Office for National Statistics

Compendium

National Population Projections: 2012-based Reference Volume Series PP2

2012-based Reference Volume Series PP2

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Chapters in this compendium

Compendium

An Executive Summary, 2012-based NPP Reference Volume

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1 . Introduction

This publication presents the results of the 2012-based population projections produced by ONS for the United Kingdom and its constituent countries. These results were previously published in statistical releases on 6 November 2013 and 10 December 2013. This volume is the latest in a regular series started in 1970 which 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 – Results
- Chapter 3 – Fertility
- Chapter 4 – Mortality
- Chapter 5 – Migration
- Chapter 6 – Variants

2 . Key points

Since the 2010-based projections were published the results of the 2011 Census have been released and used to rebase the population estimates series. There were around 500,000 more people estimated by the 2011 United Kingdom Census than had been previously estimated. At mid-2012 the estimated population of the UK was about 460,000 higher than that projected for mid-2012 in the 2010-based projections. The key points of the 2012-based population projections are:

- The population of the UK is projected to increase by 4.3 million over the next 10 years from an estimated 63.7 million in mid-2012 to 68.0 million in mid-2022. This increase is equivalent to an annual growth rate of 0.6% each year between mid-2012 and mid-2022. The UK population is projected to be 73.3 million at mid-2037, a total increase of 9.6 million over the next 25 years.
- The projected total population of the UK in mid-2037 is about 639,000 (0.9%) lower than in the 2010-based projections. This slower projected growth is due to the assumptions for migration being less and those for fertility being lower in the short term (but higher in the long term) than the 2010-based projections, resulting in fewer births and fewer net migrants.
- Some 43% of the projected 9.6 million increase in the population between mid-2012 and mid-2037 is directly attributable to the assumed level of net inward migration. The remaining 57% is attributable to projected natural change (an excess of births over deaths) of which 39% would occur in the absence of migration, or where migration inflows and outflows are exactly equal at every age from 2012 onwards (where there is zero net migration). The remaining 17% arises from the effect of net migration on births and deaths. It is estimated therefore, that about 60% of projected population growth in the period to mid-2037 is attributable, directly or indirectly, to net migration.

3 . Projected population change

The projection has the following features:

- The population is projected to continue ageing with the median age of the population expected to rise from 39.7 years in mid-2012 to 42.8 years in mid-2037.
- The number of children aged under 16 is projected to increase by 8% from 12.0 million in mid-2012 to 13.0 million by mid-2037. The projected increase is at school age, rather than pre-school age.
- The number of people of working age is projected to rise from 39.4 million in mid-2012 to 44.2 million by mid-2037.
- The number of people of pensionable age is projected to increase by 31% from 12.3 million in mid-2012 to 16.1 million by mid-2037. In mid-2012, there were 0.3 million more people of pensionable age than children aged under 16; by mid-2037 this difference is projected to be 3.1 million.
- The population aged 80 and over is projected to grow from 3.0 million in mid-2012 to 6.2 million by mid-2037, more than doubling over 25 years. Longer-term projections suggest this rapid increase will continue throughout the projection period, tempered only by periods such as the late 2050s where the small population cohorts born in the 1970s reach this oldest age group. By mid-2087 the projections suggest there will be 11.3 million people aged 80 and over.

The change in the age distribution between mid-2012 and mid-2037 is shown in Figure 0-1.

Figure 0-1: Estimated and projected age structure of the United Kingdom population, mid-2012 and mid-2037

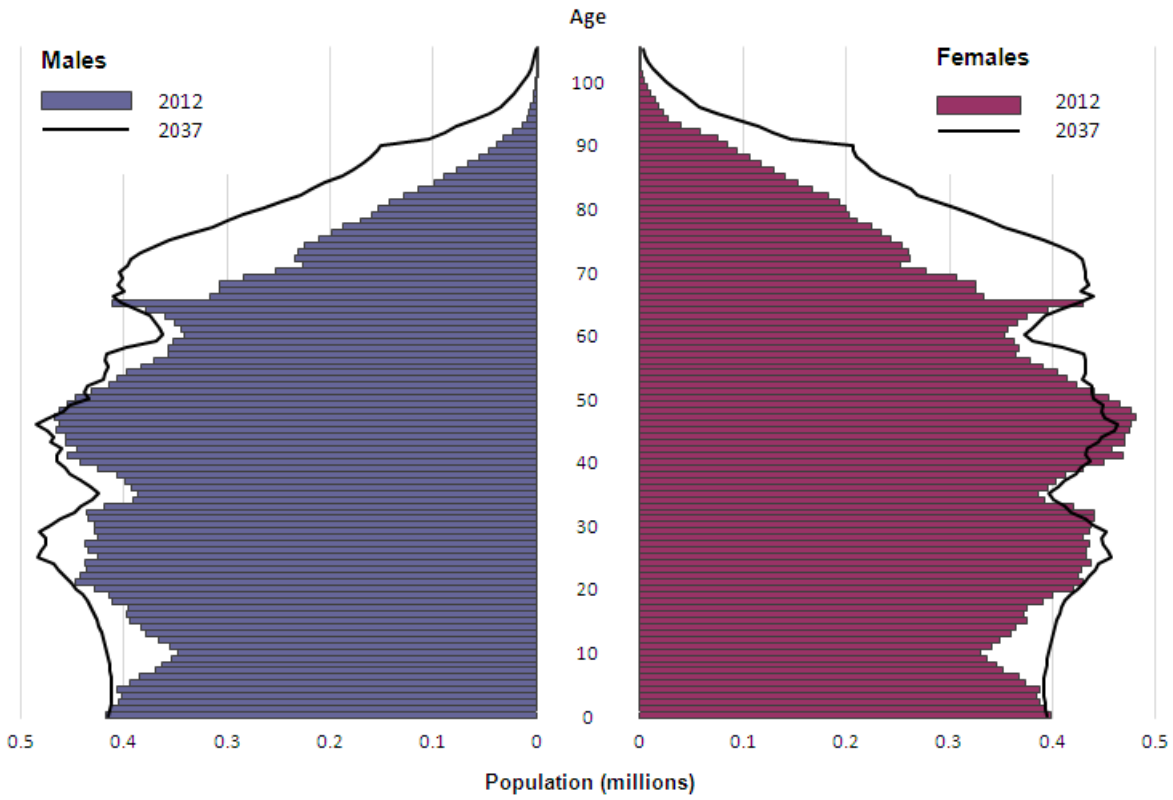

Table 0-1: Actual and projected population by age, United Kingdom, mid-1971 to mid-2087

Thousands

Year	All ages	Under 16	16-64	65 & over	(80 & over)
Estimates					
1971	55,928	14,257	34,263	7,408	1,287
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
2012	63,705	11,984	40,880	10,841	2,973
Projections					
2017	65,825	12,432	41,308	12,085	3,330
2022	67,969	13,002	41,709	13,258	3,804
2032	71,713	13,048	42,197	16,468	5,567
2037	73,272	12,989	42,492	17,791	6,176
Longer-term projections					
2042	74,739	13,084	43,277	18,378	6,967
2052	77,493	13,647	44,188	19,658	8,574
2062	79,904	13,896	44,921	21,087	9,015
2072	82,376	14,024	46,450	21,903	10,085
2082	85,106	14,404	47,105	23,597	10,930
2087	86,463	14,573	47,445	24,445	11,290

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 four countries of the UK (see Table 0-2).

- The population of England is projected to increase by 16%, Northern Ireland by 10%, Scotland by 9% and Wales by 8% by mid-2037.

Table 0-2: Actual and projected population of the UK by constituent country, mid-1971 to mid-2062

Thousands

Year	United Kingdom	England	Wales	Scotland	Northern Ireland
Estimates					
1971	55,928	46,412	2,740	5,236	1,540
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
2012	63,705	53,494	3,074	5,314	1,824
Projections					
2017	65,825	55,414	3,132	5,407	1,871
2022	67,969	57,338	3,193	5,520	1,918
2032	71,713	60,724	3,291	5,714	1,985
2037	73,272	62,166	3,321	5,780	2,005
Longer-term projections					
2042	74,739	63,536	3,346	5,836	2,021
2052	77,493	66,128	3,391	5,935	2,040
2062	79,904	68,411	3,431	6,029	2,034

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

4 . 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. For the United Kingdom as a whole the key assumptions for the future are that:

- 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 higher than the 2010-based projection which assumed an average completed family size of 1.84 children per woman in the long term. This increase is based on the observation that the falling completed family size for women has slowed in recent years, and younger cohorts partway through their childbearing years look set to have similar levels of completed fertility to those who have recently completed childbearing.

- Expectation of life at birth, based on the mortality rates for the year in question, is projected to rise from 78.7 years in 2012/13 to 84.0 years in 2036/37 for men and from 82.4 years in 2012/13 to 87.3 years in 2036/37 for women. In 2037, period expectation of life at birth for the UK is around 0.4 years higher for males and 0.1 years higher for females compared to the previous projections. These differences are mainly due to a combination of the changes in initial rates of mortality improvement and base mortality rates, the change in the target year and the assumed interpolation of the rates of improvement between 2012 and 2037. After 2037 the life expectancies for males converge to those in the 2010-based projections whilst those for females fall to around 0.2 years lower.

- The long term assumption for net migration to the United Kingdom is +165,000 each year, compared with +200,000 a year in the 2010-based projections. This change reflects the most recent trends in international migration available at the time the projections were produced. New methods have been used to model migration trends in setting the migration assumptions for the 2012-based projections (see Chapter 5).

5. Background notes

1. The 2012-based Population Projections for United Kingdom and constituent countries were published on 6 November 2013 (main release) and 10 December 2013 (extra variants).

2. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

   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, 2012-based NPP Reference Volume

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Table of contents

1 . Introduction

The 2012-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, regardless of their nationality. The usually resident population includes all long-term international migrants (people changing their country of usual residence for at least one year). However, it does not include short-term migrants who come to or leave the UK for less than a year.

The projections are based on the population estimates as at 30 June 2012 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 key 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.

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. To give users of the projections an indication of this uncertainty, 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.

The 2012-based principal and key variant projections were published by ONS on 6 November 2013, with additional variants released on 10 December 2013.[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 were made generally available and then every second year until 1991. There was then a 1992-based set and since then projections have been produced every second year.

Additional 'interim' projections are occasionally produced. 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 started in 1970, gives details of the 2012-based national population projections produced by ONS (based on the estimated population at mid-2012). These replace the 2010-based projections published on 26 October 2011.

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 ONS on current and emerging demographic trends and their possible implications for the national population projections. This panel has met to discuss appropriate assumptions for each subsequent round of projections. The expert 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 2013 meeting of the expert panel is included in the 2012-based projections November release, in Appendix A of the Background and Methodology paper.

3 . Base population and projection period

Population estimates

The projections are based on the mid-2012 population estimates [2] produced by ONS, NRS and NISRA, published by ONS on 8 August 2013. The estimates for the UK and the constituent countries 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. Table 1-1 shows the estimates of the population at mid-2012 upon which the 2012 projections are based.

Table 1-1: Base population estimates for 2012-based projections

	thousands
England	53,494
Wales	3,074
Scotland	5,314
Northern Ireland	1,824
United Kingdom	63,705

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

Estimates of the population aged 90 and over

Official mid-year population estimates produced by 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 for those aged 90 and over[4] are published for England and Wales on an annual basis. Scotland have published population estimates of people aged 90 to 104[5] by single year of age, and the number of people aged 105 and over, for mid-2011 and mid-2012.

Projections period

The main focus of the 2012-based projections is on the next 25 years up to mid-2037, though longer term projections to mid-2112 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 ONS projections meet users' needs along with information on their fitness for purpose, please see the report on quality and methodology (109.5 Kb Pdf)[6] on the ONS website.

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[7]. For each age, the starting population plus net inward migrants less the number of deaths produces the number in the population, aged one year older, at the end of the year. To this has to be added survivors of those born during the year. Age is defined as completed years at the last birthday.

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. The number of net migrants to be added to obtain the population aged x+1 at the end of the projection year therefore 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, then applying mortality rate q_x (known as the initial mortality rate, or the probability of dying).

The number of births in a 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 applying a special 'infant mortality rate' to the projected number of births, and adding half the number of net migrants aged 0 last birthday. This special mortality rate is equivalent to about 85% of the conventional full first year of life infant mortality rate used in official statistics.

The 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 majority of assumptions have been set using rates based on revised series of population estimates and thus take into account the results of the 2011 Census. The exceptions to this are the mortality and fertility assumptions for Scotland. A revised back series of population estimates for Scotland was not available at the time of publication of the population projections so data rolled forward from the 2001 Census were used. Observed differences between the rolled forward estimates and Census results did not raise significant concerns about this approach.

Lexis diagram

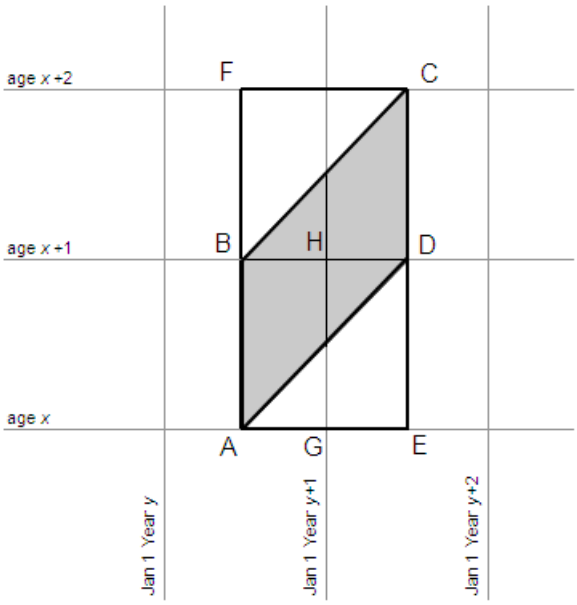
The projection process can be illustrated by means of a Lexis diagram (see Figure 1-1) where age is represented on the vertical axis and time on the horizontal axis. The life of an individual (or of a birth cohort), is represented by a diagonal line (or parallelogram) running from bottom left to top 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



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. 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 the ONS 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:

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

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 two 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 projections are available for England on the ONS release page[8], for Wales on the Welsh Government release page[9], for Scotland on the National Records of Scotland release page[10] and for Northern Ireland on the Northern Ireland Statistics and Research Agency release page[11].

Other related projections

A number of more specialised projections, all consistent with the national projections, are also prepared by government. Marital status projections[12], consistent with the 2008-based national projections, were published on 24 June 2010. These are produced on an ad hoc basis and there are currently no plans to produce marital status projections using the 2012-based national projections.

The Department for Communities and Local Government (DCLG)[13] published 2011-based interim household projections for England on 9 April 2013.

ONS no longer produce labour force projections, however, the Office for Budget Responsibility (OBR) now produce regular forecasts independent of Government, which include labour force projections. The latest available are for the period 2009 to 2019 which were published on 5 December 2013[14].

Population projections for other countries, carried out on a comparable basis, are produced by organisations such as Eurostat[15] and the United Nations[16].

6 . Data availability

Website

Detailed results of the 2012-based national population projections for the UK and its constituent countries are available from the ONS website. The results include the principal and variant projections for each country, and a summary of the assumptions upon which they are based. The key datasets can be downloaded in Microsoft Excel format for each country.

For each projection, the following datasets can be downloaded:

- Components of change, summary age distributions and dependency ratios
- Population in five-year age groups
- Population by individual age (to age 90)
- Fertility rates by individual age
- Fertility rates in five-year age groups
- Mortality rates by individual age
- Net migration by individual age

These can be more easily found using the NPP interactive table download tool[17].

The projected population numbers are shown in thousands but stored to three 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 datasets have been published as part of the government's open data agenda, mainly for modelling purposes. These files contain the 2012-based national projections by country, single year of age (0 to 105 and over) and sex, mid-2012 to mid-2112.

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

For the principal population projection and the associated components of population change, the interactive graphs[19] allow the user to view trends to mid-2037 graphically by sex and for predefined age groups.

Period and cohort life expectancy data[20] derived from historic mortality rates (from 1981 to 2012) and assumed calendar year mortality rates from the 2012-based national population projections are also available.

Further information

Further information about the National Population Projections may be obtained from the Office for National Statistics, Population Statistics Division, Population Projections Unit, 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 2012-based principal and variant projections can be found at: http://www.ons.gov.uk/ons/publications/all-releases.html?definition=tcm%3A77-21600
2. Mid-2012 estimates for each constituent country of the UK are available at: http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk--england-and-wales--scotland-and-northern-ireland/mid-2011-and-mid-2012/index.html
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5. Population estimates for Scottish Centenarians. Available at: http://www.gro-scotland.gov.uk/statistics/theme/population/estimates/special-populations/centenarians/index.html
6. ONS national population projections quality and methodology report: http://www.ons.gov.uk/ons/guide-method/method-quality/quality/quality-information/population/quality-and-methodology-information-for-national-population-projections.pdf
7. For a good introduction to projections methodology see Chapters 16 to 18 of Hinde A Demographic Methods. Arnold. (1998)
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13. Department for Communities and Local Government. Interim household projections to 2021, England. Available at: https://www.gov.uk/government/publications/household-interim-projections-2011-to-2021-in-england

14. See: http://budgetresponsibility.org.uk/economic-fiscal-outlook-supplementary-economy-tables-december-2013/

15. Regional population projections produced by Eurostat. Available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/population/publications/population_projections

16. United Nations World Population Prospects: Available at: http://esa.un.org/wpp/unpp/panel_population.htm

17. National population projections interactive data download tool can be found at: http://www.ons.gov.uk/ons/interactive/2012-npp/index.html

18. UK interactive population pyramid: http://www.ons.gov.uk/ons/interactive/uk-national-population-projections---dvc3/index.html

19. National population projections interactive graphs are available at: http://www.ons.gov.uk/ons/interactive/ppu-2012-v2/index.html

20. Period and cohort life expectancy data: http://www.ons.gov.uk/ons/rel/lifetables/historic-and-projected-data-from-the-period-and-cohort-life-tables/2012-based/index.html

8. Background notes

1. The 2012-based Population Projections for United Kingdom and constituent countries were published on 6 November 2013 (main release) and 10 December 2013 (extra variants).

2. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

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Compendium

Results, 2012-based NPP Reference Volume

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1 . Introduction

This chapter presents the key findings from the 2012-based national population projections. Included are sections on:

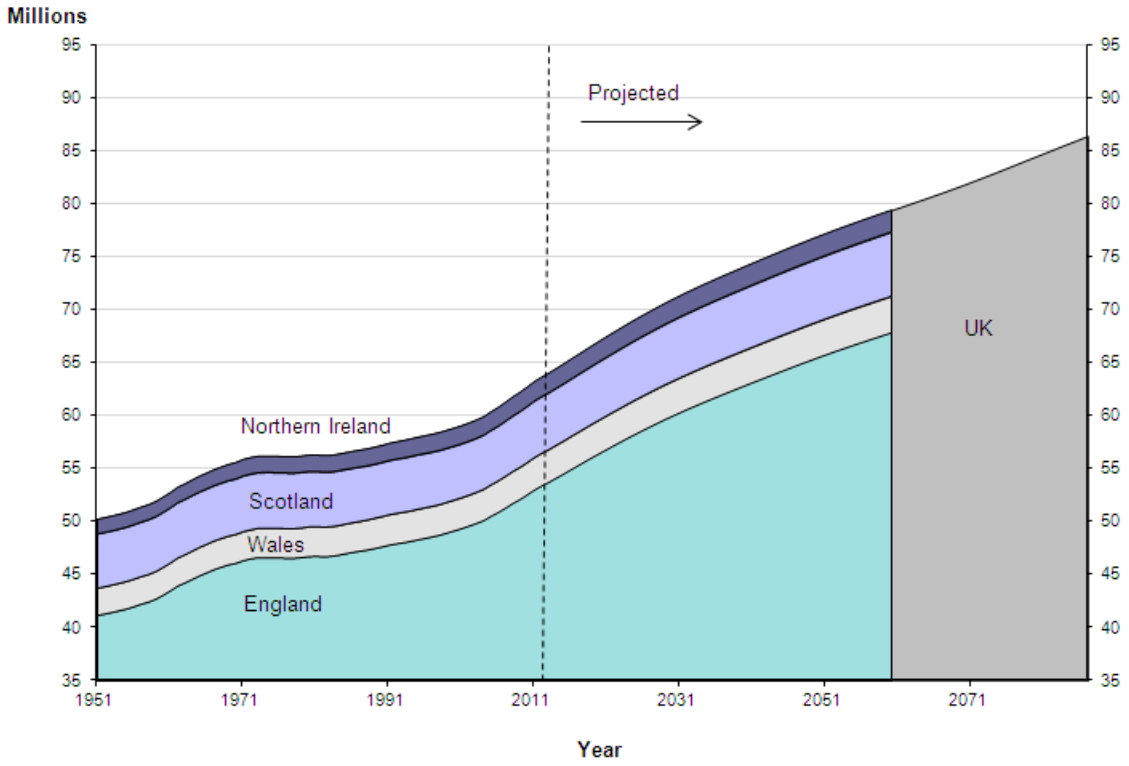
- future size of the population,
- age structure,
- comparison with the 2010-based population projections.

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

2 . Future size of the population

The United Kingdom population is projected to increase by 9.6 million (15%) to 73.3 million over the 25 year period to mid-2037. This increase is equivalent to an annual growth rate of 0.6% each year between mid-2012 and mid-2037. Longer term projections suggest that the population will continue rising beyond mid-2037 reaching 86.5 million by mid-2087. Figure 2-1 shows the actual and projected population of the UK and its constituent countries between mid-1951 and mid-2087.

Figure 2-1: Actual and projected population of the United Kingdom and constituent countries mid-1951 to mid-2087



Source: Office for National Statistics

The population of England is projected to increase by 16% by mid-2037. The population of the other UK countries are also projected to increase, but at a slower rate. Northern Ireland is projected to increase by 10%, Scotland by 9% and Wales by 8% over the 25 year period to mid-2037. Beyond mid-2037 the populations of England, Wales and Scotland are projected to continue to rise. However, Northern Ireland's population is projected to reach its peak in the mid 2050s.

3 . Births, deaths and migration

Of the 9.6 million projected increase in the population by mid-2037, 5.4 million (57%) is due to projected natural increase (more births than deaths) and 4.2 million (43%) is due to projected net migration. The projected number of births and deaths are themselves partly dependent on the assumed level of net migration. Because 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 60% of the projected increase in the population over the period mid-2012 to mid-2037 is either directly or indirectly attributable to future 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-2012 and mid-2037.

Table 2-1: Projected components of change, United Kingdom, mid-2012 to mid-2037

millions

	2012-2017	2017-2022	2022-2027	2027-2032	2032-2037
Population at start	63.7	65.8	68.0	70.0	71.7
Births	4.0	4.1	4.0	4.0	4.0
Deaths	2.8	2.8	2.9	3.1	3.3
Natural change	1.3	1.3	1.2	0.9	0.7
Net migration	0.8	0.8	0.8	0.8	0.8
Total change	2.1	2.1	2.0	1.8	1.6
Population at end	65.8	68.0	70.0	71.7	73.3

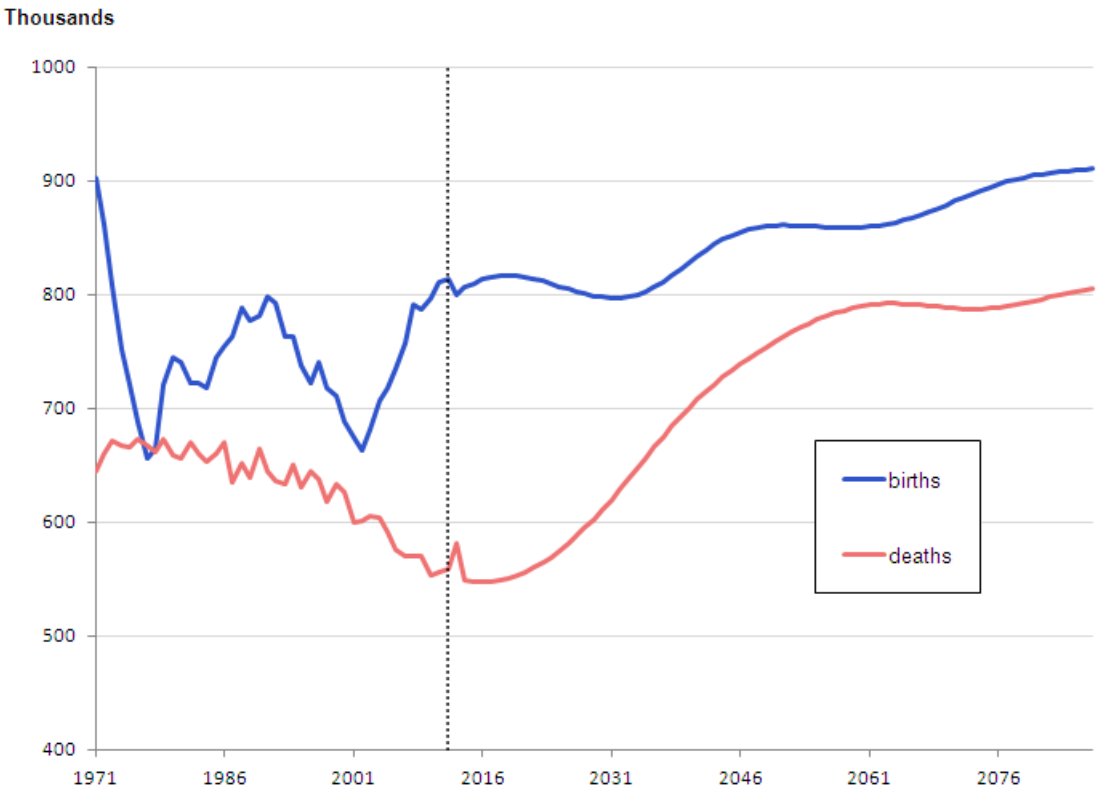
Source: Office for National Statistics

Note:

1. Figures may not sum due to rounding

With the single exception of 1976, the UK gained population through natural increase (more births than deaths) 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, United Kingdom, year ending mid-1971 to year ending mid-2087



The equivalent charts for the constituent countries of the UK can be found in appendices A-D of the Results report published on 6 November 2013.

Between 2002 and 2008, total fertility rates[1] increased in all constituent countries of the UK, followed by a dip in 2009. All countries except Scotland then showed a recovery in 2010 with Wales showing another dip in 2011. For the 2012-based projections, the total fertility rate for the UK has been assumed to decrease slightly from 2012 to 2013 then stabilise at 1.89 from then on. Figure 2-2 shows that after the initial dip in 2012-2013, births are projected to rise until mid-2019, before declining slightly, then rising again from 2033.

The annual number of deaths has generally been declining in the last few years and, excluding the first year of the projections, is projected to continue to decline until mid-2016. For the remainder of the century, deaths are expected 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 165,000 persons per year from the year ending mid-2019 onwards. In the short term, figures have been formulated to represent a smooth transition from the last year of actual data to the long-term assumptions. The year ending mid-2016 has the highest anticipated net migration with a projected net inward movement of 183,500. New methods have been used to model migration trends in setting the migration assumptions for the 2012-based projections. These are described in Chapter 5.

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, United Kingdom, mid-2012 to mid-2037

millions

Ages	2012	2017	2022	2027	2032	2037
0-14	11.2	11.7	12.2	12.3	12.2	12.2
15-29	12.6	12.4	12.1	12.3	12.9	13.3
30-44	12.8	12.7	13.3	13.6	13.5	13.2
45-59	12.6	13.3	13.0	12.6	12.4	13.0
60-74	9.4	10.1	10.7	11.6	12.3	12.1
75 and over	5.0	5.5	6.6	7.7	8.5	9.5
75-84	3.6	3.8	4.6	5.3	5.4	5.9
85 & over	1.4	1.7	2.0	2.4	3.1	3.6
All ages	63.7	65.8	68.0	70.0	71.7	73.3
Median age (years)	39.7	40.1	40.6	41.3	42.1	42.8
Under 16	12.0	12.4	13.0	13.1	13.0	13.0
Working age[1]	39.4	41.0	42.4	42.9	43.1	44.2
Pensionable age[1]	12.3	12.4	12.5	13.9	15.6	16.1
Dependents per 1,000 persons of working age						
Under 16	304	304	306	305	303	294
Pensionable age[1]	311	304	295	324	362	365
Total	615	607	602	630	665	659

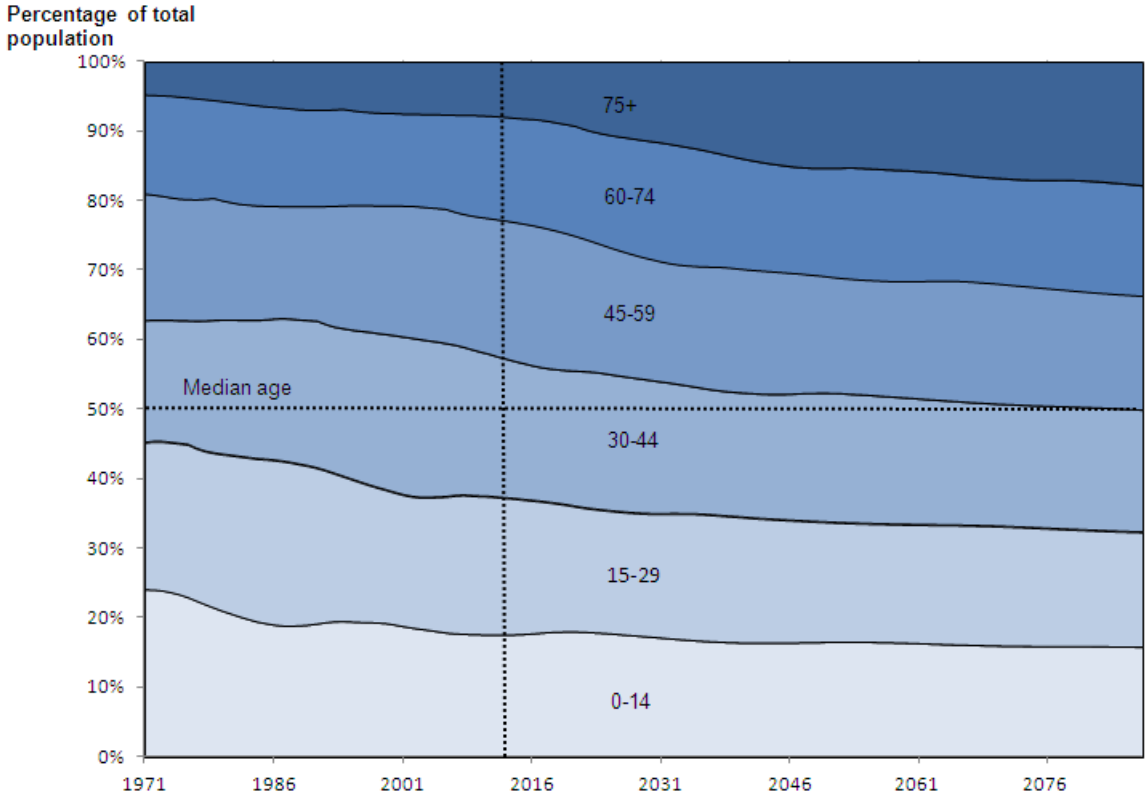
Source: Office for National Statistics

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. 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 two stages from 66 years to 68 years for both sexes. This is based on State Pension age under the 2011 Pensions Act

2. Figures may not sum due to rounding

Figure 2-3: Percentage age distribution, United Kingdom, mid-1971 to mid-2087



Source: Office for National Statistics

The equivalent charts for the constituent countries of the UK can be found in appendices A-D of the Results report published on 6 November 2013.

The age structure is projected to become gradually older with the median age of the population increasing from 39.7 years in mid-2012 to 42.8 years in mid-2037. Longer term projections show continuing ageing with the median age reaching 45.1 years by mid-2087.

Particularly notable is the projected increase in the population at older ages. By mid-2037, 13% of the population of the UK is projected to be aged 75 and over, compared to 8% in mid-2012. By mid-2087, this figure is projected to increase to 18%. The number of people aged 80 or over is projected to more than double by mid-2037, the number of people aged 90 or over is projected to more than triple, and the number of centenarians is projected to rise from 13,000 in mid-2012 to 111,000 in mid-2037, a more than eightfold increase. The increase in the number of older people means that by mid-2037 one in 12 of the population is projected to be aged 80 or over.

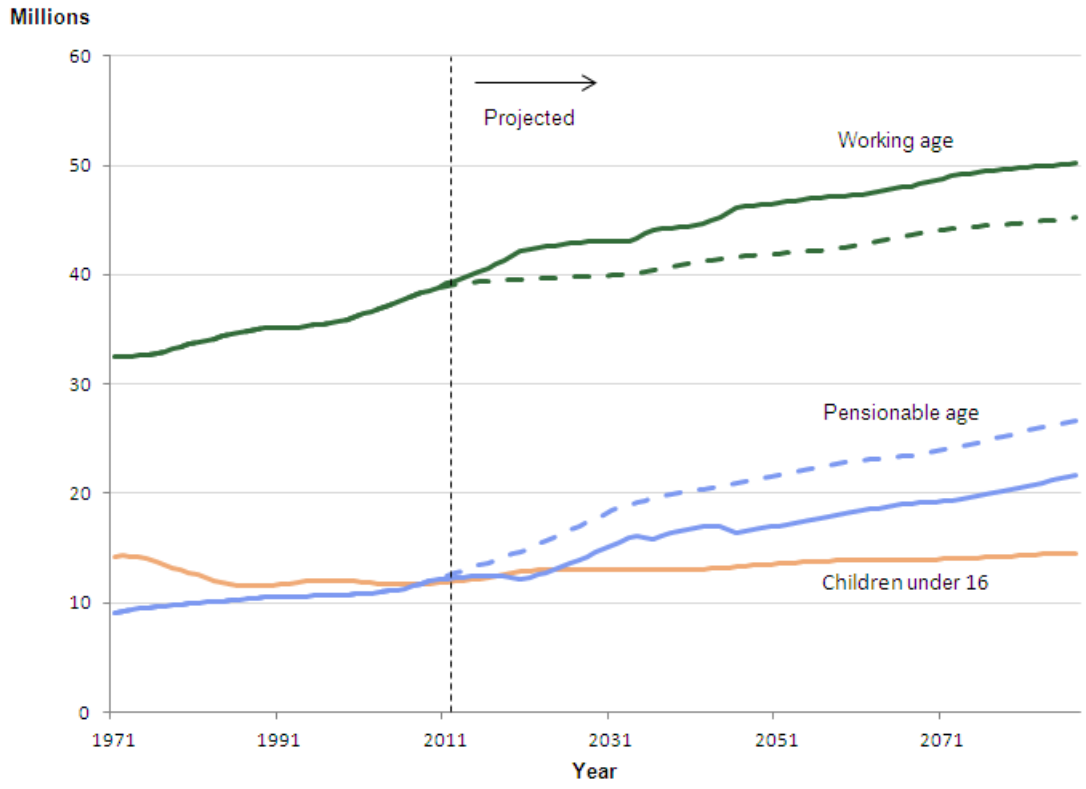
Children and the population of working and pensionable ages

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[2], 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 two stages to 68 years for both sexes between 2034 and 2046. The 2012-based projections presented in this report and on the ONS website incorporate these changed definitions to State Pension age as they occur during the projection period.

The government has recently proposed to introduce a flat rate (single-tier) State Pension from April 2016 and raise the State Pension age from 66 to 67 years gradually between 2026 and 2028. As these proposed changes are not yet law and still require the approval of Parliament, they have not been incorporated within the pension age projections assumptions. Further information relating to these proposals can be found on the gov.uk website[3] .

Figure 2-4: Actual and projected number of children and populations of working and pensionable ages, United Kingdom, mid-1971 to mid-2087



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 2034 and 2046, State Pension age will increase in two stages from 66 years to 68 years for both sexes

2. The dotted lines show what the projected population at working age and pensionable age would have been if the Pension Acts of 2005, 2007 and 2011 had not been introduced i.e. a State Pension age of 65 years for men and 60 years for women has been applied throughout

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 age population is affected by a number of different factors. This includes the level of net migration (much of which is of 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 become State Pension age.

The working age population is projected to rise from 39.4 million in mid-2012 to 44.2 million by mid-2037 and then reach 50.2 million by mid-2087. 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 to 40.5 million in mid-2037 and 45.2 million by mid-2087.

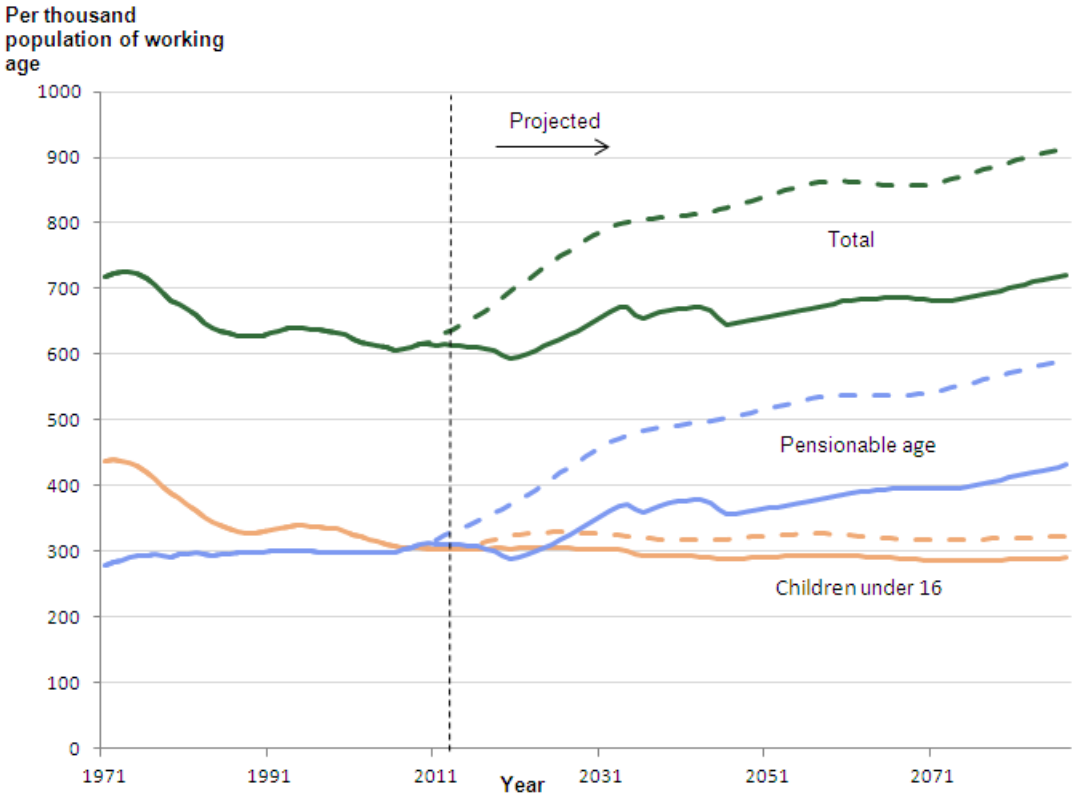
Despite increases to State Pension age, the population of pensionable age is projected to increase by 31% from 12.3 million in mid-2012 to 16.1 million by mid-2037. This increase is projected to continue into the long term reaching 21.7 million by mid-2087. Assuming State Pension age remained at 65 years for men and 60 years for women, the population of this age group would have been projected to rise to 19.7 million by mid-2037, and to 26.7 million by mid-2087 (3.6 and 5.0 million higher respectively than with the current changes).

The number of children under the age of 16 is projected to rise by around 8% from 12.0 million in mid-2012 to 13.0 million in mid-2037. This number is projected to continue to increase to 14.6 million by mid-2087.

Dependency ratios

Changes to the age structure will over time impact on the proportion of dependents 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 two) 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[4]. Table 2-2 and Figure 2-5 show the actual and projected dependency ratios for the UK.

Figure 2-5: Actual and projected dependency ratios, total, children and pensionable ages, United Kingdom, mid-1971 to mid-2087



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 2034 and 2046, State Pension age will increase in two stages from 66 years to 68 years for both sexes

2. The dotted lines show what the projected population at working age and pensionable age would have been if the Pension Acts of 2005, 2007 and 2011 had not been introduced i.e. a State Pension age of 65 years for men and 60 years for women has been applied throughout

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 615 in mid-2012. Over the period until mid-2020 when the State Pension age for both men and women is set to rise to 66 years, the total dependency ratio is projected to decline. There then follows an increase in the ratio until mid-2034, after which there is some fluctuation as further changes in State Pension age come into effect between 2034 and 2046.

The longer-term projections suggest a total dependency ratio of 722 dependants per 1,000 persons of working age by mid-2087, 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 that to support a child[5].

Without the changes to State Pension age, the total dependency ratio would be projected to increase to a much higher level, with 714 dependants per 1,000 people of working age by mid-2022, 807 by mid-2037 and 914 by mid-2087.

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-2012. 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 (307 children per 1,000 people of working age) is expected in mid-2023 whilst the lowest ratio (286 children) is expected around mid-2074. The changes to the State Pension age results in an increase to the working age population. Without these changes, the child dependency ratio would be slightly higher.

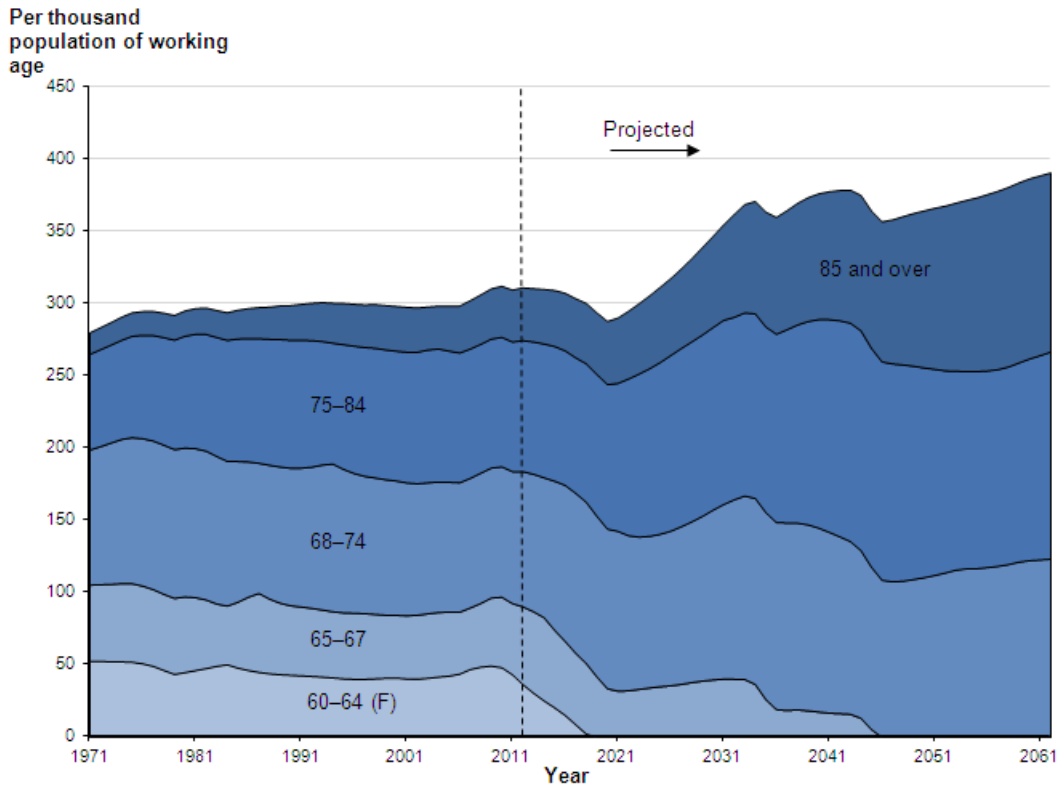
The pensionable age dependency ratio (the number of people of State Pension age per 1,000 people of working age) is affected more by the changes to the State Pension age and shows a very similar pattern to that of the total dependency ratio. The pensionable age dependency ratio is projected to fall from 311 per 1,000 persons of working age in mid-2012 to 288 by mid-2020. It then increases to 371 pensioners per 1,000 people of working age in mid-2034 before showing some fluctuation but eventually reaching a ratio of 432 by mid-2087.

Without the changes in State Pension age, the pensionable age dependency ratio would have steadily risen over the projection period, reaching 386 pensioners per 1,000 people of working age in mid-2022, 487 in mid-2037 and 591 in mid-2087 compared to figures of 295, 365 and 432 respectively based on the projections including the State Pension age changes.

Figure 2-6 splits the pensionable age dependency ratio into five age bands (60-64 (females only), 65-67, 68-74, 75-84 and 85 and over). The first two bands represent the age groups which become part of the working age population by 2046. In mid-2012, persons aged 75 and over represented 41% of the population of pensionable age. This is projected to increase to 59% by mid-2037 and 71% by mid-2087.

Population ageing will be experienced to a greater or lesser extent in all Western countries. The latest Eurostat projections[6] based on the population in 2010 show that the UK will have proportionately fewer older people than most other EU countries over the coming decades.

Figure 2-6: Actual and projected pensionable age dependency ratio, by age of dependent, United Kingdom, mid-1971 to mid-2062



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 2034 and 2046, State Pension age will increase in two stages from 66 years to 68 years for both sexes

5 . Long-term projections to mid-2087

The main focus of the projections is on the period to mid-2037. 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 can change from those being assumed.

The annual number of births is projected to still be increasing in the long-term, reaching around 910,000 by mid-2087. The annual number of deaths is projected to reach about 806,000 by mid-2087. The excess of births over deaths is projected to reach a peak of 268,000 by mid-2018 before reducing to a difference of around 69,000 in mid-2061. After this point, the excess of births over deaths is projected to increase on an annual basis to 111,000 in mid-2071, before starting to slowly decline. 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 rising strongly throughout the projection period reaching 86.5 million by mid-2087.

Population increases are greatest at the oldest ages. The number of people aged 60 and over is projected to rise throughout the projection period, with more than twice the number aged 60 and over by mid-2087 compared with mid-2012 (29.1 million compared with 14.5 million). However, the number of persons aged over 75 is projected to rise even faster, doubling by mid-2040 and more than trebling by mid-2087.

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-2112 are available on the ONS website for users who require them but these should be treated with extreme caution. They are not considered appropriate for a wide range of users but have been made available in line with making datasets publicly available under the government's transparency agenda.

6 . Comparisons with 2010-based projections

The 2012-based population projections are different to the 2010-based projections as the 2012-based figures use the latest available population estimates (mid-2012) as the base year. Further to the 2010-based projections, the underlying assumptions about future fertility, mortality and migration have been reviewed. Revised assumptions have been adopted for the 2012-based projections.

Changes in assumptions

Table 2-3 shows the long term fertility, mortality and migration assumptions used in the 2012-based population projections compared with those used for the 2010-based projections.

Table 2-3: Long-term principal assumptions for the 2012-based national population projections compared with assumptions for the 2010-based projections

	United Kingdom	England	Wales	Scotland	Northern Ireland
Fertility – Long-term average number of children per woman					
2012-based	1.89	1.90	1.90	1.75	2.00
2010-based	1.84	1.85	1.85	1.70	1.95
Mortality - Expectation of life at birth in 2037 [1]					
Males 2012-based	84.0	84.3	83.6	81.9	83.3
Males 2010-based	83.6	83.9	83.1	81.1	82.6
Females 2012-based	87.3	87.5	86.9	85.4	86.8
Females 2010-based	87.2	87.4	86.8	85.4	86.8
Net migration [2] – Annual long-term assumption					
2012-based	+165,000	+143,500	+6,000	+15,500	0
2010-based	+200,000	+172,500	+10,000	+17,500	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 2037 and do not take account of the continuing improvement in mortality projected beyond 2037.

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 are higher than the 2010-based projections. This increase is based on the observation that the falling completed family size for women has slowed in recent years, and younger cohorts partway through their childbearing years look set to have similar levels of completed fertility to those who have recently completed childbearing.

Mortality

The 2012-based projections assume that rates of improvement will converge to 1.2% for most ages in mid-2037, 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-2037, while those born before 1922 are assumed to experience annual mortality improvements below 1.2%. These are the same assumptions for the rates of mortality improvement in the target year as those used in the 2010-based projections (where the target year was mid-2035). The projected period life expectancies at birth for mid-2037 are around 0.1 years higher than in previous projections for females and 0.4 to 0.8 years higher for males.

Migration

The long-term assumption for net migration to the United Kingdom is +165,000 each year, compared with +200,000 a year in the 2010-based projections. The assumed level of annual net migration to England is +143,500, which is 29,000 lower than for the 2010-based projections. For Wales it is 4,000 lower at +6,000 at year, and for Scotland it is 2,000 lower at +15,500 a year. The assumption for Northern Ireland is the same as that used for the 2010-based projections. These changes reflect the most recent trends in both international migration and cross-border migration between the four constituent countries of the UK.

Base population

Since the 2010-based projections were published the results of the 2011 Census have been released and used to rebase the population estimates series. There were around 500,000 more people estimated by the 2011 United Kingdom Census than had been previously estimated.

Table 2-4 shows the actual population change between mid-2010 and mid-2012 compared to the projected change from the 2010-based projections. At mid-2012 the estimated population of the UK was 461,000 higher than the projections for mid-2012 in the 2010-based projections. The vast majority of this difference can be attributed to the intercensal discrepancy which had accumulated in the population estimates between the 2001 and 2011 Censuses. However, the impact of the underestimate in the base population for the 2010-based projections was reduced in part by an over projection of births and net migration and an under projection of deaths.

Table 2-4: Population change mid-2010 to mid-2012: actual change compared with 2010-based projected change, United Kingdom

	Mid-year estimates[1] (000s)	2010-based projections (000s)	Difference (000s)	Percentage difference
Population at mid-2010	62,759.5	62,262.0	497.5	0.8
Components of change (2010-2012)				
Births	1,624.3	1,639.6	-15.3	-0.9
Deaths	1,114.8	1,119.8	-5.0	-0.4
Natural change	509.6	519.9	-10.3	-
Net migration and other changes[2]	436.0	462.0	-26.0	-
Total change	945.6	981.9	-36.3	-
Population at mid-2012	63,705.0	63,243.8	461.2	0.7
England	53,493.7	53,106.5	387.2	0.7
Wales	3,074.1	3,032.2	41.8	1.4
Scotland	5,313.6	5,281.7	31.9	0.6
Northern Ireland	1,823.6	1,823.4	0.3	0.0

Source: Office for National Statistics

Notes:

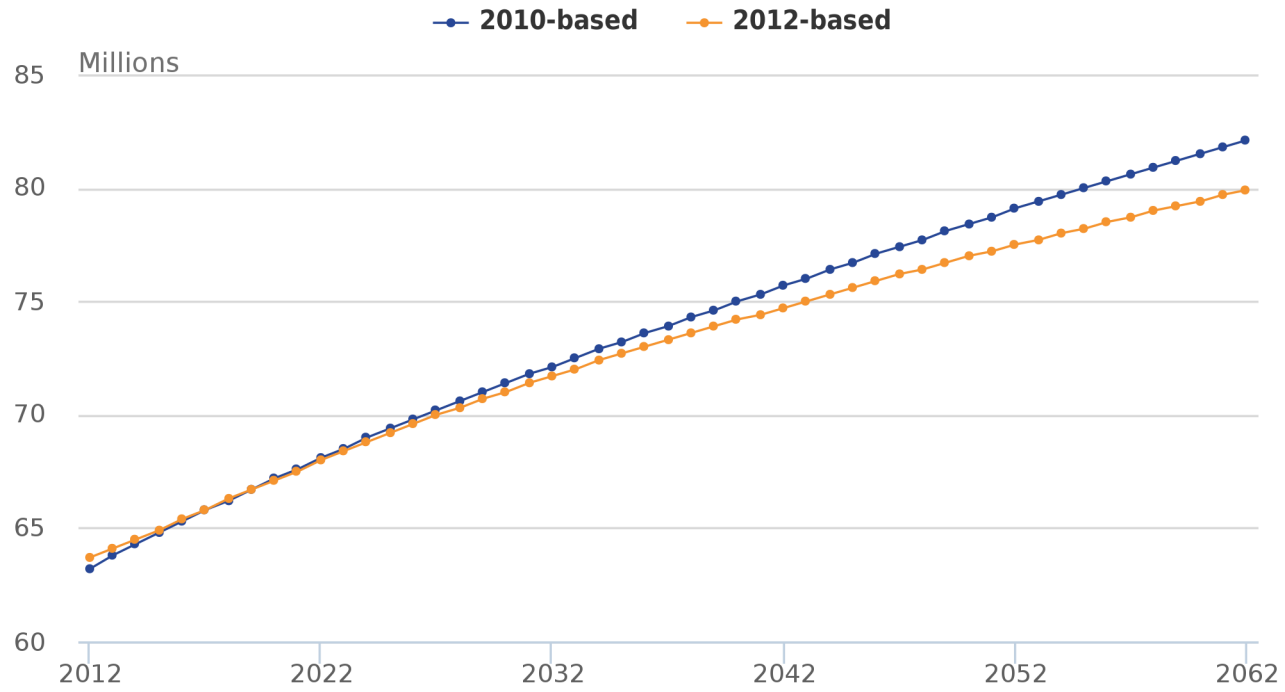
1. Mid-year estimates have been rebased to take account of the results of the 2011 Census

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

Total UK population

Although the 2012-based projections start from a higher base than the 2010-based projections, the population is projected to grow at a slower rate (Figure 2-7). The slower projected growth is due to the change in the assumptions made for the 2012-based projections, with the assumptions for migration being lower and for fertility being lower in the short term (but higher in the long term) than the 2010-based projections.

Figure 2-7: 2010-based and 2012-based population projections, United Kingdom, mid-2012 to mid-2062



Source: Office for National Statistics

The 2012-based projected total population of each country is compared with the 2010-based projections in Table 2-5. Figures are compared one year, ten years and twenty five years into the projection period. The difference between the two sets of projections is broken down into changes due to the base population and changes due to the projected numbers of births, deaths and migrants.

Table 2-5: Change in projected population compared with 2010-based projections

				Change due to difference in:			
	2012-based projection	2010-based projection	Total change	base population	projected births	projected deaths	projected migrants
Population at mid-2013							
England	53,844	53,563	281	387	-35	-18	-53
Wales	3,083	3,048	35	42	-2	-2	-3
Scotland	5,328	5,312	16	32	-3	-2	-10
Northern Ireland	1,832	1,836	-3	0	-1	-1	-2
United Kingdom	64,087	63,758	329	461	-41	-23	-68
Population at mid-2022							
England	57,338	57,428	-91	387	-202	40	-315
Wales	3,193	3,204	-10	42	-17	3	-38
Scotland	5,520	5,532	-12	32	-10	6	-41
Northern Ireland	1,918	1,928	-9	0	-5	1	-6
United Kingdom	67,969	68,092	-123	461	-234	49	-399
Population at mid-2037							
England	62,166	62,730	-564	387	-259	57	-750
Wales	3,321	3,389	-67	42	-24	12	-98
Scotland	5,780	5,780	1	32	17	22	-71
Northern Ireland	2,005	2,013	-8	0	-6	3	-6
United Kingdom	73,272	73,911	-639	461	-271	95	-924

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

Table 2-5 shows that in England and Wales the projected populations in mid-2013 are higher than in the 2010-based projections but are lower in mid-2022 and mid-2037. For Scotland, the projected population is higher in mid-2013, lower in mid-2022 but then marginally higher in mid-2037. Whereas the Northern Ireland 2012-based projection is lower than the 2010-based projection in all three years. The largest difference at mid-2037 is for Wales, where the 2012-based population projection is 2.0% lower than the 2010-based projection.

In mid-2022 and mid-2037 in addition to the increase due to the rebasing of the population to take into account results of the 2011 Census, there has been a decrease in projected deaths and net migration in all countries. There has generally been a decrease in births projected in all countries with the exception of Scotland where projected births over the 25 years to mid-2037 are higher than the 2010-based projections. These differences generally reflect the changes to the long term assumptions (Table 2-3).

Distribution by age and sex

The change in the projected size of the UK population for selected age groups is shown in Table 2-6. Compared with the 2010-based projection, the projected UK population at mid-2037 is lower for those in the age groups between 16-59 but higher for children and the older population.

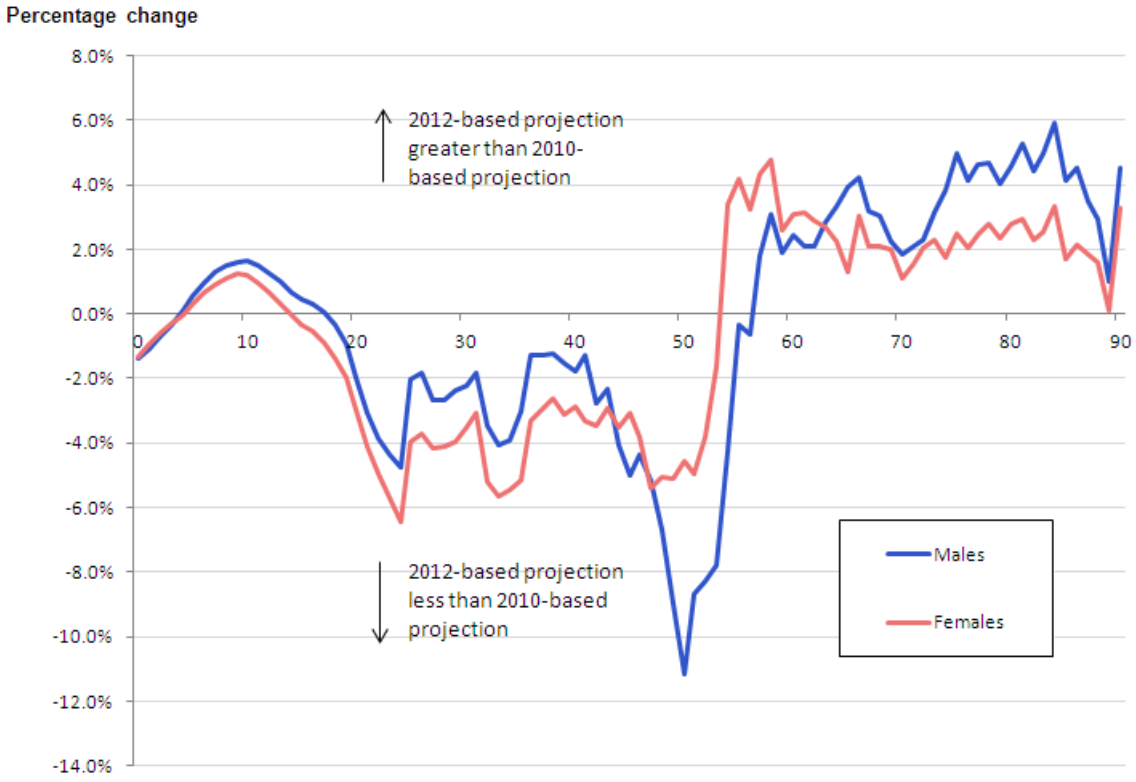
Table 2-6: Change in projected population by age group, United Kingdom, 2012-based projections compared with 2010-based projections

	mid-2012		mid-2022		mid-2032		mid-2037	
	000s	%	000s	%	000s	%	000s	%
Under 16	188	1.6	-151	-1.2	9	0.1	51	0.4
16-29	-88	-0.7	49	0.4	-288	-2.3	-372	-2.9
30-44	291	2.3	-345	-2.5	-453	-3.3	-414	-3.1
45-59	77	0.6	121	0.9	-79	-0.6	-401	-3.0
60-74	55	0.6	204	1.9	255	2.1	295	2.5
75 and over	-62	-1.2	-0	0.0	136	1.6	201	2.2
All ages	461	0.7	-123	-0.2	-420	-0.6	-639	-0.9

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 0.9% lower than the 2010-based projections.

Figure 2-8: Change in projected population at mid-2037 by age and sex compared with the 2010-based projections, United Kingdom



Source: Office for National Statistics

7. References

1. The total fertility rate is a summary measure 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 child bearing years and experienced the exact current age-specific fertility rates throughout their lifetime

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8. Background notes

1. The 2012-based Population Projections for the United Kingdom and constituent countries were published on 6 November 2013 (main release) and 10 December 2013 (extra variants).

2. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

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

Compendium

Fertility, 2012-based NPP Reference Volume

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Table of contents

1 . Introduction

For the UK as a whole the key measure used in setting the fertility assumptions in the national projections is average completed family size. 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 for women born in 2005 and later. This long-term assumption represents a rise of 0.05 from the 2010-based projections.

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.

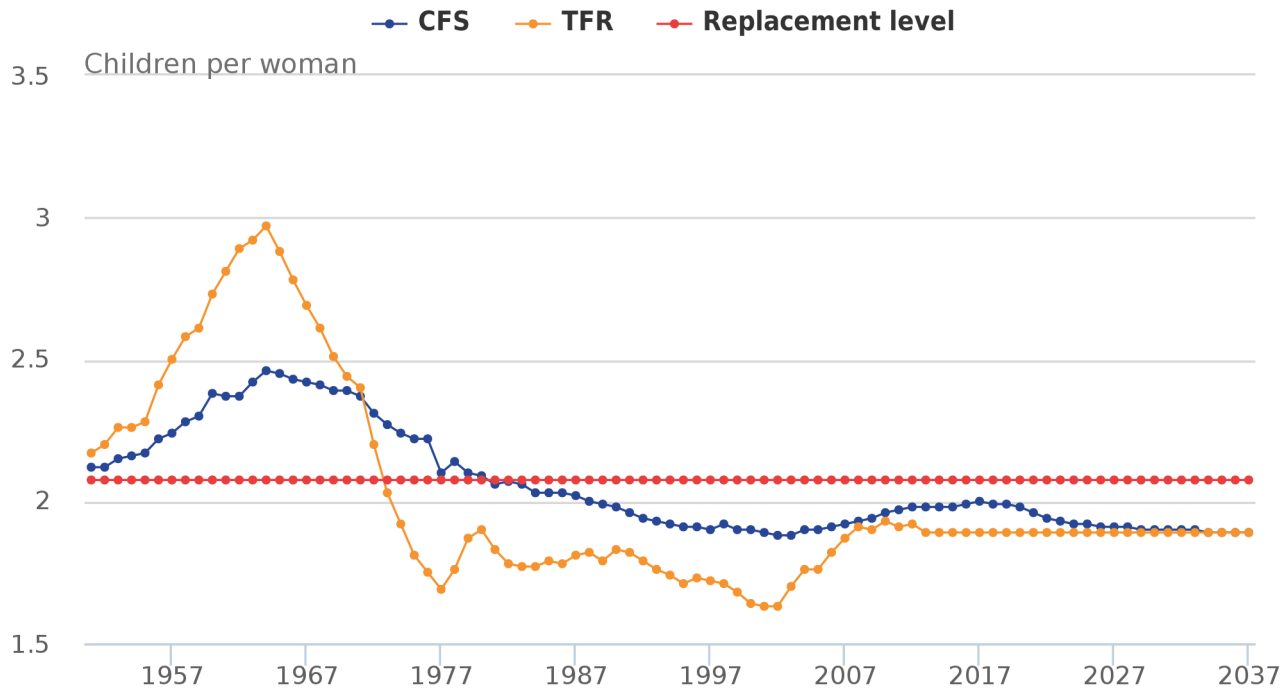
This chapter discusses past trends in fertility and summarises the resulting assumptions adopted for the 2012-based population projections.

2 . Recent trends in fertility

Fertility assumptions are formulated in terms of completed family size – the average number of children that women born in particular years will have. As Figure 3-1 shows, this cohort measure of fertility is more stable than the total fertility rate (TFR), 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 the women were, or will be, aged 30 (the approximate mid-point of the 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 1967 – the most recent cohort for whom there are data up to age 45 – having on average 1.90 children.

Figure 3-1: Actual and assumed total fertility rate (TFR) and average completed family size (CFS), United Kingdom, 1951–2037



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. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

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

Fertility rates in the UK fell sharply from the 'baby boom' peak in the TFR of just under three children in 1964 to a trough of 1.69 in 1977. During the 1980s, the TFR stayed relatively stable at around 1.8 children then fell to around 1.7 in the second half of the 1990s. In recent years the UK has seen increases in the TFR, from 1.63, the lowest point ever recorded in 2001, to 1.91 in 2008. In 2009 the TFR fell slightly to 1.90, a dip likely to be related to the economic recession. Following this the TFR increased slightly in 2010 to 1.93 and has fluctuated since. There has been some variation between UK countries since 2009 with a stabilisation then recovery in England, while in Scotland the TFR continued to fall, in Wales it fluctuated and Northern Ireland’s fertility was broadly stable from 2010 onwards.

Fertility rates among women in their thirties and forties 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 despite the TFR drop in 2009 and the fluctuations since. Since 2002 there have also been smaller increases in fertility among women in their late twenties and stabilisation among women in their early twenties, following declining fertility in these age groups 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.

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 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] 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, 1985 and 1990 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 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 25-29 year olds from 2002 to 2008.

Women born between 1960 and 1970 have been increasingly 'catching up' in their thirties. For example, women born in 1975 on average achieved 0.53 children between their 30th and 35th birthdays compared with 0.45 for women born ten years earlier.

Table 3-1: Average achieved family size by age (exact years) and year of birth of woman, United Kingdom, women born 1950–1990

						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	:	:
1975	0.15	0.51	0.98	1.51	:	:	:
1980	0.15	0.50	1.00	:	:	:	:
1985	0.14	0.49	:	:	:	:	:
1990	0.13	:	:	:	:	:	:

Source: Office for National Statistics

Note:

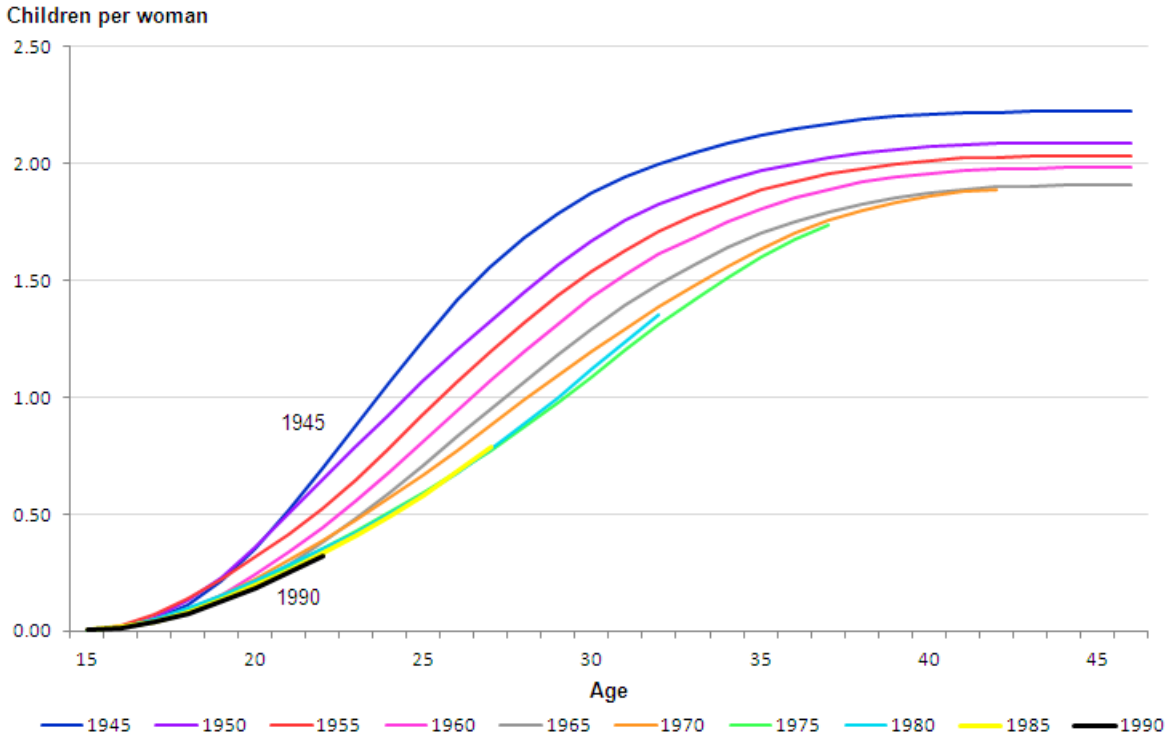
1. Figures have not been revised to take account of the 2011 Census for Scotland. Frevised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

3 . Fertility assumptions for the United Kingdom

In the 2012-based projections, the long-term completed family size is assumed to be 1.89 children per woman. This is 0.05 above the level assumed in the 2008 and 2010-based projections, but is still below '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).7 The 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, each subsequent cohort has had fewer children by each age (with the exception of teenagers) than earlier cohorts. For example, the 1975 cohort had averaged 0.98 children each by their 30th birthday, 0.11 children fewer on average than the 1970 cohort at the same age. However, the 1980 cohort has more children by age 30 than the 1975 cohort. The relative stabilisation of recent cohort sizes was one of the factors that supported raising the fertility assumptions of UK countries in this projection round.

Figure 3-2: Average achieved family size by age and year of birth of woman, United Kingdom, women born 1945–1990



Source: Office for National Statistics

Notes:

1. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

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 35–39, compared with 0.16 children for the 1955 cohort. 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, United Kingdom, women born 1950–1990

	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	:	:
1975	0.15	0.36	0.47	0.53	:	:	:
1980	0.15	0.35	0.50	:	:	:	:
1985	0.14	0.36	:	:	:	:	:
1990	0.13	:	:	:	:	:	:

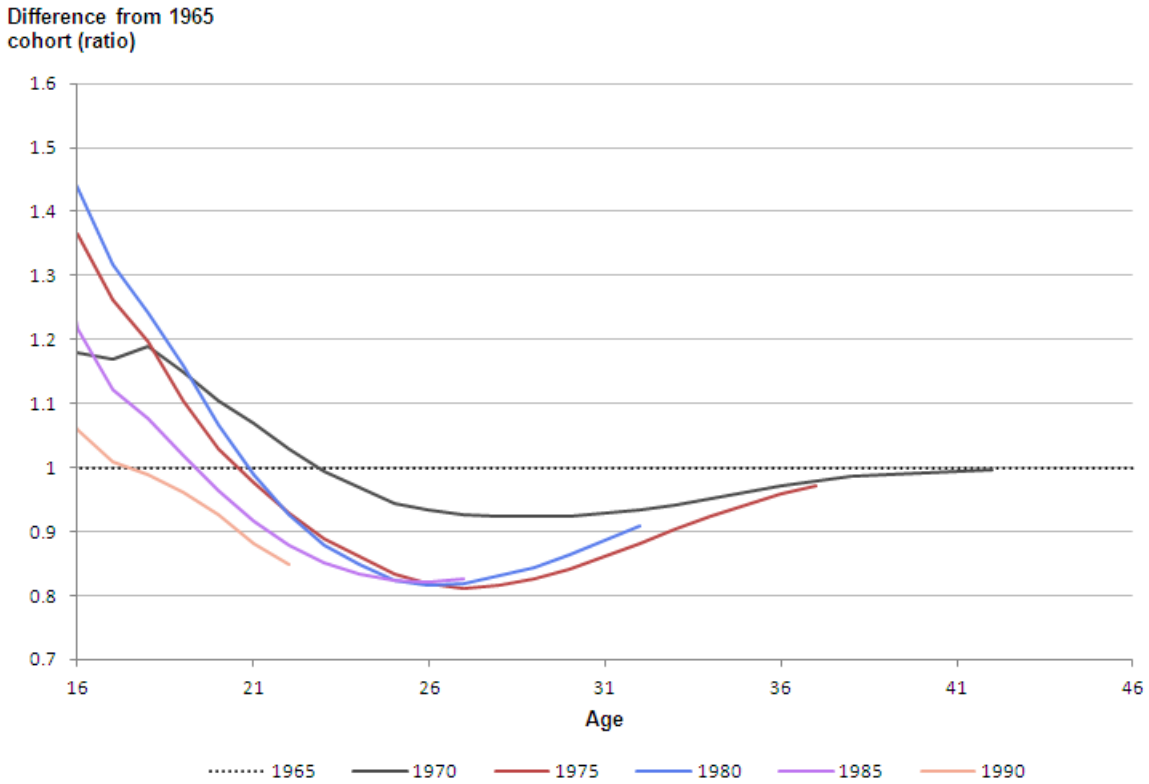
Source: Office for National Statistics

Notes:

1. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

Figure 3-3 shows this recuperation more clearly. The fertility of selected cohorts is shown 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 twenties, 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, United Kingdom, 1965 cohort compared with women born 1970 -1990



Source: Office for National Statistics

Notes:

1. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

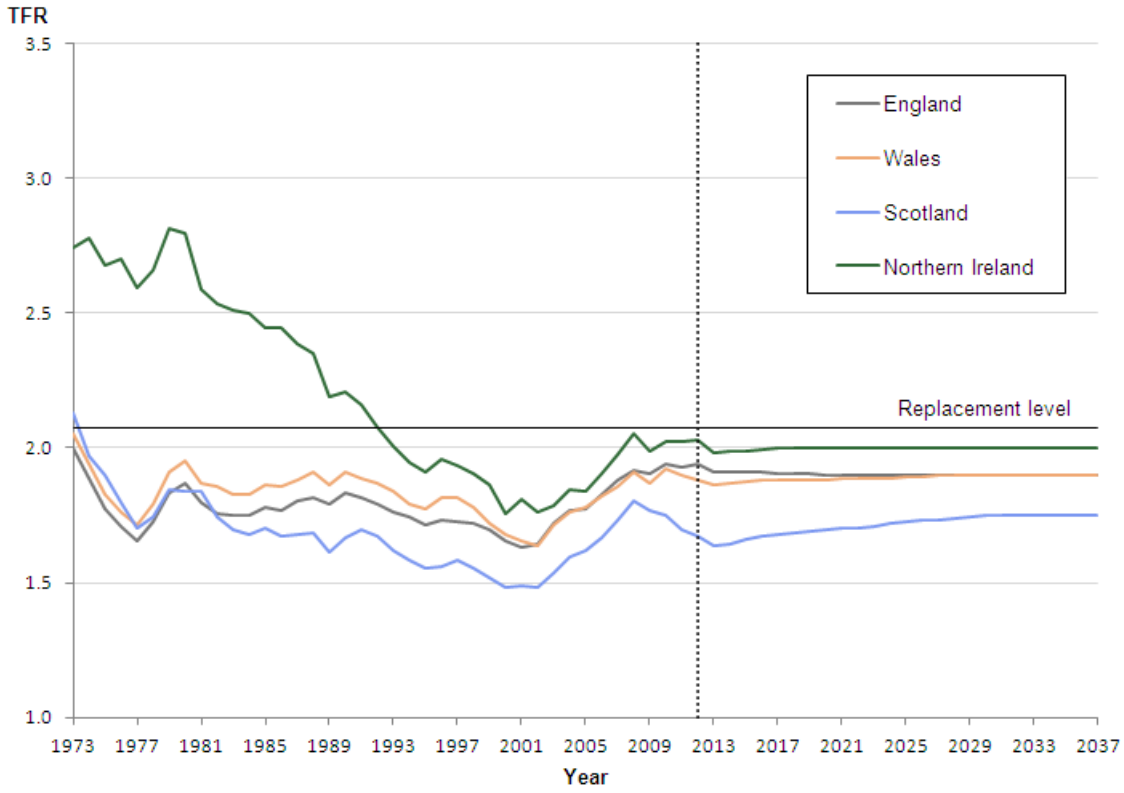
Women born in 1980 have followed a very similar fertility trajectory to the 1975 cohort up to age 25, but are now showing higher fertility from age 28 onwards. This represents a marked difference from the previous pattern where successive cohorts born between the 1940s and the 1960s achieved lower fertility by each age than their predecessors, and suggests that falls in cohort fertility are bottoming out. However women born in the late 1980s have experienced slightly lower teenage fertility than those born in the 1970s and early 1980s and 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 actual and assumed trends in the TFR and completed family size for the constituent countries of the UK. All four countries have seen an upturn in the TFR between 2002 and 2008, and then broadly stable rates, except for Scotland which declined (Figure 3-4). In 2012 the TFRs for England and Wales were 1.94 and 1.88 children per woman, respectively. Northern Ireland has historically had higher fertility than the rest of the UK and in 2012 its TFR was 2.03. Scotland has had lower fertility than England since the early 1980s and in 2012 its TFR was 1.67.

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: Actual and assumed total fertility rates, constituent countries of the UK, 1973–2037

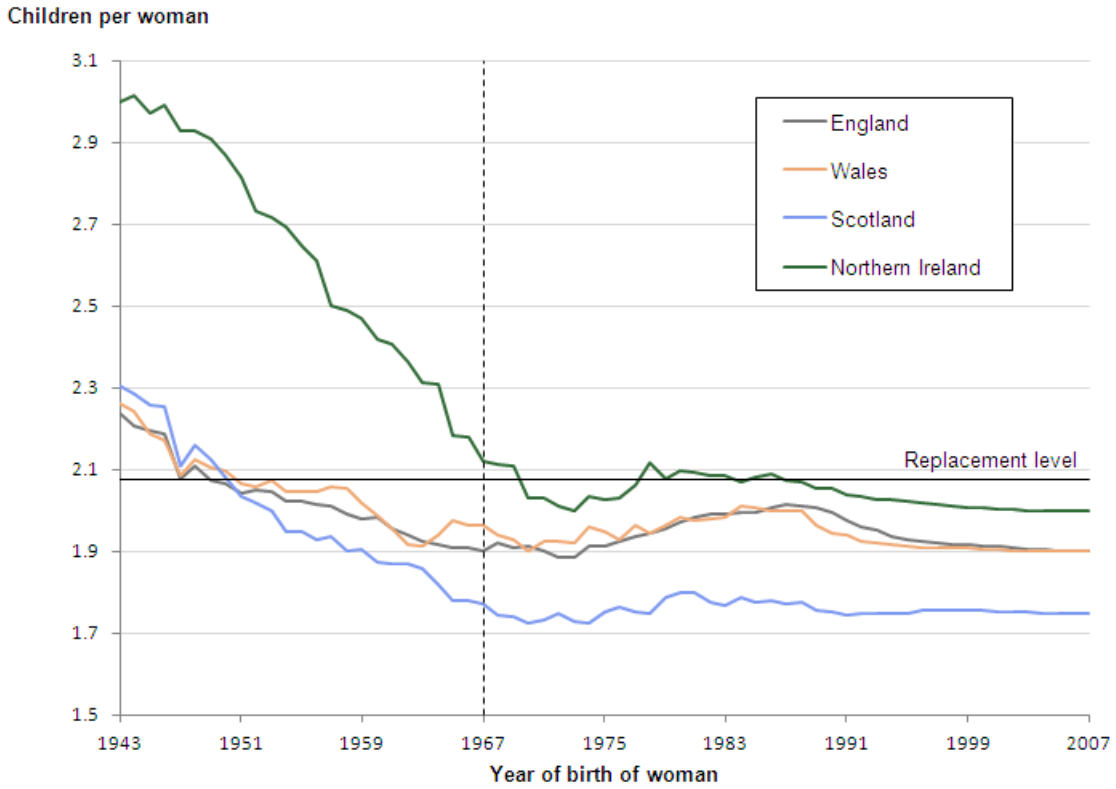


Source: Office for National Statistics

Notes:

1. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

Figure 3-5: Actual and assumed completed family size, constituent countries of the UK, women born 1943–2007



Source: Office for National Statistics

Notes:

1. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

2. Figures to the right of the dotted line are partly or wholly assumed

The achieved family sizes to date for the individual countries of the UK for selected cohorts are shown in Table 3-3. For the 1962 and 1967 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 1962 cohort England had larger completed family size than Wales, and this was reversed for 1967, the most recent cohort to complete childbearing. While the 1962 and 1967 CFS for the UK, England and Wales are similar, there were declines for Scotland and Northern Ireland between these cohorts. These 1967 patterns persist among the 1972 and 1977 cohorts, but for younger cohorts Wales' CFS is higher than for Northern Ireland, due to the younger age pattern of childbearing in Wales.

For the 2012-based projections, the long-term fertility assumptions for England, Wales, Northern Ireland and Scotland have been slightly raised when compared to the 2010 and 2008 based; the assumed long-term completed family size is 1.90 children per woman for England and for Wales, 2.00 for Northern Ireland and 1.75 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 1990, before declining back down to the long term trend.

Table 3-3: Achieved family size attained by 2012, constituent countries of the UK, women born 1952–1992

Cohort born	Achieved to age	United Kingdom	England	Wales	Scotland	Northern Ireland
1952	Complete	2.07	2.05	2.06	2.02	2.73
1957	Complete	2.02	2.01	2.06	1.94	2.50
1962	Complete	1.94	1.94	1.92	1.87	2.36
1967	Complete	1.90	1.90	1.97	1.78	2.18
1972	Age 40	1.83	1.84	1.87	1.69	1.99
1977	Age 35	1.62	1.63	1.70	1.50	1.71
1982	Age 30	1.13	1.13	1.24	1.05	1.17
1987	Age 25	0.60	0.60	0.68	0.52	0.53
1992	Age 20	0.16	0.16	0.18	0.16	0.15

Source: Office for National Statistics

Note:

1. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

Table 3-4: Actual and assumed average completed family size for the constituent countries of the UK, women born 1950–2010

Cohort born	United Kingdom	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	1.90	1.91	1.94	1.74	2.11
1975	1.90	1.91	1.92	1.73	2.00
1980	1.96	1.97	1.94	1.75	2.12
1985	1.98	2.00	1.98	1.77	2.08
1990	1.98	2.00	2.00	1.77	2.07
1995	1.92	1.93	1.92	1.75	2.03
2000	1.90	1.91	1.91	1.76	2.01
2005	1.89	1.90	1.90	1.75	2.00
2010 and later	1.89	1.90	1.90	1.75	2.00

Source: Office for National Statistics

Note:

1. Figures in bold are partly or wholly projected

2. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

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 from 2010 onwards. For the latest projections, the total fertility rate for the UK has been assumed to slightly decrease from 2012 before fluctuating in the short term and levelling off at 1.89 by 2029.

5 . Fertility assumptions age and sex distribution

Assumed age pattern of fertility

Table 3-5 summarises assumed fertility rates for the UK by five-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 30.2 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 29.5 years in Wales, to 30.1 in Scotland, 30.2 in England and 30.4 years in Northern Ireland.

Table 3-5: Actual and assumed births per 1,000 women by age and year of birth of woman, United Kingdom, women born 1950–2010

Cohort born	Under 20	20–24	25–29	30–34	35–39	40 and over	Mean age at motherhood (years)
1950	231	699	634	365	132	28	26.4
1955	221	561	650	403	163	36	27.1
1960	156	527	630	438	190	43	27.8
1965	133	457	594	454	216	57	28.4
1970	152	418	522	466	276	70	28.8
1975	147	361	469	534	314	73	29.4
1980	154	346	499	561	322	75	29.5
1985	135	357	517	566	328	76	29.6
1990	128	350	519	574	332	77	29.7
1995	96	321	509	579	335	77	30.0
2000	87	318	506	580	335	77	30.1
2005	81	316	504	580	335	77	30.2
2010 and later	80	315	504	580	336	77	30.2

Source: Office for National Statistics

Note:

1. Figures have not been revised to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

2. Figures in bold are partly or wholly projected

Assumed sex ratio at birth

It is assumed that there will be 105 boys born for every 100 girls. This is in line with the actual sex ratios recorded in the UK over the period 1999 to 2012, which averaged 105.2. The average levels in each constituent country of the UK are similar, although there is substantial year-on-year fluctuation, particularly in Scotland, Wales and Northern Ireland. Varying the sex ratio to reflect small changes over time or any differences between countries would have a very small effect on the resultant UK population projections. Thus the ratio of 105 assumed since the 2006-based projections has been maintained in all individual 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 & Wales maintained by the Office for National Statistics (ONS)[8, 9, 10]. This model also provides details of a distribution of women by number of children that is consistent with the fertility assumptions used for the 2012-based projections.

Table 3-6 shows that the proportion of women who remain childless by age 45 in England & Wales 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 drop 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 completed family size of women who have children from 2.45 to 2.33. The family size distribution consistent with the 2012-based projections is similar to the distribution produced alongside the 2010-based projections, though the 2012-based projections assume a slightly lower level of childlessness, and slightly more children for women who have children.

Table 3-6: Actual and assumed distribution of women by number of children and year of birth of woman, consistent with 2012-based projections, England and Wales women born 1950–2010

Cohort born	Average family size all women	Average family size women who have children	Number of children (percentages)				
			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	18	10
1975	1.91	2.34	18	17	37	16	11
1980	1.97	2.36	16	17	38	18	11
1985	2.00	2.39	17	17	36	18	12
1990	2.00	2.40	17	17	36	18	12
1995	1.93	2.35	18	18	37	17	11
2000	1.91	2.33	18	18	37	17	11
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 (inc) are actual, 2000 onwards are wholly assumed, and between 1970 and 1995 (inc) are based on partly actual 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. The review by ONS prior to the 2012-based projections proposed raising the assumptions slightly to reflect continued high level of period fertility and the impact of this on the achieved fertility of women born in the 1970s and 1980s, suggesting that falls in completed family size are slowing. This recommendation was accepted in line with the following arguments:

The NPP advisory panel was asked their views on the likely level of fertility in 2036. Six out of seven experts thought that the UK TFR would be between 1.80 and 2.00 in 2036, with four of the experts feeling it would be between 1.90 and 2.00. This suggests that experts believe fertility is likely to maintain its current period level in the long-term.

When considering likely factors affecting future fertility for the 2012-based projections, some could put downward pressure on fertility levels, for example continued increases in female employment and higher education that raise the opportunity costs of childbearing, and changes in socio-economic conditions such as housing cost and availability. Others factors could put upward pressure on fertility in the long-term; these include the continuing in-migration of women from countries with higher fertility than the UK and perhaps the increased ability of women to realise their fertility intentions, for example by more flexible working patterns for parents. The uncertainty inherent in future trends in these factors, particularly in the prevailing economic and social climate, makes it difficult to judge whether those having an upward or downward influence will have the stronger influence on fertility in the long-term.

In order to decide on plausible assumptions for long-term fertility, the completed family sizes resulting from different scenarios for possible trends in fertility at different ages were examined. As agreed in consultation with key users, the final projection for the UK is broadly based on a long-term scenario with a fairly flat profile, with only minimal variation over time before reaching the end TFR. This scenario projects small declines for women aged under 20 and in their early 20s. Women aged 25-34 are projected to have stable fertility at a similar level to 2012. Women aged 35-39 and women aged over 40 are projected to experience small increases in their fertility.

For the short-term, fertility projections have been based around the latest trends in age-specific fertility. This means that the fertility rates of all countries are projected to decline slightly in the first year of the projection, on the basis of published births numbers for the first quarter of 2013 being lower than for previous years. Following this decline the fertility rates gradually climb towards the longer term projected levels, and due to the long term assumptions being close to current levels, these are reached quite quickly.

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8. Smallwood S (2002). New estimates of trends in births by birth order in England and Wales. Population Trends 108: http://www.ons.gov.uk/ons/rel/population-trends-rd/population-trends/no--108--summer-2002/new-estimates-in-trends-of-birth-by-birth-order-in-england-and-wales.pdf

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

9. Background notes

1. The 2012-based Population Projections for United Kingdom and constituent countries were published on 6 November 2013 (main release) and 10 December 2013 (extra variants).

2. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

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

Compendium

Mortality, 2012-based NPP Reference Volume

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Table of contents

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 driven 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].

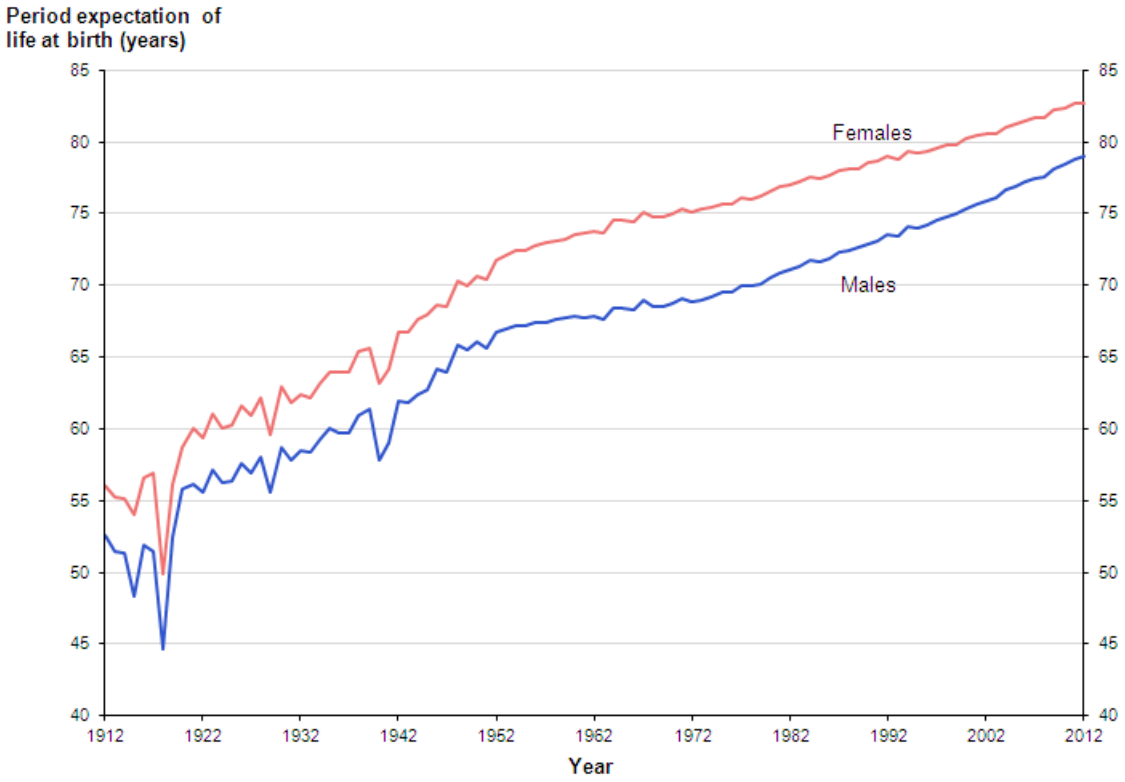
The 2012-based principal projection assumes that mortality rates will continue to improve into the future to an annual target rate of improvement from 2037 of 1.2% for most ages. This target rate was based on the examination of past rates of improvement and expert advice. The average annual rate of improvement over the last hundred years was around 1.1% for males and 1.2% for females.

This chapter summarises past trends in mortality and life expectancy and discusses the assumptions about future mortality made for the 2012-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, 1912–2012, United Kingdom



Source: Office for National Statistics

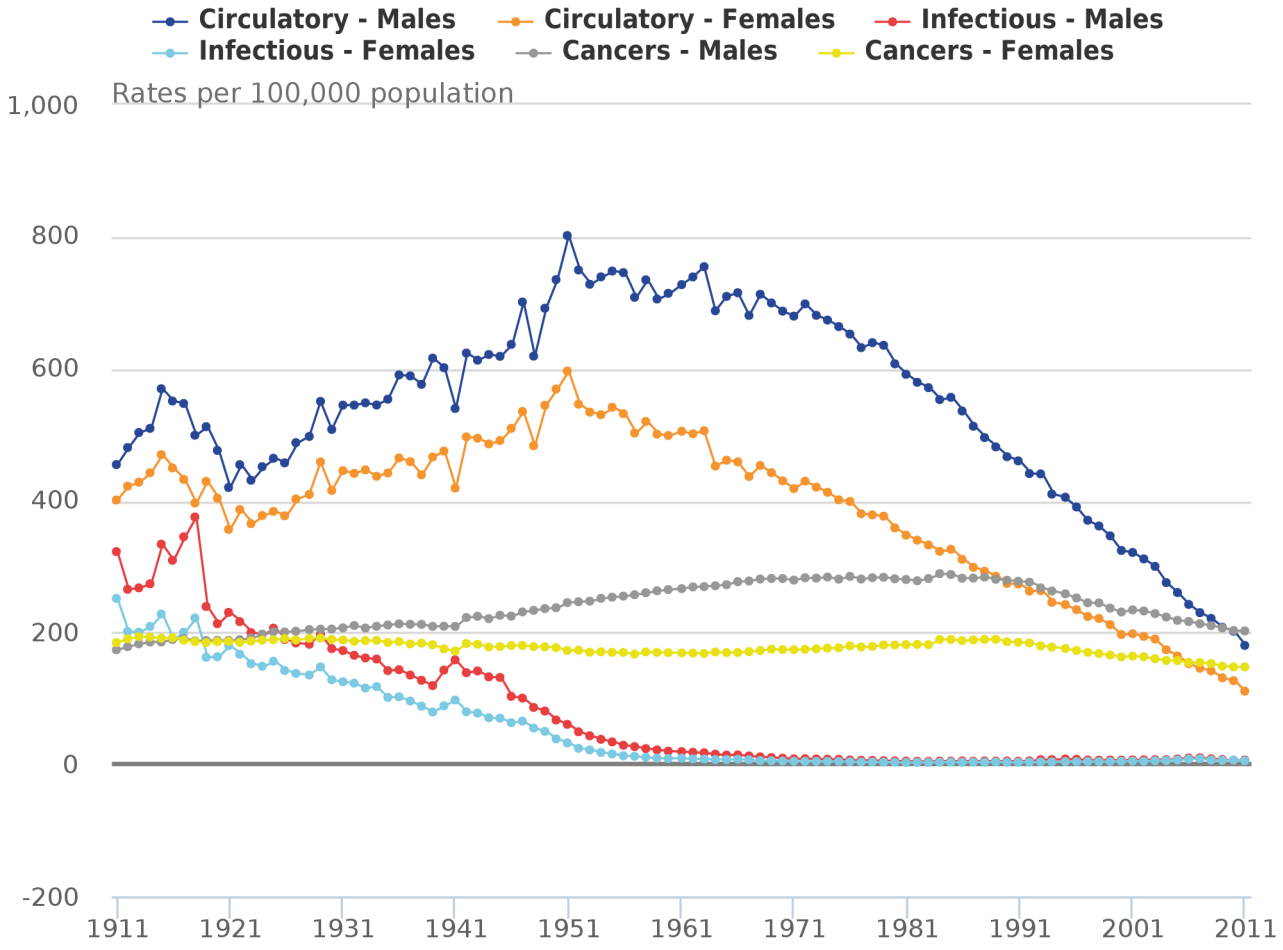
Notes:

1. Figures for 1921-1950 relate to England and Wales and figures for 1951-2012 are for the UK

2. Scottish figures have not been revised to take account of the 2011 Census

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, 1911-2011



Source: Office for National Statistics

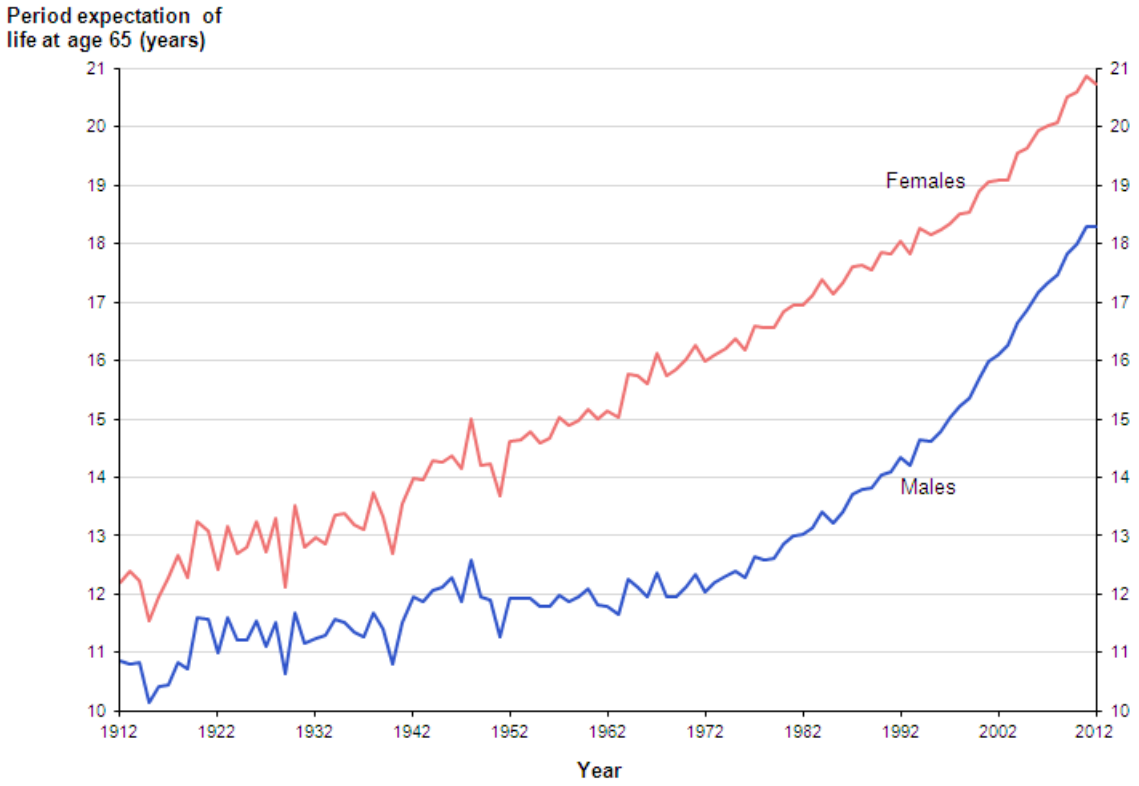
Notes:

1. Mortality rates are not available for the UK before 1951; for long historic trends England & 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 2.4 years in 2012. 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 (1940–1960) 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, 1912–2012, United Kingdom



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. 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]. One can point to Japan, where the period expectation of life at birth in 2012 was about 86.4 years for females and 79.9 years for males[13], and to other countries in Europe, such as Italy, Norway, Sweden and Switzerland, which 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 40–64 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 NPP interactive table download tool by selecting the assumed age specific mortality rates.

Age-specific mortality rates were calculated for each year using deaths data and mid-year population estimates for 1961 to 2011 (deaths data for 2012 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 gender [17]. This was the same approach as used for the 2010-based national population projections. Comparisons of the annual percentage change in the smoothed mortality rates using different ranges of calendar years and ages found that the addition of an extra year's data or extending the age range can result in quite different rates of mortality improvement at some ages for the most recent years in the data used (this is often termed 'edge effects'). In particular, when an extra year's data are added improvements calculated for the final and penultimate years of the data range tend to be altered more than those for earlier years, which were usually not altered to a significant degree.

As a result of these analyses, smoothed mortality rates were calculated using data for years 1961 to 2011 and age ranges 0 to 100 for males and 0 to 105 for females. Percentage changes in mortality were then calculated by age for the year 2009 using the smoothed mortality rates for 2008 and 2009. These rates of percentage change for 2009 were then projected forward to 2012 by assuming that the same rates of change applied in 2010, 2011 and 2012. 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 2012 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 2012 were obtained by applying the resulting assumed rates of improvement to the smoothed age-specific mortality rates produced for 2009.

Base year mortality rates for individual countries

Mortality rates for the base year 2012 were initially calculated for the UK. Mortality rates for 2012 for the four 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 three years 2009 to 2011. 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 2012 for each country to obtain the projected mortality rates for future years.

Table 4-1: Assumed base year mortality rates (mx) per 100,000 population, by selected ages, 2012

	Males				Females			
Age	England	Wales	Scotland	Northern Ireland	England	Wales	Scotland	Northern Ireland
0	469	443	429	513	381	344	340	408
2	14	11	13	16	13	12	12	13
12	10	12	8	11	8	9	8	9
22	53	66	79	101	22	23	32	30
32	81	112	149	111	44	50	70	40
42	175	204	268	203	103	108	139	121
52	366	399	490	418	252	282	333	289
62	914	971	1179	999	600	665	790	659
72	2440	2643	3103	2668	1571	1737	2058	1745
82	7143	7539	8374	7653	5137	5499	6177	5418
92	21288	22309	21359	22786	17251	17963	18488	18392
102	51832	51832	51832	51832	44793	45014	47239	46122

Source: Office for National Statistics

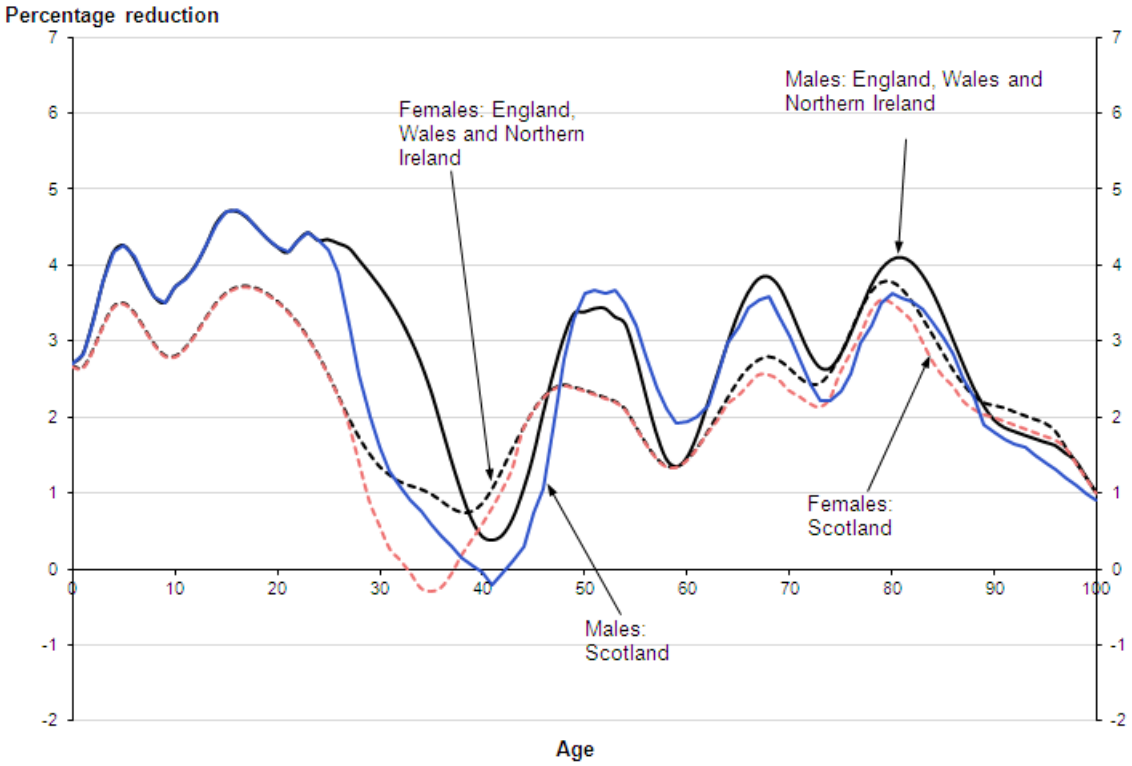
5 . Trends in mortality by age

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 2011 (mostly of improvement in mortality) would initially continue at similar rates with improvements for 2011 to 2012 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 with lower rates of improvement for Scottish males aged 25 to 49 and 65 to 100 and for Scottish females aged 27 to 43 and 63 to 96 than for the rest of the United Kingdom. Conversely, higher rates of improvement were assumed for Scottish males aged 50 to 61. 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 United Kingdom as a whole. The resulting assumed smoothed changes in mortality rates between 2011 and 2012 for each country are shown in Figure 4-4.

Figure 4-4: Assumed smoothed percentage changes in mortality rates between 2011 and 2012 by age, Scotland compared with combined figures for England, Wales, and Northern Ireland



Source: Office for National Statistics

Notes:

1. Scottish figures have not been revised to take account of the 2011 Census

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 81 in 2012) have continued. 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.

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.

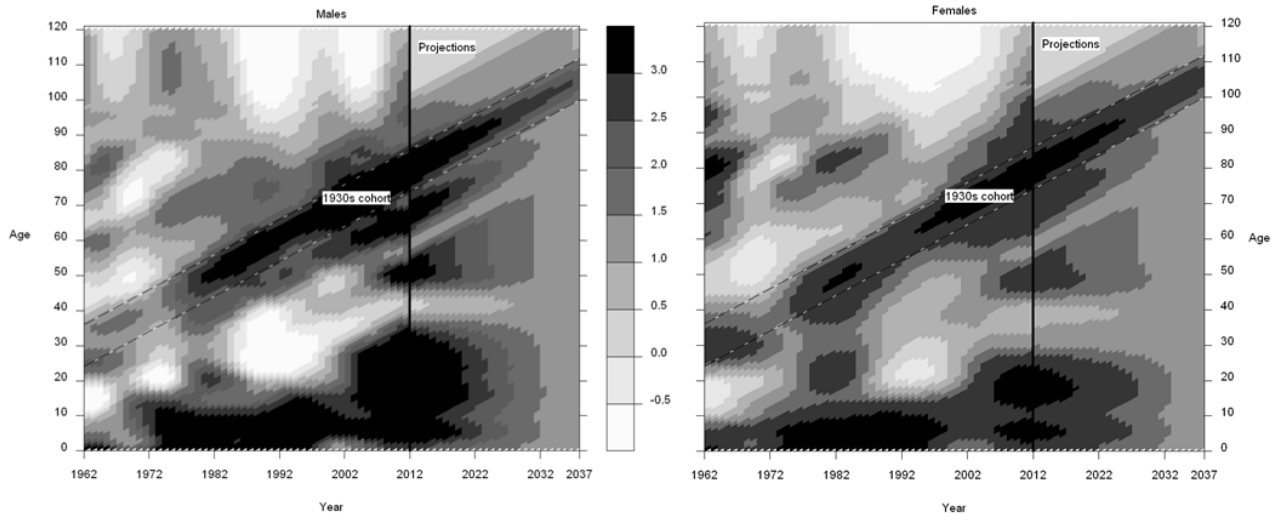
Over the 40-year period 1971–2011, the average annualised rate of improvement in aggregate standardised mortality rates in the UK has been around 2.0% for males and 1.5% for females. (These rates of improvement are derived from aggregate mortality rates for ages 0 to 99 calculated using the 2011 population estimates for the

England and Wales 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 1.1% for males and 1.2% for 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 2037 (the 25th year of the 2012-based projections) has been assumed to be 1.2% for most ages (that is, broadly equivalent to the average annual rate of improvement over the period 1911 to 2011).

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 (Figure 4-5) where the highest improvements are shown by the dark areas. 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 2037 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 1912 to 0.1% for those born in 1904 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 2010-based projections (where the target year was 2035).

Figure 4-5: Historic and projected percentage change in smoothed mortality rates, UK



Source: Office for National Statistics

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 2012 to 2037 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 2037 more rapidly for males than females. For ages where the improvement rate in 2012 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. The speed of convergence to the target rates is faster. Where the improvement rate is lower in 2012 than the target rate the cumulative reduction is higher this means 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 2037 has been done by cohort for those born before 1960

(shown in bold in Table 4-2). For those born in 1960 and later (that is, projections not in bold 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 2037 are assumed to remain constant (by cohort or by age) at the rate assumed in 2037 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 2037, it is assumed that they will continue to experience these higher rates of improvement after 2037 for the remaining years of their lives.

Table 4-2: Assumed percentage change in mortality rates, mx, between consecutive calendar years in the projection period and the total reduction over 25 years (2012-2037)

Percentages

Age	2012 to 2013		2016 to 2017		2026 to 2027		2036 to 2037		Reduction over 25 years	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
England, Wales and Northern Ireland										
0	2.62	2.60	2.28	2.32	1.58	1.69	1.20	1.20	36.08	37.11
2	3.13	2.79	2.67	2.48	1.72	1.76	1.20	1.20	39.40	38.54
12	3.82	2.99	3.20	2.64	1.91	1.83	1.20	1.20	43.59	39.94
22	4.13	3.14	3.43	2.76	1.99	1.88	1.20	1.20	45.38	40.99
32	3.18	1.14	2.71	1.15	1.73	1.18	1.20	1.20	39.69	25.56
42	0.49	1.30	0.66	1.28	1.01	1.23	1.20	1.20	20.49	26.86
52	3.30	2.20	2.80	2.00	1.77	1.55	1.20	1.20	40.44	34.14
62	**1.72**	**1.56**	1.63	1.40	1.74	1.53	1.20	1.20	34.44	31.06
72	**3.02**	**2.45**	**3.07**	**2.38**	1.35	1.29	1.20	1.20	37.84	34.06
82	**4.01**	**3.63**	**3.01**	**3.08**	**1.86**	**1.71**	1.20	1.20	41.15	40.14
92	**1.81**	**2.06**	**2.33**	**2.19**	**2.36**	**2.47**	**1.20**	**1.20**	41.64	41.52
Scotland										
0	2.62	2.60	2.28	2.32	1.58	1.69	1.20	1.20	36.08	37.11
2	3.13	2.79	2.67	2.48	1.72	1.76	1.20	1.20	39.40	38.54
12	3.82	2.99	3.20	2.64	1.91	1.83	1.20	1.20	43.59	39.94
22	4.13	3.14	3.43	2.76	1.99	1.88	1.20	1.20	45.38	40.99
32	1.08	0.17	1.11	0.37	1.17	0.84	1.20	1.20	25.17	16.75
42	0.02	1.05	0.31	1.08	0.88	1.15	1.20	1.20	16.64	24.80
52	3.49	2.20	2.94	2.00	1.81	1.55	1.20	1.20	41.57	34.14
62	**1.95**	**1.56**	2.05	1.40	1.82	1.53	1.20	1.20	37.06	31.06
72	**2.66**	**2.23**	**2.88**	**2.24**	1.50	1.29	1.20	1.20	37.51	33.12
82	**3.51**	**3.36**	**2.70**	**2.84**	**1.79**	**1.65**	1.20	1.20	38.76	38.53
92	**1.66**	**1.90**	**2.19**	**2.03**	**2.25**	**2.37**	**1.20**	**1.20**	39.82	40.02

Source: Office for National Statistics

Notes:

1. Projections made by cohort shown in bold (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 2012, but the base death rates for 2012, 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 2037 at some ages for males and for females in Scotland, as discussed earlier. Similar adjustments were made in recent past projections.

Taking account of the generally higher rates of improvement assumed prior to 2037 this produces an average annualised rate of mortality improvement of around 1.4% for males and around 1.5% for females over the next 79 years for England and Wales (Table 4-3) and slightly lower rates for Scotland, which, in all cases, are slightly higher than those experienced over the past 79 years. As Table 4-3 shows the new projections generally assume for males broadly similar annualised rates of improvement in the future and for females, higher annualised rates of improvement over future periods than experienced over corresponding periods in the past.

Table 4-3: Actual and assumed overall average annual rates of mortality improvement

Percentages

	Males		Females	
	Past (actual)	Future (assumed)	Past (actual)	Future (assumed)
England & Wales				
Last/next 29 years	2.18	1.85	1.59	1.93
Last/next 49 years	1.63	1.58	1.41	1.63
Last/next 79 years	1.29	1.44	1.31	1.47
Scotland				
Last/next 29 years	1.97	1.77	1.42	1.69
Last/next 49 years	1.44	1.54	1.35	1.49
Last/next 79 years	1.14	1.41	1.23	1.38

Source: Office for National Statistics

Notes:

1. Historic estimates are based on comparison of the 2009-11 interim life tables with English and Scottish Life Tables for 1930–32, 1960–62 and 1980–82, hence using the periods 29, 49 and 79 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 England and Wales as the standard population. Decennial tables are not available for the historical periods shown in the table for the UK or Northern Ireland

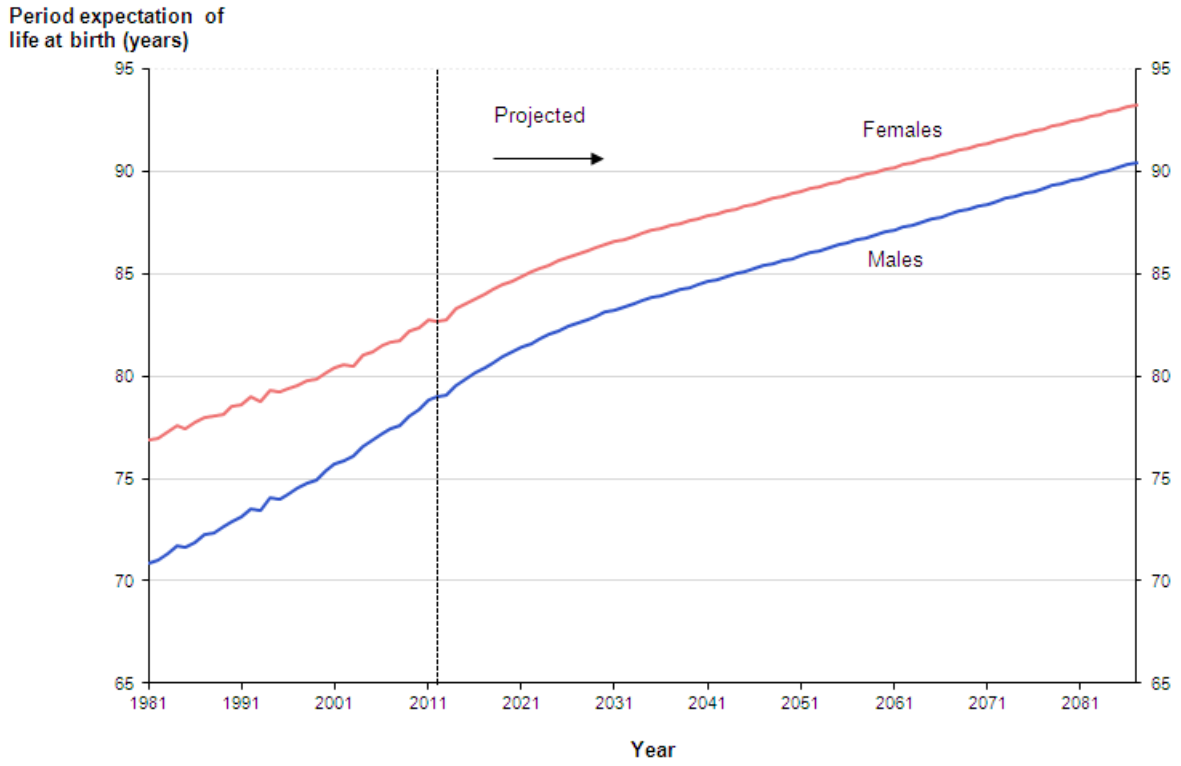
2. Making projections of mortality rates is speculative and users must bear in mind that the range of possibilities is wide. Variant projections using alternative assumptions for the future improvement in mortality are considered in Chapter 6

3. Scottish figures have not been revised to take account of the 2011 Census

6 . 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, 1981–2087, United Kingdom

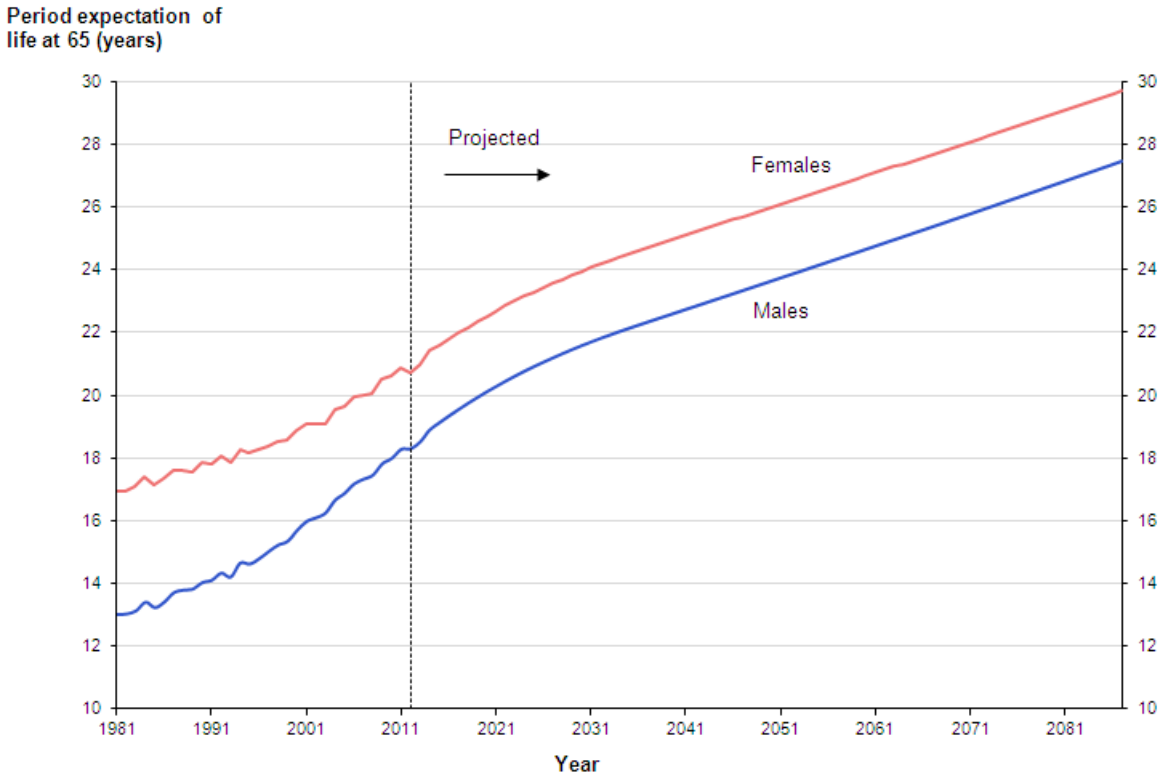


Source: Office for National Statistics

Notes:

1. Scottish figures have not been revised to take account of the 2011 Census

Figure 4-7: Actual and projected period expectation of life at age 65 according to mortality rates for given year, 1981–2087 United Kingdom



Source: Office for National Statistics

Notes:

1. Scottish figures have not been revised to take account of the 2011 Census

In 2037, period expectation of life at birth for the UK is around 0.4 years higher for males and 0.1 years higher for females compared to the previous projections. These differences are mainly due to the age-specific mortality rates for 2012 being assumed to be lower at many ages below 70 and the rates of mortality improvement between 2012 and 2013 assumed to be higher at many ages below 90 compared to those projected for the same period in the 2010-based projections.

7 . 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 allows 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 the ONS website[21]. Table 4-4 shows projected period and cohort expectations of life at selected ages for four different years.

Table 4-4 shows that the projected period expectation of life at birth for a male in the UK was 79.0 years on the basis of the mortality rates for 2012. 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 90.6 years. Similarly, the average man aged 65 in 2012 would live for a further 18.3 years based on the mortality rates for 2012 (period).

However, taking account of the assumed further mortality improvement after 2012 (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, United Kingdom, for the years 2012, 2013, 2023, 2033 and 2037

	Males					Females				
	2012	2013	2023	2033	2037	2012	2013	2023	2033	2037
Period expectation of life										
0	79.0	79.0	81.8	83.5	84.1	82.7	82.8	85.2	86.8	87.3
15	64.5	64.5	67.2	68.9	69.4	68.1	68.2	70.6	72.1	72.6
60	22.3	22.6	24.8	26.2	26.6	25.0	25.2	27.3	28.7	29.1
65	18.3	18.5	20.6	21.9	22.3	20.7	21.0	23.0	24.3	24.7
75	11.2	11.4	13.2	14.3	14.6	12.9	13.1	14.9	16.1	16.5
85	5.8	5.9	7.2	8.1	8.4	6.7	6.9	8.3	9.3	9.5
Cohort expectation of life										
0	90.6	90.7	92.2	93.7	94.3	93.9	94.0	95.4	96.8	97.3
15	73.9	74.1	75.5	77.0	77.5	77.3	77.5	78.8	80.1	80.7
60	25.8	25.9	27.2	28.4	28.9	28.7	28.8	30.0	31.2	31.6
65	21.2	21.4	22.6	23.7	24.1	23.9	24.0	25.2	26.3	26.7
75	12.9	13.1	14.3	15.2	15.6	15.0	15.1	16.3	17.2	17.6
85	6.3	6.5	7.8	8.6	8.8	7.4	7.6	9.0	9.8	10.0

Source: Office for National Statistics

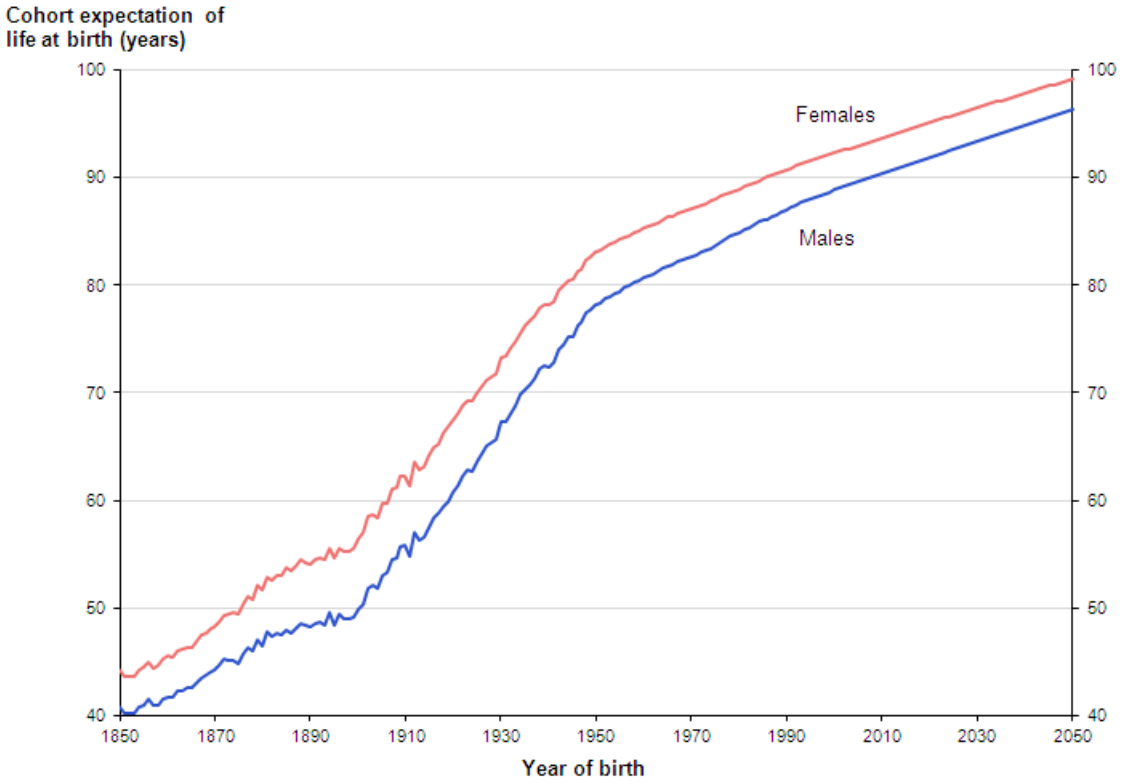
Notes:

1. Scottish figures have not been revised to take account of the 2011 Census

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 & Wales

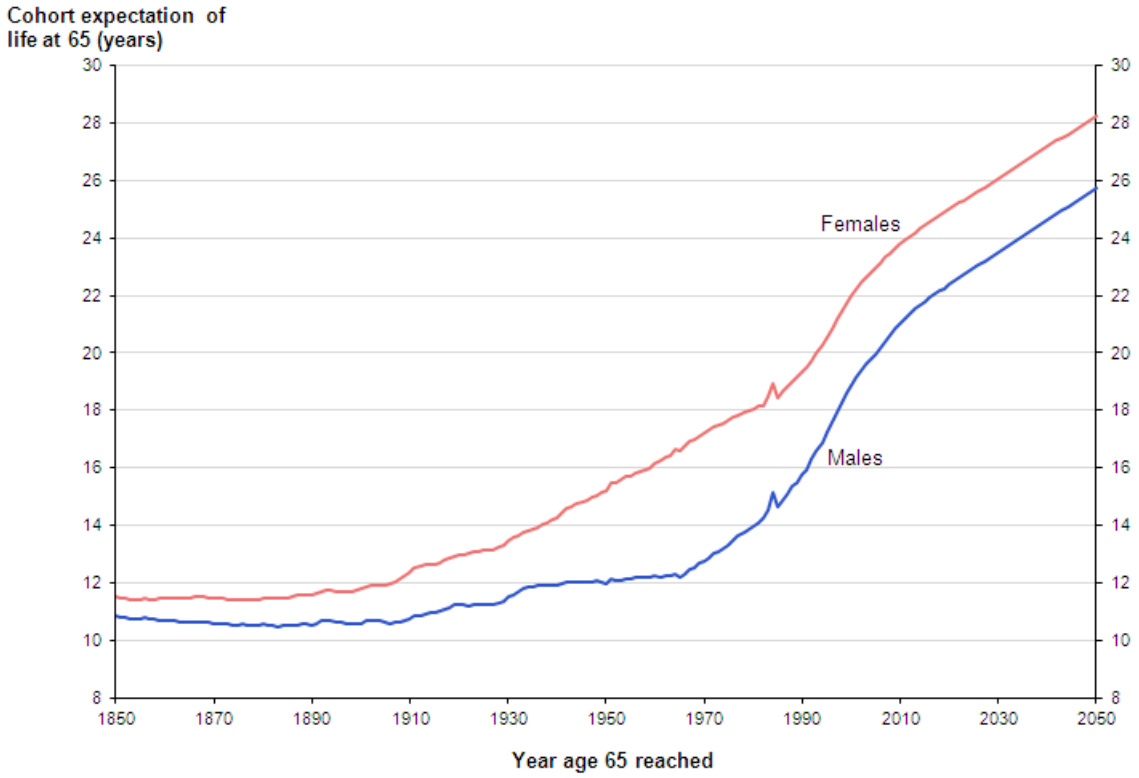


Source: Office for National Statistics

Notes:

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



Source: Office for National Statistics

Notes:

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

2. The 'blip' in the trend lines in 1984 relates to the birth cohorts of 1918-1920, 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.

8 . 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 four countries, England shows the highest life expectancy and Scotland the lowest.

Table 4-5 also shows the comparable life expectancies from the 2010-based projections. The 2012-based period expectations of life at birth are a little higher for males and broadly similar for females compared to the 2010-based projections over the period 2012 to 2037 for all the constituent countries. In 2037, period expectations of life at birth for females are projected to be very similar with only differences of 0.1 year in England, Scotland and Wales. The differences in 2037 are larger for males with period life expectancies at birth around 0.8 years higher in Scotland, 0.6 years higher in Northern Ireland and 0.4 years higher in the UK, England and Wales.

Cohort life expectancies at birth for both males and females are projected to be slightly higher than in the previous projections for each country of the UK for all years except for English males and females and Welsh males. In England cohort life expectancy at birth in the 2012-based projections is broadly similar or slightly lower than in the 2010-based projections. Cohort life expectancy for Welsh males is higher in the 2012-based projections than the 2010-based projections in the early years of the projections but is 0.2 years lower by 2037.

Table 4-5: Period and cohort expectation of life at birth for the years 2012, 2013, 2023, 2033 and 2037, 2012-based and 2010-based projections

Years

	2012		2013		2023		2033		2037	
Period expectation of life at birth										
Males										
England	79.3	*79.2*	79.4	*79.5*	82.1	*81.8*	83.8	*83.4*	84.4	*84.0*
Wales	78.3	*78.3*	78.4	*78.6*	81.4	*80.9*	83.1	*82.6*	83.6	*83.2*
Scotland	76.8	*76.5*	76.9	*76.7*	79.6	*78.9*	81.4	*80.6*	82.0	*81.2*
Northern Ireland	78.1	*77.9*	78.2	*78.2*	81.0	*80.5*	82.8	*82.1*	83.3	*82.7*
United Kingdom	79.0	*78.9*	79.0	*79.2*	81.8	*81.4*	83.5	*83.1*	84.1	*83.7*
Females										
England	82.9	*83.0*	83.1	*83.3*	85.5	*85.4*	87.1	*87.0*	87.6	*87.5*
Wales	82.1	*82.4*	82.3	*82.6*	84.9	*84.7*	86.5	*86.4*	87.0	*86.9*
Scotland	80.8	*81.0*	80.9	*81.2*	83.4	*83.2*	85.0	*84.9*	85.5	*85.4*
Northern Ireland	82.3	*82.4*	82.3	*82.7*	84.8	*84.8*	86.3	*86.4*	86.9	*86.9*
United Kingdom	82.7	*82.8*	82.8	*83.0*	85.2	*85.1*	86.8	*86.7*	87.3	*87.3*
Cohort expectation of life at birth										
Males										
England	90.8	*90.8*	91.0	*90.9*	92.5	*92.5*	93.9	*94.1*	94.5	*94.7*
Wales	90.0	*89.3*	90.2	*89.5*	91.6	*91.0*	92.7	*92.6*	93.0	*93.2*
Scotland	88.6	*87.3*	88.7	*87.5*	90.4	*89.1*	92.0	*90.8*	92.6	*91.4*
Northern Ireland	89.9	*88.6*	90.0	*88.8*	91.5	*90.3*	93.1	*91.9*	93.7	*92.5*
United Kingdom	90.6	*89.8*	90.7	*89.9*	92.2	*91.5*	93.7	*93.0*	94.3	*93.6*
Females										
England	94.1	*94.1*	94.2	*94.3*	95.6	*95.7*	97.0	*97.1*	97.5	*97.6*
Wales	93.5	*92.8*	93.7	*93.0*	95.1	*94.4*	96.5	*95.7*	97.0	*96.3*
Scotland	92.2	*91.4*	92.3	*91.6*	93.8	*93.0*	95.2	*94.5*	95.8	*95.0*
Northern Ireland	93.4	*92.8*	93.5	*92.9*	94.9	*94.3*	96.3	*95.7*	96.9	*96.2*
United Kingdom	93.9	*93.2*	94.0	*93.3*	95.4	*94.7*	96.8	*96.1*	97.3	*96.6*

1. Scottish figures have not been revised to take account of the 2011 Census

2. Corresponding results from the 2010-based projections are shown in italics

Source: Office for National Statistics

Mortality differences between males and females

In common with other Northern European countries[1], 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. In the UK the differential has fallen from 6.0 years in 1980 to 3.7 years in 2012; it is projected to fall to about 3.3 years by 2037. In contrast, although the difference in period life expectancy at age 65 for females over males fell from the late 1980s to 2.4 years in 2012 it is projected to remain broadly the same in 2037.

9 . 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 1851–2031, England & Wales

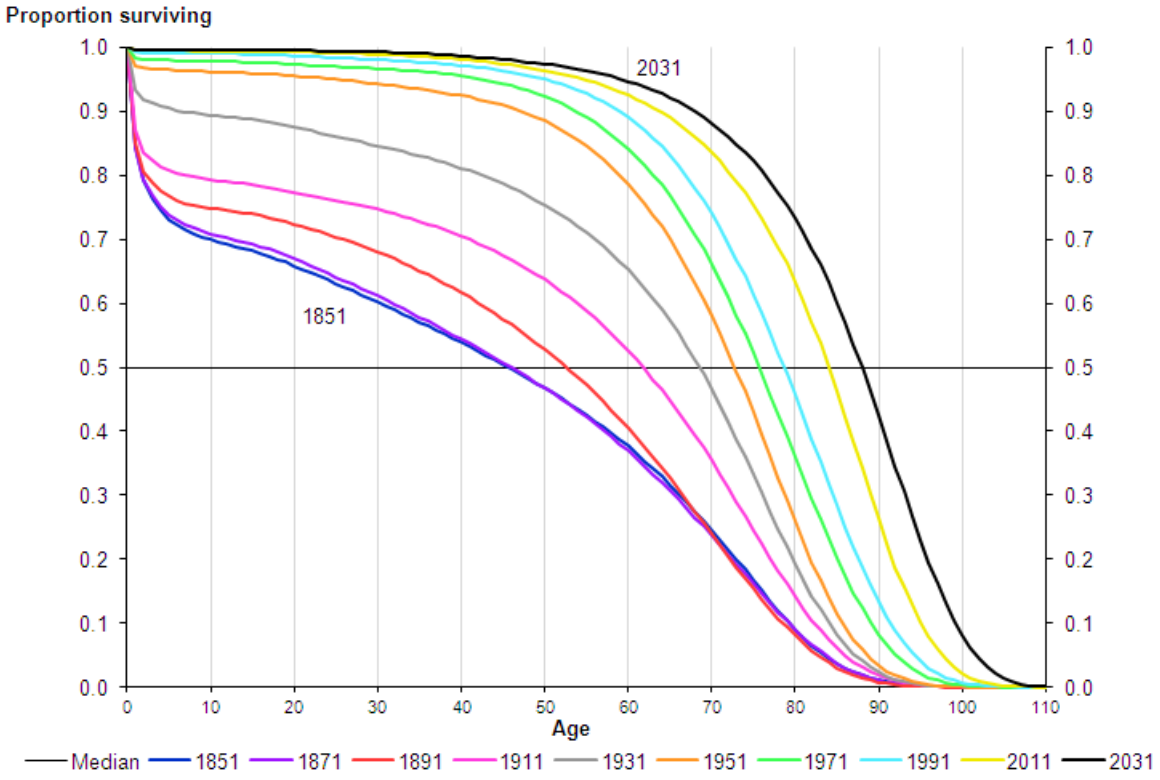
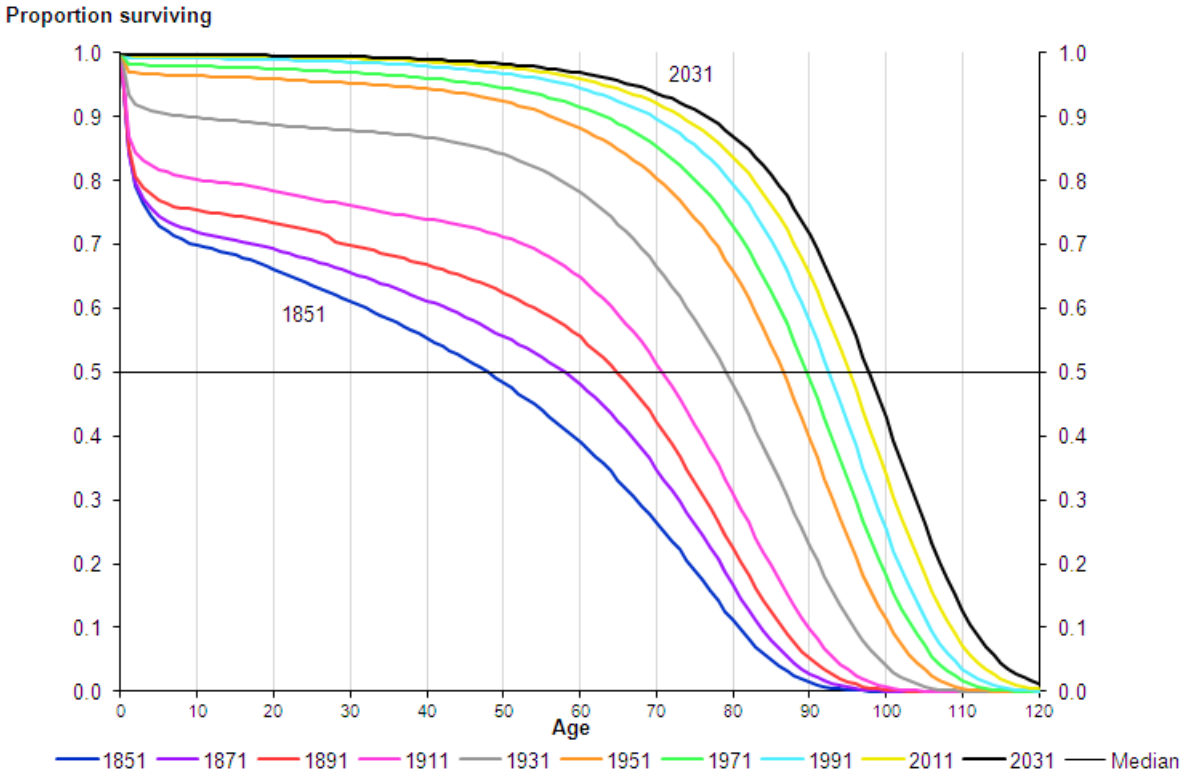


Figure 4-11: Proportion of persons surviving (on a cohort basis) to successive ages, according to mortality rates experienced or projected, persons born 1851–2031, England & Wales



Source: Office for National Statistics

Notes:

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

Further details

Projected numbers of deaths and comparisons with the previous (2010-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 given on the ONS website.

10 . 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 drivers 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 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. In general the UK experts felt that the current high rates of mortality improvement were likely to continue into the future, although there was disagreement as to whether improvements would converge for males and females over time. It was felt that factors such as medical and bio-technological advances, more effective health care systems and better health information and changes in lifestyle behaviour which have occurred and have been identified as increasing the chances of longevity would continue. It was also felt that society would be able and willing to afford new treatments. However, there were factors which would work in the opposite direction and not all sectors of the population may choose to adopt lifestyle behaviours leading to increasing longevity. Smoking has been a large explanatory factor in changing mortality trends and it is possible to be reasonably confident about its effects. However, behavioural factors and their effects were harder to predict. For example, it was agreed that there would be an increase in obesity levels and that this would have an effect on morbidity but there was less agreement as to the subsequent impact of this on mortality and whether any increase might be reversible in the medium-term. Also, there might be a protective effect if some weight was gained at older ages. Some believed rising levels of obesity would lead to large downward influence on life expectancy but others believed the effect would be relatively small.

It was acknowledged that there are elements influencing mortality improvement in both directions and that these need to be considered together to determine if the overall effect will be positive or negative. However, it was felt that those factors tending to increase longevity would outweigh negative influences and that the increase in life expectancy over the next 25 years would be similar to that experienced over the preceding 25 years.

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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12. Background notes

1. The 2012-based Population Projections for United Kingdom and constituent countries were published on 6 November 2013 (main release) and 10 December 2013 (extra variants).

2. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

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

Compendium

Migration, 2012-based NPP Reference Volume

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Next release:
To be announced

Table of contents

1 . Introduction

A new method for determining assumptions of future migration was introduced for the 2012-based population projections.[1] This approach was formulated as a result of a review of the assumptions setting methodology carried out by the Economic and Social Research Council (ESRC) Centre for Population Change in 2012. [2] The review recommended that the existing arguments-based methodology should be streamlined and brought into line with current academic recommendations as the first step of a multi-stage redevelopment process.

The previous assumptions setting methodology had been in place since the 1991-based projections and the review suggested that while 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.

A user forum was run in parallel to the review to ensure that users' views fed into the process. The users agreed with the principle of moving to gross flows as long as net migration levels were also available. As the first step in the redevelopment process, the recommendations to move to the use of gross flows and to streamline and update the methodology were therefore incorporated into the 2012-based projections.

This chapter summarises the resulting assumptions adopted for the 2012-based population projections.

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

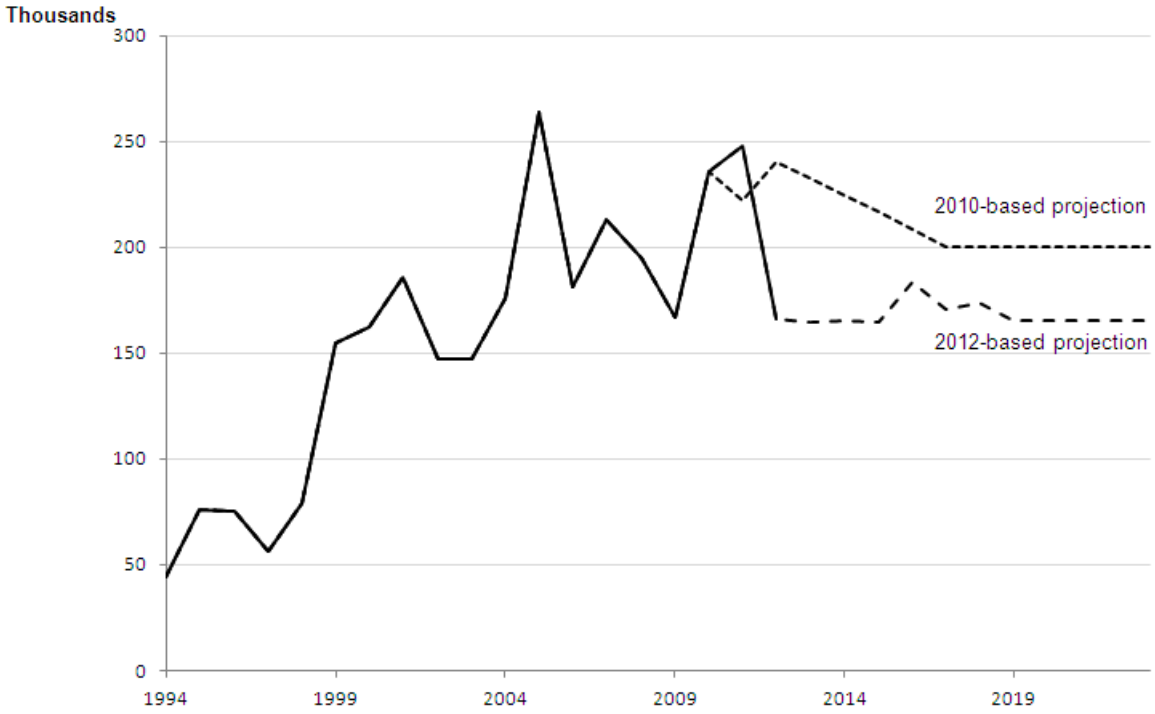
Since the early 1980s, the UK has transitioned from being a country characterised by net emigration to one characterised by net immigration. This is due to the fact that the growth in immigration, which has risen from less than 200,000 per year in 1981 to over 500,000 in 2012, has outstripped any increases in emigration. Net migration peaked in 2004/05 partly as a result of immigration from countries that joined the EU in 2004. Since the peak, annual net migration has fluctuated between 150,000 and 250,000.[3]

In the year ending June 2012 (the base year of the projection) 515,000 people immigrated to the UK which was the lowest immigration estimate since the year to June 2004, when 528,000 people migrated to the UK. Net migration in the year to June 2012 fell to +163,000, a significant decrease 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 +165,000 each year compared with +200,000 a year in the 2010-based projections. 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 2010-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 166,000 between mid-2011 and mid-2012.

Figure 5-1: Actual and assumed total net migration, year ending mid-1994 to year ending mid-2023, United Kingdom



Source: Office for National Statistics

Notes:

1. All data are displayed on a mid year basis
2. Historic 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 . International Migration

ONS uses 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 one 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 leave, or return to, the UK within one 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, ONS 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 therefore 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

In contrast to previous projections, 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.

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 using ARIMA4, which is a standard technique for time series forecasting. A number of models are fitted to each flow, with the most suitable one chosen based on a mixture of goodness of fit measures and consultation regarding the plausibility of the extrapolations with National Records of Scotland (NRS), NISRA and the Welsh Government. For each flow, the resulting extrapolated figures for mid-2019 are fixed as the long term assumption and are held constant for the remaining length of the projection. The short term assumptions are calculated based on the extrapolated figures as well as linear interpolation to provide a smooth run-in to the long term assumptions for each UK country.

The modelling is based on data up to mid-2012 with the length of the time series used dependent on the data source. Where there is a noticeable and explainable discontinuity in the data, for example for international inflow to the UK after EU accession of the EU8 countries in 2004, an 'intervention' can be applied during modelling to take this into account.

After modelling, the separate gross flows for each country are 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.

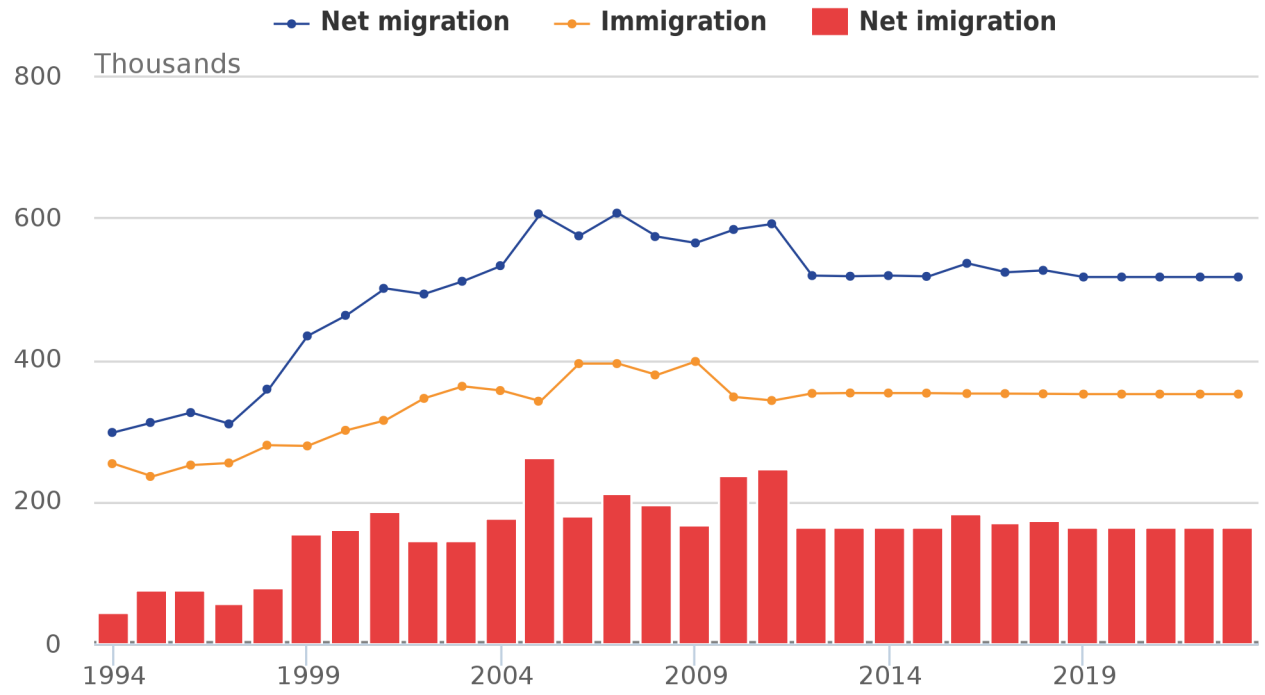
Table 5-1: Assumed annual long-term gross international migration flows, mid-2019 onwards

	England	Wales	Scotland	Northern Ireland	United Kingdom
International inflow	434,000	14,500	34,500	13,000	496,000

International outflow	296,000	12,000	23,500	13,000	344,500
Asylum seeker inflow	17,500	1,000	1,500	-	20,000
Asylum seeker outflow	5,500	500	500	-	6,500
Total international inflow	451,500	15,500	36,000	13,000	516,000
Total international outflow	301,500	12,500	24,000	13,000	351,000
Net international migration	150,000	3,000	12,000	0	165,000

Source: Office for National Statistics

Figure 5-2: Estimated and projected international migration to/from the UK, year ending mid-1994 to year ending mid-2023



Source: Office for National Statistics

Notes:

1. All data are displayed on a mid year basis

2. Historic 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

5 . Cross-border Migration within the UK

Regular estimates of the movements of population between the countries of the UK are made by ONS, NRS and NISRA. These estimates are based on changes of residence recorded by the National Health Service Central Register (NHSCR). As with the international flows, the cross border flows between each UK country (e.g. England to Northern Ireland, and so on) are modelled using ARIMA and a suitable model selected for each flow to produce the long term assumptions, with a smooth short term run-in to the long term formulated based on the modelling output and linear interpolation. Table 5-2 shows the annual long term flows between the four UK countries.

Table 5-2: Matrix of assumed long term cross border flows between the UK constituent countries, mid-2019 onwards

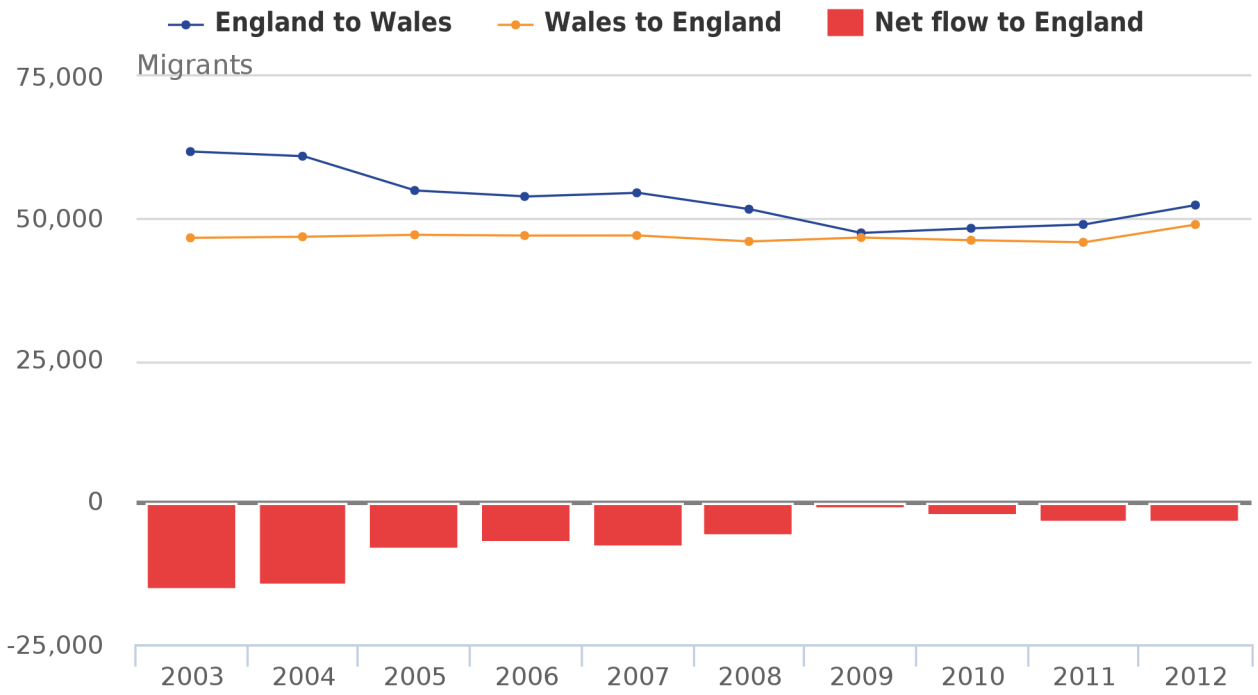
Country of origin	England	Wales	Scotland	Northern Ireland
England	-	52,500	41,000	9,500
Wales	49,000	-	2,000	500
Scotland	38,500	1,500	-	2,000
Northern Ireland	9,000	500	2,500	-
Net	-6,500	3,000	3,500	0

Source: Office for National Statistics

The resulting assumed annual long-term cross border net inflows are therefore -6,500 to England, +3,000 to Wales, +3,500 to Scotland and zero to Northern Ireland. These assumptions are compared with those from the 2010-based projections in Table 5-3.

Numerically, the dominant flows within the UK are between the smaller countries and England. Figures 5-3 to 5-5 show the trend in these flows between 2002–03 and 2011–12. Note that the scales differ in the three charts and that the flows to and from Northern Ireland are much smaller than those to and from Wales and Scotland. The figures show that cross-border migration for the flows between England and Wales and England and Scotland in particular have moved closer to a figure of net zero (represented by the bars) over the last ten years.

Figure 5-3: Migration between England and Wales, year ending mid 2003 to year ending mid 2012

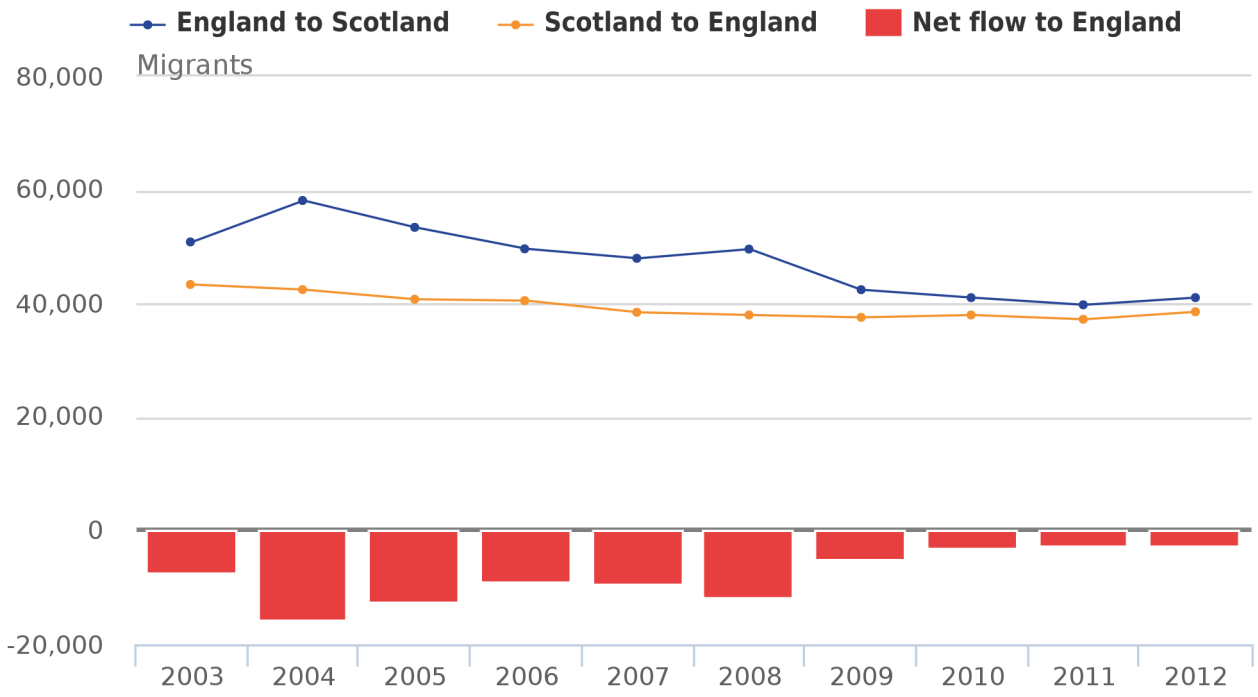


Source: Office for National Statistics

Notes:

1. All data are displayed on a mid year basis

Figure 5-4: Migration between England and Scotland, year ending mid 2003 to year ending mid 2012

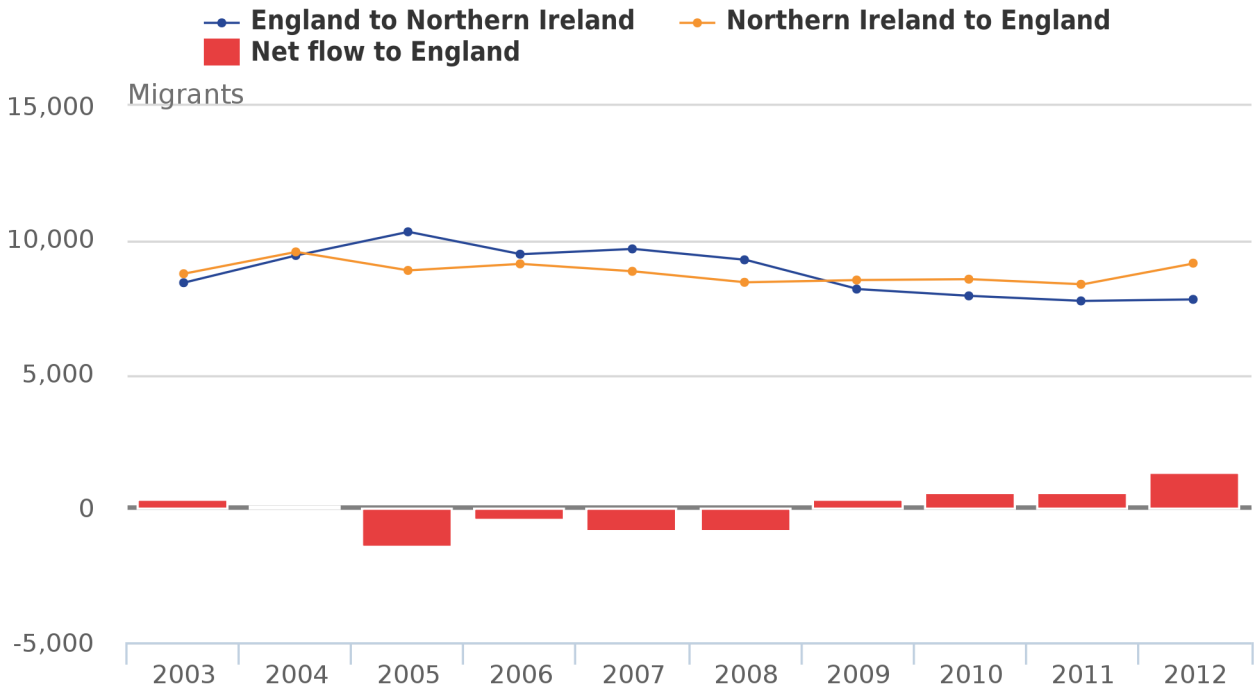


Source: Office for National Statistics

Notes:

1. All data are displayed on a mid year basis

Figure 5-5: Migration between England and Northern Ireland, year ending mid 2003 to year ending mid 2012



Source: Office for National Statistics

Notes:

1. All data are displayed on a mid year basis

6 . Total long-term net migration assumptions

Combining the assumptions for the international migration and cross border flows, gives total net migration of 143,500 to England, 6,000 to Wales, 15,500 to Scotland and zero to Northern Ireland. Table 5-3 shows that the overall assumptions for England, Wales and Scotland are lower than the 2010-based projections and those for Northern Ireland are the same.

Table 5-3: Long-term annual net migration assumptions, UK and constituent countries, mid-2019 onwards

Country	2012-based	2010-based	Difference
International net migration (includes asylum seekers)			
England	150,000	188,000	-38,000
Wales	3,000	3,000	0
Scotland	12,000	9,000	3,000
Northern Ireland	0	0	0
United Kingdom	165,000	200,000	-35,000
Cross-border net migration			
England	-6,500	-15,500	9,000
Wales	3,000	7,000	-4,000
Scotland	3,500	8,500	-5,000
Northern Ireland	0	0	0
Total net migration			
England	143,500	172,500	-29,000
Wales	6,000	10,000	-4,000
Scotland	15,500	17,500	-2,000
Northern Ireland	0	0	0
United Kingdom	165,000	200,000	-35,000

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 migration beyond mid-2019. 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.

7 . Assumptions for the short-term

Special assumptions have been applied for the first few years of the projections (mid-2013 to mid-2018). The breakdown of these assumptions is shown in Table 5-4. 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. The run in also takes the following factors into account:

1. The modelling output over the short term, although the difference from the long term is minimal in the 2012-based projections.

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.

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 2019. The flow is set to zero in the long term.

Table 5-4: Short-term annual net migration assumptions, United Kingdom and constituent countries, year ending mid-2013 onwards

	United Kingdom	England	Wales	Scotland	Northern Ireland
Total net migration					
2012-13	164.5	145.1	6.9	13.4	-0.9
2013-14	165.5	145.8	6.7	13.7	-0.7
2014-15	164.5	144.4	6.6	14.1	-0.6
2015-16	183.5	163.1	6.4	14.4	-0.4
2016-17	171	150.2	6.3	14.8	-0.3
2017-18	174	152.9	6.1	15.1	-0.1
2018-19 onwards - long-term assumption	165	143.5	6	15.5	0
International migration assumption[1]					
2012-13	164.5	151.1	3.7	9.9	-0.2
2013-14	164.5	150.8	3.5	10.2	0
2014-15	164.5	150.5	3.4	10.6	0
2015-16	165	150.9	3.2	10.9	0
2016-17	165	150.6	3.1	11.3	0
2017-18	165	150.4	3	11.6	0
2018-19 onwards - long-term assumption	165	150	3	12	0
Cross border migration					
2012-13	0	-6	3.2	3.5	-0.7
2013-14	0	-6	3.2	3.5	-0.7
2014-15	0	-6.1	3.2	3.5	-0.6
2015-16	0	-6.3	3.2	3.5	-0.4
2016-17	0	-6.4	3.2	3.5	-0.3
2017-18	0	-6.5	3.1	3.5	-0.1
2018-19 onwards - long-term assumption	0	-6.5	3	3.5	0
Returning armed forces from Germany (including dependants)					
2012-13	0	0	0	0	0
2013-14	1	1	0	0	0
2014-15	0	0	0	0	0

2015-16	18.5	18.5	0	0	0
2016-17	6	6	0	0	0
2017-18	9	9	0	0	0
2018-19 onwards - long-term assumption	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

8 . Other considerations

Illegal migration

In line with ONS 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 are based on averages of the last five years' data (2008-2012). The international distributions are also applied to the asylum seeker flows because single year of age distributions are not available for this data source.

For cross-border migration, separate age and sex distributions, based on NHSCR data, were calculated for each flow, with the exception of the flows to and from Northern Ireland, where the age and sex distributions were obtained directly from NISRA.

Where appropriate, the age distributions for each sex were smoothed with a variation of the Rogers-Castro model [5], which was able to include a student migration peak where necessary. This method involves fitting a curve with a number of parameters to the data, allowing the age distributions to be smoothed while retaining the typical migration patterns at different ages, for example student and retirement peaks.

In each case the age and sex distributions were considered separately for immigrants and emigrants. The long-term net migration distribution for the UK is summarised in Table 5-5. The table shows that the projections assume slightly more male migrants than female migrants. Equivalent tables for the constituent countries and further tables containing in- and out-migration by age and sex are available on the ONS website.

Table 5-5: Assumed annual long-term net migration by age and sex, United Kingdom

thousands

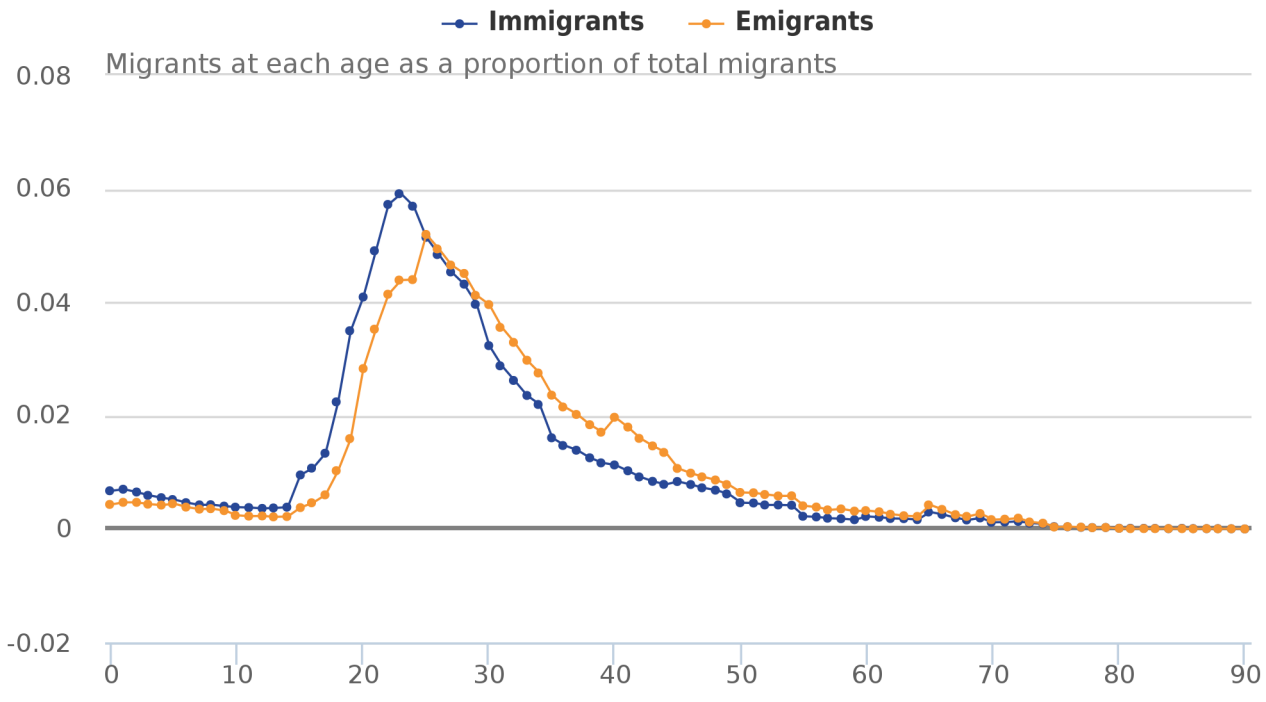
Age group	Persons	Males	Females
0 - 4	8.3	4.6	3.7
5 - 9	5.4	2.7	2.8
10 - 14	5.0	3.1	1.9
15 - 19	35.3	17.8	17.6
20 - 24	69.6	36.7	33.0

25 - 29	28.9	18.6	10.3
30 - 34	9.6	5.2	4.3
35 - 39	0.1	-0.2	0.4
40 - 44	-2.5	-2.7	0.2
45 - 49	1.9	1.3	0.6
50 - 54	1.1	0.2	0.9
55 - 59	-0.4	-0.8	0.3
60 - 64	0.7	0.1	0.6
65 - 69	0.8	0.2	0.6
70 - 74	0.5	0.1	0.4
75 & over	0.6	0.3	0.4
All ages	165.0	87.1	77.9

Source: Office for National Statistics

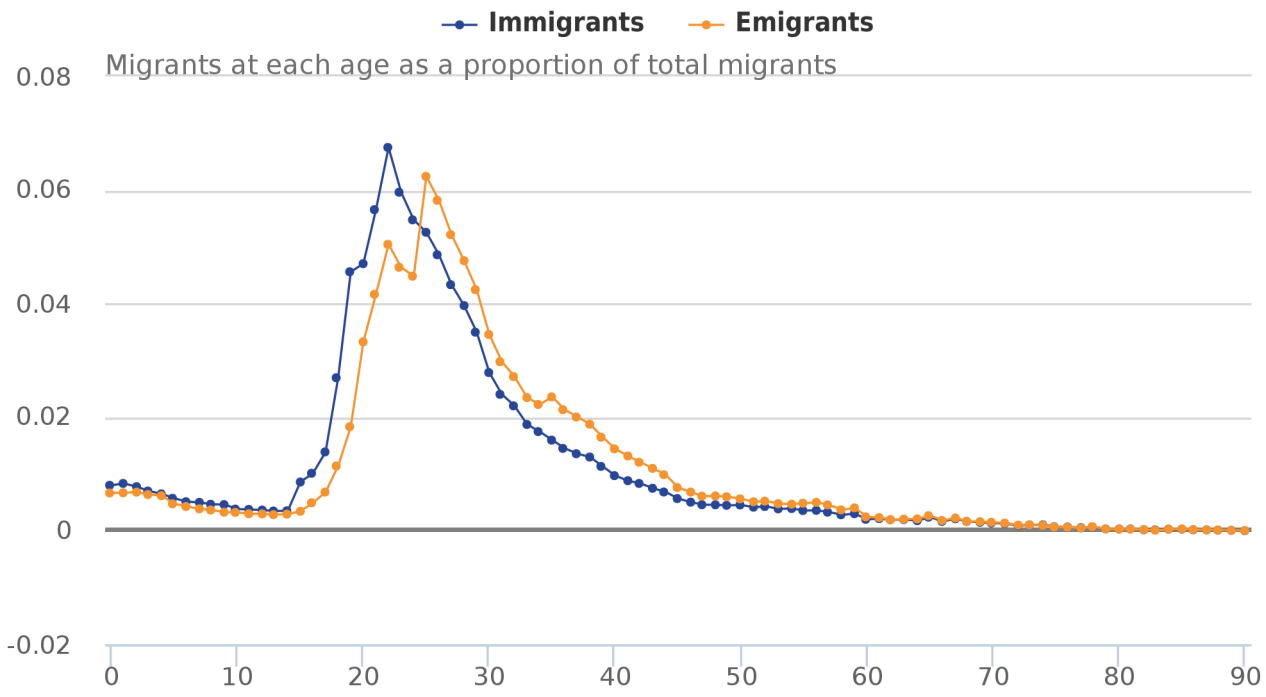
The assumed age distributions for international migration to and from the UK, and the NHSCR derived distributions for cross-border migration for England, are shown in Figures 5.6-5.9. All these distributions are highly peaked at the young working ages, with an additional prominent student peak visible in the cross border distributions. This was also the case for the distributions assumed for cross-border migration for Wales, Scotland and Northern Ireland.

Figure 5-6: Assumed long-term age distribution for international migration to/from the UK, males



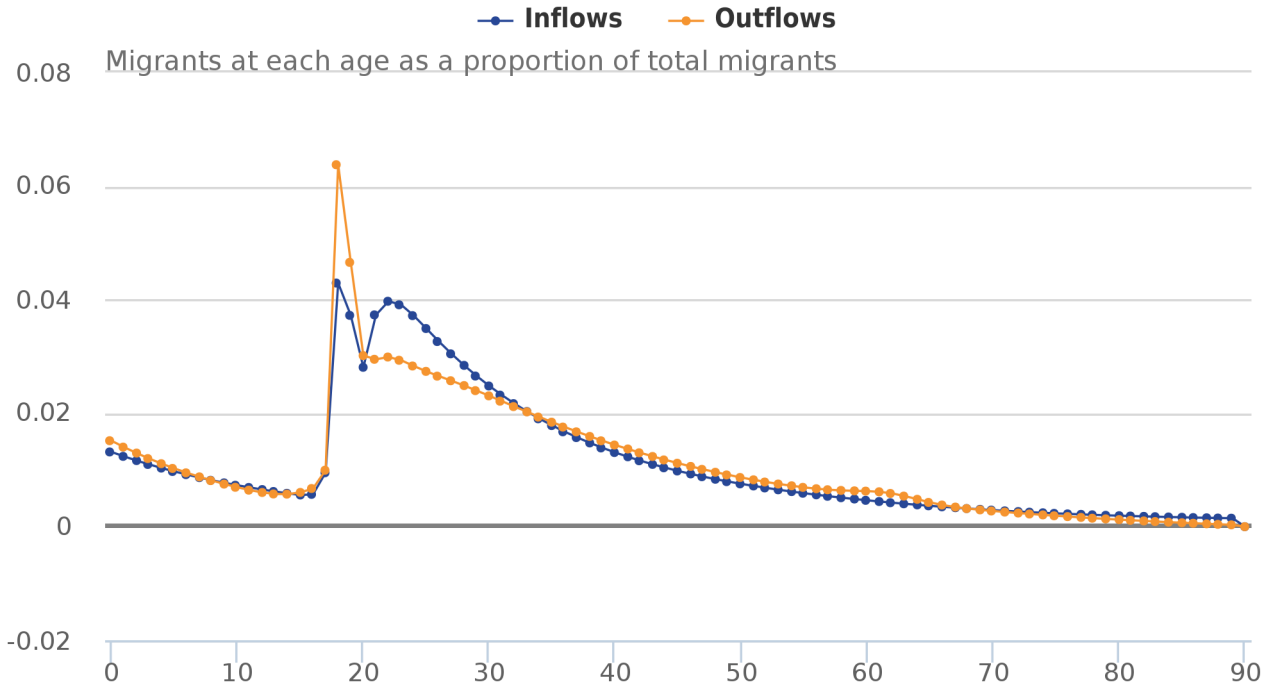
Source: Office for National Statistics

Figure 5-7: Assumed long-term age distribution for international migration to/from the UK, females



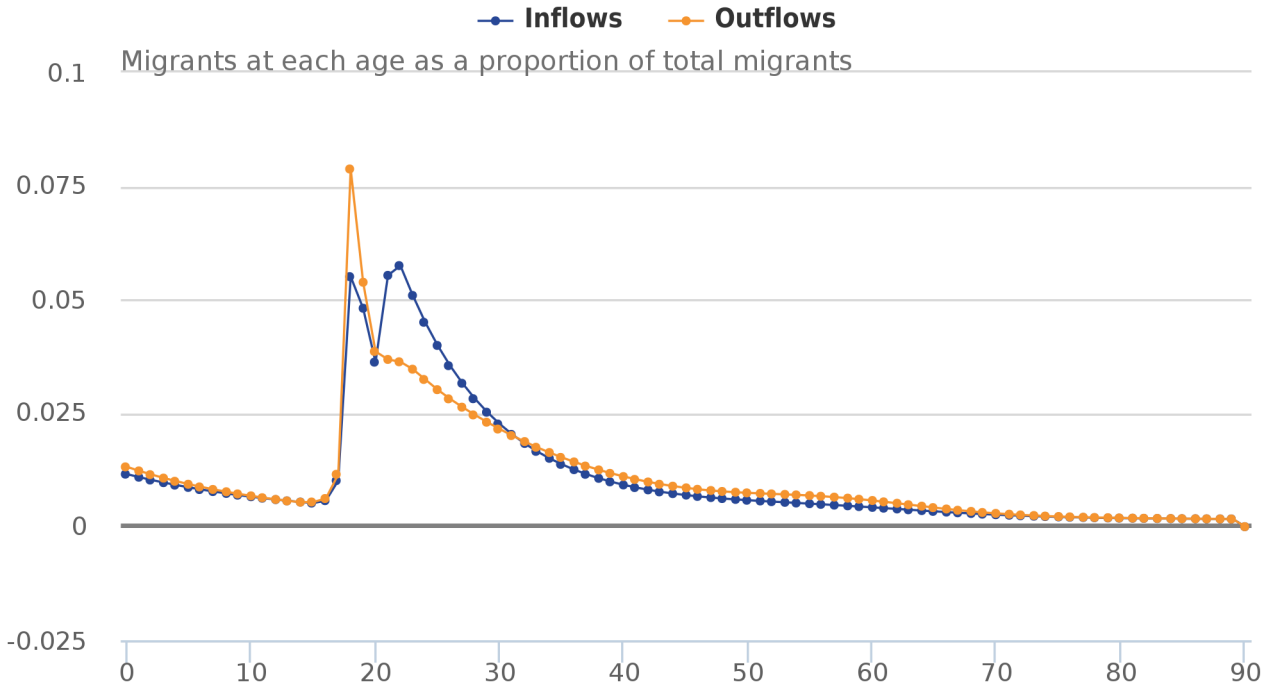
Source: Office for National Statistics

Figure 5-8: Assumed long-term age distribution for cross-border migration between England and the rest of the UK, males



Source: Office for National Statistics

Figure 5-9: Assumed long-term age distribution for cross-border migration between England and the rest of the UK, females



Source: Office for National Statistics

9 . Views of future migration levels

The NPP Expert Advisory Panel of seven academic demographic experts met in April 2013. A note of the meeting is included in the 2012-based projections November release, in Appendix A of the Background and Methodology paper. In an accompanying questionnaire, the experts were asked for their opinions on the likely levels of international migration to and from the UK in 2016 and 2036 (that is, five years and twenty-five years into the future from mid-2011, which were the latest estimates at the time).

Taking the average of the experts' responses, their predicted average annual net migration for 2036 was a net inflow of +162,000 per year (with an average 67% confidence interval of 120,000 to 280,000). This is close to the 2012 based long-term assumption for net migration to the UK of +165,000 per year.

The experts were also asked to consider five overall forces with the potential to affect levels of net migration to the UK in the long-term and assess the importance and likely impact of each force upon future migration:

- The main motives for international migration – work, study, joining/accompanying family
- Migration pressure resulting from changes in the countries of origin
- The attractiveness of the UK as a country of residence
- Costs of migration (in the broader sense)
- Controls on migration flows (referring to both the tightening and removal of controls)

The majority of experts considered the first two forces to have a small upward effect or no influence on total net migration, and forces three and four to have a downward effect or no influence. Almost all experts considered the last force, controls on migration, to have a downwards influence on migration. Other forces identified by the experts were conflict and political instability, environmental change, the economy and labour market policies.

Regarding short term migration, the annual net migration estimate derived from the experts' responses for 2016 was a net inflow of +183,000 per year (with an average 67% confidence interval of 140,000 to 232,000). This is somewhat higher than the corresponding experts' average for 2036 (+162,000 per year) and the proposed 2012-based long-term assumption of +165,000, but is close to the assumed short term run-in figure for 2015-16 of +183,500.

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

There were mixed views on the effects of the economy on migration over the next five years. Two experts thought it would have an upwards influence on net migration, two that it would have a downwards influence and two that it would have little or no effect.

There were also mixed views on EU and non-EU migration in relation to the effects of controls and government policies on migration.

All but one expert thought that net migration from the EU would be roughly similar or somewhat higher over the next five years while views on non-EU net migration were more mixed, with three experts thinking it would be somewhat lower, two that it would be somewhat higher and two that it would be roughly similar.

In the long-term, four experts thought that EU migration would be higher than now, two that it would be lower, and one that there would be no change. Regarding immigration from outside the EU, three experts thought it would be higher, three lower, and one that there would be no change.

The experts also gave their opinions on the current main reasons for migration to the UK. Four experts thought that migration for study would be lower in five years time and three thought it would be similar. Three experts thought that migration for work would be lower, two that it would be higher and two that it would be about the same. Two experts thought that migration for family reasons would be higher, one lower and four that it would be about the same.

The experts' predictions for total migration from the 13 countries which joined the EU between 2004 and 2013 (Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia) ranged from 68,000 to 100,000 for 2016 and from 30,000 to 150,000 for 2036.

Generally, the experts thought that migration would continue to be concentrated in London and the South of England. They also noted that the results of the Scottish independence referendum could have an effect on future migration patterns.

It should be noted that trends in underlying 'push' and 'pull' factors in western countries do not automatically follow through to corresponding trends in net migration. For example, increases in the numbers of people wishing to enter a country may lead governments to consider more targeted or restrictive immigration policies. The different responses of EU governments to the opening of their labour markets to people from the EU8 accession countries is a reminder that migrant numbers are not just dependent on the demographic characteristics of the sending and receiving countries, but will also be affected by any intervening obstacles or incentives placed on their movement.

There is evidence that levels of international migration are correlated with economic factors such as unemployment rates, although the strength of the relationship may vary from country to country [6]. Nevertheless, few agencies explicitly use explanatory variables (whether economic or other), in projection making, other than perhaps in the very short-term. This is often because the explanatory variables are considered to be as, or more, difficult to predict than the demographic variables.

10. References

1. For further information see the revised methodology for setting the migration assumptions for the 2012-based national population projections, available at: http://www.ons.gov.uk/ons/guide-method/method-quality/specific/population-and-migration/population-projections/npp-migration-assumptions-methodology-review/revised-migration-assumptions-setting-methodology.pdf.

2. For further information see the Migration Assumptions in the UK National Population Projections: Methodology Review, available at: http://www.ons.gov.uk/ons/guide-method/method-quality/specific/population-and-migration/population-projections/npp-migration-assumptions-methodology-review/migration-assumptions-in-the-uk-npp-methodology-review.pdf.

3. For the latest migration statistics data see the Migration Statistics Quarterly Report available at: http://www.ons.gov.uk/ons/rel/migration1/migration-statistics-quarterly-report/index.html

4. 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.

5. Rogers A, and Castro LJ (1981). Model Migration Schedules, IIASA Research Report RR-81-030, available at: http://www.iiasa.ac.at/publication/more_RR-81-030.php

6. Analysis and forecasting of international migration by major groups. Eurostat Working Paper 3/2002/E/no. 17. Eurostat, 2003, available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-AP-01-032

11. Background notes

1. The 2012-based Population Projections for United Kingdom and constituent countries were published on 6 November 2013 (main release) and 10 December 2013 (extra variants).

2. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

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

Compendium

Variants, 2012-based NPP Reference Volume

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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 future 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 three 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 two 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 or no change.

Aside from the principal projection, nine standard variant projections were published on 6 November 2013. These included six possible 'single component' variants, two 'combination' variants producing the largest/smallest total population size, and one special case scenario of zero net migration. A second release on 10 December 2013 included seven additional standard ‘combination’ and special case scenario variants. A full list of 2012-based variant projections 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.

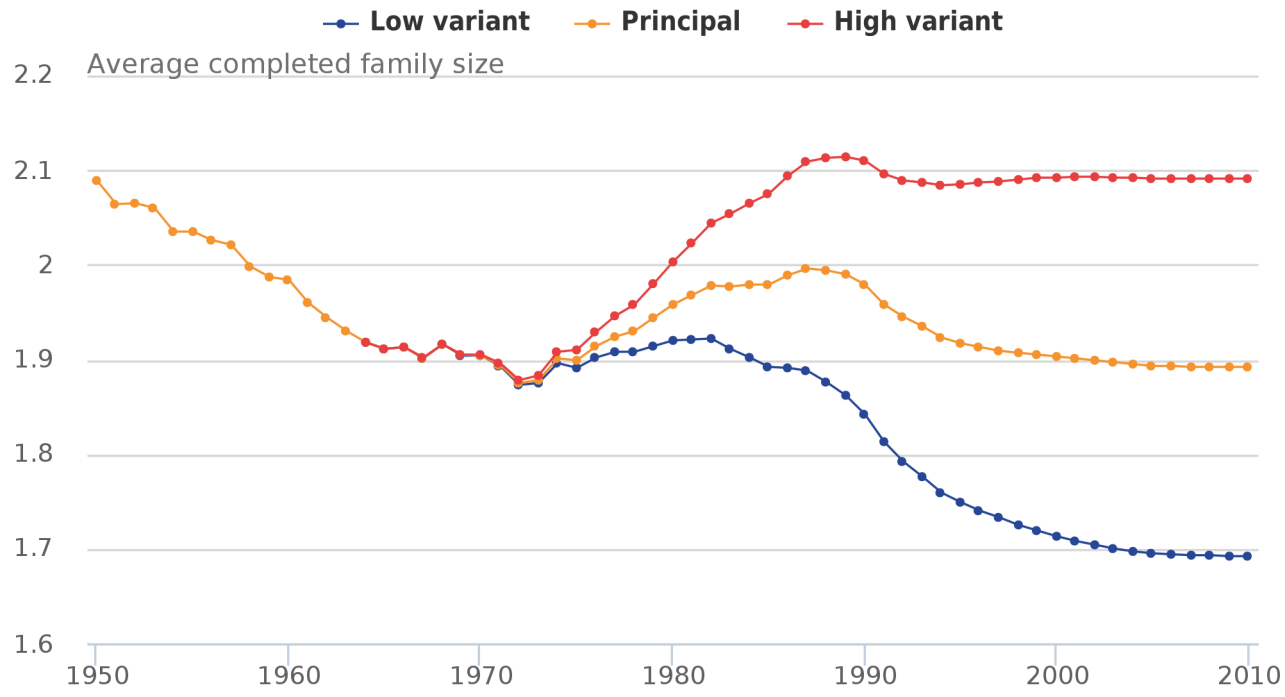
Cohorts of women who have already completed their childbearing have shown a wide range of completed family sizes. Therefore, assumptions for generations who have not yet entered the childbearing ages, or who have done so only recently, are necessarily highly speculative.

Variant projections have been produced based on high and low fertility assumptions. In addition, two special case scenarios are available. The replacement fertility projection assumes a level of fertility required for the population to replace itself in size in the long-term given constant mortality rates and in the absence of migration. The constant fertility projection assumes that age specific fertility rates will remain constant at the values assumed for the first year (mid-2012 to mid-2013) of the principal projection.

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 successive cohorts between 1975 and 1987, before falling to an ultimate level of 1.89 for women born from 2010 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 children.

Over the past ten 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 30.2 years for those born from 2010 onwards.

Figure 6-1: Actual and assumed completed family size, United Kingdom, women born 1950 to 2010



Source: Office for National Statistics

Notes:

1. Figures have not been rebased to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

Table 6-1: Actual and assumed average number of children by age and year of birth of women, United Kingdom, women born 1950 to 2010

		Average number of children born to women at ages:					
	Average family size	Under 20	20–24	25–29	30–34	35–39	40 and over
Actual values							
1950	2.1	0.2	0.7	0.6	0.4	0.1	0.0
1955	2.0	0.2	0.6	0.7	0.4	0.2	0.0
1960	2.0	0.2	0.5	0.6	0.4	0.2	0.0
1965	1.9	0.1	0.5	0.6	0.5	0.2	0.1
High variant							
1970	1.9	0.2	0.4	0.5	0.5	0.3	0.1
1975	1.9	0.1	0.4	0.5	0.5	0.3	0.1
1980	2.0	0.2	0.3	0.5	0.6	0.3	0.1
1985	2.1	0.1	0.4	0.5	0.6	0.4	0.1
1990	2.1	0.1	0.4	0.6	0.6	0.4	0.1
1995	2.1	0.1	0.3	0.6	0.6	0.4	0.1

2000	2.1	0.1	0.4	0.6	0.6	0.4	0.1
2005	2.1	0.1	0.4	0.6	0.6	0.4	0.1
2010 and later	2.1	0.1	0.4	0.6	0.6	0.4	0.1
Principal projection							
1970	1.9	0.2	0.4	0.5	0.5	0.3	0.1
1975	1.9	0.1	0.4	0.5	0.5	0.3	0.1
1980	2.0	0.2	0.3	0.5	0.6	0.3	0.1
1985	2.0	0.1	0.4	0.5	0.6	0.3	0.1
1990	2.0	0.1	0.3	0.5	0.6	0.3	0.1
1995	1.9	0.1	0.3	0.5	0.6	0.3	0.1
2000	1.9	0.1	0.3	0.5	0.6	0.3	0.1
2005	1.9	0.1	0.3	0.5	0.6	0.3	0.1
2010 and later	1.9	0.1	0.3	0.5	0.6	0.3	0.1
Low variant							
1970	1.9	0.2	0.4	0.5	0.5	0.3	0.1
1975	1.9	0.1	0.4	0.5	0.5	0.3	0.1
1980	1.9	0.2	0.3	0.5	0.6	0.3	0.1
1985	1.9	0.1	0.4	0.5	0.5	0.3	0.1
1990	1.8	0.1	0.3	0.5	0.5	0.3	0.1
1995	1.7	0.1	0.3	0.4	0.5	0.3	0.1
2000	1.7	0.1	0.3	0.4	0.5	0.3	0.1
2005	1.7	0.1	0.3	0.4	0.5	0.3	0.1
2010 and later	1.7	0.1	0.3	0.4	0.5	0.3	0.1

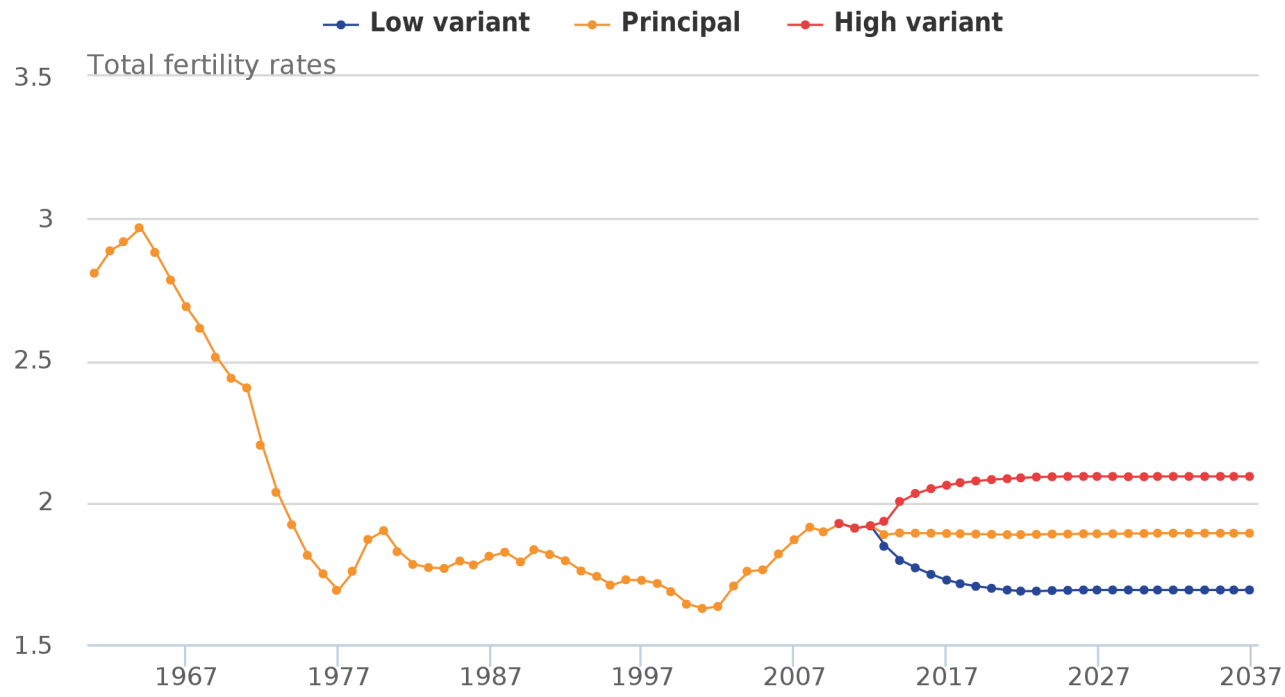
Note: Figures have not been rebased to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection.

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 decreases slightly from mid-2012 to mid-2013 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: Actual and assumed total fertility rates, United Kingdom, 1961 to 2037



Source: Office for National Statistics

Notes:

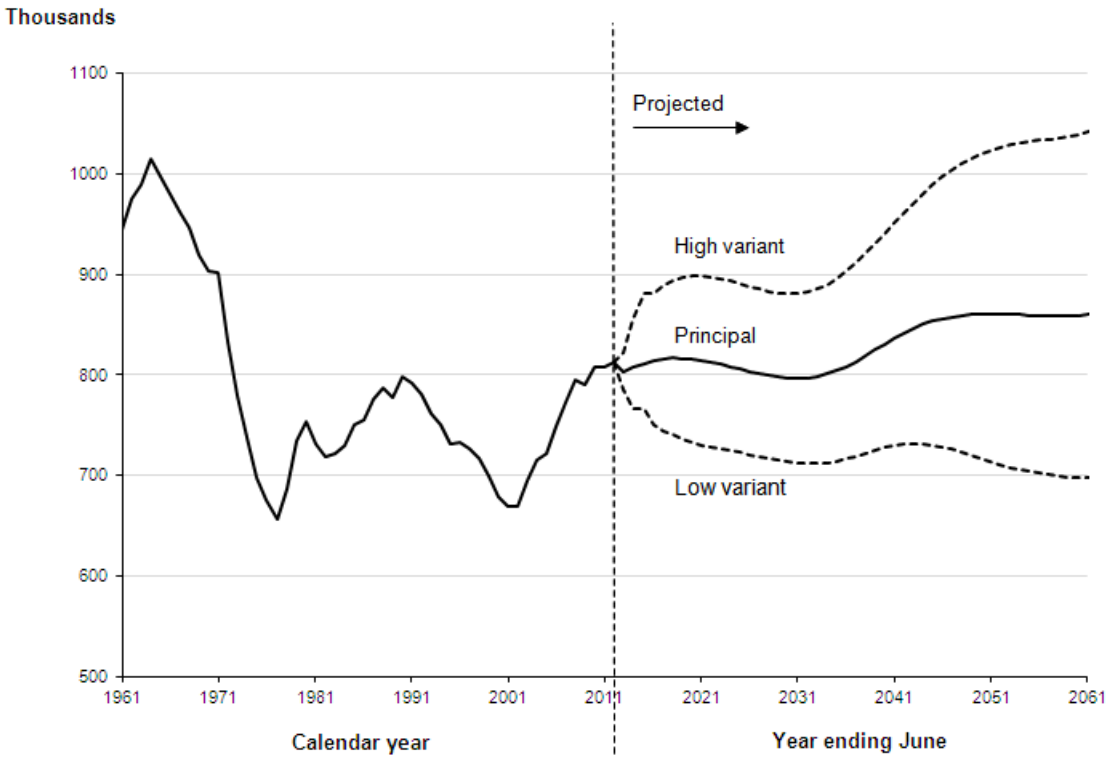
1. Figures have not been rebased to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

2. 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 813,000 in the year to mid-2012 to around 899,000 in mid-2021, dropping slightly to 881,000 in mid-2030 before rising to a level of 1,045,000 by mid-2062. However, under the low fertility variant, the number of births is projected to fall to approximately 712,000 by mid-2032 before increasing slightly to 732,000 in mid-2043, before starting to steadily decline. Under the principal projection, the number of births is projected to fluctuate in the short term but from mid-2032 is projected to increase year on year (less sharply than for the high fertility variant), to 861,000 births in mid-2051. After this point, projected births are expected to start to level out.

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

Figure 6-3: Actual and projected number of births, United Kingdom, 1961 to 2062



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. Under the alternative fertility assumptions, the population would be 1.9 million higher or 1.9 million lower than the principal projection by mid-2037. In the high fertility variant, the projected population at mid-2037 would be 75.2 million compared with 73.3 million in the principal projection, while in the low fertility variant it would be 71.4 million.

Figure 6-7 later in this chapter, demonstrates how long-term total population size is sensitive to changes in the fertility assumption. By mid-2087, there is a difference of over 21 million between the total population projected by the high and low fertility variants.

Table 6-2: Population differences between fertility variant projections and principal projection by age, United Kingdom, mid-2017 to mid-2037

Thousands

	All ages	0–4	5–9	10–14	15–19	20–24
Difference between high fertility variant and principal projection						
2017	230	230	-	-	-	-
2022	635	405	229	-	-	-
2032	1,477	419	424	405	229	-
2037	1,928	452	419	424	405	229

Difference between low fertility variant and principal projection						
2017	-208	-208	-	-	-	-
2022	-607	-399	-207	-	-	-
2032	-1,440	-417	-416	-399	-207	-
2037	-1,882	-444	-417	-416	-399	-207

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-2037. 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 2012-2013.

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 2037, 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 at 2037 is 2.4%, thereafter annual improvement will remain at 2.4%. For those born between 1925 and 1938 rates of annual improvement in and after 2037 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 of those born in 1939 or later.

Principal projection

Annual improvement at 2037 is 1.2%, thereafter annual improvement will remain at 1.2%. For those born between 1925 and 1938 rates of annual improvement in and after 2037 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 and later.

Low life expectancy variant

Annual improvement of 0% at 2037, thereafter mortality rates will remain constant. For those born between 1925 and 1938 rates of annual improvement in and after 2037 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

Annual improvement of 0% at all ages, so mortality rates remain constant throughout the projection period at the levels assumed for 2012-13.

Because of fluctuations in annual mortality rates, there is always some uncertainty about establishing the 'real' current rate of mortality improvement. Further, 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 variant mortality 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.

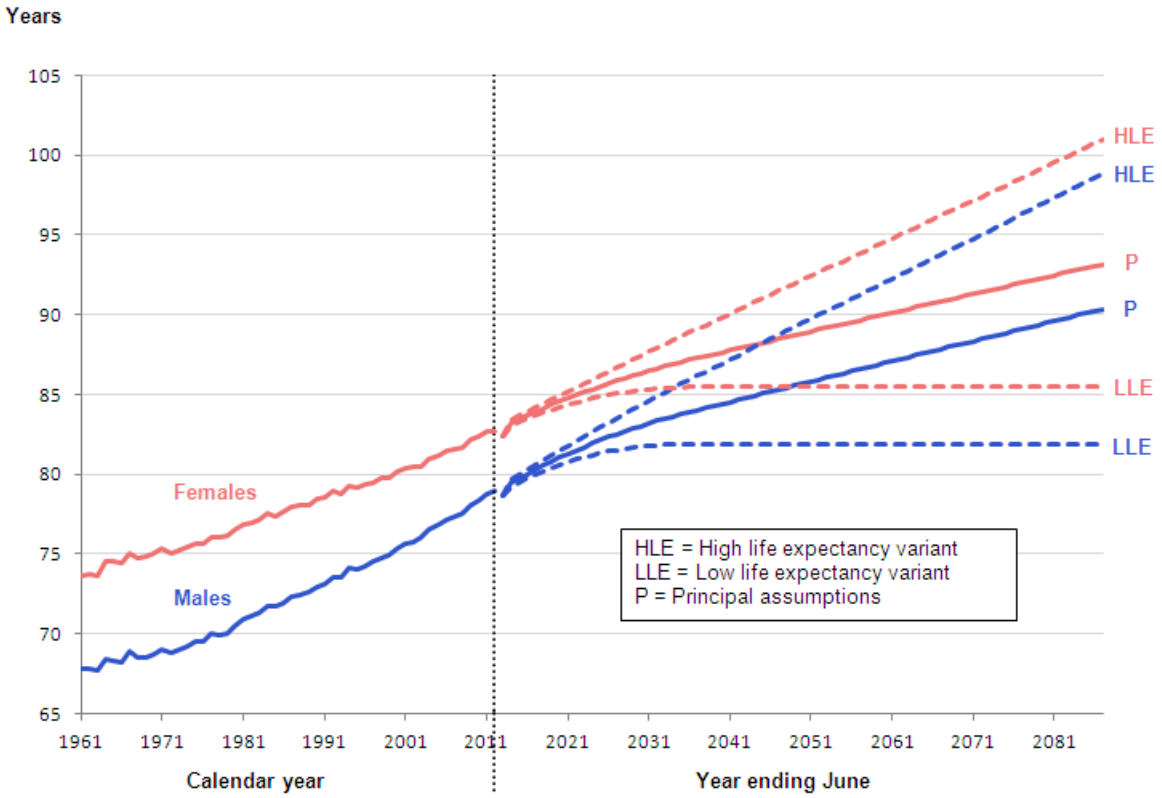
Table 6-3: Period expectation of life at birth according to mortality rates assumed for selected years. Variant mortality projections, United Kingdom, years to mid-2037

Years

	Males			Females		
	High life expectancy	Principal projection	Low life expectancy	High life expectancy	Principal projection	Low life expectancy
year to mid-2013	78.7	78.7	78.7	82.4	82.4	82.4
year to mid-2022	82.1	81.5	80.9	85.4	85.0	84.5
year to mid-2032	84.9	83.3	81.8	87.9	86.6	85.4
year to mid-2037	86.2	84.0	81.9	89.1	87.3	85.5

Source: Office for National Statistics

Figure 6-4: Actual and projected period expectation of life at birth according to mortality rates for given years, United Kingdom, 1961 to 2087

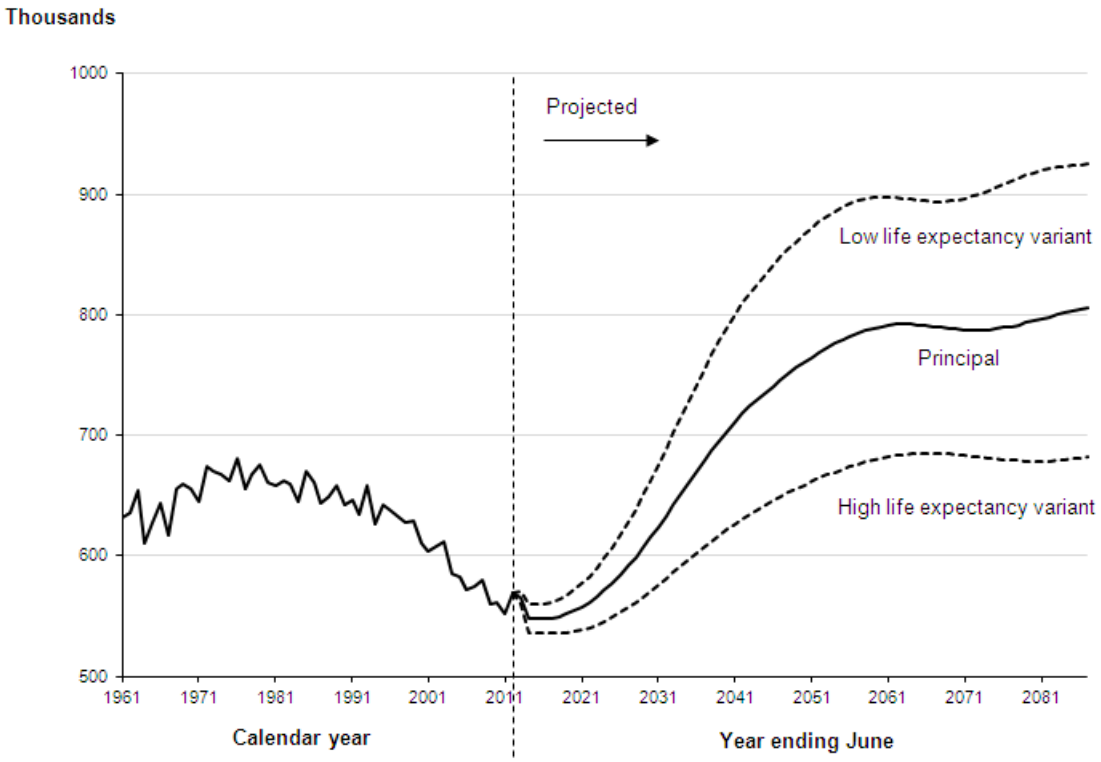


Source: Office for National Statistics

Notes:

1. Figures have not been rebased to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

Figure 6-5: Actual and projected number of deaths, United Kingdom, 1961 to 2087



Source: Office for National Statistics

In the high life expectancy variant, period expectation of life at birth for males is projected to increase by 7.5 years from 78.7 years in mid-2013 (the first year of the projection) to 86.2 years in mid-2037 (25 years into the projection), while the corresponding increase for females is 6.8 years (from 82.4 to 89.1 years). In the low life expectancy variant, period expectation of life at birth is projected to increase by 3.2 years for males and 3.1 years for females reaching 81.9 and 85.5 years respectively by mid-2037.

Figure 6-4 illustrates the further improvements assumed in the longer term with life expectancy at birth reaching 98.9 years for males and 101.0 years for females by mid-2087 for the high life expectancy variant. In the low life expectancy variant, there are only very marginal increases beyond mid-2037, as mortality rates are assumed to remain constant beyond mid-2037 at most ages.

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-2037 may be 74.1 million in the high life expectancy variant compared with 73.3 million in the principal projection (796,000 higher), but 72.4 million (830,000 lower) given the low life expectancy assumptions. Figure 6-7, later in this chapter, shows that by mid-2087, there is a difference of over 12 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, United Kingdom, mid-2017 to mid-2037

Thousands

		All ages	Under 60	60-74	75-84	85 and over
Difference between high life expectancy variant and principal projection						
	2017	47	5	10	13	18
	2022	129	14	27	36	53
	2032	484	41	88	124	230
	2037	796	62	128	189	417
Difference between low life expectancy variant and principal projection						
	2017	-47	-6	-10	-13	-18
	2022	-130	-14	-27	-36	-52
	2032	-499	-45	-95	-132	-227
	2037	-830	-70	-144	-208	-408

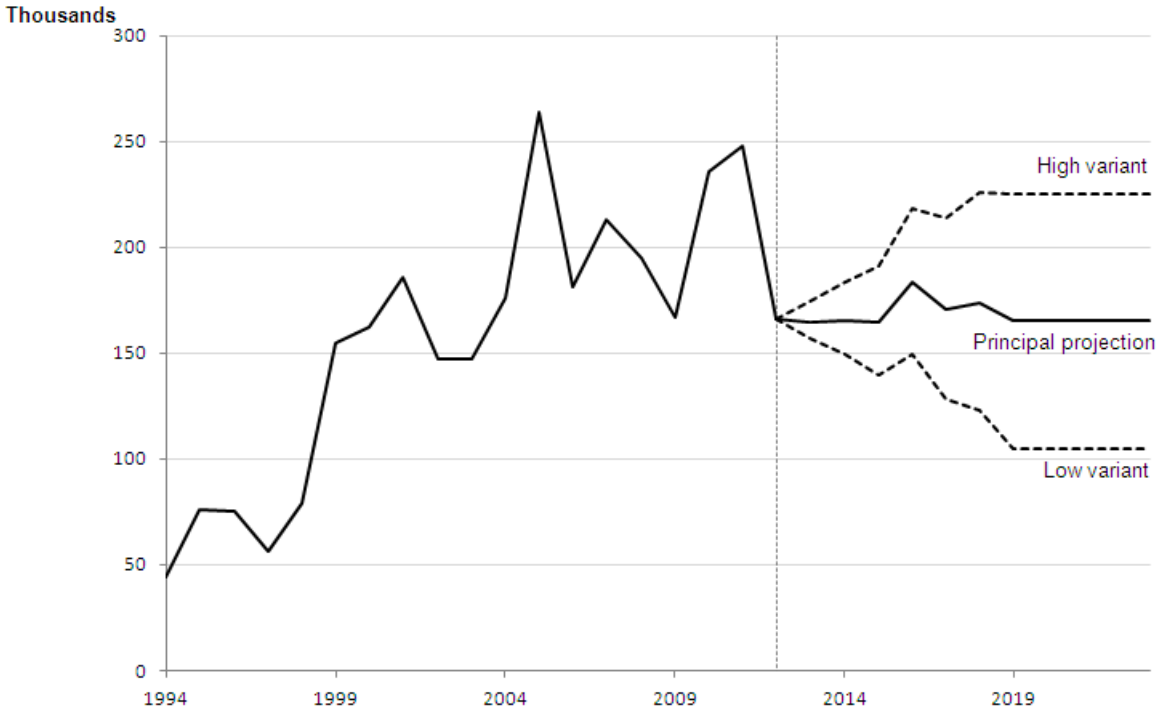
4 . Assumptions for migration variants

For the principal projection, the new long-term assumption for net migration to the UK is +165,000 each year from mid-2019 onwards. For the variant projections, annual net migration has been assumed to be 60,000 higher or lower than the principal projection. So the high and low variants assume annual long-term net migration to the UK of 225,000 and 105,000 persons per year respectively.

In addition, two special case scenario projections are available. The zero net migration projection 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, with in-migration and out-migration total flows being equal from the year ending mid-2034 onwards.

Special assumptions have been applied for the first few years of the projections (mid-2013 to mid-2018). 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. A short-term armed forces flow has also been included between mid-2014 and mid-2018 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: Actual and assumed total net migration, United Kingdom, year ending mid-1994 to year ending mid-2023



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 6th November 2013, under appendices A-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 net migration assumed to be 60,000 a year more (or fewer) than the principal projection after the first year, this would lead to just under 1.5 million more (or fewer) 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, United Kingdom, mid-2017 to mid-2037

Thousands

	All ages	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70 and over
Difference between high migration variant and principal projection									
2017	140	13	7	57	36	15	6	3	2
2022	471	64	20	149	141	56	24	11	7
2032	1258	216	92	200	366	227	92	40	25
2037	1679	265	170	221	403	356	157	66	41
Difference between low migration variant and principal projection									
2017	-131	-12	-7	-54	-34	-14	-6	-3	-2
2022	-460	-61	-20	-147	-137	-54	-23	-11	-7
2032	-1245	-214	-90	-200	-364	-223	-90	-39	-25
2037	-1666	-264	-168	-220	-403	-353	-154	-65	-40

Source: Office for National Statistics

Table 6-5 shows that the alternative migration assumptions would lead to 1.7 million more (or fewer) people in the population at mid-2037 as compared with the principal projection. But even 25 years ahead, these alternative assumptions would have little effect on the number of people aged over 60. By mid-2037, the population would be 75.0 million in the high migration variant compared with 73.3 million in the principal projection, but only 71.6 million under the low variant assumptions. Figure 6-7, later in this chapter, shows that by mid-2087 there is a projected difference of 12.8 million between the total population in the high and low migration variants.

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 365 per 1,000 at mid-2037. But this ratio is not greatly different under the alternative migration assumptions; in the high and low migration variants, the ratios at mid-2037 are 356 and 374 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 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-2037 would be 487 per 1,000 persons of working age rather than 365.

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

In the principal projections, the UK projection is calculated simply as the sum of the projections for the four individual 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 just the sum of those for the four individual countries. The 'assumed' UK fertility and mortality rates are then 'back-calculated' from these projected births, deaths and population numbers. This can be done because the principal migration assumption is set so that migration between England, Wales, Scotland and Northern Ireland (cross-border flows) sums to zero.

However, it does not necessarily follow that the same process should be used for variant projections. It is intended that the standard variants for individual countries should represent broadly comparable margins of uncertainty to those for the UK. However, for migration at least, relative uncertainty tends to increase for smaller areas. In particular, for Scotland, Wales and Northern Ireland, migration flows from the rest of the UK are at least as large as international migration flows from outside the UK. These cross-border flows, therefore, account for much of the uncertainty regarding total net migration for these countries. However cross-border migration flows cannot be high in all four countries simultaneously, or low for all countries so the cross-border flows do not sum to zero at the UK level for the variant migration assumptions.

For these reasons the variant migration assumptions for the UK are 'non-additive', that is, they have not been calculated as the sum of those for the four individual countries.

5 . Combination variants

For particular applications, users may also be interested in projections combining two or more of these alternative scenarios, for example, high fertility, high migration and low life expectancy. Some key summary statistics from selected combination variants are given in Table 6-6. For example, the largest total population size would result from combining the high variant assumptions for fertility, life expectancy and migration (the 'high population' variant). With this combination of assumptions, the population would be over 77 million by mid-2037 and just over 93 million by mid-2062. However, for the lowest population size which results from combining the low variant assumptions for the three components (the 'low population' variant) the population in mid-2062 is projected to be 67.5 million.

Over the 50 year period to mid-2062, the highest dependency ratios (amongst the single component and standard combination variants) occur given low fertility, high life expectancy and low migration (the 'old age structure' variant). The lowest dependency ratios occur where there is low fertility, low life expectancy and low migration (the 'low population' variant) or when the assumptions for fertility and migration are consistent with the principal projections but low life expectancy is assumed (the ‘low life expectancy’ single component variant).

Table 6-6: Measures of population structure under the principal projection, standard variant projections and special case scenarios, United Kingdom, mid-2037 and mid-2062

	Total population (000s)		% of population aged under 16		% of population aged 65 & over		Dependants per 1,000 population of working age	
	(2012 = 63,705)		(2012 = 18.8)		(2012 = 17.0)		(2012 = 615)	
Projection	2037	2062	2037	2062	2037	2062	2037	2062
Principal projection	73,272	79,904	17.7	17.4	24.3	26.4	659	684
SINGLE COMPONENT VARIANTS								
High fertility	75,200	85,554	19.1	19.4	23.7	24.6	682	696
Low fertility	71,390	74,645	16.3	15.4	24.9	28.2	636	673
High life expectancy	74,068	83,162	17.5	16.7	25.0	29.0	673	742
Low life expectancy	72,443	76,529	17.9	18.1	23.5	23.6	644	626
High migration	74,952	83,882	17.8	17.4	23.8	25.8	650	669
Low migration	71,606	75,942	17.6	17.3	24.8	27.0	668	700
COMBINATION VARIANTS								
High population	77,717	93,012	19.0	18.7	23.9	26.6	687	736
Low population	68,935	67,540	16.4	16.0	24.7	25.9	629	626
Young age structure	76,083	86,239	19.4	20.1	22.5	21.6	659	631

Old age structure	70,552 74,037	16.0	14.7	26.1	31.7	660	757
SPECIAL CASE SCENARIOS							
Replacement fertility	75,300 85,550	19.0	19.3	23.6	24.6	678	693
Constant fertility	73,157 79,566	17.6	17.3	24.3	26.5	658	683
No mortality improvement	70,462 73,750	18.4	18.7	21.7	21.2	608	580
Zero net migration (natural change only)	67,477 66,248	16.8	16.4	26.3	30.1	684	763
No change	70,346 73,415	18.3	18.6	21.8	21.3	606	578
Long-term balanced net migration (UK only)	71,080 71,222	17.6	16.8	25.0	29.0	672	734

Source: Office for National Statistics

Notes:

1. Dependants are children under 16 and people of state pensionable age. Working age and pensionable age populations based on state pension age for given year. Between 2010 and 2020, state pension age will change from 65 years for men and 60 years for women, to 66 years for both sexes. Between 2034 and 2046, state pension age will increase in two stages from 66 years to 68 years for both sexes

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 (UK only)

More information on the six special case variant projections can be found in releases published on 6 November and 10 December 2013.

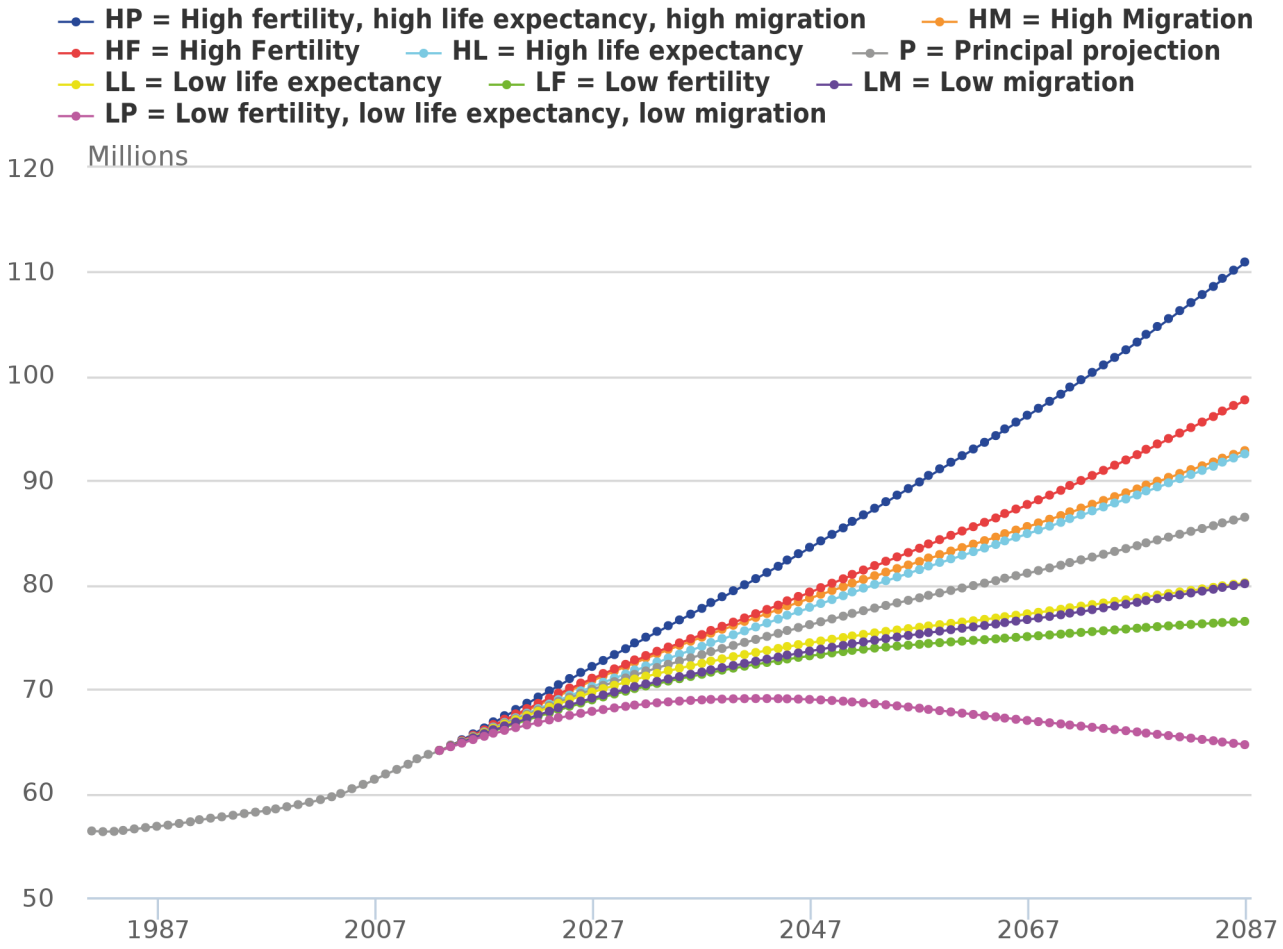
6 . Comparison of variant projections

Total population size

Figure 6-7 shows the implications for future population growth under each of the 'single component' variant projections. It also shows the results of the high and low population combination variants. The chart shows that there is considerable uncertainty about the future size of the population and that uncertainty widens over time.

In the principal projection, the high population combination variant and all the single combination variants, 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. Under this combination of assumptions, the UK population would peak in size by the mid 2040s.

Figure 6-7: Actual and projected total population, United Kingdom, mid-1981 to mid-2087



Source: Office for National Statistics

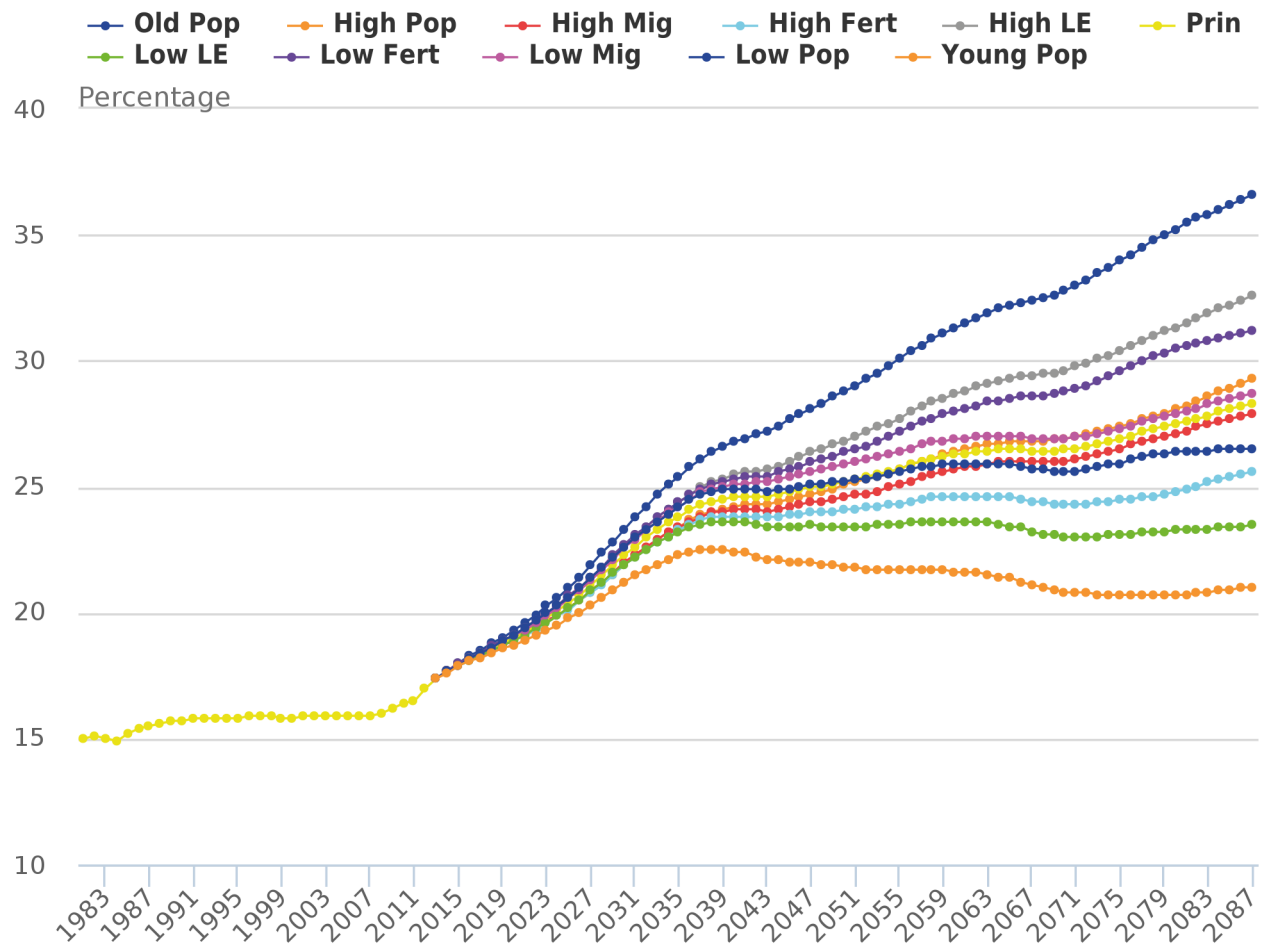
The equivalent figures for the constituent countries of the UK can be found in the results report published on 6th November 2013, under appendices A-D.

Population aged 65 and over

Figure 6-8 shows the projected proportion of the population aged 65 and over under 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 population ageing will occur under any plausible set of future assumptions. In mid-2012, some 17% of the population were aged 65 and over. This is projected to rise sharply at first then more steadily to reach 28% by mid-2087 in the principal projection, 33% in the high life expectancy variant and 31% in the low fertility variant. Under the low life expectancy or high fertility variants, ageing would be significantly reduced but the proportion over 65 would still increase to 23 or 26% respectively. Even in the 'young age structure' variant, the proportion aged over 65 is projected to increase to a peak of 23% by mid-2038 before levelling out at 21% in the longer term.

Figure 6-8: Actual and projected percentage of the population aged 65 and over, United Kingdom, mid-1981 to mid-2087



Source: Office for National Statistics

The equivalent figures for the constituent countries of the UK can be found in the extra variants report published on 10th December 2013, Appendix B.

7 . Probabilistic interpretation of population projections

One of the limitations of the traditional deterministic approach – used in the UK to produce the official population projections – is that no probabilities are attached to the principal projections, so users are given no information about the uncertainty associated with them or, with respect to the variants, are given no indication of how these compare to the principal projections in terms of certainty. In response to these concerns, increasing attention is now being given to stochastic forecasting methods. Typically, stochastic forecasts use probability distributions for the components of demographic change, namely of fertility, mortality and migration. These are derived using some combination of three recognised approaches: analysis of past projection errors, expert opinion and time series analysis. By using these approaches, ONS in the 2000s started looking at developing a stochastic forecasting model for the UK and a progress report[7] was published in August 2009. The paper reports the early findings of research. ONS is not currently engaged in any further research on using stochastic methods to produce projections.

Relative uncertainties of fertility, mortality and migration

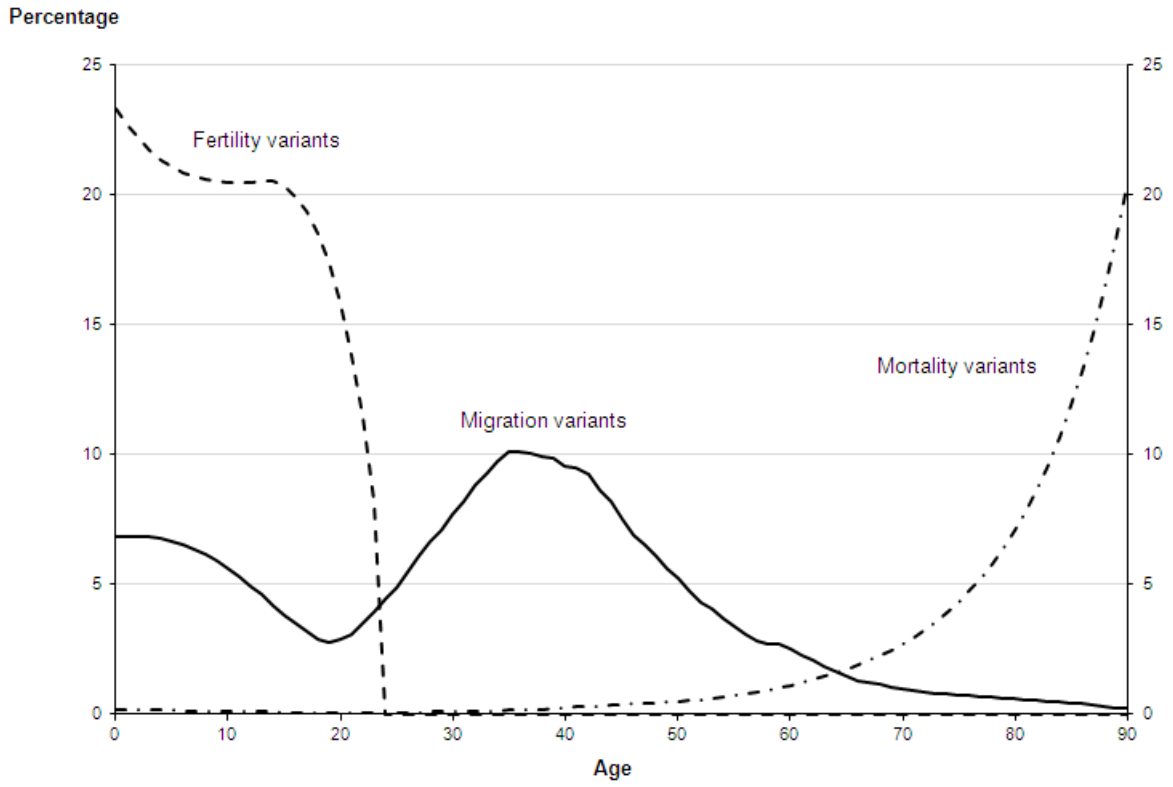
Because precise probability statements cannot be ascribed to the variant assumptions, strictly the indications of uncertainty given for fertility, mortality and migration are not directly comparable. Nevertheless, it is possible to make some general comments about the relative importance of fluctuations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

The majority of users are interested principally in the first twenty years of the projection, over which period possible variations in migration numbers or fertility patterns are likely to have a greater impact on the 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 work force 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 has been published[8]. The analysis was based on the extensive database of past national projections. This UK study was followed by an analysis of how UK projections compared with those for other European countries[9]. These articles concluded that in the UK, as in most other countries, fertility had tended to be over projected while life expectancy and net inward migration had generally been under projected. Compared with other countries, fertility errors were somewhat larger in UK projections, but mortality errors were smaller. Migration errors in UK projections were around the European average.

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-2037. 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, United Kingdom, mid-2037



Source: Office for National Statistics

8. References

1. Excess winter mortality in England and Wales available at: http://www.ons.gov.uk/ons/publications/all-releases.html?definition=tcm%3A77-210640

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9. Background notes

1. The 2012-based Population Projections for United Kingdom and constituent countries were published on 6 November 2013 (main release) and 10 December 2013 (extra variants).

2. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

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