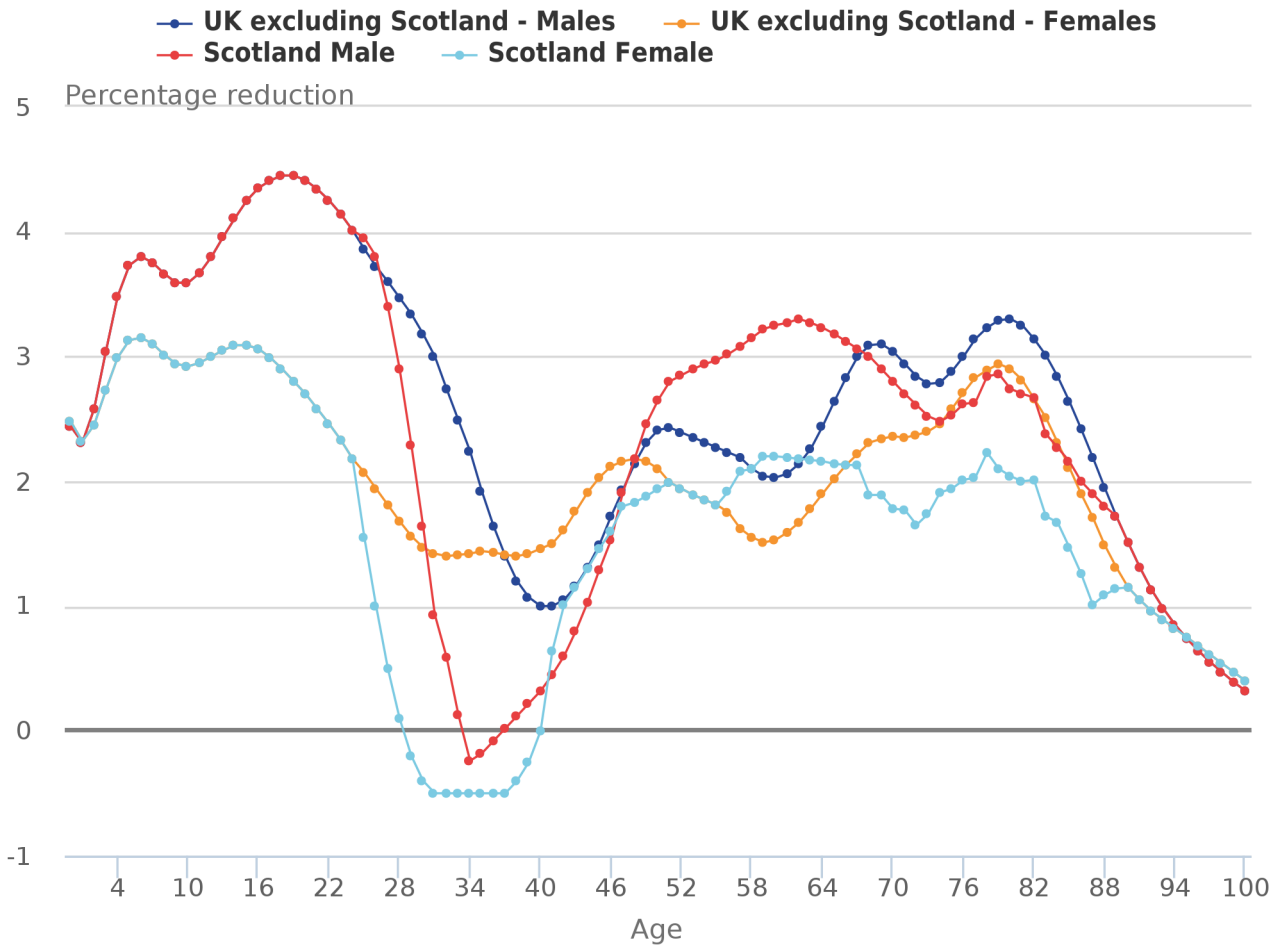
The smoothed mortality rates for the UK fluctuate between increases and reductions at older ages for men up to the mid-1970s, as well as temporary increases for middle-aged men in the 1960s and amongst young men in the 1960s and the early 1970s. Mortality rates for men aged 21 to 40 generally rose during the mid-1980s to the mid-1990s. These increases were partly attributable to deaths caused by HIV infection and AIDS. [18] Suicide rates and alcohol-related mortality also increased for men at young ages until the late 1990s. [19] Since the late 1990s, mortality rates for men in this age-group have generally been declining. Apart from increasing mortality rates for women aged between 45 and 60 during the 1960s and early 1970s, mortality rates are generally falling for women of all ages. Mortality rates for women aged 15 to 30 generally showed little improvement, or even worsened, during the 1990s but since then this trend has reversed.

It was assumed that the trends apparent during the period 1961 to 2013 (mostly of improvement in mortality) would initially continue at similar rates, with improvements for 2013 to 2014 being those derived as described earlier.

Comparisons of the rates of improvement experienced in each individual country with those experienced in the UK as a whole suggested that the assumed initial rates of improvement by age and sex for the UK could be adopted for each individual country, except for Scotland. Mortality for Scottish males and females at some ages

has been improving more slowly or worsening at a faster rate than elsewhere in the UK in recent years. As a result, different initial rates of mortality improvement were assumed for Scottish males and females at several ages. Lower rates of improvement have been assumed for Scottish males in their 20s, 30s, 40s and mid-60s to early 90s, with higher rates assumed for those aged 48 to 67. For Scottish females, lower rates have been assumed for those aged 25 to 50 and 67 to 89, with higher rates assumed for those aged 56 to 65, than for the rest of the UK. The improvement rates for the other countries were then adjusted so that the weighted country-specific improvements by age were the same as those initially derived for the UK as a whole. The resulting assumed smoothed changes in mortality rates between 2013 and 2014 for each country are shown in Figure 4.4.

Figure 4.4: Assumed smoothed percentage changes in mortality rates between 2013 and 2014 by age, Scotland compared with combined figures for England, Wales, and Northern Ireland



Source: Office for National Statistics, NRS, NISRA

The peak levels of improvement in mortality rates (of around 4% a year) for both males and females noted in previous projections for the cohorts born around 1931 (aged around 83 in 2014) have continued, although the peak is now for a slightly younger cohort. It is not understood precisely why the members of the generation born around the early 1930s have been enjoying higher rates of mortality improvement throughout their adult life than preceding generations, or why the rate of improvement slowed down for following generations. It may, however, be relevant that this generation was the first to benefit from a combination of better childhood health, the conquest of infectious diseases affecting young and middle-aged adults and, in later middle-age, improvements in the treatment of circulatory diseases. Additionally, the men, in particular, stopped smoking cigarettes sooner than those in preceding generations.

7 . Future improvements in age-specific mortality rates

Consideration was then given to how the trends might change in the future. The methodology used for mortality projections in the UK assumes “target” rates of mortality improvement for a specific future year 25 years ahead of the base year for the projections.

Over the 40-year period 1971 to 2011, the average annualised rate of improvement in aggregate standardised mortality rates in England and Wales has been around 1.9% for males and 1.5% for females. (These rates of improvement are derived from aggregate mortality rates for ages 0 to 99 calculated using the 2011 population estimates for the UK as the standard population.) The rate of improvement over the latter half of this period was higher for both males and females than over the first half, and particularly so for males. This appears to be partly due to differential trends in smoking behaviour between males and females. Relatively higher numbers of men have now given up smoking and mortality rates for males at older ages have shown large rates of improvement in recent years.[5,6]

The average annual rate of improvement over the last hundred years was around 1.2% for both males and females although the improvement rates vary by age. There is ongoing debate as to whether the impact of future technical, medical and environmental changes will have a greater or lesser effect on improvements in mortality in the future than they had over the 20th century. Taking these various factors into consideration together with the views of the expert panel, the rate of improvement for 2039 (the 25th year of the 2014-based projections) has been assumed to be 1.2% for most ages (that is, equivalent to the average annual rate of improvement over the period 1913 to 2013).

However, those born after 1924 and before 1939 have exhibited greater rates of improvement over the last 25 years than those born on either side.[20] This is evident in the heat maps (Figures 4.5a and 4.5b) where the highest improvements are shown by the areas denoted by 2.5% and 3% per year improvement (shaded orange and red in Figures 4.5a and 4.5b). There is currently no evidence that these differentials are declining. As a result, it is now assumed that these cohorts will continue to experience higher rates of improvement with the assumed rate of improvement in 2039 rising from 1.2% a year for those born before 1924 to a peak of 2.5% a year for those born in 1931 and 1932 and then declining back to 1.2% a year for those born in 1939 and later.

However, there is little evidence of past mortality improvements at the very oldest ages in the UK. As a result, and in order to avoid implausible numbers surviving to extreme ages, the notional assumed rates of improvement in the 25th year of the projections are assumed to reduce to 1.0% for those born in 1922 and to reduce further from 1.0% for those born in 1911 to 0.1% for those born in 1902 and earlier. These are the same assumptions for the rates of future mortality improvement, by year of birth, in the target year as those assumed for the 2012-based projections (where the target year was 2037).

Figure 4.5a: Historic and projected percentage change in smoothed mortality rates, males, UK, 1962 to 2039

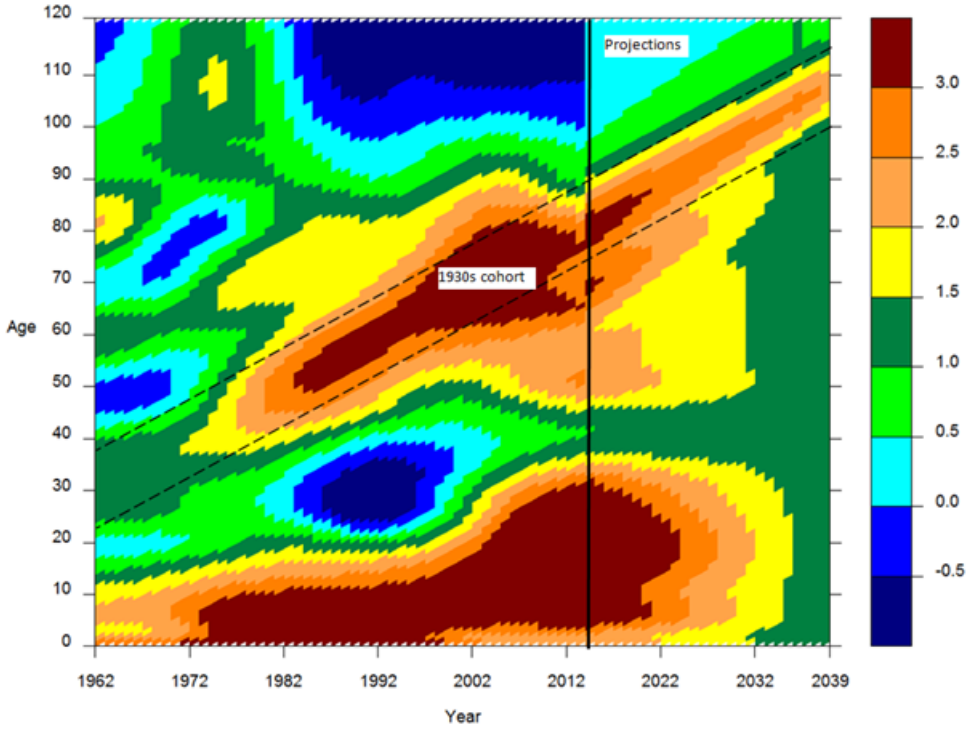


Figure 4.5b: Historic and projected percentage change in smoothed mortality rates, females, UK, 1962 to 2039

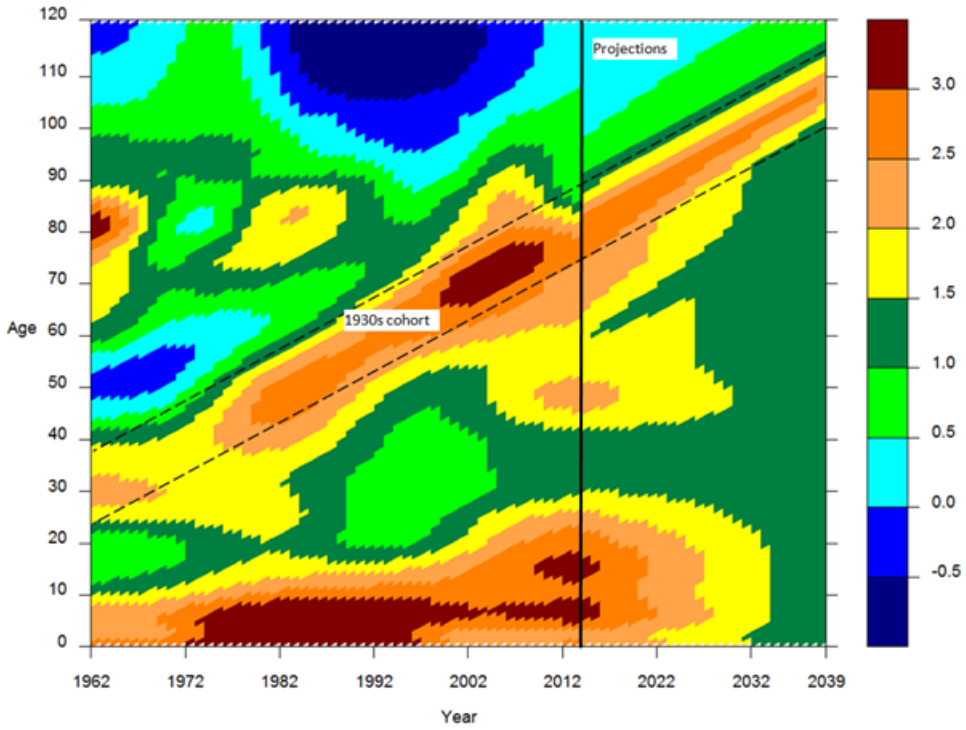


Table 4.2 shows the reductions in mortality rates assumed for selected years in the future and the total reduction over the next 25 years from 2014 to 2039 for each country of the UK. Current rates of mortality improvement by age are assumed to converge to the target rates of 1.2% to 2.5% in 2039 more rapidly for males than females. For ages where the improvement rate in 2014 is higher than the target rate, the cumulative reduction in mortality rates throughout the 25 year projection period is lower than would be given if a linear interpolation was assumed, that is the speed of convergence to the target rates is faster. Where the improvement rate is lower in 2014 than the target rate the cumulative reduction is higher, that is the speed of convergence is slower.

There is also some evidence of cohort effects for those born after 1939. Therefore, in these projections, convergence to the assumed rate of improvement in 2039 has been done by cohort for those born before 1960 (shown with † symbol in Table 4.2). For those born in 1960 and later (that is, projections with no † symbol in Table 4.2), for whom there is little evidence of generational effects, the changes in the rates of improvement to the target rate are projected by calendar year. Of course, at young ages mortality rates are already at low levels and the precise assumptions made for future mortality have a relatively minor impact on the projections.

The rates of improvement after 2039 are assumed to remain constant (by cohort or by age, as described above) at the rate assumed in 2039 for each year thereafter. So, for those born during the period 1925 to 1938, who are assumed to have higher rates of improvement than 1.2% in 2039, it is assumed that they will continue to experience these higher rates of improvement after 2039 for the remaining years of their lives.

Table 4.2: Assumed percentage change in UK mortality rates, m_x, between consecutive calendar years in the projection period and the total reduction over 25 years, 2014 to 2039

percentages

	2014 to 2015		2018 to 2019		2028 to 2029		2038 to 2039		Reduction over 25 years	
Age	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
England, Wales and Northern Ireland										
0	2.38	2.42	2.15	2.18	1.61	1.63	1.20	1.20	35.54	35.81
2	2.52	2.39	2.26	2.16	1.66	1.62	1.20	1.20	36.52	35.61

12	3.68	2.91	3.19	2.58	2.07	1.80	1.20	1.20	44.59	39.39
22	4.10	2.40	3.53	2.17	2.22	1.62	1.20	1.20	47.29	35.69
32	2.67	1.39	2.38	1.35	1.71	1.27	1.20	1.20	37.66	27.66
42	1.06	1.59	1.09	1.51	1.15	1.34	1.20	1.20	24.85	29.29
52	2.33	1.90	2.11	1.77	1.60	1.45	1.20	1.20	35.15	31.85
62	2.02†	1.57†	1.96†	1.52†	1.56	1.40	1.20	1.20	33.74	30.06
72	2.85†	2.30†	2.57†	1.98†	1.53†	1.34†	1.20	1.20	36.63	32.25
82	3.21†	2.79†	2.77†	2.54†	1.80†	1.54†	1.20†	1.20†	39.73	36.58
92	1.30†	1.05†	2.10†	1.73†	2.11†	2.01†	1.20†	1.20†	38.79	35.80
Scotland										
0	2.38	2.42	2.15	2.18	1.61	1.63	1.20	1.20	35.54	35.81
2	2.52	2.39	2.26	2.16	1.66	1.62	1.20	1.20	36.52	35.61
12	3.68	2.91	3.19	2.58	2.07	1.80	1.20	1.20	44.59	39.39
22	4.10	2.40	3.53	2.17	2.22	1.62	1.20	1.20	47.29	35.69
32	0.62	-0.42	0.73	-0.10	1.00	0.63	1.20	1.20	20.91	10.94
42	0.63	1.02	0.74	1.05	1.00	1.14	1.20	1.20	21.02	24.48
52	2.77	1.90	2.46	1.77	1.75	1.45	1.20	1.20	38.38	31.85
62	3.17†	2.14†	2.64†	1.87†	1.79	1.40	1.20	1.20	39.83	31.95
72	2.63†	1.75†	2.62†	1.91†	1.83†	1.49†	1.20	1.20	39.75	32.36
82	2.69†	2.02†	2.39†	1.93†	1.82†	1.51†	1.20†	1.20†	38.25	32.56
92	1.30†	1.05†	1.88†	1.19†	1.94†	1.74†	1.20†	1.20†	36.64	32.02

Source: Office for National Statistics

Notes:

1. Projections made by cohort marked with† symbol (see text for further details), otherwise projections are made by calendar year

2. The first column shows the reductions not from the actual death rates from 2014, but the base death rates for 2014, projected from trends in preceding years

The same future improvements are assumed for all countries of the UK except for some differences (generally, slightly smaller improvements) in the period to 2039 at some ages for males and for females in Scotland, as discussed earlier. Similar adjustments were made in recent past projections.

This produces an average annualised rate of mortality improvement of around 1.4% for males and 1.3% for females over the next 80 years for England and Wales and Scotland (Table 4.3). The new projections generally assume for males in England and Wales lower annualised rates of improvement in the future than corresponding periods 30 and 50 years in the past. In Scotland rates of improvement in the future are lower than the corresponding period 30 years in the past but higher than rates observed in the last 50 and 80 years. For females there are higher annualised rates of improvement over future periods than experienced over corresponding periods in the past in England and Wales and Scotland.

Table 4.3: Past and assumed overall average annual rates of mortality improvement, England and Wales and Scotland

percentages

	Males		Females	
	Past (actual)	Future (assumed)	Past (actual)	Future (assumed)

England & Wales				
Last/next 30 years	2.19	1.75	1.57	1.59
Last/next 50 years	1.64	1.53	1.40	1.44
Last/next 80 years	1.30	1.40	1.31	1.35
Scotland				
Last/next 30 years	1.98	1.76	1.35	1.47
Last/next 50 years	1.46	1.54	1.31	1.36
Last/next 80 years	1.15	1.41	1.21	1.30

Source: Office for National Statistics

Notes:

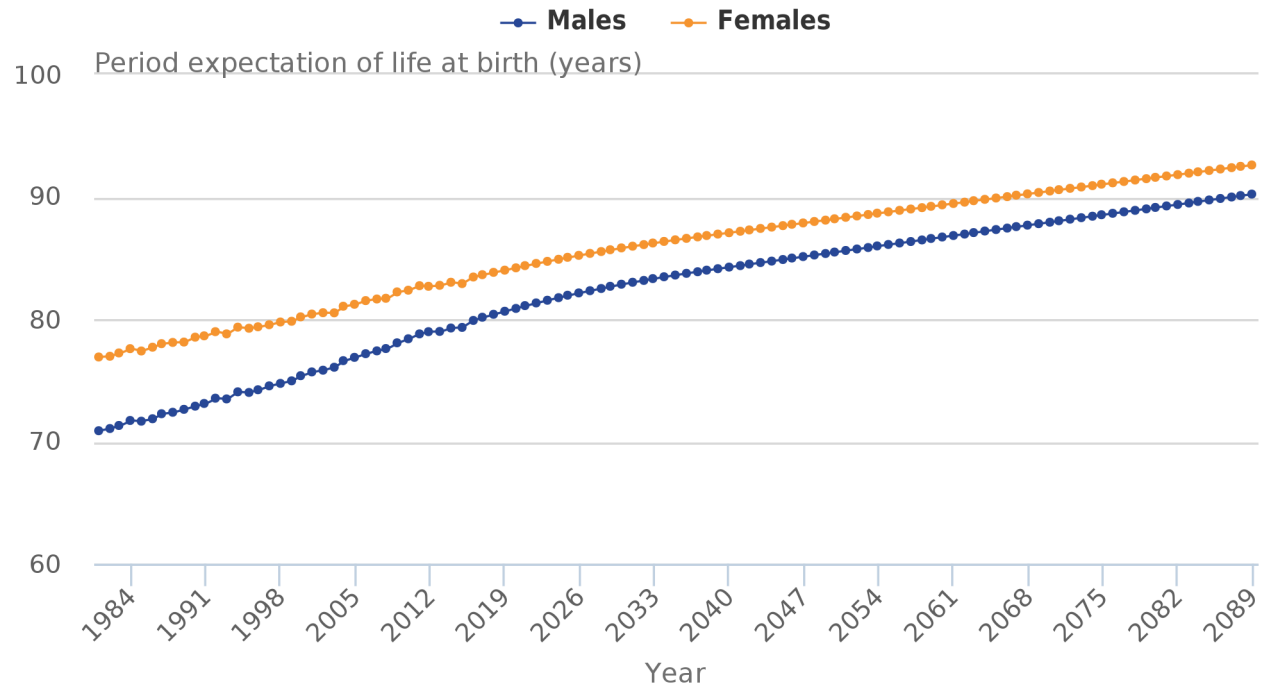
1. Past estimates are based on comparison of the 2010 to 2012 national life tables with English and Scottish Life Tables for 1930 to 1932, 1960 to 1962 and 1980 to 1982, hence using the periods 30, 50 and 80 years. In all cases the rates of improvement shown are derived from aggregate mortality rates for ages 0 to 99 calculated using the 2011 population estimates for the UK as the standard population. Decennial tables are not available for the historical periods shown in the table for the UK or Northern Ireland

2. Making projections of mortality rates is speculative and users must bear in mind that the range of possibilities is wide. Variant projections using alternative assumptions for the future improvement in mortality are considered in Chapter 6

8 . Effect of assumptions

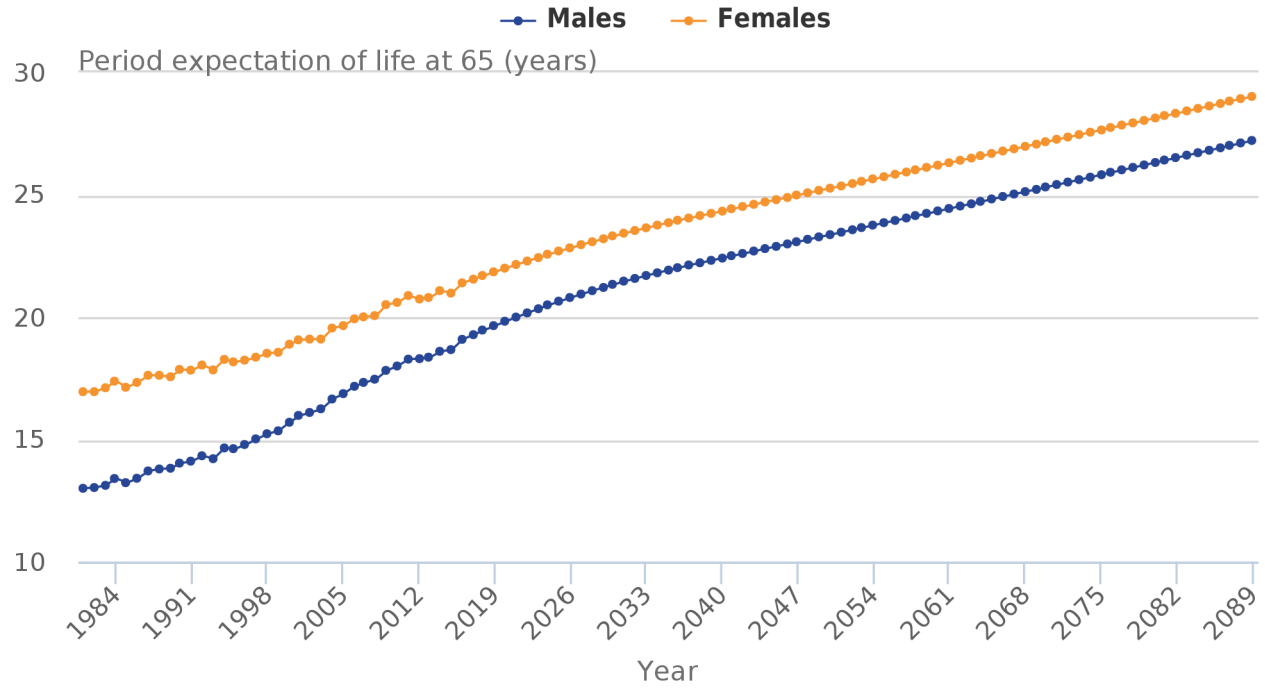
The implications of these assumptions in terms of the period expectation of life at birth and at age 65 are shown in Figure 4.6 and Figure 4.7 respectively.

Figure 4.6: Actual and projected period expectation of life at birth according to mortality rates for given year, UK, 1981 to 2089



Source: Office for National Statistics

Figure 4.7: Actual and projected period expectation of life at age 65 according to mortality rates for given year, UK, 1981 to 2089



Source: Office for National Statistics

In 2039, period expectation of life at birth for the UK is around 0.2 years lower for males and 0.7 years lower for females compared with the previous projections. These differences are mainly due to the fact that we have assumed higher mortality rates at nearly all ages and lower rates of mortality improvement at most ages over 65 in 2014 compared with those projected for 2014 in the 2012-based projections.

9 . Expectation of life for cohorts

So far in this report, expectations of life have mainly been calculated on the basis of the mortality rates for a particular calendar year (period life expectancies). In many contexts it is more meaningful to calculate the average life expectancy which allow for future known or assumed changes in mortality rates (referred to as cohort life expectancy). Further information on the difference between period and cohort life expectancies is available on our website.[21] Table 4.4 shows projected period and cohort expectations of life at selected ages for 4 different years.

Table 4.4 shows that the projected period expectation of life at birth for a male in the UK was 79.3 years on the basis of the mortality rates for 2014. However, taking into account assumed mortality improvements in later years, that is, cohort life expectancy, a male born in that year would be expected to live for 90.4 years. Similarly, the average man aged 65 in 2014 would live for a further 18.6 years based on the mortality rates for 2014 (period). However, taking account of the assumed further mortality improvement after 2014 (cohort), he would actually be expected to live for a further 21.2 years.

Table 4.4: Period and cohort expectation of life by selected ages, UK, for the years 2014, 2015, 2025, 2035 and 2039

years

	Males					Females				
Age	2014	2015	2025	2035	2039	2014	2015	2025	2035	2039
Period expectation of life										

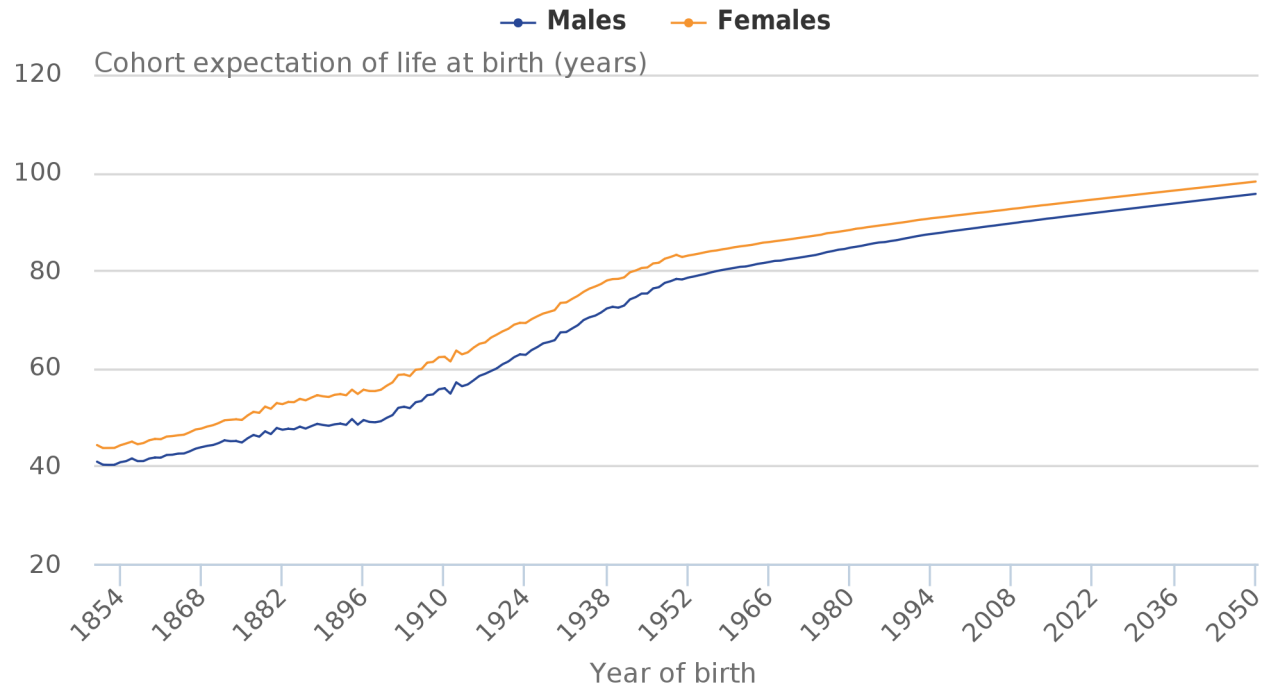
0	79.3	79.3	81.9	83.6	84.1	83.0	82.9	85.1	86.5	86.9
15	64.7	64.8	67.3	68.9	69.4	68.4	68.3	70.4	71.8	72.2
60	22.6	22.7	24.8	26.2	26.6	25.4	25.3	27.1	28.3	28.7
65	18.6	18.7	20.7	21.9	22.3	21.1	21	22.7	23.9	24.2
75	11.4	11.4	13.1	14.2	14.5	13.2	13.1	14.6	15.6	15.9
85	6.0	5.9	7.0	7.9	8.1	7.0	6.8	7.9	8.7	8.9
Cohort expectation of life										
0	90.4	90.5	91.9	93.4	93.9	93.2	93.3	94.7	96	96.5
15	73.7	73.9	75.3	76.7	77.2	76.7	76.8	78.1	79.4	79.9
60	25.8	25.9	27.2	28.3	28.8	28.2	28.3	29.5	30.6	31
65	21.2	21.3	22.5	23.6	24.0	23.5	23.6	24.6	25.7	26.1
75	12.8	12.9	14.2	15.1	15.4	14.5	14.7	15.7	16.6	16.9
85	6.2	6.4	7.5	8.2	8.5	7.2	7.3	8.4	9.1	9.4

Source: Office for National Statistics

Figure 4.8 shows the cohort expectation of life at birth for England and Wales for generations born from 1850 to 2050 and Figure 4.9 shows the cohort expectation of life at age 65 for those reaching age 65 in 1850 to 2050 based on the actual mortality rates experienced in the past or assumed for the future.

About half of the increase in cohort life expectancies at birth between generations born in 1850 and 1945 was due to the reduction in infant and child mortality to very low levels. Subsequent generations have benefited particularly from the almost complete elimination of deaths from acute and infectious diseases. Figure 4.8 illustrates the point that, while current reductions in mortality rates at the older ages will continue to extend the average lifetime, once this reaches around 78 years for males and 83 years for females (that is, for men and women born in 1950), further progress is likely to be much slower. The great majority of deaths will then be attributable to chronic and degenerative diseases.

Figure 4.8: Cohort expectation of life at birth according to historic and projected mortality rates, for persons born from 1850 to 2050, England and Wales

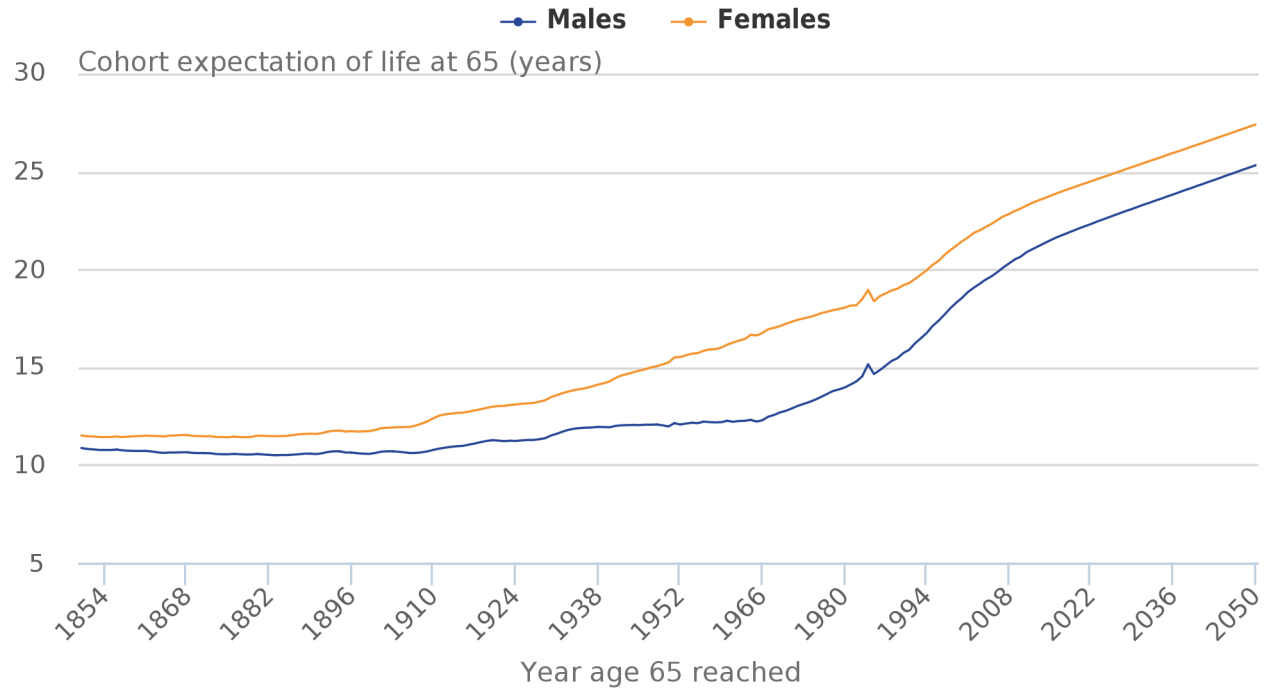


Source: Office for National Statistics

Notes:

1. Life expectancy figures are not available for the UK before 1951; for long historic trends England and Wales data are used

Figure 4.9: Cohort expectation of life at age 65 according to historic and projected mortality rates, for persons who reach age 65 in the years 1850 to 2050, England and Wales



Source: Office for National Statistics

Notes:

1. Life expectancy figures are not available for the UK before 1951; for long historic trends England and Wales data are used

2. The ‘blip’ in the trend line in 1984 relates to the birth cohorts of 1918 to 1920, where the births were not evenly distributed throughout the year

While the cohort expectation of life at age 65 for females has been increasing at a fairly steady rate since the 1930s, the cohort expectation of life at age 65 for males showed relatively little increase between 1930 and 1970 after which it began to increase more rapidly than for females. As discussed earlier, a partial explanation for this may be the different historical patterns in cigarette smoking between men and women. This is likely to have delayed mortality rates for older males falling to the levels they would have reached had they followed the improvements in female mortality rates experienced during the 1950s and 1960s.

10 . Constituent countries of the UK

The projected mortality rates and expectations of life vary between countries because of the differing starting mortality rates and, for Scotland, the different rates of mortality improvement at some ages, as discussed earlier. The resulting life expectancies are shown in Table 4.5; of the 4 countries, England shows the highest life expectancy and Scotland the lowest.

Table 4.5 also shows the comparable life expectancies from the 2012-based projections. The 2014-based period expectations of life at birth are lower for both males and females compared with the 2012-based projections over

the period 2014 to 2039 for all the constituent countries. The only exception being males in Scotland where period expectation of life at birth is broadly consistent. In 2039, period expectations of life at birth for males are projected to be between 0.4 years lower (Wales) and 0 (Scotland) than the 2012-based projections. The differences in 2039 are larger for females with period life expectancies at birth between 0.5 years lower (Northern Ireland) and 0.8 years lower (Scotland). This results in 2014-based projected life expectancies at birth in 2039 in the UK being 0.2 years lower for males and 0.7 years lower for females than the 2012-based projections.

Cohort life expectancies at birth for both males and females are also projected to be lower than in the previous projections for each country of the UK for all years. The only exception being males in Wales where cohort expectation of life at birth is slightly higher in 2039 than the 2012-based projections.

Table 4.5: Period and cohort expectation of life at birth for the years 2014, 2015, 2025, 2035 and 2039, UK

years

	2014		2015		2025		2035		2039	
Period expectation of life at birth										
Males										
England	79.5	79.9 †	79.7	80.2 †	82.2	82.5 †	83.9	84.1 †	84.4	84.6 †
Wales	78.8	79.1 †	78.6	79.4 †	81.3	81.8 †	83.0	83.4 †	83.5	83.9 †
Scotland	77.3	77.3 †	77.2	77.6 †	80.0	80.0 †	81.8	81.7 †	82.3	82.3 †
Northern Ireland	78.6	78.7 †	78.5	79.0 †	81.2	81.4 †	82.9	83.1 †	83.4	83.6 †
UK	79.3	79.6 †	79.3	79.8 †	81.9	82.2 †	83.6	83.8 †	84.1	84.3 †
Females										
England	83.2	83.6 †	83.2	83.8 †	85.3	85.9 †	86.8	87.3 †	87.2	87.8 †
Wales	82.6	82.9 †	82.3	83.2 †	84.6	85.2 †	86.0	86.7 †	86.5	87.2 †
Scotland	81.3	81.5 †	81.1	81.7 †	83.1	83.7 †	84.5	85.3 †	85.0	85.8 †
Northern Ireland	82.4	82.8 †	82.5	83.1 †	84.7	85.1 †	86.1	86.6 †	86.6	87.1 †
UK	83.0	83.3 †	82.9	83.6 †	85.1	85.6 †	86.5	87.1 †	86.9	87.6 †
Cohort expectation of life at birth										
Males										
England	90.6	91.1 †	90.7	91.3 †	92.2	92.8 †	93.6	94.2 †	94.1	94.8 †
Wales	89.7	90.4 †	89.9	90.5 †	91.4	91.8 †	92.8	92.9 †	93.4	93.2 †
Scotland	88.6	88.9 †	88.8	89.1 †	90.3	90.7 †	91.8	92.3 †	92.4	92.9 †
Northern Ireland	89.5	90.1 †	89.8	90.3 †	91.3	91.9 †	92.7	93.4 †	93.3	94.0 †
UK	90.4	90.9 †	90.5	91.0 †	91.9	92.5 †	93.4	94.0 †	93.9	94.6 †
Females										
England	93.4	94.4 †	93.5	94.5 †	94.9	95.9 †	96.2	97.3 †	96.7	97.8 †
Wales	92.9	93.8 †	92.9	94.0 †	94.3	95.4 †	95.6	96.8 †	96.2	97.3 †
Scotland	91.3	92.5 †	91.4	92.6 †	92.9	94.1 †	94.3	95.5 †	94.8	96.1 †
Northern Ireland	92.8	93.6 †	92.9	93.8 †	94.3	95.2 †	95.6	96.6 †	96.1	97.1 †
UK	93.2	94.2 †	93.3	94.3 †	94.7	95.7 †	96.0	97.1 †	96.5	97.6 †

Source: Office for National Statistics

Notes:

1. Corresponding results from the 2012-based projections are marked with a † symbol

11 . Mortality differences between males and females

In common with other northern European countries, the difference in period life expectancy at birth for females over males rose in the UK during the period 1900 to 1970, before declining in more recent years. [1] In the UK, the differential has fallen from 6.0 years in 1980 to 3.7 years in 2014; it is projected to fall to about 2.8 years by 2039. The difference in period life expectancy at age 65 for females over males fell from 3.9 years in the late 1980s to 2.5 years in 2014 and is projected to continue to decline to 1.9 by 2039.

12 . The changing life table

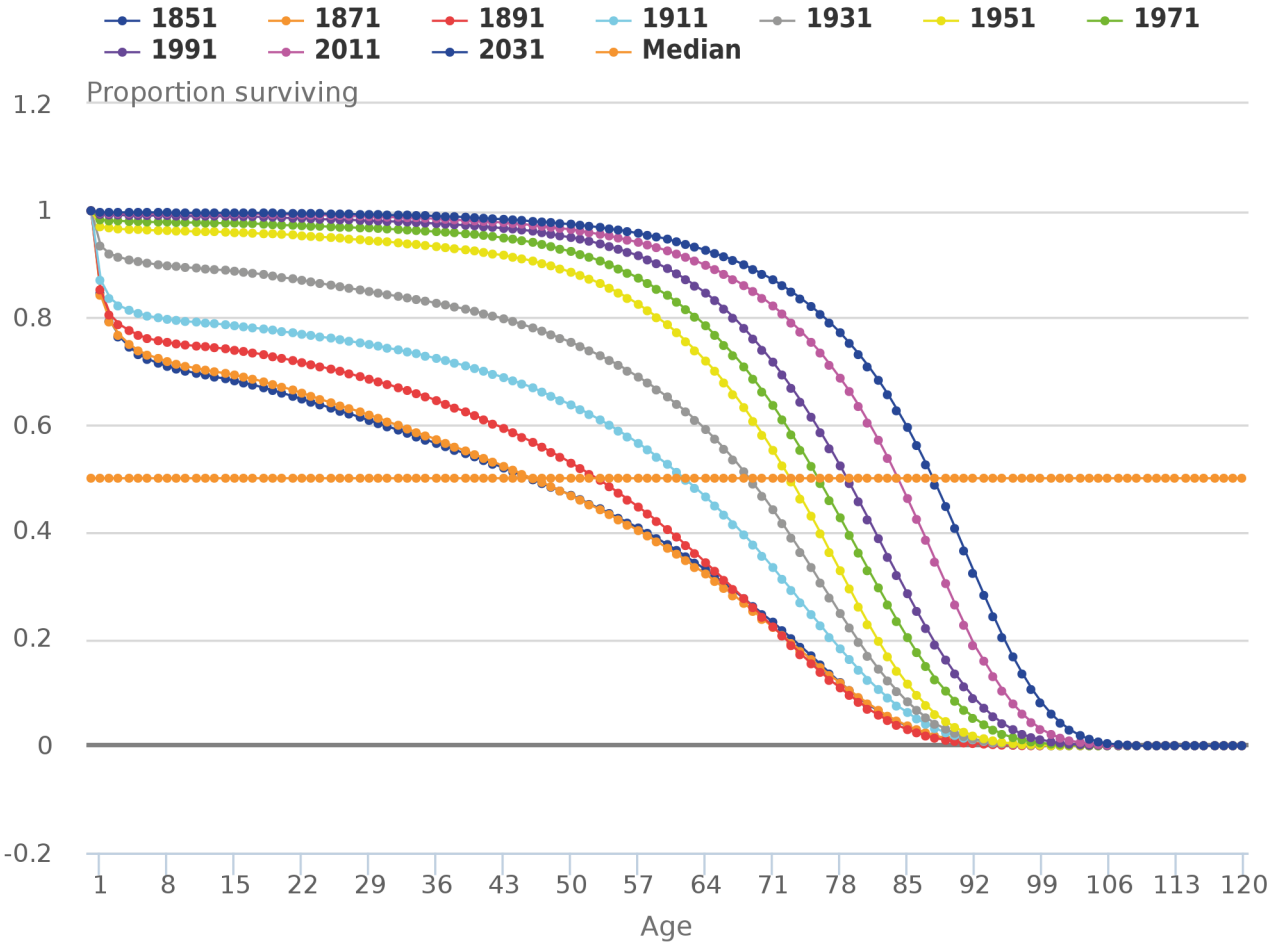
Figures 4.10 and 4.11 illustrate how the survival curve, which shows the proportion of those born in a given year who survive to each age, is getting progressively more rectangular in shape as more deaths occur at advanced ages. The charts are based on the average of male and female mortality in England and Wales.

In Figure 4.10, the survival curves are calculated on a period basis and show the percentages who would survive to successive ages if they experienced the mortality rates of the year shown with no allowance for known or projected changes in mortality rates for the years thereafter. The first, least rectangular, curve represents the life table according to the mortality rates of the year 1851 and successive curves are given at 20 year intervals, with the uppermost being the projected life table for the year 2031. From this chart it can be seen that the median age at death, that is, the age to which half of those born survive, was about 46 on the basis of the mortality rates of 1851; this is projected to increase to about age 88 by the year 2031.

It is clear from Figure 4.10 that recent improvements in period expectation of life at birth have been due primarily to increases in survival to older ages. However, the increase in the maximum age to which people can survive has been comparatively small. There is limited scope for further reduction in mortality rates in young and middle age. Any continuation of recent increases in expectation of life will only be achieved through major falls in mortality at older ages.

Figure 4.11 shows the survival curves calculated on a cohort basis, that is, allowing for known and projected future changes in mortality after the cohort's year of birth. Since mortality rates have, in general, been improving over past years and are projected to continue to improve, the survival curve for a given year in Figure 4.11 lies further to the right than that for the corresponding year in Figure 4.10. From this chart it can be seen that, on a cohort basis, the median age at death for those born in 1851 was actually about 48, this is projected to increase to about age 98 for those born in 2031.

Figure 4.10: Proportion of persons surviving (on a period basis) to successive ages, according to mortality rates experienced or projected, persons born 1851 to 2031, England and Wales

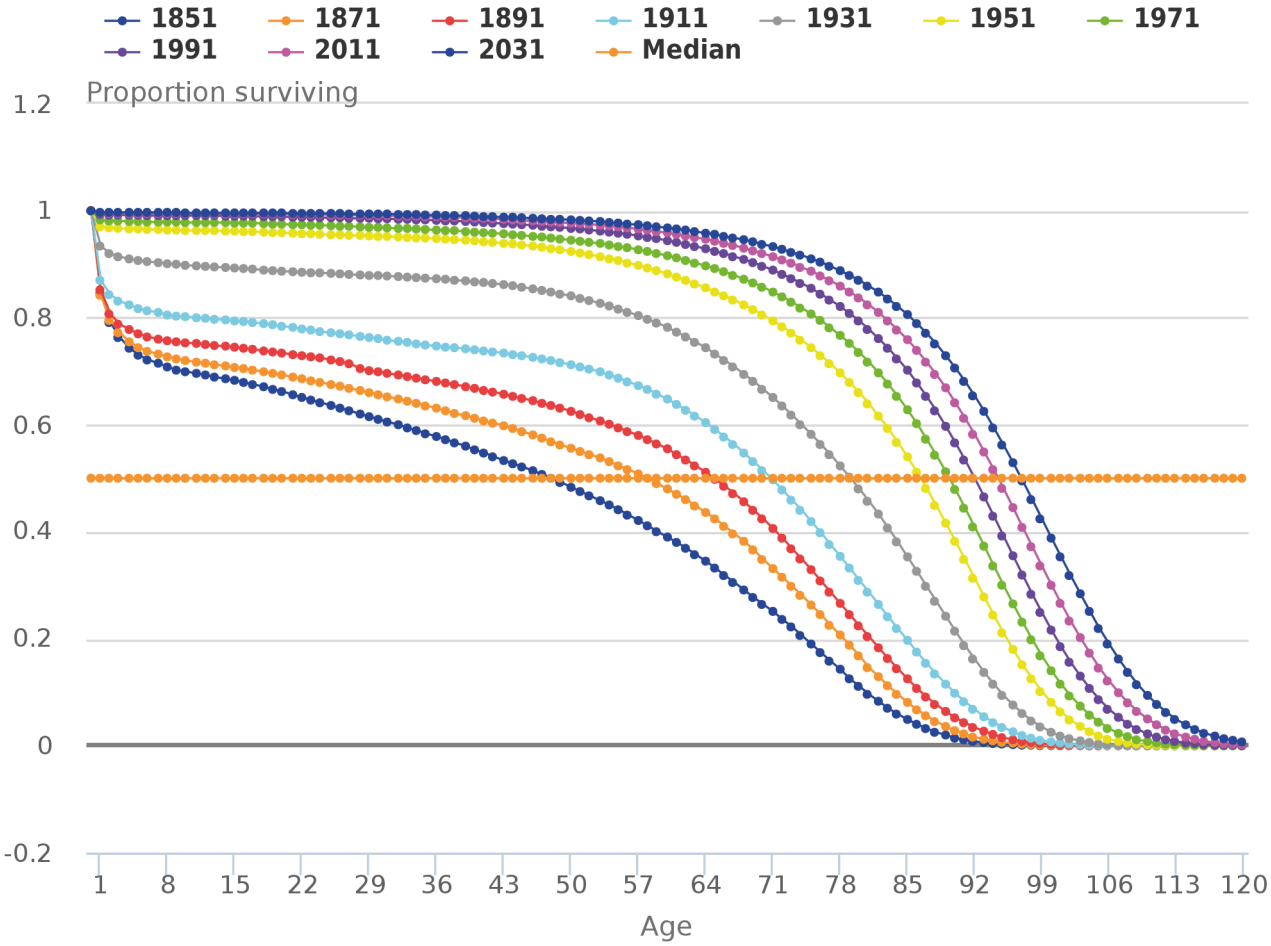


Source: Office for National Statistics

Notes:

1. Life expectancy figures are not available for the UK before 1951; for long historic trends England and Wales data are used

Figure 4.11: Proportion of persons surviving (on a cohort basis) to successive ages, according to mortality rates experienced or projected, persons born 1851 to 2031, England and Wales



Source: Office for National Statistics

Notes:

1. Life expectancy figures are not available for the UK before 1951; for long historic trends England and Wales data are used

13 . Further details

Projected numbers of deaths and comparisons with the previous (2012-based) projections are discussed in Chapter 2 while Chapter 6 presents the results of variant projections based on alternative assumptions about future mortality. The detailed age specific rates assumed in the principal and variant projections for each country are available on our website.

14 . Views on future levels of mortality improvements and expectations of life

Mortality projections prepared in other countries and by other agencies tend to be based largely on extrapolation of past trends either in mortality rates, rates of mortality improvement or in expectations of life. Expert opinion is often used to inform the assumptions made. It is therefore perhaps helpful to summarise some of the current arguments put forward by experts regarding future levels of mortality improvements and life expectancy, for the UK and for other developed countries.

For the UK, several factors have been identified amongst the likely causes of future mortality change including the “cohort effect”, the “ageing of mortality improvement” (where the ages at which the highest rates of improvement have occurred have been increasing over time), increased uncertainty at younger ages, changes in prevalence of cigarette smoking, the effects of other lifestyle changes, medical advances, possible increased resistance to antibiotics and the potential re-emergence of old diseases and climate change.

Appendix A in background and methodology for the 2014-based national population projections reports a meeting of the National Population Projections Expert Advisory Group at which members were asked their views on the validity of a large range of arguments which might be thought likely to influence future mortality trends.

The majority of the expert panel was optimistic about future mortality improvements. However, they had differing views about period expectation of life at birth continuing to rise at the same rate as that seen over the last decade or so. The general opinion was that the target rate of improvement should vary by age and be the same for males and females. Most were of the opinion that the rate of improvement for males and females should be set at 1.2% or higher.

The main forces thought most likely to affect future mortality levels were changes in bio-medical technology, effectiveness of health care and behavioural changes related to health. The majority opinion of the expert panel was that these 3 forces should have a small upward influence on life expectancy, with 3 experts reporting a large upward influence for bio-medical technology.

The experts generally felt that possible new infectious diseases and the resurgence of old diseases would have little or no influence on life expectancy although comment was made surrounding anti-biotic resistant bacteria. They were also of the opinion that changes in population composition and differential trends in population sub-groups would have little impact. The majority of the panel thought that the level of obesity in the UK would increase over the next 25 years, but that this would have relatively little effect on future life expectancy.

Oeppen and Vaupel[12] have noted that record life expectancy (the highest life expectancy observed in any country of the world at any particular time) has increased at a steady pace over the last 160 years or so and suggest that this is likely to continue into the future. However, Olshansky[11] and others have argued that there will be countervailing trends to the high rates of mortality improvements seen in recent years, driven by increasing levels of obesity, sedentary behaviours and other adverse lifestyle factors.

Given this disparity of views as to the likely future course of longevity, users of the projections can gain some insight into the sensitivity of their results to the various views on future mortality by considering the high and low life expectancy variants (see Chapter 6). However, these are intended to represent plausible alternative assumptions and are far from reflecting the extremes of thinking on future mortality.

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21. Further information on the difference between period and cohort life expectancies is available at: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/guide-method/method-quality/specific/population-and-migration/demography/guide-to-period-and-cohort-life-expectancy/index.html

16. Background notes

1. These National Statistics are produced to high professional standards and released according to the arrangements approved by the UK Statistics Authority.

Compendium

Migration, 2014-based national population projections reference volume

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To be announced

Table of contents

1 . Introduction

In the national population projections, assumptions are made regarding future levels of migration to or from the UK and its constituent countries. This is broken down into international migration (the movement of people to or from countries outside of the UK) and cross border migration (the movement of people between countries of the UK).

In 2012, the Economic and Social Research Council (ESRC) Centre for Population Change (CPC) carried out a review of the migration assumptions-setting methodology for the national population projections [1].

The previous assumptions-setting methodology had been in place since the 1991-based projections and the review suggested that whilst these methods were in line with the current practice of many statistical agencies, they were not necessarily in accordance with the recommendations from academic literature, in particular surrounding the use of net migration levels. The methodology was also found to contain a number of “patches” which had to be included to respond to unpredicted changes in trends (for example, for migration from Central and Eastern Europe following the EU enlargement), or specific data situations. These patches were found to reduce the cohesion of the whole system of assumption-setting.

The review recommended that the existing arguments-based methodology should be brought into line with current academic recommendations as a multi-stage redevelopment approach. With the support of a user forum run in parallel to the review, in the 2012-based projections there was a move to modelling migration inflows and outflows separately and a general streamlining of the methodology [2].

For the 2014-based projections a new SAS-based projections system was developed, enabling the setting and applying of the cross-border (intra-UK) migration assumptions as rates rather than fixed numbers of migrants [3]. Introducing migration rates into the projections is a continuation of the work to implement the recommendations from the ESRC review and is another step towards fully aligning our projections with the most up to date academic ideas. By using rates, cross-border migrant flows change on the basis of the underlying population size and age structure. This means that the projections cannot produce implausible values, such as negative population stocks, when projected fixed levels of emigration are greater than the initial population size. This was previously an issue for Northern Ireland where there is a high level of cross-border migration at some ages.

This chapter summarises the resulting assumptions adopted in the short-term and long-term for the 2014-based population projections, both in terms of international and cross-border migration.

It is important to emphasise that the migration assumptions are based on past demographic trends. They do not attempt to predict the impact that new or future government policies, changing economic circumstances or other factors (whether in the UK or overseas) might have on migration patterns.

2 . Past trends in migration

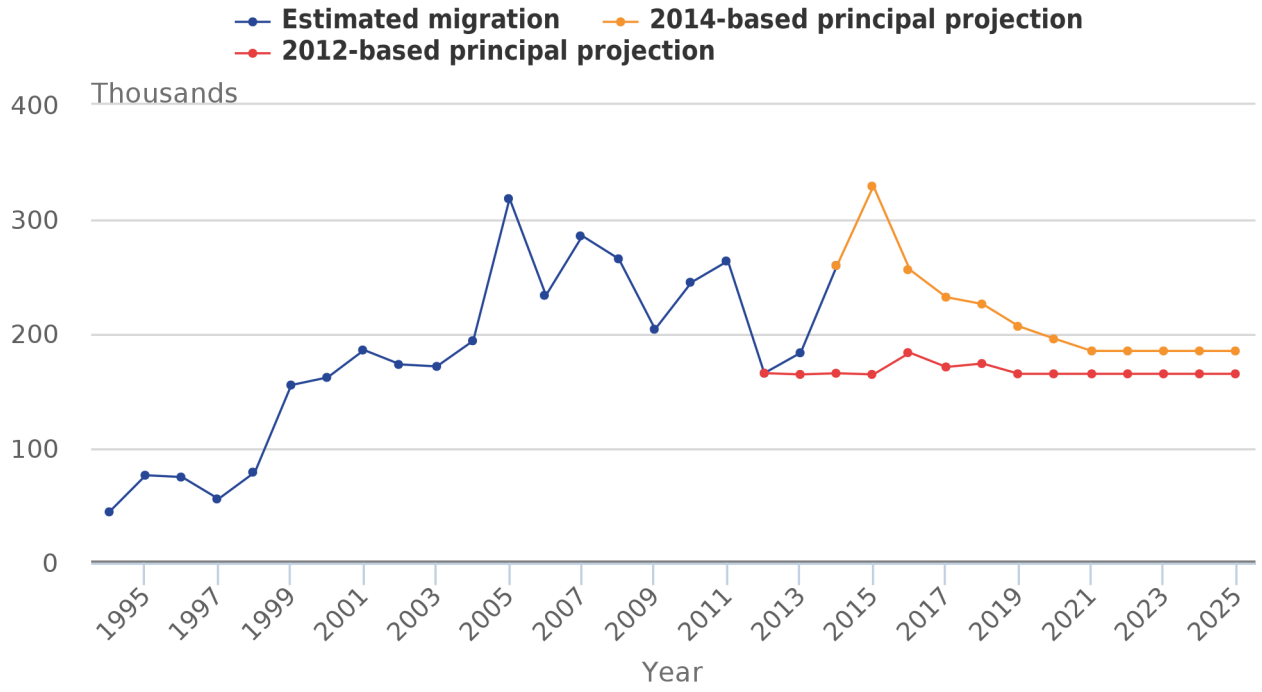
Since the early 1980s, the UK has transitioned from being a country characterised by net emigration to one characterised by net immigration. This is due to the fact that the growth in immigration, which has risen from less than 200,000 per year in 1981 to over 600,000 [4] in 2014, has outstripped any increases in emigration. Net migration peaked in 2004 to 2005 partly as a result of immigration from countries that joined the EU in 2004. Since the peak, annual net migration has fluctuated between +160,000 and +290,000 per annum.

In the year ending June 2014 (the base year of the projections), 583,000 people immigrated to the UK. Net migration in the year to June 2014 rose to +260,000, a significant increase compared with the previous year. These recent trends are reflected in the migration assumptions.

3 . Overall assumptions

The new assumptions result in long-term net migration to the UK of +185,000 each year compared with +165,000 a year in the 2012-based projections, reflecting the rise in net migration to the UK since 2012. Figure 5.1 compares the future net migration assumptions with historical international migration estimates back to 1994 and also includes the assumptions made for the previous 2012-based projections. It is based on mid-year to mid-year, rather than calendar year figures, so the latest “actual” data point shown is the estimated total net inflow to the UK of 260,000 between mid-2013 and mid-2014.

Figure 5.1: Estimated and assumed total net migration, year ending mid-1994 to year ending mid-2025, UK



Source: Office for National Statistics

Notes:

1. All migration data are displayed on a mid-year basis

2. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA so aggregate totals may differ from published international migration data

3. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the totals may differ from the published international migration data

4 . International migration

We use the United Nations recommendation for defining an international long-term migrant. That is, someone who changes their country of usual residence for a period of at least a year, so that the country of destination effectively becomes the country of usual residence.

International migration figures are derived from a number of sources. The principal source is the International Passenger Survey (IPS). Adjustments are made to account for people who enter or leave the country initially for a short stay but subsequently decide to remain for a year or more (“visitor switchers”) and people who originally intend to be migrants but in reality stay in the UK or abroad for less than 1 year (“migrant switchers”). Flows to and from the Republic of Ireland, taking into account the discontinuity in 2008 due to methodological changes, are included in the IPS flows.

Visitor switchers are people who enter or leave the UK for a short visit (that is, less than 12 months) but end up migrating for more than a year. These people are visitors who subsequently become migrants and therefore need to be added to the migration estimates.

Migrant switchers are people who state in the IPS that their intention is to remain in their destination country for more than a year (and are therefore classed as migrants) but who actually leave, or return to, the UK within 1 year, so are actually visitors. They need to be removed from IPS migrant flows. This is effectively the converse situation to visitor switchers. The adjustments for “switchers” are made before modelling so that these components do not have to be modelled separately.

The IPS excludes most, but not all, persons seeking asylum and some dependants of such asylum seekers. Therefore, asylum seekers are modelled separately. Data on asylum seekers and their dependants (based on the number of people applying for asylum) obtained from the Home Office, are used to estimate the number of migrants arriving or leaving Great Britain.

Northern Ireland

From 2008, our migration estimates no longer use IPS data for Northern Ireland and instead use data from the Northern Ireland Statistics and Research Agency (NISRA). In order to obtain the longest possible continuous time series for modelling, Northern Ireland data back to 1992 are obtained directly from NISRA. The NISRA data are derived from administrative sources so they incorporate visitor and migrant switchers, asylum seekers and Republic of Ireland flows into one flow, which means that the modelling of asylum seeker flows has to be carried out at the Great Britain level only.

EU accession

Migrants from EU8 and EU2 countries are modelled as part of the international flows, with any discontinuity encountered after EU accession in 2004 being accounted for during modelling where necessary. This is consistent with the 2012-based projections, but in contrast to previous rounds of projections where migrants from EU8 and EU2 countries were excluded from IPS modelling and adjusted for separately.

Modelling of international flows

International migration flows to and from each UK constituent country and asylum seeker flows to and from Great Britain are modelled separately. Initially the flows were modelled using ARIMA [5], which is a standard technique for time series forecasting and which was used for the 2012-based projections. A number of models were fitted to each flow, with the most suitable one chosen based on goodness of fit measures.

ARIMA modelling, by its nature, gives more weight to most recent trends in the data. As the UK has recently experienced a period of high net in-migration, the modelled long-term trends assume that these high levels will continue. As this trend is contrary to the expert academic advisory panel’s views [6] on long-term migration, alternative assumptions (using a moving average approach) were also produced.

The moving average modelling was based on data up to mid-2014 with the length of the time series used dependent on the data source. For international immigration and emigration, a 25 year moving average was calculated for each flow to/from England, Scotland and Wales. For Northern Ireland a 20 year moving average was used, as a consistent time series of data was not available for 25 years. For asylum seekers a 10 year moving average was calculated for each flow. This time frame was selected to exclude the unusually high historic peak of asylum seekers in Great Britain around the year 2000, after which legislative changes (Nationality, Immigration and Asylum Act 2002) were implemented that reduced unfounded asylum applications.

At the national population projections consultation, the long-term assumptions based on the moving average approach were agreed in preference to those from the ARIMA modelling. The resulting figures were fixed as the long-term assumption for the year to mid-2021 and held constant for the remaining length of the projection. Short-

term assumptions were calculated based on a linear interpolation between the latest estimates (mid-2014) and the long-term assumptions to provide a smooth run-in for each UK country. At the time of producing the national population projection assumptions, migration estimates were available for the year ending December 2014 and National Insurance number allocations to March 2015. These figures were extrapolated and used to adjust the migration assumptions in the first year of the projection to reflect anticipated migration levels.

The separate gross flows for each country were summed to produce total numbers by country and for the UK as a whole. The resulting long-term assumptions can be seen in Table 5.1.

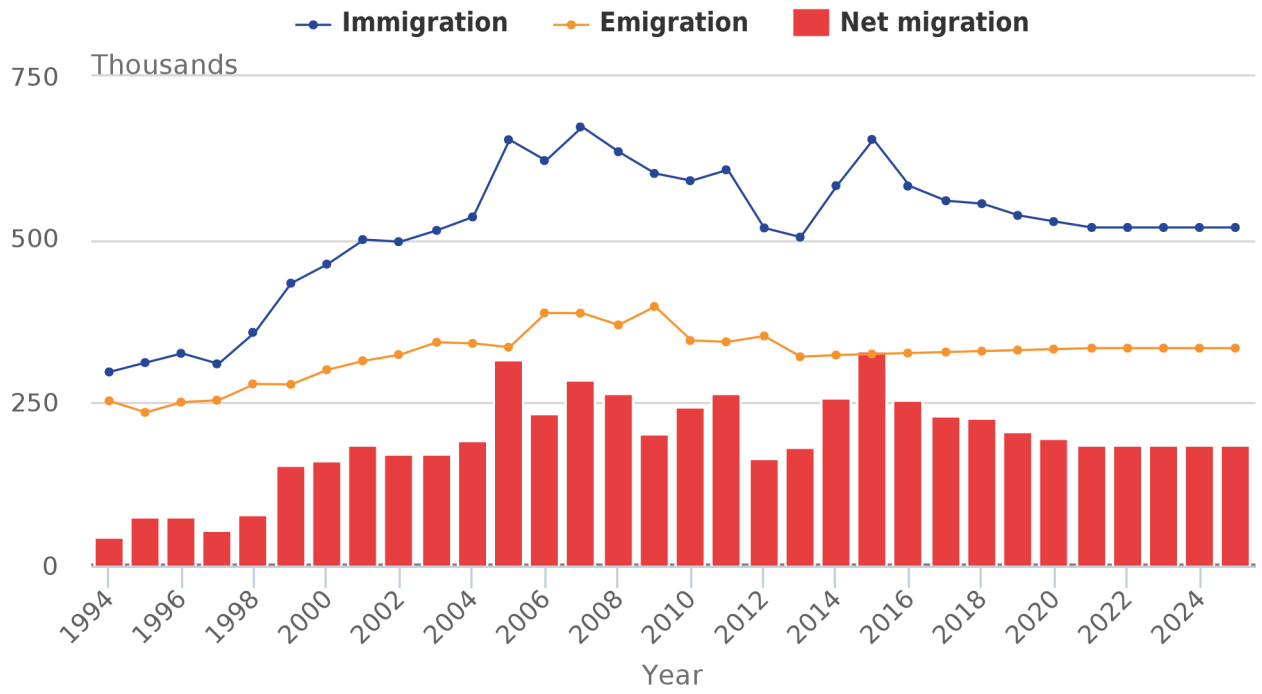
Table 5.1: Assumed annual long-term gross international migration flows, year to mid-2021 onwards, UK

	England	Wales	Scotland	Northern Ireland	UK
International inflow	438,000	12,500	32,000	13,000	495,500
International outflow	281,000	9,000	23,500	12,000	325,500
Asylum seeker inflow	20,500	1,000	1,500	-	23,000
Asylum seeker outflow	7,000	500	500	-	8,000
Total international inflow	458,500	13,500	33,500	13,000	518,500
Total international outflow	288,000	9,500	24,000	12,000	333,500
Net international migration	170,500	4,000	9,500	1,000	185,000

Source: Office for National Statistics

The estimated and projected international in and out flows to or from the UK are shown in Figure 5.2.

Figure 5.2: Estimated and projected international migration to or from the UK, year ending mid-1994 to year ending mid-2025



Source: Office for National Statistics

Notes:

1. All migration data are displayed on a mid-year basis

2. Figures up to and including the year ending mid-2014 are international migration estimates. Figures for year ending mid-2015 onwards are assumed levels of international migration

3. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA so aggregate totals may differ from published international migration data

4. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the totals may differ from the published international migration data

Table 5.2 shows that the long-term international migration assumptions for England, Wales and Northern Ireland are higher than the 2012-based projections and those for Scotland are lower.

Table 5.2: Long-term annual net international migration assumptions, UK and constituent countries, mid-2021 onwards

Country	2014-based	2012-based	Difference
England	170,500	150,000	20,500
Wales	4,000	3,000	1,000
Scotland	9,500	12,000	-2,500
Northern Ireland	1,000	0	1,000
UK	185,000	165,000	20,000

Source: Office for National Statistics

Notes:

1. International migration includes IPS, migrant and visitor switchers, asylum seekers and Republic of Ireland flows

The projections assume constant levels of annual net international migration beyond mid-2021. In reality, of course, migration will inevitably continue to fluctuate from year to year, but such long-term fluctuations are impossible to predict. The assumptions should therefore be regarded as representing average annual levels of net migration for the future.

5 . Cross-border migration with the UK

Regular estimates of the movements of population between countries of the UK are made by the Office for National Statistics, National Records Scotland and the Northern Ireland Statistical Research Agency. These estimates are based on changes of residence recorded by National Health registration systems in the respective countries.

In the 2014-based projections, migration assumptions between countries of the UK have been set as rates rather than as fixed numbers of migrants. Annual age and sex-specific migration rates for each cross-border flow (England to Northern Ireland and so on) are calculated as the number of migrants at the end of the year divided by the population of the country of origin at the start of the year. An average of the rates for the last 5 years (year ending mid-2010 to year ending mid-2014) is then taken. An adjustment is applied to these average rates to take into account the population size of the country of destination in addition to the country of origin. When only the country of origin is taken into account, migration out of fast-growing countries will always increase at a faster rate than that from slow-growing countries. By applying the adjustment, net migration rates to each country over the course of the projection are stabilised and therefore more closely resemble past trends.

These adjusted rates are applied to the population of the country of origin at the beginning of each projection year to calculate the projected number of migrants for each cross-border flow.

Using a rates-based method results in cross-border flows between countries of the UK varying year-on-year as the population size and age structure changes. In the long-term cross-border flows tend to stabilise. In previous rounds of projections, total cross-border migration assumptions to or from the other countries of the UK were set as a constant value in the long-term.

Table 5.3 shows the flows between the 4 UK countries for the year ending mid-2039, 25 years into the projection.

Table 5.3: Matrix of assumed long-term cross-border flows between the UK constituent countries, mid-2039

	Country of destination			
Country of origin	England	Wales	Scotland	Northern Ireland
England	-	55,200	42,700	8,200
Wales	53,600	-	1,500	400
Scotland	37,600	1,300	-	1,900
Northern Ireland	8,800	400	2,200	-

Source: Office for National Statistics

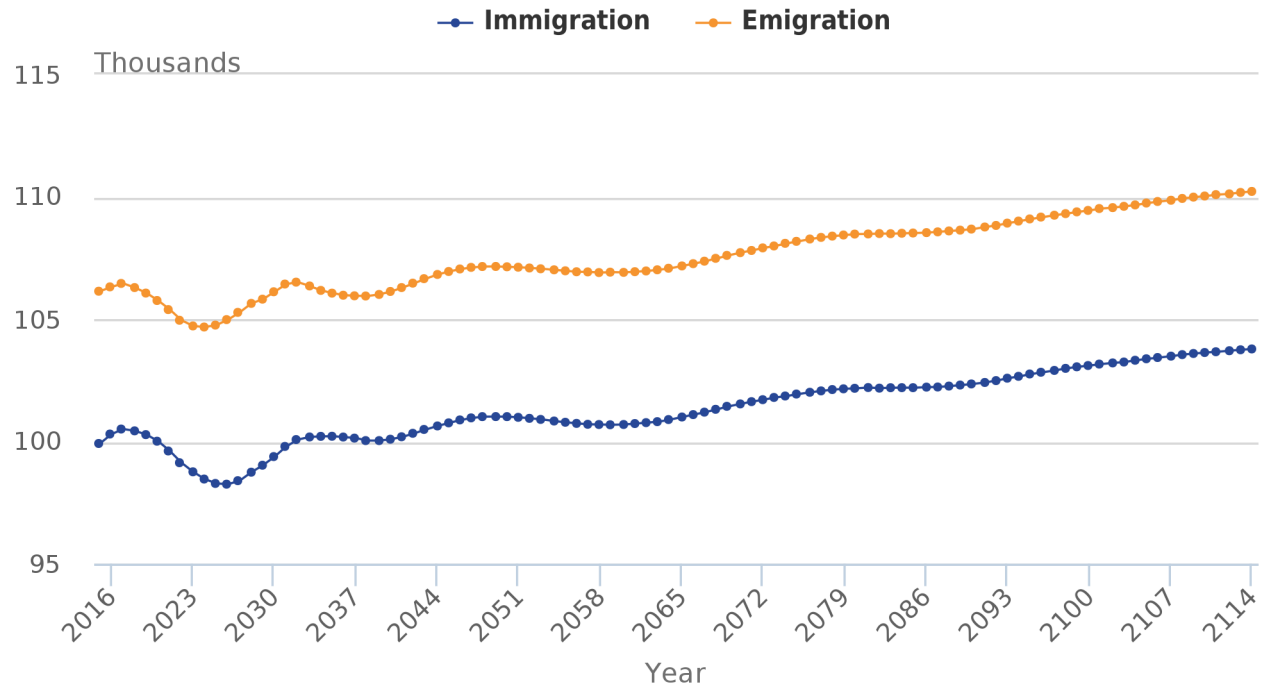
Notes:

1. Figures may not sum due to rounding

Table 5.3 shows that numerically the dominant flows within the UK are between the smaller countries and England. England tends to have a net loss to Scotland and Wales, but a small net gain in migrants from Northern Ireland. Scotland has a net gain from all 3 countries. The numbers moving between Wales and Northern Ireland each year are very small with a negligible net gain to Northern Ireland.

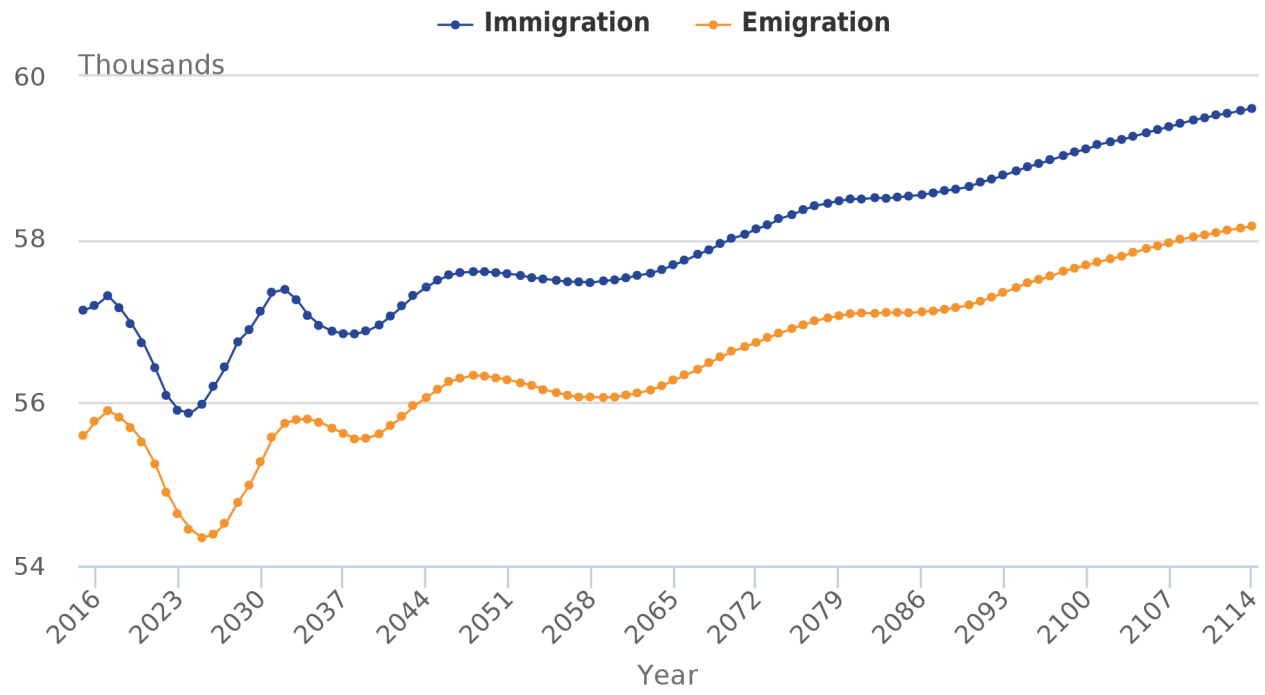
Figures 5.3 to 5.6 show the trend in cross-border in- and out-flows for England, Wales, Scotland and Northern Ireland throughout the projection period.

Figure 5.3: Cross-border migration assumptions, England, year ending mid-2015 to year ending mid-2114



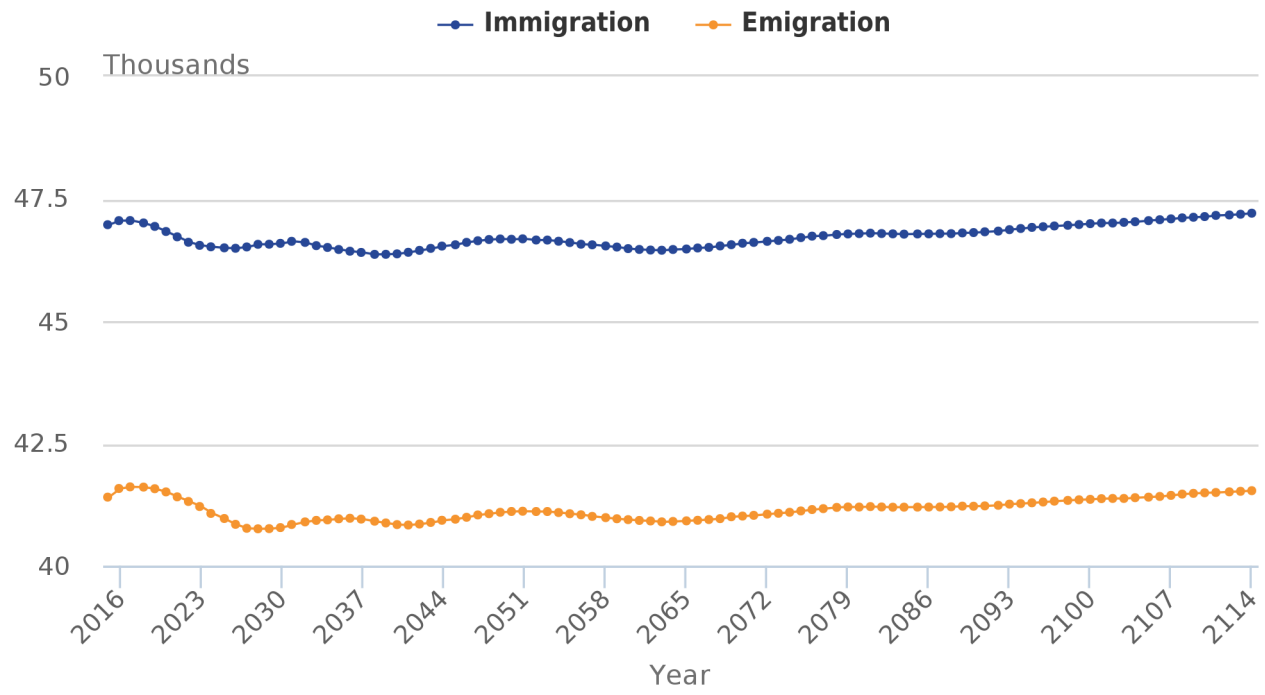
Source: Office for National Statistics

Figure 5.4: Cross-border migration assumptions, Wales, year ending mid-2015 to year ending mid-2114



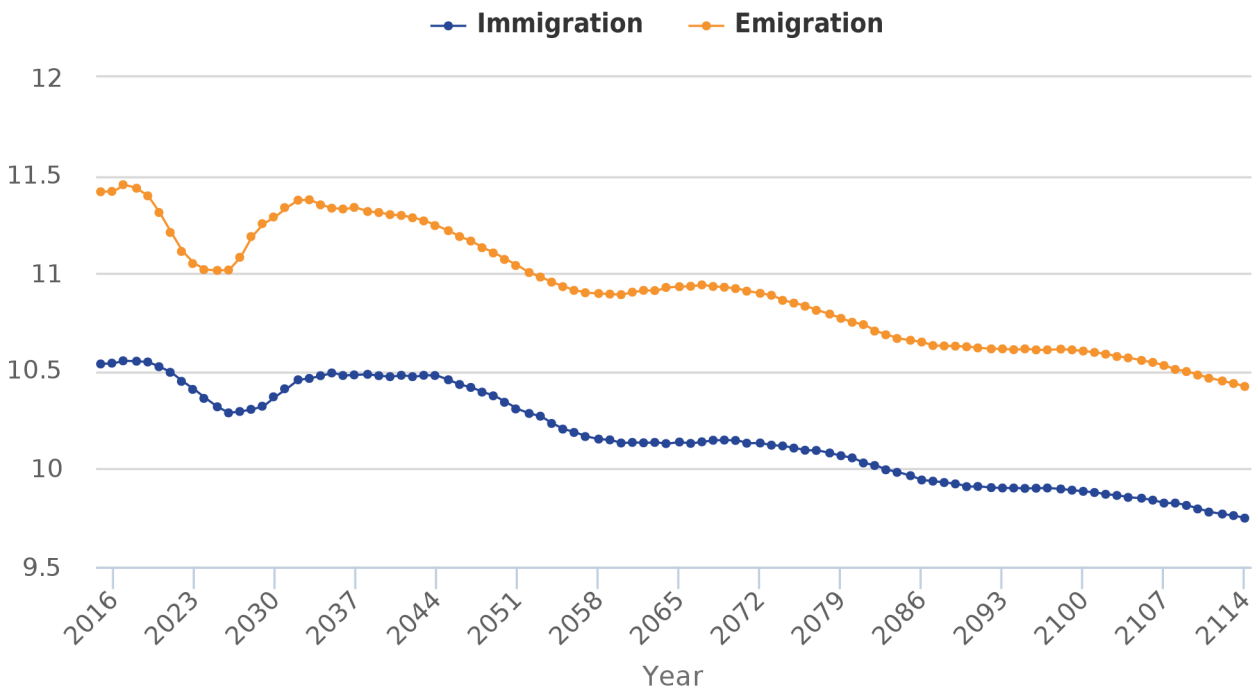
Source: Office for National Statistics

Figure 5.5: Cross-border migration assumptions, Scotland, year ending mid-2015 to year ending mid-2114



Source: Office for National Statistics

Figure 5.6: Cross-border migration assumptions, Northern Ireland, year ending mid-2015 to year ending mid-2114



Source: Office for National Statistics

For each country, the assumptions show fluctuations in the early years reflecting the impact of the underlying age and sex structure and population sizes of the respective countries. In the long-term the trends stabilise.

Table 5.4 shows the net cross-border migration assumptions for selected years compared with those from the 2012-based projections.

Table 5.4: Long-term annual net cross-border migration assumptions, UK constituent countries, selected years

	2014-based assumptions					2012-based assumptions
Country	Mid-2024	Mid-2039	Mid-2064	Mid-2089	Mid-2114	
England	-6,200	-6,000	-6,200	-6,300	-6,400	-6,500
Wales	1,400	1,300	1,400	1,500	1,400	3,000
Scotland	5,500	5,500	5,600	5,600	5,700	3,500
Northern Ireland	-700	-800	-800	-700	-700	0

Source: Office for National Statistics

For the 2014-based projections, England and Northern Ireland have a projected net outflow of migrants to other countries of the UK, whereas Wales and Scotland have a projected net inflow.

The long-term net cross-border assumptions for England are broadly consistent with the 2012-based projections. Wales and Northern Ireland assume a lower level of net cross-border migration in the 2014-based projections whereas the assumption for Scotland is approximately 2,000 per year higher than the 2012-based projections.

6 . Assumptions for the short-term

Special international migration assumptions have been applied for the first few years of the projection (mid-2015 to mid-2020). The breakdown of these assumptions is shown in Table 5.5. The short-term run-in has been formulated to represent a smooth transition from the last year of actual data to the long-term assumptions, with an adjustment made in the first year of the projection to take into account provisional extrapolated migration estimates for the year to mid-2015. The run-in also includes a short-term armed forces flow, which has been included to account for the planned return of home armed forces personnel and their dependants from Germany.

For cross-border migration, rates are applied in the first few years of the projection in the same way that they are applied throughout the projection period. No distinction is made between the short- and long-term.

Home armed forces

A separate flow to account for the planned return of home armed forces personnel from Germany to England (plus their dependants) is included in the short-term assumptions. This flow is not modelled, rather it is based on actual planned numbers of troops returning up until mid-2018. The flow is set to zero in the long term.

Table 5.5: Short-term annual net international migration assumptions, UK and constituent countries, year ending mid-2015 onwards

thousands

	United Kingdom	England	Wales	Scotland	Northern Ireland
Total net international migration					
2014-15	329.0	304.7	7.7	13.6	3.0
2015-16	256.0	239.5	5.4	8.4	2.7
2016-17	232.0	216.0	5.1	8.6	2.3
2017-18	226.0	210.3	4.8	8.9	2.0
2018-19	206.5	191.1	4.6	9.1	1.7
2019-20	195.5	180.7	4.2	9.3	1.3
Long term assumption (2020-21 onwards)	185.0	170.5	4.0	9.5	1.0
International migration assumption[1]					
2014-15	329.0	304.7	7.7	13.6	3.0
2015-16	238.5	222.0	5.4	8.4	2.7
2016-17	227.5	211.5	5.1	8.6	2.3
2017-18	217.0	201.3	4.8	8.9	2.0
2018-19	206.5	191.1	4.6	9.1	1.7
2019-20	195.5	180.7	4.2	9.3	1.3
Long term assumption (2020-21 onwards)	185.0	170.5	4.0	9.5	1.0
Returning armed forces from Germany (including dependants)					
2014-15	0.0	0.0	0.0	0.0	0.0
2015-16	17.5	17.5	0.0	0.0	0.0
2016-17	4.5	4.5	0.0	0.0	0.0
2017-18	9.0	9.0	0.0	0.0	0.0
2018-19	0.0	0.0	0.0	0.0	0.0

2019-20	0.0	0.0	0.0	0.0	0.0
Long term assumption (2020-21 onwards)	0.0	0.0	0.0	0.0	0.0

Source: Office for National Statistics

Notes:

1. International migration includes IPS, migrant and visitor switchers, asylum seekers and Republic of Ireland flows

7 . Other considerations

Illegal migration

In line with our estimates of total international migration, no explicit or separate allowance has been made in the projections for illegal migrants entering the UK.

Age and sex distribution

For England, Wales, Scotland and Northern Ireland, the assumed age and sex distributions for the international migrant flows have been based on the age-sex distributions of the international migration component in the relevant mid-year population estimates. The assumed distributions were considered separately for immigrants and emigrants and are based on averages of the last 5 years' data (mid-2010 to mid-2014). The international distributions are also applied to the asylum seeker flows because single year of age distributions are not available for this data source.

The long-term net international migration distribution for the UK is summarised in Table 5.6. The table shows that the projections assume slightly more male than female international migrants.

For cross-border migration, age and sex-specific rates were calculated for each cross-border flow (England to Northern Ireland and so on) based on an average of the past 5 years' data. These rates were adjusted year on year to take into account the change in the destination country's proportion of the UK population relative to the reference period (mid-2010 to mid-2014). As adjustments are calculated and applied by age and sex, unlike the long-term international migration assumptions, the age-sex distributions for cross-border migration do not remain constant in the long-term and can vary year on year.

Table 5.6: Assumed annual long-term net international migration by age and sex, UK, 2020 to 2021 onwards

thousands

	2020-21 onwards		
Age group	Persons	Males	Females
0 - 4	17.0	9.4	7.6
5 - 9	10.6	5.5	5.0
10 - 14	11.0	5.8	5.2
15 - 19	31.4	17.0	14.4
20 - 24	65.1	35.4	29.8
25 - 29	28.5	16.1	12.4
30 - 34	6.1	1.8	4.4
35 - 39	0.7	0.3	0.4

40 - 44	-0.7	-2.3	1.6
45 - 49	3.5	2.0	1.5
50 - 54	2.1	0.3	1.8
55 - 59	2.3	0.5	1.8
60 - 64	2.3	0.6	1.6
65 - 69	1.9	0.8	1.1
70 - 74	1.1	0.4	0.7
75 and over	2.1	1.0	1.1
All ages	185.0	94.7	90.3

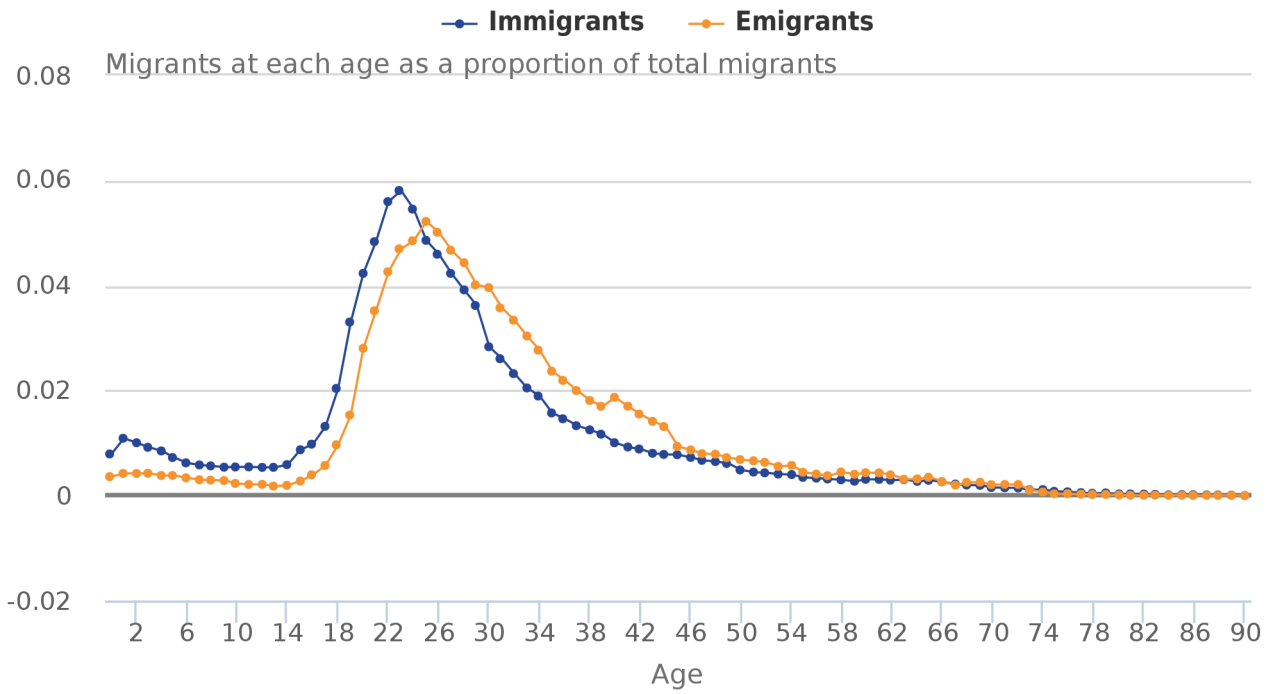
Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

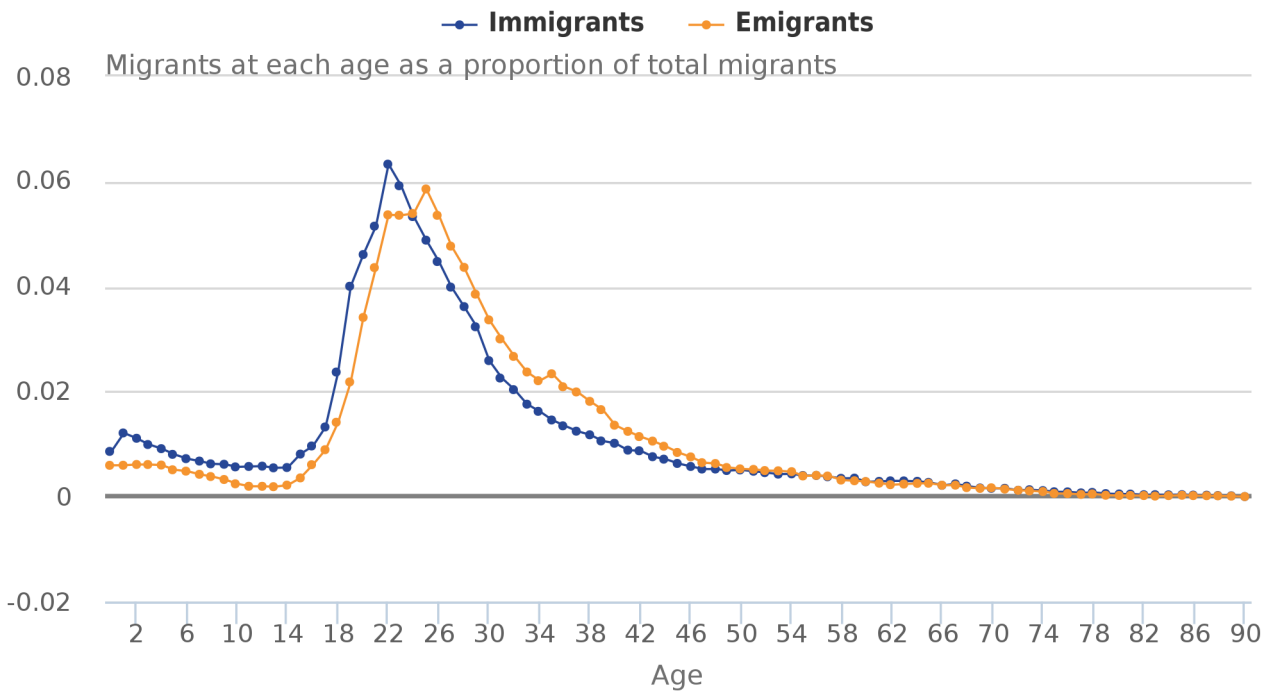
The assumed age distributions for international migration to and from the UK are shown in Figures 5.7 and 5.8. All these distributions are highly peaked at the young working ages

Figure 5.7: Assumed long-term age distribution for international migration to or from the UK, males



Source: Office for National Statistics

Figure 5.8: Assumed long-term age distribution for international migration to or from the UK, females



Source: Office for National Statistics

8 . Views on future migration levels

The National Population Projections Expert Advisory Panel of 9 academic demographic experts met in April 2015. In an accompanying questionnaire, the experts were asked for their opinions on the likely levels of international migration to and from the UK in 2018 and 2038 (that is, 5 years and 25 years into the future from the latest 2013 population estimates). A note of the meeting and an analysis of the questionnaire are included in the 2014-based projections October 2015 release, in Appendices A and B of the Background and Methodology paper.

Experts' views on migration in the long-term

Over the last 5 years (2009 to 2013), international in-migration to the UK averaged about 550,000, out-migration 339,000 and net migration (taking into account revisions after the 2011 Census) 215,000 per year. Experts were asked their views on the expected level of migration to and from the UK in the future.

The average response for the expected level of annual immigration to the UK in 2038 was 530,000, with an average 95% confidence interval of 309,000 to 750,000.

With respect to emigration from the UK, the average response for the expected level of annual emigration in 2038 was 383,000, with an average 95% confidence interval of 256,000 to 531,000.

The average annual net migration derived from the experts' responses for 2038 was a net inflow of +153,000 per year, with an average confidence interval of 0 to 377,000.

Three experts responded with a lower confidence interval level that was less than zero suggesting they thought it possible there could be negative UK net migration in the future.

The experts' average long-term net migration figure to the UK (+153,000) is lower than the 2014-based long-term assumption of +185,000 per year. The difference is due predominantly to the emigration estimate which experts on average predicted to be 383,000 per annum, compared with an assumption of 333,500.

Experts' views on migration in the short-term

The average response for the expected level of annual immigration to the UK in 2018 was 535,000, with an average 95% confidence interval of 360,000 to 660,000.

With respect to emigration from the UK, the average response for the expected level of annual emigration in 2018 was 355,000, with an average 95% confidence interval of 280,000 to 438,000.

The average annual net migration derived from the experts' responses for 2018 was a net inflow of +188,000 per year, with an average confidence interval of 78,000 to 321,000.

The experts' averages show a small decrease in immigration and an increase in emigration between the short-term and long-term. This gives an overall fall of the experts' average net migration figure of 35,000 between 2018 and 2038. The experts' short-term in, out and net figures are broadly in line with the 2014-based long-term assumptions of 518,500, 333,500 and +185,000 respectively.

Specific scenarios

The experts were also asked to consider the effects of certain specific situations on migration.

Continuing instability of Syria, the Ukraine and other regions

When asked about the impact of political instability around the world, 3 experts felt that this will have little or no impact, 4 felt it would result in a small upwards movement and 2 a large upwards movement in the level of net migration in the short- and long-term.

Environmental change

In the short-term, 6 experts anticipate little or no change and 3 a small upwards movement in the level of UK net migration due to environmental change. In the long-term, responses were very similar to the short-term, with the exception of 1 expert anticipating a large upwards movement.

Changing global economy

There were mixed views on the effects of the changing global economy on migration patterns. The majority of experts suggested an upwards movement in the level of UK net migration over the next 5 years. Five felt this increase would be relatively small, whereas 2 felt it would be large.

In the long-term, responses were more evenly spread between an anticipated small downwards movement, little or no movement and a small upwards movement, with just 1 expert suggesting a large upwards movement in UK net migration over the next 25 years.

Other factors

Experts were asked to suggest other factors which could impact on international and cross-border migration over the next 5 and 25 years. Factors suggested included changes to government policy, further debate regarding devolution, EU membership, the need for labour to support the elderly population, an increase in alternatives to a UK higher education and a reduction in the demand from other countries for migrants from the UK.

9. References

1. For further information see Migration Assumptions in the UK National Population Projections: Methodology Review, available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/methodologies/nationalpopulationprojectionsmigrationassumptionsmethodologyreview

2. For further information see Revised methodology for setting the migration assumptions for the 2012-based national population projections, available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/methodologies/nationalpopulationprojectionsmigrationassumptionsmethodologyreview

3. For further information see Method for incorporating cross border migration rates into the UK National Population Projections, available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/methodologies/methodforincorporatingcrossbordermigrationratesintotheuknationalpopulationprojections

4. For the latest migration statistics data see the Migration Statistics Quarterly Report available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/internationalmigration/bulletins/migrationstatisticsquarterlyreport/previousReleases

5. Autoregressive Integrated Moving Average time series modelling. Time series data are used to predict future trends. ARIMA modelling can take into account trends, seasonality, cycles, errors and non-stationary aspects of a data set when making forecasts.

6. Minutes of the 2014-based National Population Projections Expert Academic Advisory Panel, available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/compendium/nationalpopulationprojections/2015-10-29/backgroundandmethodology#appendix-a-minutes-of-expert-panel

10. Background notes

1. These National Statistics are produced to high professional standards and released according to the arrangements approved by the UK Statistics Authority.

Compendium

Variants, 2014-based national population projections reference volume

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Release date:
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Next release:
To be announced

Table of contents

1 . Introduction

Population projections provide a consistent starting point for all government planning which is affected by the numbers in the population. The projections are based on assumptions considered to best reflect demographic patterns at the time they are adopted. Due to the inherent uncertainty of demographic behaviour, any set of projections will inevitably be proved wrong, to a greater or lesser extent, as a forecast of future demographic events or population structure. Therefore, in addition to the principal (main or central) projection, variant projections are produced based on alternative assumptions of fertility, mortality and migration. These variant projections are intended to provide an indication of uncertainty and sensitivity to alternative assumptions; they do not represent upper or lower limits of future demographic behaviour.

Variants can be grouped into 3 types. Single component variants look at the effect of varying one assumption at a time from the principal projection. For example, the high fertility variant uses mortality and migration assumptions consistent with the principal projections, but assumes a higher rate of fertility. Combination variants assume alternative rates for 2 or more of the assumptions. For instance, the young population variant assumes high fertility, low life expectancy and high net migration, which results in projections with a younger age profile than the principal projection. It is also sometimes useful to prepare special case scenarios or “what if” projections to illustrate the consequences of a particular, but not necessarily realistic, set of assumptions, such as zero net migration.

Aside from the principal projection, 9 standard variant projections were published on 29 October 2015. These included 6 possible “single component” variants, 2 “combination” variants producing the largest or smallest total population size, and one special case scenario of zero net migration (natural change only). A second National Population Projections 2014-based extra variants report on 26 November 2015 included 7 additional standard “combination” and special case scenario variants. A full list of 2014-based variant projections with their associated assumptions is available in Appendix A of the Extra Variants report.

This chapter summarises the results of the variant projections for the UK.

2 . Assumptions for fertility variants

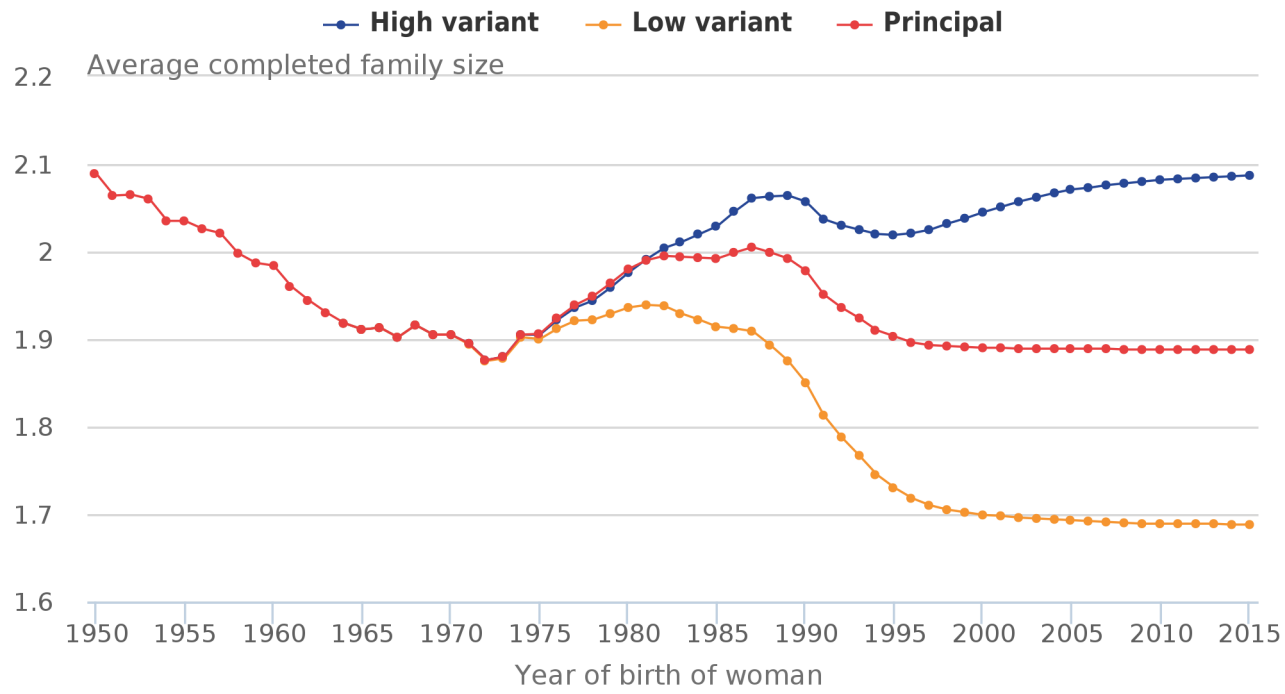
In the long-term, changes in the level of fertility are critical in determining the size of the population. For example, a sustained increase in the level of fertility would clearly increase the number of births. In a generation’s time, it would also increase the number of women of childbearing age, compounding the effect on births.

Cohorts of women who have already completed their childbearing have shown a wide range of completed family sizes. Therefore, assumptions for generations who have not yet entered the childbearing ages, or who have done so only recently, are necessarily highly speculative.

Figure 6.1 and Table 6.1 show the assumed completed family sizes for the principal, high fertility and low fertility variants for the UK. For the principal projection, the average completed family size is seen to rise for cohorts between 1975 and 1987, before falling to an ultimate level of 1.89 for women born from 2015 onwards. For the low fertility variant, the average completed family size is projected to start to fall from the 1983 cohort onwards to an ultimate level of 1.69. The high fertility variant is projected to become stable from the 1995 cohort onwards to an average completed family size of 2.09.

Over the past 10 years, fertility rates have generally been rising faster among women in their thirties and forties than for women in their twenties, so mean age at childbirth has continued to rise. The average age at motherhood for the UK as a whole is projected to increase from 28.4 years for women born in 1965 to its long-term level of 30.6 years for those born from 2010 onwards.

Figure 6.1: Estimated and assumed completed family size, UK, women born 1950 to 2015



Source: Office for National Statistics

Setting variant assumptions for fertility involves assuming higher or lower age-specific fertility rates, particularly at the younger end of the childbearing ages (under 30). For this reason the high variant does not differ greatly from the principal variant for women who are already through the majority of their childbearing years, that is, there is little scope for fertility rates to rise even more substantially than already projected in their remaining years (women born between 1974 and 1982). However, it is possible for these women to not have as many children as projected in their later years and the lower variant reflects this.

Variant assumptions for fertility are set using period age-specific rates. In the 2014-based projections there are instances where the high variant falls marginally below the principal variant (at the third decimal place) when the assumptions are translated to cohort-based measures. This is a facet of the assumption setting process where the focus was on smoothing period measures. We will consider a more optimal smoothing process in the next round of national population projections.

Table 6.1: Estimated and assumed average number of children by age and year of birth of women, UK, women born 1950 to 2015

			Average number of children born to women at ages:					
	Average family size	Mean age at motherhood (years)	Under 20	20–24	25–29	30–34	35–39	40+
Estimated values								
1950	2.09	26.4	0.23	0.70	0.63	0.36	0.13	0.03
1955	2.03	27.1	0.22	0.56	0.65	0.40	0.16	0.04
1960	1.98	27.8	0.16	0.53	0.63	0.44	0.19	0.04
1965	1.91	28.4	0.13	0.46	0.59	0.45	0.22	0.06
High variant								
1970	1.91	28.9	0.15	0.42	0.52	0.47	0.28	0.07
1975	1.91	29.5	0.15	0.36	0.47	0.53	0.32	0.08

1980	1.98	29.6	0.15	0.35	0.50	0.56	0.34	0.09
1985	2.03	29.8	0.14	0.36	0.51	0.57	0.36	0.09
1990	2.06	30.0	0.13	0.34	0.51	0.61	0.37	0.09
1995	2.02	30.5	0.09	0.29	0.53	0.64	0.38	0.09
2000	2.04	30.5	0.08	0.31	0.54	0.64	0.38	0.09
2005	2.07	30.4	0.08	0.32	0.55	0.65	0.38	0.09
2010	2.08	30.4	0.08	0.32	0.55	0.65	0.38	0.09
2015 and later	2.09	30.4	0.08	0.32	0.55	0.65	0.38	0.09
Principal projection								
1970	1.91	28.9	0.15	0.42	0.52	0.47	0.28	0.07
1975	1.91	29.5	0.15	0.36	0.47	0.53	0.32	0.08
1980	1.98	29.7	0.15	0.35	0.50	0.56	0.34	0.09
1985	1.99	29.7	0.14	0.36	0.51	0.55	0.35	0.09
1990	1.98	29.9	0.13	0.34	0.50	0.56	0.35	0.09
1995	1.90	30.4	0.09	0.28	0.51	0.57	0.36	0.09
2000	1.89	30.5	0.07	0.28	0.51	0.57	0.36	0.09
2005	1.89	30.6	0.07	0.28	0.51	0.57	0.36	0.09
2010	1.89	30.6	0.07	0.28	0.51	0.57	0.36	0.09
2015 and later	1.89	30.6	0.07	0.28	0.51	0.57	0.36	0.09
Low variant								
1970	1.91	28.9	0.15	0.42	0.52	0.47	0.28	0.07
1975	1.90	29.4	0.15	0.36	0.47	0.53	0.32	0.07
1980	1.94	29.4	0.15	0.35	0.50	0.56	0.31	0.07
1985	1.91	29.4	0.14	0.36	0.51	0.53	0.30	0.07
1990	1.85	29.6	0.13	0.34	0.48	0.53	0.31	0.07
1995	1.73	30.2	0.09	0.27	0.46	0.53	0.31	0.07
2000	1.70	30.3	0.07	0.26	0.45	0.53	0.31	0.07
2005	1.69	30.4	0.07	0.26	0.45	0.53	0.31	0.07
2010	1.69	30.4	0.07	0.26	0.45	0.53	0.31	0.07
2015 and later	1.69	30.4	0.07	0.26	0.45	0.53	0.31	0.07

Source: Office for National Statistics

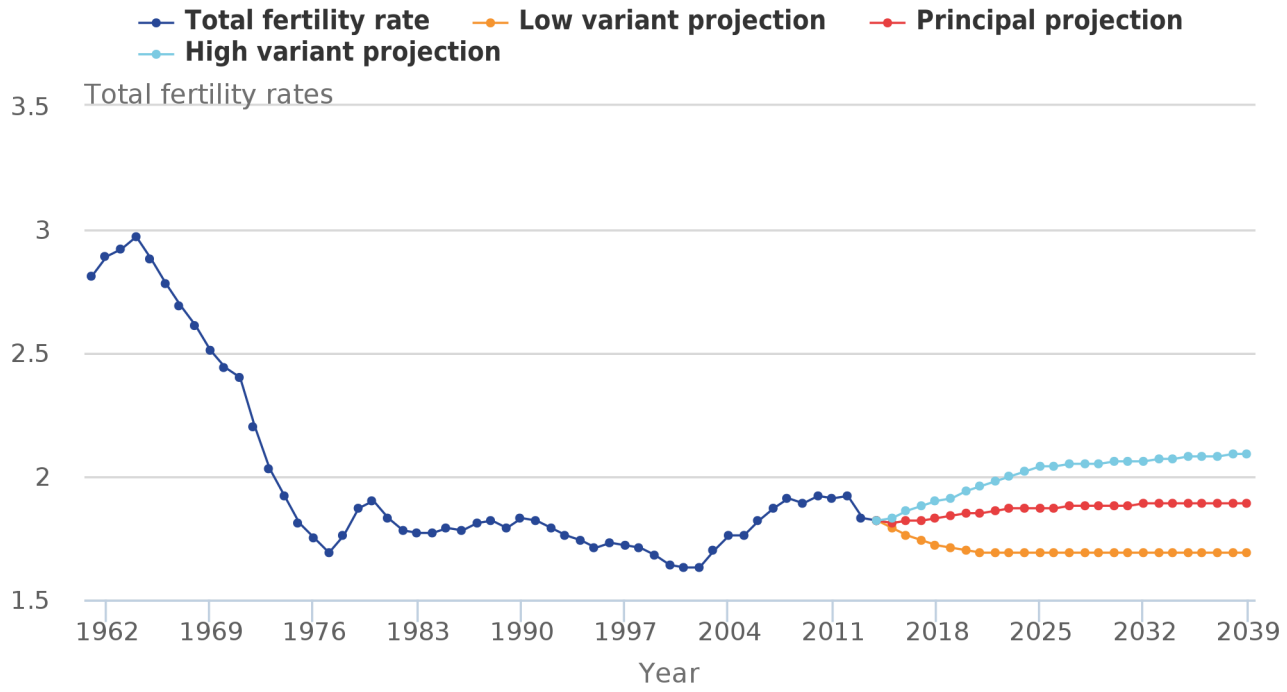
Total fertility rates and numbers of births

The assumed total fertility rates and projected numbers of births resulting from these alternative assumptions of future fertility levels are shown in Figures 6.2 and 6.3. History shows that there can be quite sudden changes in period fertility. It is therefore important to demonstrate the effect of significant short-term changes, as well as the long-term effects that would result from sustained levels of fertility significantly above or below that assumed in the principal projection.

Figure 6.2 shows that the principal projection assumes the total fertility rate for the UK increases slightly from 1.81 in mid-2014 to mid-2033 then stabilises at 1.89 from then on. Longer-term, the high and low fertility variants

assume total fertility rates of 0.2 children higher or lower than the principal assumptions, that is, 2.09 and 1.69 children per woman for the UK.

Figure 6.2: Estimated and assumed total fertility rates, UK, 1961 to 2039



Source: Office for National Statistics

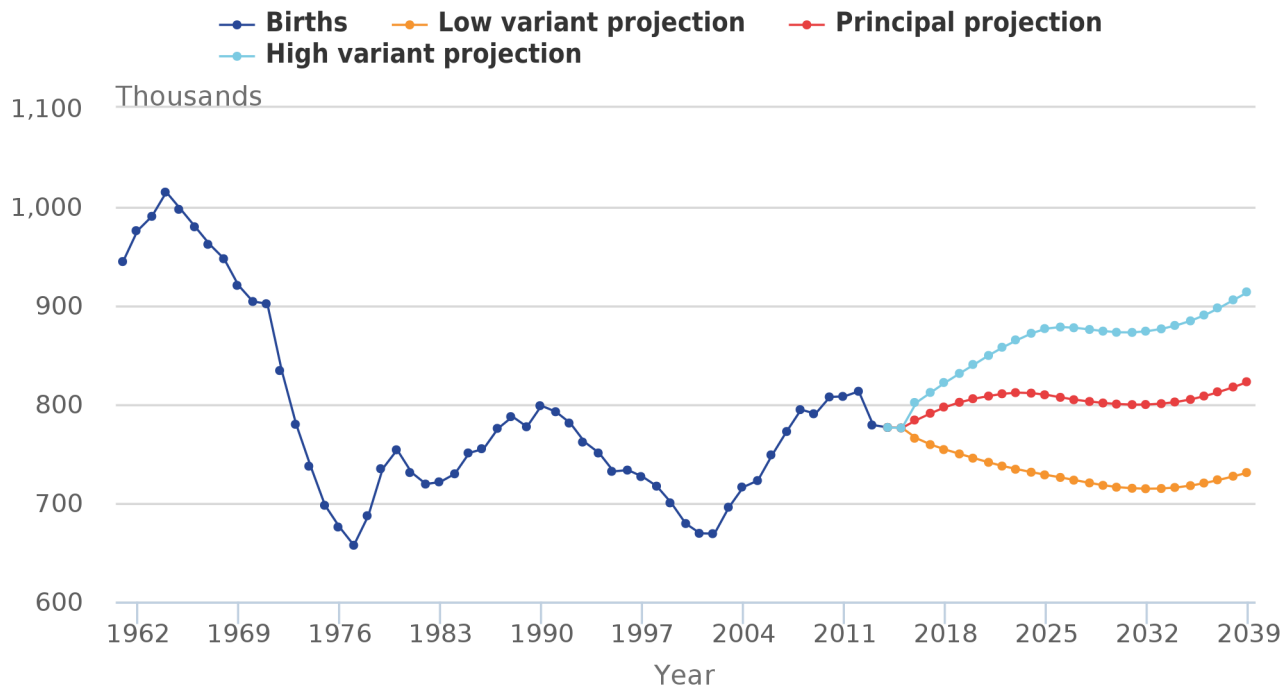
Notes:

1. All fertility data are displayed on a calendar year basis

Figure 6.3 shows that under the high fertility variant, the number of births is projected to rise year on year, from around 776,000 in mid-2014 to around 878,000 in mid-2026, dropping slightly to 873,000 by mid-2031 before rising to a level of 914,000 by mid-2039. However, under the low fertility variant, the number of births is projected to decrease in the short-term but from mid-2033 is projected to increase year on year (less sharply than for the high fertility variant).

In practice, variations in the timing of childbearing within women's lives are unlikely to produce considerable fluctuations in the total fertility rate and the annual numbers of births. However, even if trends in completed family size reflect the long-term assumptions underlying the principal projection or either the high or low fertility variants, for any individual year the number of births could differ considerably from those shown here.

Figure 6.3: Estimated and projected number of births, UK, 1961 to mid-2039



Source: Office for National Statistics

Effect of fertility variants on population size

The differences between the projected population according to the high and low fertility variant projections and the principal projection are summarised in Table 6.2. For the high fertility variant, the projected population at mid-2039 would be 75.8 million compared with 74.3 million in the principal projection, while the low fertility variant would be 72.5 million.

Figure 6.7, later in this chapter, demonstrates how long-term total population size is sensitive to changes in the fertility assumptions.

Table 6.2: Population differences between fertility variant projections and principal projection by age, UK, mid-2019 to mid-2039

thousands

	All ages	0–4	5–9	10–14	15–19	20–24
Difference between high fertility variant and principal projection						
2019	93	93	-	-	-	-
2024	329	236	93	-	-	-
2034	1,056	372	356	236	92	-
2039	1,481	425	372	355	236	92
Difference between low fertility variant and principal projection						
2019	-145	-145	-	-	-	-
2024	-502	-357	-145	-	-	-
2034	-1,335	-425	-408	-357	-145	-
2039	-1,780	-446	-425	-408	-357	-145

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

3 . Assumptions for mortality variants

The mortality chapter discusses the current wide range of views about prospects for future longevity. To give some indication of these uncertainties, variant projections have been produced based on target improvement rates in mortality by mid-2039. The low life expectancy variant assumes slower improvements in mortality rates than in the principal projection, and the high life expectancy variant assumes faster improvements. In addition, a no mortality improvement variant projection has also been produced. This holds mortality rates at the same level as those used for 2014 to 2015.

Current annual improvements in mortality rates vary considerably by age and sex. In each of these variants it is assumed that, for most ages, the improvements will gradually converge to common target rates of improvement at each age and by both sexes by 2039, and continue to improve at that constant rate thereafter. However, as with the principal projection, these variant mortality projections also assume that those born between 1925 and 1938 (cohorts which have consistently experienced relatively higher rates of mortality improvement over the last 25 years than those born either side) will continue to experience higher rates of mortality improvement than the rest of the population.

The target rate assumptions (for most ages) are as follows.

High life expectancy variant

Annual improvement is 2.4% at 2039, thereafter annual improvement will remain at 2.4%. For those born between 1925 and 1938, rates of annual improvement in and after 2039 will rise to a peak of 3.7% a year for those born in 1931 and 1932 and then decline back to 2.4% a year for those born in 1939 or later.

Principal projection

Annual improvement is 1.2% at 2039, thereafter annual improvement will remain at 1.2%. For those born between 1925 and 1938, rates of annual improvement in and after 2039 will rise to a peak of 2.5% a year for those born in 1931 and 1932 and then decline back to 1.2% a year for those born in 1939 or later.

Low life expectancy variant

Annual improvement is 0% at 2039, thereafter mortality rates will remain constant. For those born between 1925 and 1938, rates of annual improvement in and after 2039 will rise to a peak of 1.3% a year for those born in 1931 and 1932 and then decline back to 0% a year for those born in 1939 or later.

No mortality improvement

In the first year of the projections, the mortality rates are adjusted to constrain the number of deaths in 2014 to 2015 to the provisional estimates. For the no mortality improvement variant, the mortality rates remain constant throughout the projection period at the adjusted levels assumed for 2014 to 2015 after constraining has taken place. Annual improvement is 0% at all ages.

Due to fluctuations in annual mortality rates, there is always some uncertainty about establishing the “real” current rate of mortality improvement. Furthermore, epidemics (there have been no major ones in recent years), or hard

winters[1,2,3], can have a considerable effect on the number of deaths, although this may be partially offset by fewer deaths than normal in the following year.

Expectations of life at birth and numbers of deaths

The resulting expectations of life at birth in the mortality variant projections are summarised in Table 6.3 and shown in Figure 6.4. These are period expectations of life, calculated on the basis of the mortality rates for a given calendar year. The projected number of deaths resulting from these different expectations of life at birth are shown in Figure 6.5.

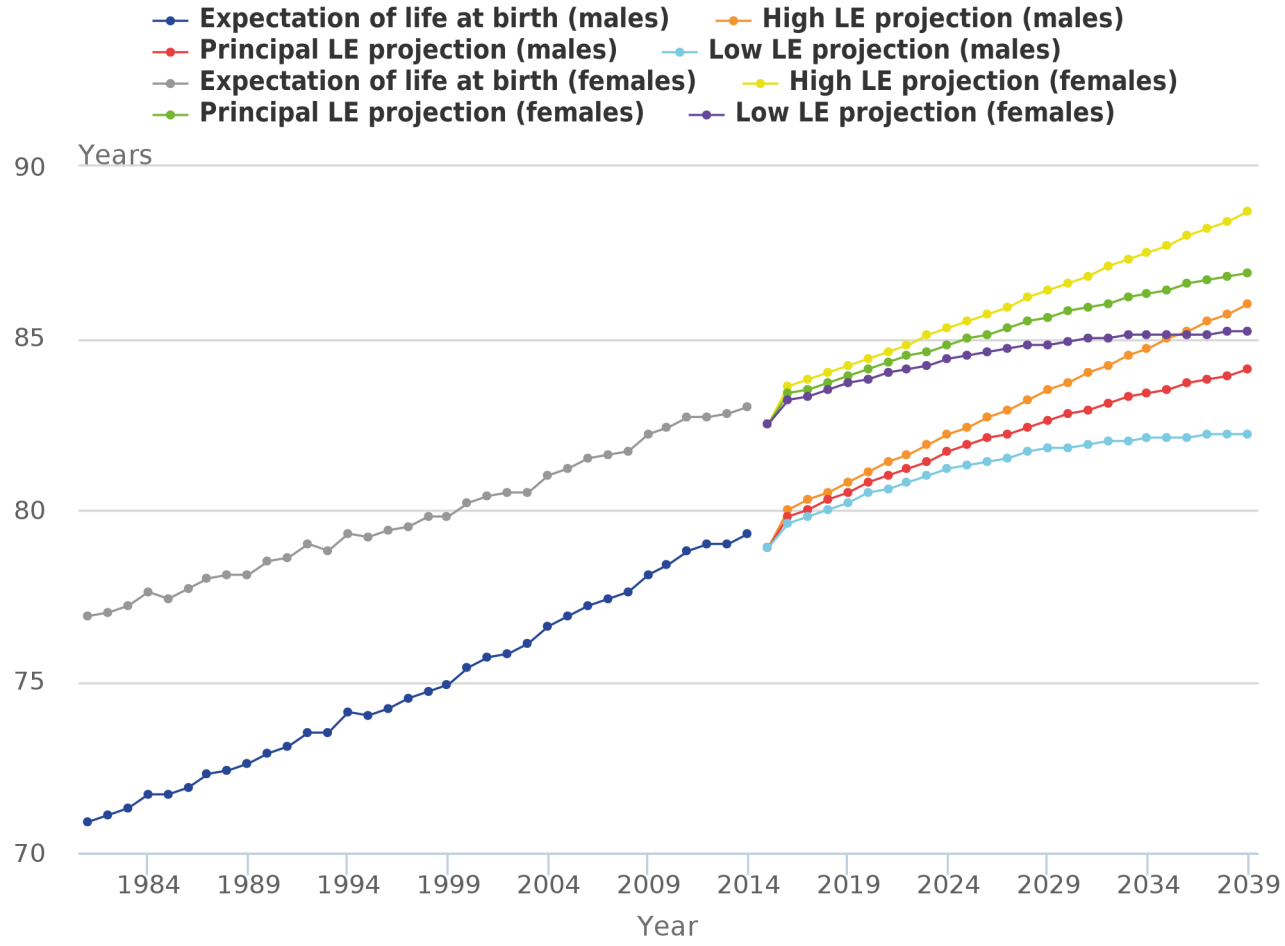
Table 6.3: Period expectation of life at birth according to mortality rates assumed for selected years, variant mortality projections, UK, years to mid-2039

years

	Males			Females		
	High life expectancy	Principal projection	Low life expectancy	High life expectancy	Principal projection	Low life expectancy
2014 to 2015	78.9	78.9	78.9	82.5	82.5	82.5
2023 to 2024	82.2	81.7	81.2	85.3	84.8	84.4
2033 to 2034	84.7	83.4	82.1	87.5	86.3	85.1
2038 to 2039	86.0	84.1	82.2	88.7	86.9	85.2

Source: Office for National Statistics

Figure 6.4: Estimated and projected period expectation of life at birth according to mortality rates for given years, UK, 1961 to mid-2039

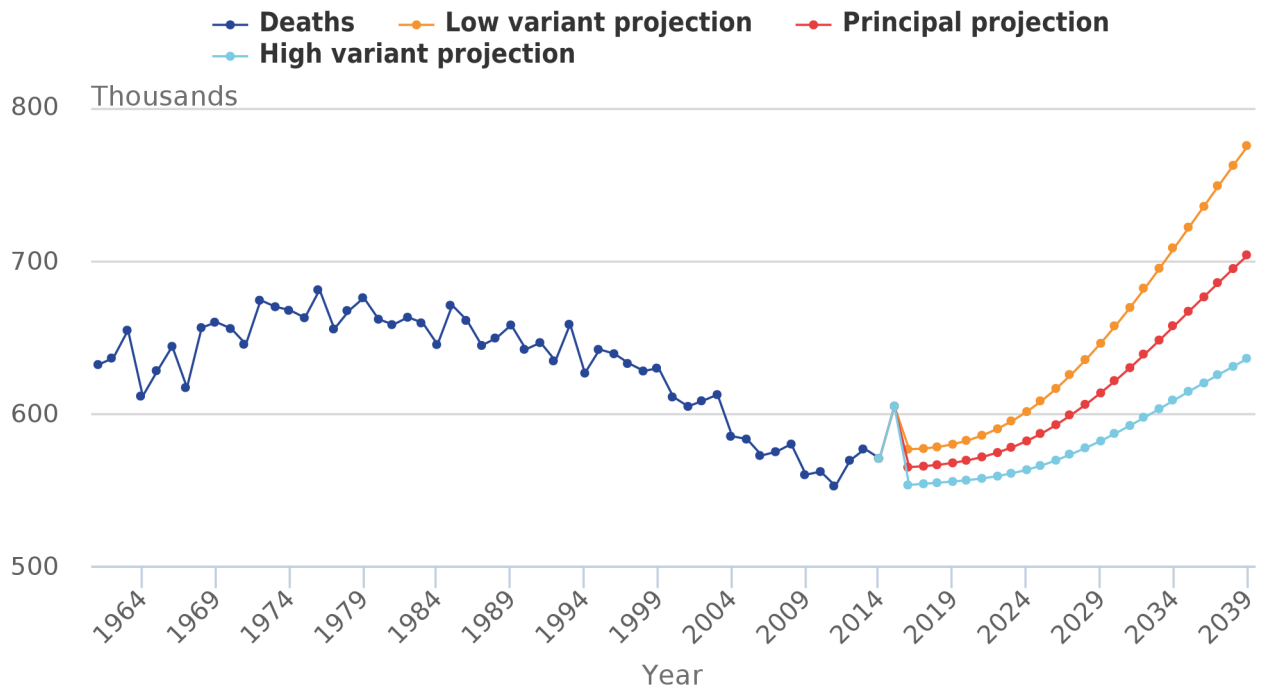


Source: Office for National Statistics

Notes:

1. Figures up to 2014 are displayed on a calendar year basis. Figures for 2014 onwards are as at year ending June

Figure 6.5: Estimated and projected number of deaths, UK, 1961 to mid-2039



Source: Office for National Statistics

Notes:

1. Figures up to 2014 are displayed on a calendar year basis. Figures for 2014 onwards are as at year ending June

In the high life expectancy variant, period expectation of life at birth for males is projected to increase by 7.1 years, from 78.9 years in mid-2015 (the first year of the projection) to 86.0 years in mid-2039 (25 years into the projection), while the corresponding increase for females is 6.2 years (from 82.5 years to 88.7 years). In the low life expectancy variant, period expectation of life at birth is projected to increase by 3.3 years for males and 2.7 years for females, reaching 82.2 and 85.2 years, respectively, by mid-2039.

Effect of mortality variants on total population size

The differences between the projected populations according to the high and low life expectancy variant projections and the principal projections are summarised in Table 6.4.

The population at mid-2039 for the high and low life expectancy variants may be 767,000 higher or 797,000 lower than the principal projection of 74.3 million, with 75.1 million in the high life expectancy variant projection, but 73.5 million given the low life expectancy assumptions. Figure 6.7, later in this chapter, shows that by mid-2039, there is a difference of around 1.6 million between the total population in the high and low life expectancy variant projections.

Table 6.4: Population differences between mortality variant projections and principal projection by age, UK, mid-2019 to mid-2039

thousands

	All ages	Under 60	60-74	75-84	85 and over
Difference between high life expectancy variant and principal projection					
2019	47	5	10	13	19

2024	126	13	25	36	52
2034	465	38	82	116	229
2039	767	58	118	187	405
Difference between low life expectancy variant and principal projection					
2019	-47	-5	-10	-13	-19
2024	-127	-13	-26	-36	-51
2034	-478	-41	-89	-123	-226
2039	-797	-65	-132	-204	-396

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

4 . Assumptions for migration variants

For the principal projection, the new long-term assumption for international net migration to the UK is +185,000 each year from mid-2021 onwards. For the variant projections, in the first year of the projection annual net migration has been assumed to be 40,000 higher or lower than the principal projection. For all subsequent years it has been assumed to be 80,000 higher or lower. This results in the high and low annual long-term international net migration assumptions to the UK being 265,000 and 105,000 persons per year, respectively.

In the 2014-based projections, the high and low variant migration assumptions for the UK were produced as an aggregation of the international migration figures set for the constituent countries. This is different to the method used in previous projections where the high and low assumptions were set non-additively. The difference between the high and low migration assumptions and the principal in the 2014-based projections is higher than used in the 2012-based projections (which were 60,000 higher or lower than the principal in the long-term).

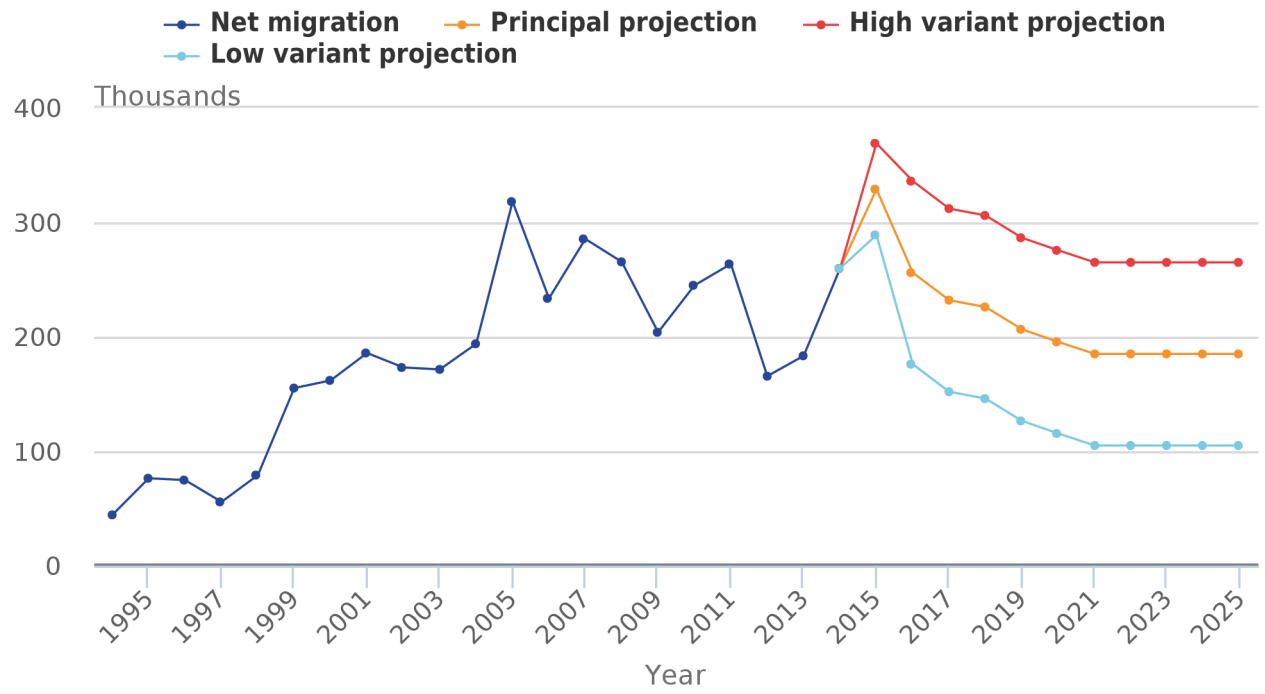
In addition to the high and low migration variants, 2 special case scenario projections are available. The zero net migration (natural change only) variant uses the principal assumptions of fertility and mortality and assumes that there will be zero net migration for every age for each sex. The long-term balanced net migration projection (available at UK level only) assumes that net migration will decline to zero in the long-term (from the year ending mid-2022 onwards), with in-migration and out-migration total flows being equal. However, although long-term total inflows and outflows are assumed to be equal at 250,000 each, inflows and outflows are not necessarily assumed to be equal for each individual age or sex (so a net inflow at one age might be offset by a net outflow at another age). For the 2014-based projections, the long-term balanced net migration variant follows the assumptions of the low migration variant, as published on 29 October 2015, in the run-in period to the long-term assumption (from the year ending mid-2015 to year ending mid-2021). In previous projections it followed the principal assumption; however, feedback at consultation showed users required the long-term balanced net migration to follow a lower level of migration.

Special assumptions have been applied for the first few years of the projections (mid-2015 to mid-2020). These assumptions have been formulated to represent a transition from the last year of actual data to the constant long-term assumptions. They also take into account the following factors:

1. further information on migration from the Migration Statistics Quarterly Report, published in August 2015
2. a short-term armed forces flow, which has been included to account for the planned return of home armed forces personnel and their dependants from Germany

The variant assumptions are shown in Figure 6.6.

Figure 6.6: Estimated and assumed total net migration, UK, year ending mid-1994 to mid-2025



Source: Office for National Statistics

Notes:

1. All data are displayed on a mid-year basis

The equivalent figures for the constituent countries of the UK can be found in the migration assumptions report published on 29th October 2015, under appendices A to D.

Variants are not intended to represent limits for future demographic behaviour. Indeed, in the case of migration, whatever average level occurs in the future, it is possible that there will be some years when net migration exceeds the level of the high variant and others where it will be below the level of the low variant. Therefore, these migration variants should be regarded as giving an indication of the implications for the future if average migration levels were to differ significantly from those assumed in the principal projection.

Effect of migration variants on total population size

The differences between the population according to the high and low migration variant projections and the principal projection are summarised in Table 6.5. Unlike the fertility and mortality variants, the migration variants are broadly symmetrical with respect to the principal projection.

With annual international net migration assumed to be 80,000 a year more (or fewer) than the principal projection after the first year, this would lead to just under 2.0 million more (or fewer) international migrants over the next 25 years. Because migration is concentrated at young adult ages, there is also a significant second generation effect with the different number of migrants changing the number of women of childbearing age and hence the future number of births. The effect on the number of deaths over this period is considerably smaller as migrants are predominantly young.

Table 6.5: Population differences between variant migration projections and principal projection by age, UK, mid-2019 to mid-2039

thousands

	0-9	10-19	20-29	30-39	40-49	50-59	60-69

	All ages								70 and over
Difference between high migration variant and principal projection									
2019	381	42	20	149	97	39	18	11	5
2024	857	131	42	234	260	105	46	25	15
2034	1,935	328	175	280	512	371	152	70	49
2039	2,501	381	285	324	536	536	255	110	75
Difference between low migration variant and principal projection									
2019	-381	-42	-20	-149	-97	-39	-18	-11	-5
2024	-857	-131	-42	-234	-260	-105	-46	-25	-15
2034	-1,935	-328	-175	-280	-512	-371	-152	-70	-48
2039	-2,501	-381	-285	-324	-536	-535	-254	-110	-74

Source: Office for National Statistics

Table 6.5 shows that the alternative migration assumptions would lead to 2.5 million more (or fewer) people in the population at mid-2039, compared with the principal projection. However, even 25 years ahead, these alternative assumptions would have little effect on the number of people aged over 60. By mid-2039, the population would be 76.8 million in the high migration variant compared with 74.3 million in the principal projection, but 71.8 million under the low migration variant assumptions.

An interesting feature of these migration variants is that, although it is assumed that migration will continue to be concentrated at working ages, there is comparatively little effect on long-term dependency ratios. In the principal projection, the "pensionable age dependency ratio"[4] (defined as the number of persons of pensionable age per 1,000 persons of working age[5]), would be 370 per 1,000 at mid-2039. However, this ratio is not greatly different under the alternative migration assumptions; in the high and low migration variants, the ratios at mid-2039 are 357 and 383 per 1,000 persons of working age, respectively.

Previous work has shown that any realistic assumption of future migration could only have a very limited effect on population ageing[6]. In contrast, the raising of the State Pension age has a much greater effect. If State Pension age remained at 65 for men and 60 for women, the pensionable age dependency ratio at mid-2039 would be 487 per 1,000 persons of working age, rather than 370.

Relationship between UK level projections and individual country level projections for migration variants

The assumptions for the flows between the countries of the UK are now set as rates instead of fixed numbers of migrants. Annual age and sex-specific migration rates for each cross-border flow are calculated as the number of migrants at the end of the year divided by population of the country of origin at the start of the year. An average of the rates for the last 5 years of actual data (year ending mid-2010 to year ending mid-2014) is then taken and applied to the population of the country of origin at the beginning of each projection year to calculate the projected number of migrants for each flow.

The UK projection is calculated "additively", simply as the sum of the projections for the 4 constituent countries (England, Wales, Scotland and Northern Ireland). Therefore, the projected population numbers, deaths at each age, and births at each age of mother for the UK are simply the sum of the 4 individual countries. The "assumed" UK fertility and mortality rates are then "back-calculated" from these projected births, deaths and population numbers. The only exception to this is the UK long-term balanced net migration variant, which is calculated at the UK level only. For this variant projection, the "back-calculated" fertility and mortality rates for the UK principal projection are used.

5 . Combination variants

For particular applications, users may also be interested in projections combining 2 or more of these alternative scenarios, for example, the largest total population size, or the “high population” variant projection (high fertility, high life expectancy and high migration assumptions). With this combination of assumptions, the population would be 79.1 million by mid-2039, whereas the lowest total population size, (“low population” variant, which combines the low variant assumptions for fertility, mortality and migration) projects 69.3 million. Some main summary statistics from selected combination variants are given in Table 6.6.

Over the 25 year period to mid-2039, the highest dependency ratios (the total number of children and those of pensionable age per 1,000 persons of working age) amongst the single component and standard combination variants occur given high fertility, high life expectancy and high migration (the “high population” variant). The lowest dependency ratios occur where there is low fertility, low life expectancy and low migration (the “low population” variant).

Table 6.6: Measure of population structure under the principal projection, standard variant projections and special case scenarios, UK, mid-2039

	Total population (mid-2014 = 64,597)	% of population aged under 16 (mid-2014 = 18.8)	% of population aged 65 & over (mid-2014 = 17.7)	Dependants per 1,000 persons of working age * (mid-2014 = 614)
Projection	mid-2039	mid-2039	mid-2039	mid-2039
Principal projection	74,284	17.8	24.3	666
SINGLE COMPONENT VARIANTS				
High fertility	75,765	19.0	23.8	689
Low fertility	72,504	16.4	24.9	642
High life expectancy	75,051	17.6	25.0	680
Low life expectancy	73,488	18.0	23.6	652
High migration	76,786	18.0	23.7	654
Low migration	71,783	17.6	25.0	679
COMBINATION VARIANTS				
High population (high fertility, high life expectancy, high migration)	79,090	19.0	23.8	691
Low population (low fertility, low life expectancy, low migration)	69,273	16.4	24.9	640
Young age structure (high fertility, low life expectancy, high migration)	77,514	19.4	22.5	664
Old age structure (low fertility, high life expectancy, low migration)	70,825	16.0	26.3	670
SPECIAL CASE SCENARIOS				
Replacement fertility	76,600	19.1	23.6	683
Constant fertility	73,637	17.2	24.5	656
No mortality improvement	71,568	18.4	21.9	617
	67,658	16.8	26.3	690

Zero migration (natural change only)				
No change (constant fertility, no mortality improvement)	70,921	17.8	22.1	607
Long-term balanced net migration	70,419	17.5	25.4	685

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

2. * Dependants are children under 16 and people of state pensionable age and over. Working age and pensionable age populations are based on State Pension Age (SPA) for the given year. Between 2012 and 2018, SPA will change from 65 years for men and 61 years for women, to 65 years for both sexes. Then between 2019 and 2020, SPA will change from 65 years to 66 years for both men and women. Between 2026 and 2027 SPA will increase to 67 years and between 2044 and 2046 to 68 years for both sexes. This is based on SPA under the 2014 Pensions Act

Special case scenarios

It is also sometimes useful to prepare special case scenarios or “what if” projections to illustrate the consequences of a particular, but not necessarily realistic, set of assumptions. Six additional variant projections have been produced based on the following special case assumptions:

- replacement fertility
- constant fertility
- no mortality improvement
- zero net migration (natural change only)
- no change
- long-term balanced net migration

More information on these 6 special case variant projections can be found in releases published on 29 October and 26 November 2015.

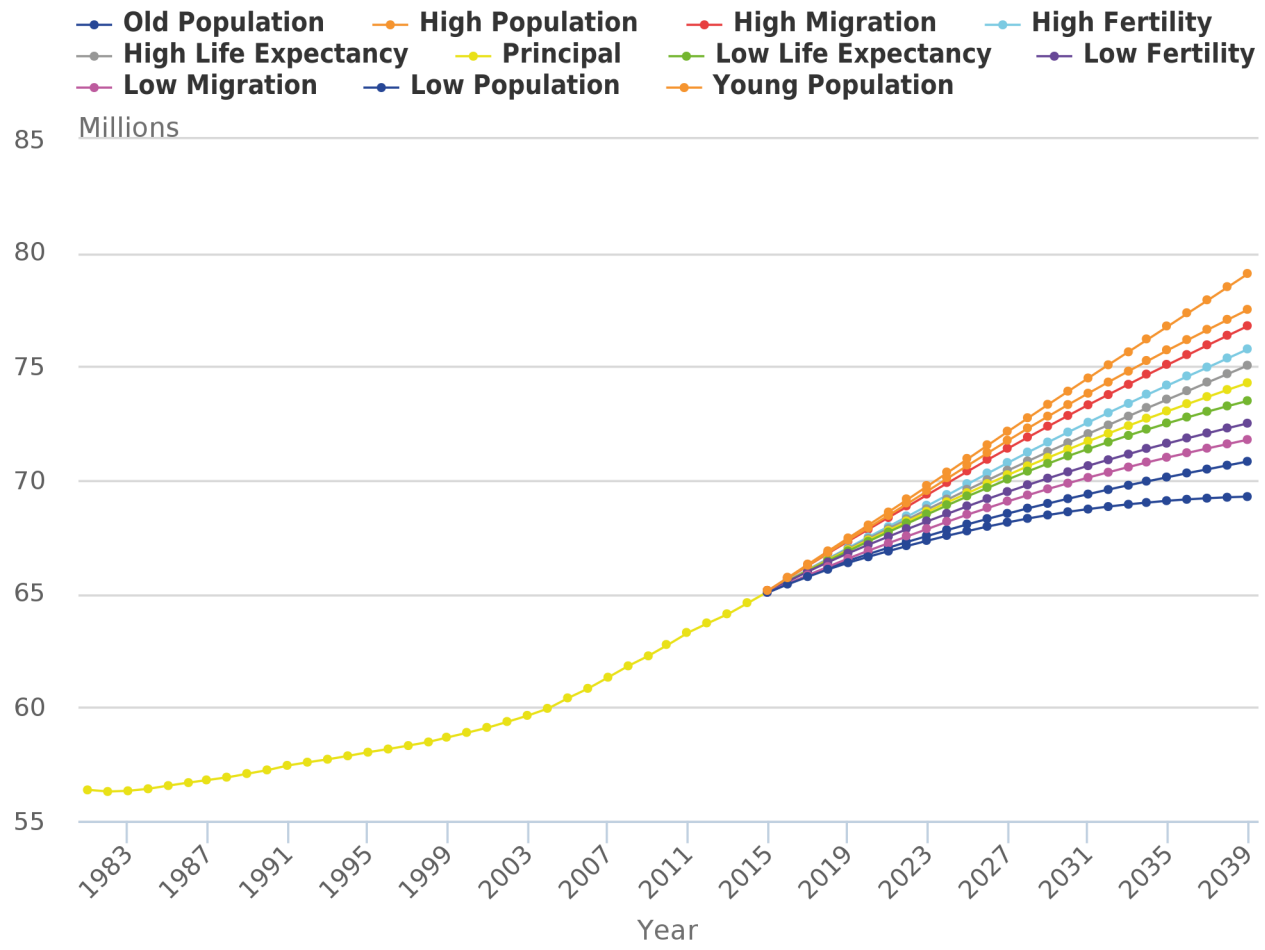
6 . Comparison of variant projections

Total population size

Figure 6.7 shows the implications for future population growth under each of the single component and standard combination variant projections. The chart demonstrates the uncertainty about the future size of the population and that uncertainty widens over time.

For the majority of projections, the total population of the UK is projected to continue growing throughout the projection period. However, the low population variant shows that continuing population growth is not inevitable longer-term.

Figure 6.7: Estimated and projected total population, UK, mid-1981 to mid-2039



Source: Office for National Statistics

Notes:

1. Figures up to and including the year ending mid-2014 are mid-year population estimates. Figures for year ending mid-2015 onwards are population projections

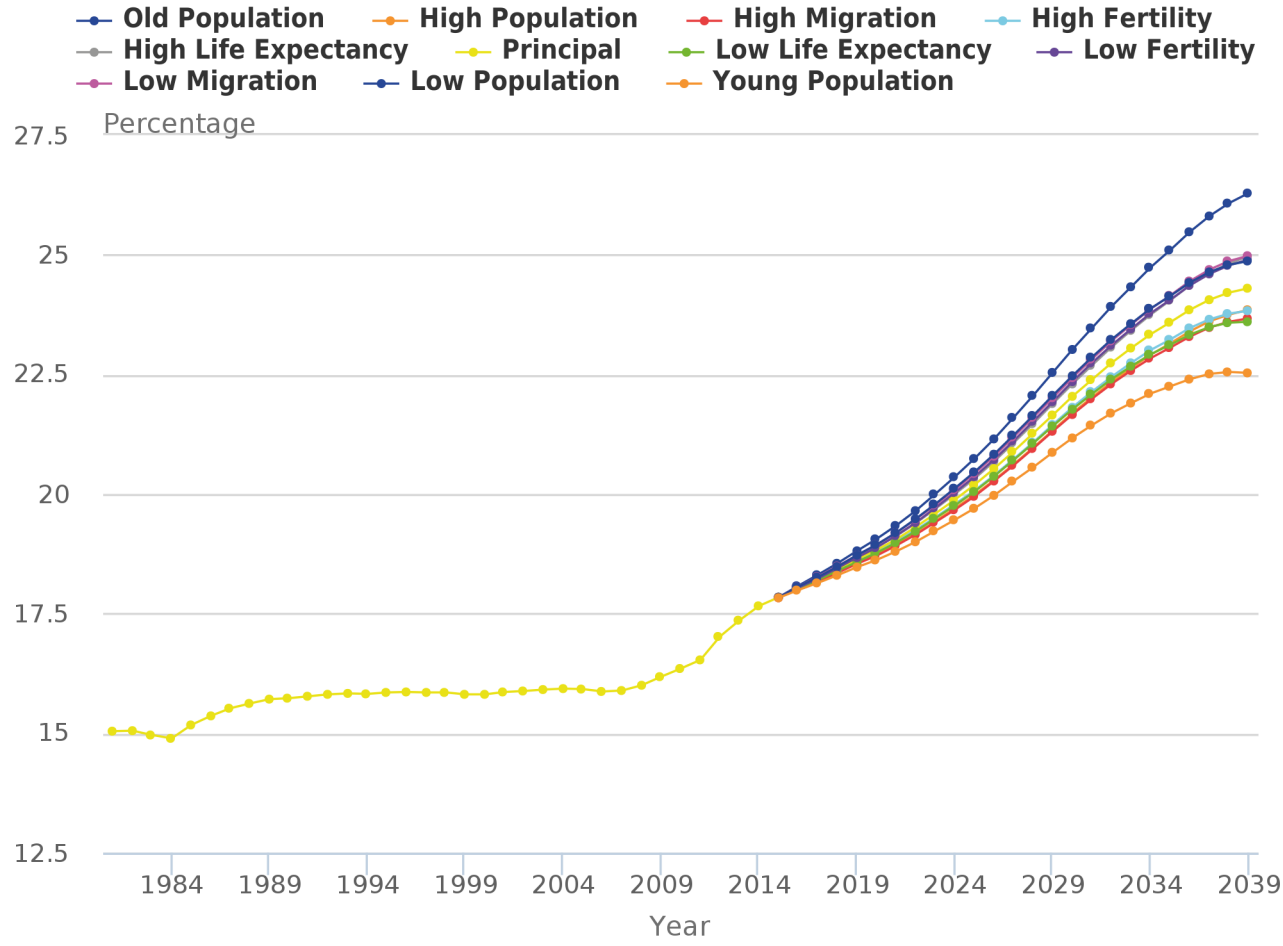
The equivalent figures for the constituent countries of the UK can be found in the results report published on 29th October 2015, under appendices A to D.

Population aged 65 and over

Figure 6.8 shows the projected proportion of the population aged 65 and over using various alternative assumptions. In this case, as well as the single component variants, the chart also shows the results of the “old age structure” and “young age structure” combination variants.

The chart shows that an ageing population will occur under any plausible set of future assumptions. In mid-2014, 17.7% of the population were aged 65 and over. This is projected to rise to 24.3% by mid-2039 in the principal projection, 26.3% in the old age structure variant and even a rise to 22.5% with the young age structure variant.

Figure 6.8: Estimated and projected percentage of the population aged 65 and over, UK, mid-1981 to mid-2039



Source: Office for National Statistics

Notes:

1. Figures up to and including the year ending mid-2014 are mid-year population estimates. Figures for year ending mid-2015 onwards are population projections

The equivalent figures for the constituent countries of the UK can be found in the extra variants report published on 26th November 2015, Appendix C.

7 . Describing uncertainty in population projections

Variant population projections are produced to provide an indication of the effect of alternative assumptions on the future size and structure of the population. This deterministic approach however does not provide an indication of how likely any scenario might be.

One way to understand the uncertainty in projections is to consider the accuracy of past projections as predictors of future populations. A National Population Projections accuracy report was published in July 2015 which focuses on projections produced in the past 40 years, although where possible it also analyses data from further back.

Describing uncertainty in projections has been identified as one of our research priorities.

Relative uncertainties of fertility, mortality and migration

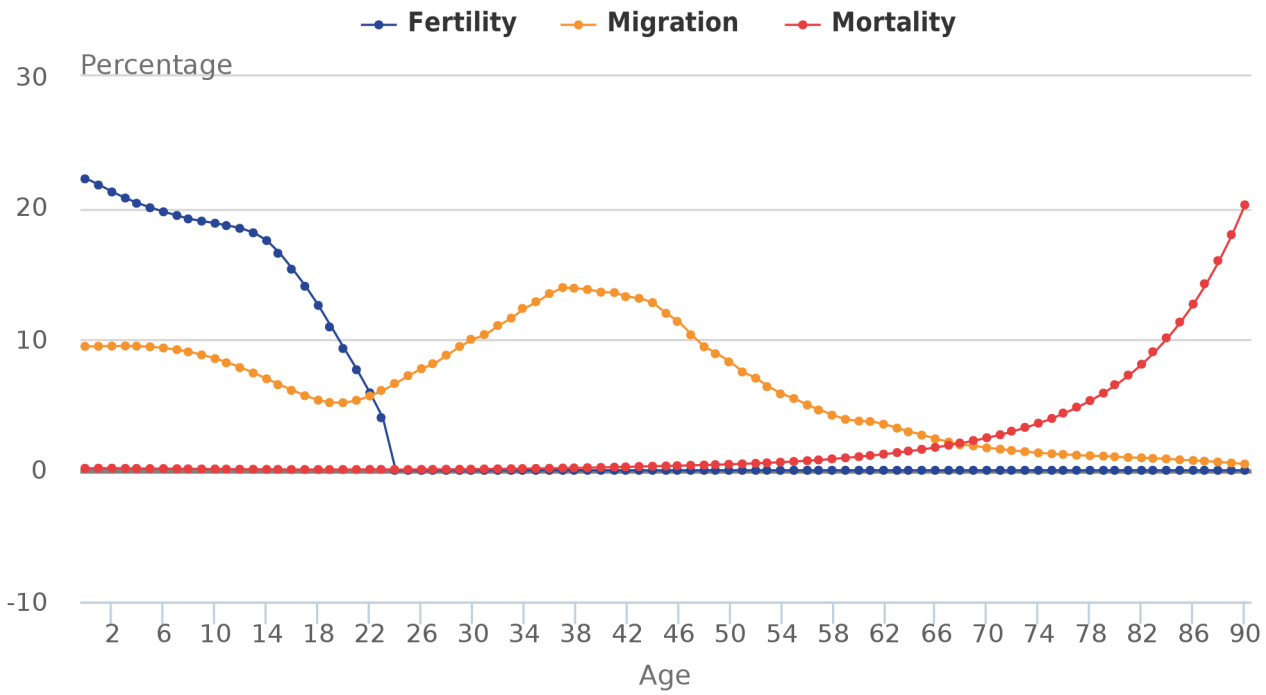
As precise probability statements cannot be ascribed to the variant assumptions, strictly the indication of uncertainty given for fertility, mortality and migration are not directly comparable. Nevertheless, it is possible to make some general comments about the relative importance of fluctuations in fertility, mortality and migration for particular users of the projections.

The majority of users are interested principally in the first 20 years of the projections, over which period possible variations in migration numbers or fertility patterns are likely to have a greater impact on projected size and age structure of the population than variations in mortality rates. However, for applications concerned primarily with the elderly such as planning health and social care services, interest will centre on variations in mortality. In areas such as long-term social security benefit planning, the effect of both mortality and fertility variants has to be considered, whilst for other applications, such as those concerned with the size of the workforce and the numbers of households, future migration levels are of particular importance.

Another way of indicating uncertainty is to consider the accuracy of previous sets of projections. A detailed study of the accuracy of past UK national population projections[8] has been published. The analysis was based on the extensive database of past national projections. This report concluded that fertility had tended to be over-projected whilst life expectancy and net inward migration had generally been under-projected.

Figure 6.9 gives an indication of the relative importance of the assumptions regarding fertility, mortality and migration for the population at each age in mid-2039. It shows (for each component) the difference between the populations in the high and low variant projections at each age, expressed as a percentage of the population in the principal projection. The greatest cause of uncertainty at younger ages is fertility. Migration is the most important variable in determining the size of the working age population in 25 years' time, while mortality only begins to become the dominant factor after age 65.

Figure 6.9: Population differences between high and low variants as a percentage of the population in the principal projection by age, UK, mid-2039



Source: Office for National Statistics

8. References

1. Excess winter mortality in England and Wales available at: http://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/previousReleases

2. Excess winter mortality in Scotland available at: http://www.gro-scotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/vital-events/deaths/winter-mortality

3. Excess winter mortality in Northern Ireland available at: http://www.nisra.gov.uk/demography/default.asp32.htm

4. 2014-based projected pensionable age dependency ratios are available in the “components of change and summary indicators” datasets, avvailable at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2015-10-29/relateddata?page=1

5. Working age and pensionable age populations based on the changed definitions of State Pension age under the Pensions Act 2011. Between 2012 and 2018, State Pension age will change from 65 years for men and 61 years for women, to 65 years for both sexes. Then between 2019 and 2020, State Pension age will change from 65 years to 66 years for both men and women. Between 2034 and 2046, State Pension age will increase in 2 stages from 66 years to 68 years for both sexes.

6. Shaw C (2001) United Kingdom population trends in the 21st century. Population Trends 103, pp37-46. Available at: http://webarchive.nationalarchives.gov.uk/20150904113534/http://ons.gov.uk/ons/rel/population-trends-rd/population-trends/no--103--spring-2001/index.html

7. Office for National Statistics (Quarter 3 2009) Progress report on developing stochastic population forecasts for the United Kingdom. Available at: http://webarchive.nationalarchives.gov.uk/20160204094749/http://ons.gov.uk/ons/guide-method/method-quality/imps/updates-and-reports/historical-updates-and-releases/updates-and-releases-from-2009/index.html

8. National Population Projections Accuracy Report (July 2015). Available at: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/methodologies/nationalpopulationprojectionsaccuracyreport

9. Background notes

1. These National Statistics are produced to high professional standards and released according to the arrangements approved by the UK Statistics Authority.