Office for National Statistics

Compendium

# National population projections: 2016-based projections, methodology

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

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## Chapters in this compendium

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# Background and methodology

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# 1 . Introduction

We publish national population projections by age and sex for the UK and constituent countries every two years. We base them on the latest mid-year population estimates together with assumptions of future levels of fertility, mortality and migration.

The primary purpose of the projections is to provide information on potential future population levels. They are used as a common framework for national planning in a number of different fields.

The Government Actuary's Department (GAD) produced the first projections of the population of the UK in the 1920s. These earliest projections were mainly used 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. GAD produced projections each year from 1955 to 1979 and then every second year until 1991. There was then a 1992-based set and since then projections have reverted to being produced every second year. Office for National Statistics (ONS) took over responsibility for the production of the national population projections in 2006.

We occasionally produce additional "interim" projections. We published 2001-based projections following the 2001 Census and an additional set based on the 2003 estimates to incorporate revisions to the population estimates for England and Wales.

The main focus of the 2016-based projections is on the next 25 years up to 2041, though we also produce longer-term projections to 2116. The uncertainty of population projections increases the further they are carried forward and particularly so for smaller geographical areas and age-sex breakdowns. In addition to the principal (main) projections, we also make available variant projections, based on alternative assumptions of future fertility, mortality and migration. 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.

The 2016-based projections supersede the 2014-based projections published on 29 October 2015.

We produce the projections on behalf of the National Statistician and the Registrars General of Scotland and Northern Ireland. We agree the underlying assumptions in liaison with the devolved administrations – Welsh Government, National Records of Scotland (NRS) and Northern Ireland Statistics and Research Agency (NISRA) – following consultation with the main users of projections in each country and advice from an expert advisory panel.

This report contains background information for the 2016-based national population projections. Included are sections on:

- defining the base population
- the method of projection
- background on principal and variant projections
- summary of the long-term assumptions of future levels of fertility, mortality and migration
- datasets available
- changes to State Pension age
- national population projections expert advisory panel

# 2 . Base population

## Definition

We use estimates of the usually resident population of the UK and its constituent countries at mid-2016 as our starting population. The usually resident population is defined by the standard United Nations definition for population estimates, and includes people who reside in the area for a period of at least 12 months whatever their nationality. Members of HM Armed Forces in the UK are included, but members of HM Armed Forces and their families who are abroad are excluded. Members of foreign armed forces in the UK are included, with any accompanying dependants.

## Base populations for individual countries

We base the projections for England and Wales on the mid-2016 population estimates published by Office for National Statistics (ONS) on 22 June 2017. The projections for Scotland are based on the mid-2016 population estimates published by NRS on 27 April 2017, and likewise the projections for Northern Ireland are based on the mid-2016 estimates published by NISRA on 22 June 2017. Population estimates use the 2011 Census as the starting population and then update these annually to account for population change.

**Table 1.1: Base population estimates for 2016-based projections, UK**

| | millions |
|---|---|
| England | 55.3 |
| Wales | 3.1 |
| Scotland | 5.4 |
| Northern Ireland | 1.9 |
| United Kingdom | 65.6 |

Source: Office for National Statistics

## Estimates of the population aged 90 and over

We prepare official mid-year population estimates by individual age to the age of 89 years, with an upper age band for all those aged 90 and over. We produce estimates of the population aged 90 to 104 years by single year of age and for the 105 and over age group using the Kannisto-Thatcher survivor ratio method, controlling the results to agree with the official estimates of all those aged 90 and over.

# 3 . Method of projection

We produce projections for successive years running from one mid-year to the next. For each age we take the starting population, account for net migration less the number of deaths, to produce the number in the population, one year older, at the end of the year. We then add survivors of those born during the year. Age is defined as completed years at the last birthday.

We assume migration occurs 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 we add to obtain the population aged x plus 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 plus 1.

We obtain the number of deaths in a year 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 $q_{x+1/2}$, which is the probability of death between one mid-year and the next. The mortality rates we use in the projections represent the probabilities of death between one mid-year and the next, according to a person's age last birthday at the beginning of the period. The appropriate rate of infant mortality, the probability of a new-born child not surviving until the following mid-year, is also given. This is about 85% of the full, first year of life infant mortality rate more generally used in official statistics.

We calculate the number of births in the year 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. We assume the total number of births in a year is divided between the sexes in the ratio of 105 males to 100 females, in line with recent experience. We calculate the number of infants aged zero at the end of the year by taking the projected number of births, deducting the number of deaths found by applying the infant mortality rate and adding half the number of net migrants aged zero at their last birthday.

We compute principal projections for each of the constituent countries of the UK and add together the results to produce projections for England and Wales, Great Britain and the UK.

# 4 . Summary of long-term assumptions

We base the new principal projections on the long-term assumptions of future fertility, mortality and net migration (that is, immigrants minus emigrants), summarised in Table 1.2. We agree the long-term assumptions in consultation with the Northern Ireland Statistics Research Agency (NISRA), the National Records of Scotland (NRS) and the Welsh Government. Table 1.2 compares figures for the 2016-based projections with the assumptions for the previous 2014-based projections.

**Table 1.2: Long-term assumptions for the 2016-based national population projections compared with assumptions for the 2014-based projections, UK**

| | UK | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|---|
| Fertility – Long-term average number of children per woman | | | | | |
| 2016-based | 1.84 | 1.85 | 1.85 | 1.65 | 2.00 |
| 2014-based | 1.89 | 1.90 | 1.90 | 1.70 | 2.00 |
| Mortality - Expectation of life at birth in 2041[1] | | | | | |
| Males 2016-based | 83.4 | 83.6 | 82.8 | 81.7 | 82.8 |
| Males 2014-based | 84.3 | 84.6 | 83.7 | 82.5 | 83.6 |
| Females 2016-based | 86.2 | 86.4 | 85.7 | 84.5 | 85.8 |
| Females 2014-based | 87.1 | 87.4 | 86.7 | 85.2 | 86.7 |
| Net international migration[2] – Annual long-term assumption | | | | | |
| 2016-based | +165,000 | +152,000 | +4,500 | +7,000 | +1,500 |
| 2014-based | +185,000 | +170,500 | +4,000 | +9,500 | +1,000 |

Source: Office for National Statistics

Notes:

1. Expectations of life for 25 years ahead given as specimen year. Note these are period expectations of life based on the mid-year mortality rates assumed for the year 2041 and do not take account of the continuing improvement in mortality projected beyond 2041.

2. Net international migration does not include cross-border migration between the countries of the UK.

For the UK, the long-term assumption of average completed family size is 1.84 children per woman, 0.05 lower than the 2014-based projections. More information can be found in the Fertility assumptions section of the release.

Assumptions on improvements in principal mortality are broadly unchanged from the 2014-based projections. We assume annual improvement in mortality rates in 25 years time (2041) to be 1.2% for most ages for both males and females for all constituent countries of the UK. We assume lower annual rates of mortality improvement for those born before 1924.

Although we haven't changed our assumptions about the long-term rate of improvement in life expectancy, actual life expectancy has increased less than projected since mid-2014. This means in each year of the 2016-based projections the projected life expectancy is lower than in the 2014-based projections. More information can be found in the Mortality assumptions section of the release.

The new long-term assumption for net international migration to the UK is +165,000 each year compared with +185,000 a year in the 2014-based projections. We calculate cross-border migration (moves between countries of the UK) by applying rates of movement between each pair of countries to the population by age and sex. The rates are derived as an average of the last five years' estimates (2012 to 2016). More information can be found in the Migration assumptions section of the release.

# 5 . Datasets available

We have published projections to 100 years ahead. For each country and variant combination we have made two summary tables and a zipped open data file (XML format) available to download.

The first summary table contains the total projected population for all years of the projection, the components of change and other summary statistics.

The second summary table contains the projected population in five-year age groups for all years of the projection.

The XML open data files contain:

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

# 6 . Changing State Pension age

## Pensionable ages for men and women

Since 2010, State Pension age has been increasing. By 2020 it will change from 65 years for men and 60 years for women, to 66 years for both sexes. State Pension age will then increase to 67 years for both men and women between 2026 and 2028. Under the current law, State Pension age is due to increase to 68 years between 2044 and 2046.

The data presented in this bulletin do not reflect proposed further changes to State Pension age recently published by the government. Following a recent review, the government has announced plans to bring the current timetable forward. If these plans are adopted, State Pension age will increase to 68 years between 2037 and 2039.

The proportions used to calculate the population of working age and pensionable age, along with a worked example of how these proportions are applied, are available in the Table of State Pension Age Factors Pensions Act 2014.

Full details about the current and planned changes to State Pension ages under the Pension Acts of 1995, 2007, 2011 and 2014 can be found in Appendix C.

# 7 . National population projections expert advisory panel

An expert panel advises Office for National Statistics (ONS) early on in the assumption-setting process on current and emerging demographic trends and their possible implications for the national population projections. This panel met in 2017 to advise on the assumptions for 2016-based population projections.

The membership of the panel for the 2016-based national population projections was as follows:

- Professor Ann Berrington, University of Southampton
- Ben Corr, Greater London Authority
- Professor Peter Goldblatt, University College London
- Professor Carol Jagger, Newcastle University
- Dr Nik Lomax, University of Leeds
- Professor Mike Murphy, London School of Economics
- Professor John Salt, University College London
- Professor Ludi Simpson, University of Manchester

## Panel meeting

A note of the panel meeting held on 4 April 2017 is available in Appendix A.

## Questionnaire

The panel completed a questionnaire where they were asked what they thought were the most likely future levels of fertility, life expectancy and migration. We also asked for their views on the validity and importance of a wide range of factors that might be thought likely to influence future trends. The questionnaire was originally devised by the International Institute for Applied Systems Analysis (IIASA) in Vienna and has been adapted by ONS for use in the UK. We review the questionnaire for each projection round to ensure that the experts' views on current and emerging trends are collected.

Details of the panel's views on the most likely levels of the total fertility rate, life expectancy at birth and total net migration to the UK (and associated 67% and 95% confidence intervals) in the years 2020 and 2040 can be found in Appendix B.

# 8 . Appendix A: Minutes of expert panel

# 2016-based national population projection (NPP) expert advisory panel meeting

Government Actuary's Department, Finlaison House
15-17 Furnival Street, London, EC4A 1AB

Tuesday 4 April 2017, 10:30am to 3:00pm

## Expert group

Professor Ann Berrington, University of Southampton
Ben Corr, Greater London Authority
Professor Carol Jagger, Newcastle University
Professor John Salt, University College London
Professor Ludi Simpson, University of Manchester
Professor Mike Murphy, London School of Economics
Dr. Nik Lomax, University of Leeds

## ONS Population Statistics Division attendees

Paul Vickers, Head of Population Outputs (Chair)
Adrian Gallop, Demographic Analysis Unit and Government Actuary's Department
Emily Knipe, Demographic Analysis Unit
Sophie Chapman, Demographic Analysis Unit
Andrew Nash, Population Projections Unit
Paula Guy, Population Projections Unit (Secretary)
Yifan Zheng, Population Projections Unit (Secretary)
Liam Fleming, Analytical Impact Team (Shadowing Paul Vickers)

## Observers

Denise Patrick, National Records of Scotland
William Howes, National Records of Scotland
Catherine O'Donnell, Northern Ireland Statistics and Research Agency
Olga Krikun, Office for National Statistics
Dan Horscroft, Office for National Statistics
Alan Evans, Office for National Statistics

## Apologies

Professor Peter Goldblatt, University College London
Alan Jackson, Welsh Government

## 1. Introduction

1.1 Paul Vickers welcomed attendees and opened the panel.

1.2 He explained that the aim of the panel is to hear the experts' full range of views on what long-term assumptions should be and not seek consensus where none existed. Though all opinions would be considered, the final decision on the assumptions to be adopted for the next set of projections rests with the NPP committee, which includes representatives from Office for National Statistics (ONS) and the devolved administrations.

1.3 Attendees of the panel introduced themselves.

1.4 Currently the national population projections (NPPs) are due to be published in October or November 2017.

## 2. Fertility

### Introduction

2.1 Emily Knipe delivered a presentation on fertility trends and the results of the expert questionnaire:

2.2 The current total fertility rate (TFR) for the UK is 1.80. The long-term assumption for the TFR in the 2014-based projections was set at 1.89.

2.3 Trends for the four constituent countries were compared. Since the 2001 low point, TFR has been increasing in all countries, at roughly equal rates until about 2009. The trends for England and Wales were very similar over this time period; however, Wales experienced a larger dip in 2009 than England did, but both countries then recovered in 2010. A divergence has been noted more recently. The TFR in Northern Ireland (NI) has remained consistently higher than England and Wales but has been broadly stable since 2009. The TFR in Scotland remains consistently below England and Wales. Scotland also showed no clear recovery from the 2009 dip, instead showing consistent decreases since the peak in 2008. All countries' TFR declined in 2013, for Scotland this was just a continuation of their five-year trend. There was some recovery in 2014. England and Wales and NI have levelled whereas Scotland has fallen again slightly in 2015.

2.4 Fertility rates by age were explored. Age specific fertility rates (ASFRs) for women in their 30s and 40s have been rising consistently since the late 1970s. Those aged 30 to 34 years have been the peak age group for fertility since 2004; previously the peak age group was 25 to 29 years.

2.5 Trends in cohort fertility were presented. Completed family size (CFS) has declined gradually since the 1945 birth cohort. The most recent cohort to have completed fertility was the 1969 cohort who had 1.90 children on average, which is very similar to the 1965 cohort (1.91).

2.6 Fertility of recent cohorts was compared with the 1969 cohort. In general, cohorts since 1969 have experienced higher teenage fertility but lower fertility in their early 20s than the 1969 cohort. They are partially catching up in their late 20s and 30s; though still remain below the 1969 cohort level. The two most recent cohorts (1990 and 1995) have seen lower teenage fertility compared with the 1969 cohort and fertility levels are remaining low in their early 20s.

2.7 Results of the expert questionnaire were discussed. Experts' UK TFR estimates for 2040 averaged 1.79, this was lower than the figure of 1.82 from the 2014-based NPP expert panel. The lowest long-term estimate was 1.60 with the majority between 1.80 and 1.90; however, there was less certainty around these estimates than was expressed by the experts in the previous expert group meeting prior to the 2014-based projections.

2.8 In terms of the experts' responses to questions regarding the forces and impacts of fertility, the majority agreed that changes in population composition and differential trends in fertility among population sub-groups would have an upwards effect on fertility. Changing bio-medical conditions would have an upwards or little or no influence, while trends in ideal family size and trends in income would have a downwards effect or little or no influence. There was some disagreement amongst experts on the effect of the changing nature and stability of partnerships, and trends in patterns of education and work.

2.9 Graphs showing the estimated TFR and ASFRs for UK-born and non UK-born mothers were presented. The TFR among non UK-born women was clearly higher than for UK-born women. However, the rates seem to be converging over time. UK-born and non-UK born women show different patterns of ASFRs. For all age groups, the non UK-born ASFR was above that of UK-born; this holds true in 2015 except for the under 20s age group, which was almost the same as the UK-born.

2.10 Trends on period parity progression were presented. Progression to higher parities is much lower, so around 40% of women who have two births go on to have a third. A similar proportion of women who have three births go on to have a fourth and so on. Progression to the first child rose until 2013 when it dropped, but progression to second child has stayed fairly steady with a small decline in 2013.

## Discussion

2.11 An expert questioned whether the period TFR is the right indicator to be analysing, since a quarter of births in the UK are from non-UK born mothers. These women have low fertility exposure before they arrive and high fertility subsequently. This means that the period TFR is artificially inflated upwards.

2.12 There was a discussion on the link between fertility and migration. The experts noted UK and non-UK groups have different trends in fertility.

2.13 One expert highlighted research they had done using the ONS Longitudinal Study to look at the effects of migration on fertility. It was noted that the fertility of EU migrants is not necessarily affected the most by migration patterns. There are counteracting forces. Some non-UK born women come to the UK and bear children, others do not and some will come but their family building might change. There are a lot of unknowns and the relationship between migration and fertility can also change. They suggested that ONS needs to consider looking at fertility rates by country of birth as part of the projection methodology, and suggested this may be an area of further research. Finally, one expert stated that migration creates the biggest uncertainty about fertility, having both a direct and second generation impact.

2.14 One expert proposed exploring links between the fertility and migration assumptions. Another noted views expressed at the British Society for Population Studies (BSPS) Sub-national Projections Variants Day, that too much information is lost if a bottom-up approach to projections is not adopted. It was asked whether there is scope to incorporate the research suggested into the 2016-based NPPs, to which Paul explained there is limited scope for the upcoming projection. Emily will revisit the work undertaken after the last round of projections and plan work for the future.

2.15 There was a discussion on the relationship between house prices and fertility.

2.16 One expert stated there was evidence suggesting a strong link between housing affordability and family or partnership formation. The young are now more likely to be living in the parental home. If this feeds through to child-bearing, some of the drop in fertility for those in their 20s might be related to housing costs. However, other factors may also have an effect. For example, people staying longer in education, different contraception options, and the lagged impact of the government’s teenage pregnancy agenda.

2.17 Another expert pointed out trends seen in Denmark; where young people generally left home earlier compared with the UK but there was no strong evidence to suggest they have children earlier. It was also noted that Greece has a TFR of 1.3. Nearly half of all 15- to 34-year-olds are living with their parents and there is 50% unemployment. Housing and economic uncertainty are important influences there.

2.18 There was discussion on the effect of the decline in the availability of social housing in explaining some of the decline in fertility rates at younger ages, with young socio-economically disadvantaged families tending to be more reliant on social housing. It was also noted that the media focus on lack of affordability of housing is likely to have an impact on young people’s behaviour. More research is needed in this area.

2.19 It was suggested that family friendly policies are more powerful than housing in explaining fertility trends for some countries, although it was noted that these policies have a different impact on different sectors of society. In the UK, less educated women tend to have higher completed family sizes than graduates, whereas in Scandinavian countries policies support women to combine a career and family, meaning that educational differences in completed family sizes are smaller in some Scandinavian countries than they are in the UK.

2.20 One expert reflected on research, which shows that the reason why we see relatively high completed family sizes in the UK, as compared with some other European countries, is that the less educated tend to have children earlier and have larger completed family sizes, and these patterns counteract the relatively high levels of childlessness among female graduates.

2.21 It was noted by the experts that the rate of increase in fertility at older ages is not levelling off. The experts questioned whether this increase in older age fertility relates to the recuperation of postponed births and whether this may be due to the impact of family friendly policies introduced under the Labour Government.

2.22 One expert pointed out that an important unknown is whether those currently in their teens and 20s who are postponing childbearing will end up with lower completed family size than previous cohorts when they reach 45.

2.23 One expert felt intended family size is the most important factor affecting fertility – if people want children, they will find a way to have them.

2.24 Long-term trends were discussed and an expert felt that the drop in first birth rates will have the most impact. Currently just under 20% of women remain childless at age 45 in the UK, which is higher than some other countries. This could justify a lower long-term trend.

2.25 One expert questioned why trends in Scotland might have diverged from trends seen in England and Wales and why there has been a continued drop in the number of births. NRS will look into this.

2.26 Another expert suggested looking at fertility rates according to “time since leaving education” rather than age. Staying in education longer may reduce the time available to have more children since people would generally be having children later. With 50% of people now going into higher education, the expert questioned whether we have reached a point where that trend will stop.

2.27 There was a discussion about how experts had reached their conclusion of lower long-term fertility. One expert noted the strong association between the age at which a woman has her first child and completed family size (CFS). If childbearing starts later, there is less time to have a CFS of three or more children. They also took into account their assessment of future levels of migration. Another based their assumption on the current precariousness of employment and housing. Whilst another agreed on the point made about employment and economic uncertainty, they based their assumption on climate and environmental change impacting on attitudes.

2.28 It was noted that the availability of Child Tax Credit for a third child has now been restricted within current UK welfare policy. One expert had undertaken an analysis, which showed that receipt of Child Tax Credit is associated with the likelihood of making the transition to a third birth. However, this association does not prove a causal connection between the policy and fertility. Research by Mike Brewer on the introduction of the Child Tax Credit showed a small effect with the least educated women showing a slight rise in fertility.

2.29 The general consensus was the long-term TFR assumption of 1.89 should be lowered.

2.30 Experts felt Assisted Reproductive Technology (ART) would only have a small effect in the short term, but they were uncertain of its effect in the long term (25 or more years). In Denmark, 4% of births are via ART, however, only a fraction of those who would have started their fertility earlier can benefit.

2.31 There was further discussion relating to research carried out on ethnic projections concluding that, regardless of assumption, the population becomes more diverse over time. However, there is much uncertainty on the effect of this on fertility. Integration into British culture and the culture of particular groups may also have an effect on fertility decisions.

2.32 There was a discussion about whether the fertility rates of second and third generation migrants converge to those of the native population. For those born in Pakistan and Bangladesh, the births rates have converged but are still higher. A PhD thesis by Ben Wilson contains a more detailed analysis, which suggests there is convergence. It was noted that birth rates for second-generation migrants from countries such as Pakistan and Bangladesh depend on lifestyle, desires and expectations of the roles of women. It was noted that Poland has a lower fertility rate than the UK and there was speculation as to whether the fertility rates of second-generation Polish mothers will increase towards the UK average. One expert suggested looking at research on the fertility of second-generation ethnic minorities undertaken by Hill Kulu and Tina Hannemann. It was also noted that these differences give a regional pattern.

2.33 Emily asked whether TFR is the right method to use or whether parity progression ratios (which are lower than the traditional TFR) should be used. One expert explained that if parity progression ratios were used it would be difficult to know if a change in a pattern was due to a change of methodology in collecting information about birth order, or is a real trend.

2.34 Attendees discussed the use of variant projections. Experts felt that the high and low variants around population projections should not produce impossible figures. So rather than arbitrarily setting variants to plus or minus a certain figure, care should be taken in assessing whether the resulting projections could actually happen. One expert suggested exploring the use of confidence intervals similar to the UN projections. Paul noted that the high and low variants do not need to be symmetrical around the principal assumption if this means that one and /or the other is implausible. Another expert asked whether variants aim to show confidence or whether they are scenarios. They felt that if the variants are to indicate confidence, asymmetry is more sensible.

## 3. Mortality

### Introduction

3.1 Sophie Chapman and Adrian Gallop gave a presentation on mortality trends and summarised the results of the expert questionnaire:

3.2 Past trends in UK period life expectancy at birth were reviewed. From 1841 to 2015, there were three stages; a slow increase in period life expectancy over the last half of the 19th century followed by a faster increase in 1900 to 1950 before a slower increase again from 1950 onwards. Period life expectancy at birth in 2015 was 79.1 years for males and 82.7 years for females, a gap of 3.7 years. Period life expectancy at age 65 years for females rose from the early 1900s whereas for males increases only really began from the late 1960s.

3.3 Period expectations of life at birth in 2015 were compared internationally. Japan continues to have the highest life expectancy at birth in the world for females, at 86.8 years. For males, Switzerland, at 80.7 years, has overtaken Japan (at 80.5 years).

3.4 UK age standardised mortality rates (ASMR) from 1995 to 2015 were presented. ASMR for both males and females have been falling; however, a small increase was seen from 2014 to 2015 for both sexes.

3.5 The standardised numbers of deaths from 2002 to 2015 were presented. There has been a clear steady decrease in the standardised number of deaths seen in both males and females from 2002 to 2011; however, since 2011, the trend began to slow down, and increased between 2014 and 2015. It is difficult to tell what will happen in the next few years.

3.6 ASMR by selected major cause for males and females for 1983 to 2013 was shown. Recent improvements in mortality have been driven by large falls in deaths from circulatory diseases. The ASMR for cancer is now higher than for circulatory diseases so is likely to have greater effect on future rates of mortality improvement.

3.7 Dementia and Alzheimer's were the leading causes of death in females in 2015, while the leading cause of death was ischaemic heart disease for males. In 2015, dementia and Alzheimer's accounted for 11.6% of all deaths registered in England and Wales while 11.5% of deaths were attributed to ischaemic heart disease.

3.8 Lexis diagrams (heat charts) of mortality show those born around the early 1930s continue to show the highest rates of mortality improvement; this was true for both males and females. It was noted that perhaps period effects were starting to dominate improvements for those aged 70 and under in 2010.

3.8 Adrian presented two methodologies that will be dual run for the 2016-based projections:

The University of Southampton (UoS) methodology:

- models mortality improvements using a generalised additive model (GAM)
- accounts for variation in mortality differences over time and between different ages and cohorts
- uses a smoothed combination of age, age-specific improvements, period and cohort effects with the relative size of each determined by the input data
- for older ages baseline mortality and age specific mortality differences are estimated using a parametric model
- uses long-term inputs

The UK population mortality projections methodology:

- estimate current rates of mortality improvement by age and sex
- set target rates of mortality improvement for some future year (the target year)
- make assumptions on method and speed of convergence of current improvement rates to target rates and how improvement rates change after target year
- apply successively to assumed base mortality rates

3.9 Assumed percentage changes in smoothed death rates between 2013 and 2014 were presented for males and females. Scotland was assumed to have different, mainly lower levels of improvement at some ages.

3.10 Potential drivers for future mortality change were listed as:

- changes in bio-medical technology
- policy changes and funding cuts to NHS and social care
- behavioural changes related to health
- decline in smoking prevalence
- lifestyles
- obesity
- emergence of new diseases (for example, Alzheimer's)
- re-emergence of old diseases (for example, TB)
- environmental change, disasters, wars
- changes in population composition, cohort effects, migrants

3.11 The choice of the target rate of improvement was then addressed. Adrian noted that rates of improvement for the older ages are of most importance as these ages are where most deaths occur. The standardised average rate of improvement over the last 100 years has been around 1.2% per annum. Cohorts exhibiting the greatest improvement will be aged 100 to 110 years in 25 years and so will not contribute much to the overall rate of improvement. There is continuing debate as to whether future technical, medical and environmental changes will have greater or lesser impact than in the past.

3.12 It was assumed cohorts with the highest improvement rates will continue to show higher rates of improvement.

3.13 Comparisons were made for historical and assumed overall annual rates of mortality improvement.

3.14 Projected ONS period life expectancies at birth in 2060 were compared to those projected in other countries by national statistics agencies. ONS projected period life expectancies at birth were ranked around the middle for the countries shown.

3.15 The expert questionnaires were summarised. When asked about six drivers of future improvements in mortality identified, the majority of responses were either small changes up or down or little or no change. Only one response estimated a large upward change due to biomedical technology. Obesity levels are expected to remain at similar levels and have little effect on mortality.

3.16 The general opinion is that the target rate should vary by age and be the same for males and females. Opinion varied on what the target rate should be – 1.2% was the target rate in the 2014-based projections and most experts agreed with this for this round. There was some suggestion of females slowing to 1.0%. Most thought that the higher rates will continue for the golden cohort and reduce in the next 5 to 25 years. Having the higher target rates for the golden cohort doesn’t have a large effect.

3.17 The responses from the expert questionnaire gave an average life expectancy of 80.2 years for males and 83.8 years for females in 2020. Both male and female averages were lower by 0.1 compared with the previous expert panel.

3.18 In 2040, the expert responses gave average life expectancies of 84.4 years and 87.5 years for males and females respectively. In the 2014-based expert panel the life expectancies were averaged as 84.9 years for males and 88.2 years for females. The experts’ average life expectancy at birth for 2040 is higher than what was projected for that year in the 2014-based projections.

## Discussion

3.19 Questions regarding the choice of target rate of mortality improvement were presented to the experts. These encouraged discussion around whether 1.2% is too optimistic, whether the improvement rates should be varied by age and whether the same rate should be assumed for men and women. It was noted that in the US and Canada projections for their social security programs, which also use long-term target rates of improvement, the assumed target improvement rates are varied by age. However, depending on the size and differentials in improvement rates between ages this can lead to mortality rates crossing over in future years with those at older ages falling below those at younger ages.

3.20 Adrian explained there has been little improvement over the last five years in mortality. For 2015 this was initially thought to be the result of an ineffective vaccine against the strains of flu prevalent in 2015 but recent research suggests this was not the main cause. It is not known whether this deviation from the long-term trend was simply a “blip” or whether it signalled the emergence of a new trend.

3.21 Adrian noted that there is more interest in what the long-term improvement rates should be. When looking at the drivers of mortality improvement, there is no evidence to suggest obesity is improving and it is believed that most of the gains from changes in smoking patterns have now been realised.

3.22 An expert noted that Danny Dorling’s research found the recent deviations in period life expectancy to be significant for those aged 60 and over.

3.23 Further discussion surrounded the advances in medicine and the effect of “levelling out” of disease treatments and whether an improvement rate of 1.2% was too optimistic. Paul gave the example of the advances in the treatment of heart disease providing less improvement to mortality in recent years. One expert explained these “flattening” trends are also seen in other countries. Another expert stated that although these trends are observed in other countries, the causes may be different; for example, they could be related to the use of recreational drugs in certain countries.

3.24 An expert asked what was known for those aged 65 to 74 and over and whether differences in life courses, drug and alcohol use were taken into account in mortality assumptions. Adrian explained the argument for assuming an improvement of below 1.2% includes considering life courses, alcohol consumption and drug use.

3.25 One expert pointed out social economic status (SES) affects mortality too, and another expert stated that mortality also varies by ethnic groups with additional differences dependent on ethnic composition and employment composition. However, the calculation of ethnic differentials is dependent on data availability. Adrian noted that migrants tend to be among the healthiest of their country but this varies by reason for migrating but they may be more, or less, healthy than the general population of the country they migrate to. The question is then whether the mortality of migrants tends to that of the home population over time; for instance, migrants to the UK receive the same medical support as the UK population.

3.26 One expert felt an improvement rate of below 1.2% may not be suitable despite the changes seen in the last five years as the starting mortality will be higher. The expert had heard no evidence to justify reducing the improvement rate.

3.27 The variant assumptions were discussed again. It was suggested that variants should be based on possibility as opposed to simply a different value of the assumptions as a variant that is very unlikely to occur is of little use. On the other hand such variants can be used to illustrate sensitivities to the choice of assumptions. One expert noted a strong argument for asymmetric bounds for mortality as improvement rates could be lower but there is not much chance they will be higher. Adrian noted that a 2.4% per annum long-term improvement rate (the higher variant for the 2014-based NPPs) is more difficult to explain as a possibility but could represent a continuation of the rate of improvements in the life expectancy observed in the past.

3.28 There was a brief discussion on the methodology employed by other statistical organisations such as the UN, which produces probabilistic mortality assumptions.

3.29 Adrian described the ONS methodology and explained the ONS currently use a top-down approach that analyses data for the UK as whole then derives assumptions for each constituent country from that. There is a 25-year run in period before the mortality assumptions are held constant and the same for all constituent countries. ONS is undertaking research into using a more bottom-up approach to mortality.

3.30 An expert asked what assumptions are made about the future trend in inequalities in mortality, or how changes would develop by socio-economic status (SES), to which Adrian responded ONS do not make assumptions by SES.

3.31 Another expert asked how much of the regional difference in life expectancy in the UK is due to regional patterns of industry, and whether in future generations, the regional patterns will converge.

3.32 One expert discussed evidence that obesity in the UK is increasing and asked whether other experts think a link between obesity and mortality will develop, stating obesity was not found to affect mortality in the past; however, with the recent “flattening” mortality trends, would obesity now have an effect? Another responded that obesity has a large effect on long-term morbidity but not on mortality. Also noted was the Foresight report, which stated that obesity is leading to increases in other causes of mortality. On the other hand, statins may be overcompensating for obesity.

3.33 An expert questioned the effect of Brexit on mortality, suggesting that the UK’s departure from the EU may lead to older generations returning to the UK. Although these people are likely to have lower mortality risk they might place a strain on the health care system.

3.34 One expert summarised that the experts cannot think of anything in particular that will have a major effect on mortality in the next 10 years.

## 4. Migration

### Introduction

4.1 Paul opened the migration discussion and stated the overall consensus is migration is the most difficult component to project.

4.2 Andrew Nash gave a presentation on migration, highlighting recent trends and previous assumptions.

4.3 Under the 2014-based principal national population projection, the UK net migration projected for mid year ending 2015 was 329,000, the figure from the long-term international migration (LTIM) data series was estimated at 336,000 for the same period. The projected net migration for mid year ending 2016 was 256,000; the provisional LTIM figure was estimated to be 335,000.

4.4 Net migration remained relatively low until around 1997. Further increases were seen during the 2000s, this was in part as a result of immigration of citizens from the countries that joined the EU in 2004. Since the mid-2000s, annual net migration has fluctuated between around 150,000 and 300,000. There was a notable drop in net migration from 2010 to 2013 before rising to 332,000 in the year ending December 2015, the highest calendar year figure on record.

4.5 The latest provisional data indicate a statistically significant increase in Romanian and Bulgarian (EU2) immigration from 55,000 to 74,000 in the year ending September 2016.

4.6 The latest figures show around 43% of all immigration is from outside of the EU, 45% are from the EU and the rest are British. Historically, non-EU immigration has always exceeded EU immigration; provisional figures for the year ending September 2016 shows EU migration exceeding non-EU for the first time.

4.7 Work and study have been the main reasons for immigration in the recent past. Immigration for work-related reasons dropped off from the end of 2007 in the wake of the credit crunch. Study increased around the same time and overtook work as the most common reason for migration. This trend was then reversed in 2013 when work overtook study and peaked at 311,000 in the year ending June 2016. Immigration for study remained relatively stable over the same period but saw a statistically significant decrease most recently from 175,000 in the year ending September 2015 to 134,000 in the year ending September 2016. Work now accounts for 49% of immigrants while 22% immigrated for study.

4.8 The top five most common countries of last residence in 2015 were Romania, China, Poland, India and Spain.

4.9 In the latest available figures, around 40% of all emigration is by British citizens, 32% by non-EU and 29% by EU. Emigration of British citizens has remained stable since 2013; an increasing trend is seen for EU citizens since 2012.

4.10 Work is the most common reason from emigrating from the UK; over half (53%) of all emigrants left the country for work-related reasons in the year ending June 2016.

4.11 The most common countries of next residence in 2015 were Australia, US, Spain, France and China. Australia has remained the most common country of next residence since 1996. However, the number of people emigrating to Australia has fallen every year since 2011. In 2015 a total of 32,000 people emigrated to Australia, down from 38,000 in 2014.

4.12 Results of the expert questionnaire were discussed. There was much uncertainty from the experts indicated by mixed responses.

4.13 The average response of net migration in 2020 was 221,000 with average confidence ranges of 170,000 to 289,000 at 67% confidence and 64,000 to 354,000 at 95% confidence.

4.14 The average response of net migration in 2040 was 144,000 with average confidence ranges of 78,000 to 303,000 at 67% confidence and -61,000 to 374,000 at 95% confidence.

## Discussion

4.15 When asked for thoughts on the effect of the economy, political instability and the UK’s exit from the European Union (“Brexit”), one expert pointed out they felt it was a difficult question to answer; there are distinct groups of migrants to consider. For example, those coming to study may be affected by exchange rates while those coming for work may be affected by policy. The expert also pointed out that policy changes could override the effects of all of those previously mentioned and that it was impossible to know the effect of any future policies at this stage.

4.16 The same expert highlighted the huge uncertainty on the UK’s exit from the EU explaining that although Brexit is a short-term process, it is impossible to predict the future, giving an example of “No one can say for sure whether the EU would still exist in its current form by 2040”.

4.17 One expert explained the need to look at different routes of entry for migration, summarising:

- there will probably not be much change to the number of asylum seekers; the UK has historically not been associated with accepting large number of refugees and asylum seekers in comparison with other EU countries

- there may be a change in the number of students; although there is demand from UK universities for international students, the attractiveness of UK universities may be decreasing due to other countries offering higher education in the English language

- there are currently work restrictions placed on non-EU students after graduation in the UK; other countries in the EU are actively encouraging international students to enter their work forces while there are no such policies in the UK at present

- although there may be a brief decline in net migration, the expert felt that over time net flows will again increase as a result of family reunification

- in terms of the UK's dependency on EU workers in sectors such as agriculture, the expert highlighted that prior to the accession of EU8 countries, there was much more capital investments in these sectors, which stopped as more EU workers entered the work force; however, the capital investment may once again increase in response to a diminishing EU work force leading to less demand for low-skilled work – although specific skills will always be required, the expert felt that overall the net migration to the UK will decrease after Brexit

- reference was made to research by the National Institute of Economic and Social Research on National Insurance number registrations and International Passenger Survey (IPS) data; the research showed evidence to suggest that net migration will go down if there is no freedom of movement

4.18 One expert asked that although sectors such as agriculture have been considered, what about the care sector?

4.19 The previous expert responded with the following comments:

- from a previous project, just prior to 2004, some evidence suggested that the care sector in the UK was still "old fashioned", and could input new technology, reducing the need for face-to-face contact and thus demand for workers

- evidence from other EU countries at last autumn's OECD and SOPEMI conference suggests that migrants from EU8 and EU2 countries who might otherwise have come to the UK are going elsewhere, such as Germany and Austria

- it would be useful to monitor the statistics of the other EU countries to see what evidence there is of flow diversion

4.20 Another expert's view is that the long term is much more important than the short term. The UK may initially implement restrictive visa policies after leaving the EU resulting in lower levels of migration in the short term. However, since the process of leaving will take at least two years, such policies could also increase migration as migrants seek to enter the UK before they are officially enforced. Additionally, it is impossible to know how long restrictive policies will be in place, and there could also be changes to migration streams once the UK leaves the EU. In the long term, policies will adapt in response to needs. Overall this expert felt there will be a decline in net migration in the long term but levels would remain at the hundreds of thousands.

4.21 Another view was that a reduction in emigration resulting from less EU migrants in the UK would also have an impact on net migration. Andrew noted that it is currently easy for British people to work in the EU. Places such as China have growing opportunities. When suggested that British people might emigrate to countries with stronger economies such as Australia, one expert noted that the end of the mining boom is already suppressing internal migration and in the next few years there is likely to be a decline in international immigration to Australia.

4.22 An expert commented on producing projections of economy then producing population projections around them.

4.23 The experts warned against producing a “knee-jerk” decline in projections stating that policy-makers would find a scenario based on a growing population and people continuing to migrate in the long term more useful. The projections should not attempt to pre-empt policy change. Instead, the assumptions of the projections should be communicated clearly.

4.24 In response to being asked their views on cross-border migration, one expert asked if any work has been done on producing internal migration rates in the sub-national population projections using the same basis as the NPPs using the Statistics Canada model. Andrew confirmed that the ONS is not currently undertaking such work.

4.25 One expert noted that the government has been keen to attract migrants of working age. With Brexit there might be incentives to increase cross-border migration. Another suggested a potential skills shortage in London might result in more movement across the UK.

4.26 Andrew asked for the experts’ views on the use of a simple 25-year average to set long-term assumptions, since such a period would include periods of historically high migration along with the comparatively lower levels of net migration seen over the 1990s. It also includes the period prior to EU accession and after the vote to leave the EU.

4.27 The experts agreed with the simplicity and transparency of the approach and an expert further commented that there was no point in using complex methods if they do not add anything.

4.28 When asked after how many years the long-term assumption should begin, there were no strong views. One expert noted that Brexit would suggest a longer rather than a shorter run in. Another noted that 10 years would reflect a full economic cycle.

4.29 There was a general consensus of massive uncertainty surrounding migration.

4.30 Andrew asked experts for their feedback on the expert questionnaire.

4.31 The experts seemed to appreciate being able to provide confidence intervals around their suggested assumptions. There were mixed views on whether the 67% and 95% confidence questions should be reduced to only one confidence level.

4.32 An expert stated that ONS should consider the onward use of NPPs in terms of sub-national population projections, a bottom-up approach to projections may be an alternative.

4.33 Paul stated the principal projections will be independent, but if stakeholders want a variant under certain assumptions, these could be produced.

4.34 An expert asked what will happen in regards to collaboration with Eurostat to which Paul answered ONS are not sure at this stage and it is dependent on negotiations.

## 5. AOB

5.1 In closing, Paul thanked all attendees and experts for their participation.

# 9 . Appendix B: Expert panel analysis

The national population projections (NPP) expert advisory panel of eight demographic experts met in April 2017. In an accompanying questionnaire, we asked for their opinions on the likely future levels and trends in fertility, mortality and migration. This section summarises the main findings.

## Fertility

### Short-term trends in UK fertility

In terms of likely trends in age-specific fertility rates (ASFRs) up to 2020, all experts thought the ASFRs would decrease for women under the age of 20 years. For women in their 20s one expert thought the ASFRs would remain stable, all other experts thought the ASFRs would decrease. For women aged 30 and over the majority of experts thought the ASFRs would increase.

We asked experts what they expected period total fertility rate (TFR) to show in the short term (up to 2020). Five thought the TFR would continue at the levels of 2015 (1.80), and the remaining three thought TFR would experience a small and continued decrease. The main reasons given were that economic uncertainty and changes to immigration policies associated with Brexit were likely to result in the postponement of births.

### Quantitative estimates for 2020

We asked the experts to quantify the most likely level of the TFR in 2020, together with values that would define a range with 67% and 95% likelihood. Figures 1.1 and 1.2 show the predictions for 2020. Estimated TFRs for 2020 ranged from 1.70 to 1.82; four were between 1.80 and 1.82. The mean was 1.78; this is lower than the 2014-based projection for 2020 of 1.84. On average, experts believed that there was a 67% chance of the TFR lying between 1.66 and 1.95 in 2020 and a 95% chance of it lying between 1.64 and 1.94 (these figures are based on the experts' responses as written; we are aware the measures are inconsistent).

**Figure 1.1: Respondents' estimates of the total fertility rate (TFR) in 2020 (and associated 67% confidence intervals), UK**

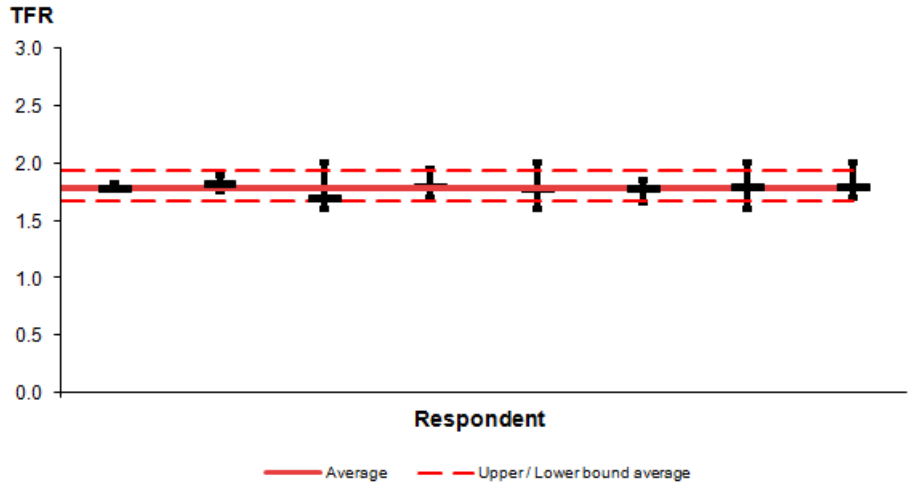
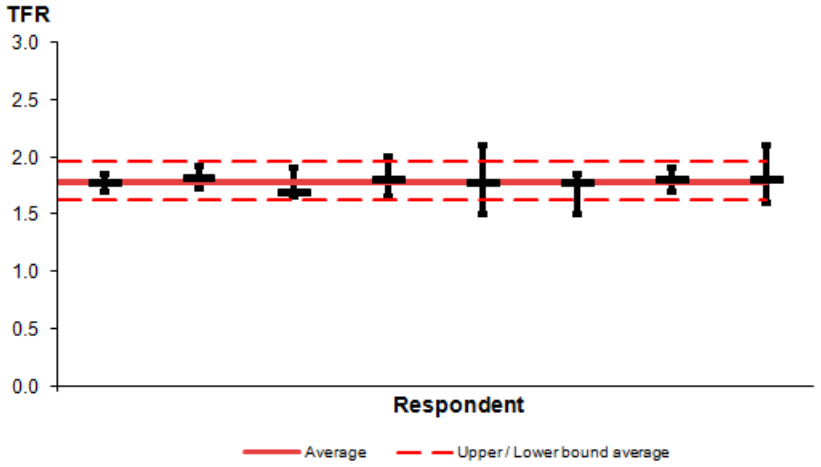



**Figure 1.2: Respondents' estimates of the total fertility rate (TFR) in 2020 (and associated 95% confidence intervals), UK**




## Long-term trends in UK fertility

We asked the experts for their views on the most likely level of the total fertility rate (TFR) in 2040. The average TFR predicted for 2040 was 1.79; this is lower than the 2014-based projection of a TFR of 1.89 in 2040, which may support decreasing the long-term assumption. Six out of eight experts thought that the TFR would be between 1.80 and 1.90 in 2040, while two experts estimated lower TFRs of 1.60 and 1.65. On average, experts believed that there was a 67% chance of the TFR in 2040 lying between 1.60 and 1.98 and a 95% chance of it lying between 1.54 and 2.06.

**Figure 1.3: Respondents' estimates of the total fertility rate (TFR) in 2040 (and associated 67% confidence intervals), UK**

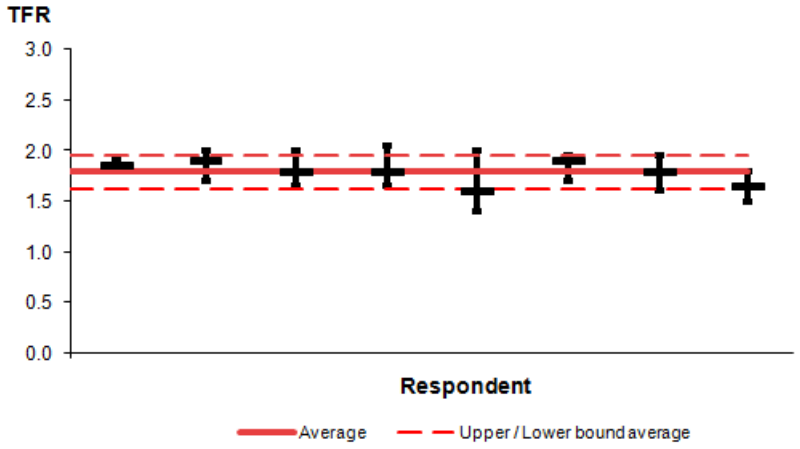
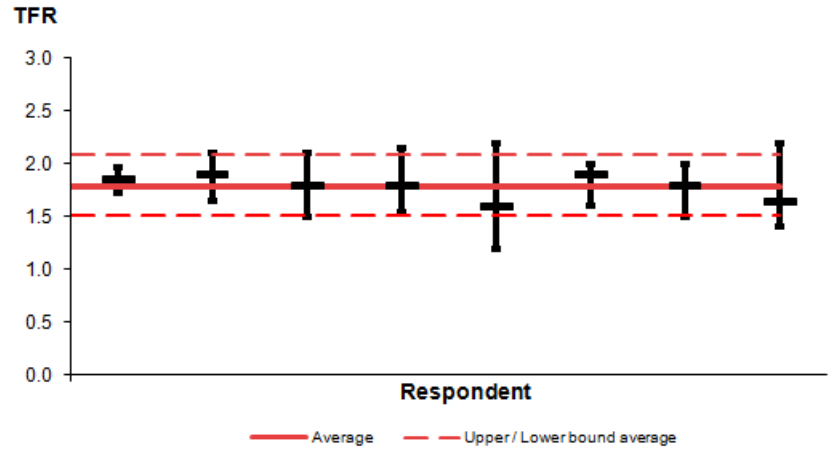



**Figure 1.4: Respondents' estimates of the total fertility rate (TFR) in 2040 (and associated 95% confidence intervals), UK**




## Underlying forces that may influence future fertility

We asked the panel to consider six forces with the potential to affect fertility levels in the long-term (to 2040) and assess the overall likely impact on future family size.

There was the highest level of agreement that “Changes in population composition and differential trends in population sub-groups, for example, the fertility of non-UK born groups”, would lead to a small upwards trend in fertility. Seven of eight panellists held this opinion, while one expert thought it would lead to a small downwards trend.

Most experts thought the “Trend in ideal family size and (the strength of) individual desires for children” would have little or no effect on fertility (five out of eight). Two thought it would have a small downwards effect, while one thought it would have a small upwards effect.

Half of the experts thought “Trends in patterns of education and work (including the proportion of time dedicated to the professional side of life)” would have a small downwards effect on fertility. Two thought it would have little or no effect, and two thought it would have a small upwards effect.

Half of the experts thought “Trends in income (including indirect income such as free childcare hours)” would have little or no effect on fertility. Three thought it would have a small downwards effect and one thought it would have a small upwards effect on fertility. One expert highlighted the research that shows the receipt of Child Tax Credit is positively associated with having a third child.

There was a mixed opinion on the effect of the “Changing nature and stability of partnerships, for example, the rise of cohabiting parents” on fertility. Three thought it would have little or no effect, another three thought it would lead to a small downwards effect and two thought it would lead to a small upwards effect.

The experts were split over the effect of “Changing biomedical conditions such as new or greater use of assisted reproductive technologies” on fertility. Half of the panellists thought it would have a small upwards effect, while the other half thought it would have little or no effect.

Additional forces some experts felt to be important in shaping future fertility were macroeconomic and political factors, shortages of affordable housing, the changing patterns in social interaction and the increased tendency to communicate remotely via social media.

## Mortality

### Short-term trends in UK mortality

We asked the experts for their views on expectations of life at birth in the UK, and on a series of factors that could influence mortality either positively or negatively.

On average the experts estimated the male expectancy of life at birth would be 80.2 years in 2020 and for females it would be 83.8 years. These values are lower than the 2014-based projected values for 2020 of 80.8 years for males and 84.1 years for females. The average 67% confidence intervals were 79.5 to 80.9 years for males and 83.0 to 84.4 years for females; and average 95% confidence intervals were 79.2 to 81.1 years for males and 82.5 to 84.6 years for females. One expert did not respond to this question.

**Figure 1.5: Respondents’ estimates of period life expectancy for males in 2020 (and associated 67% confidence intervals), UK**

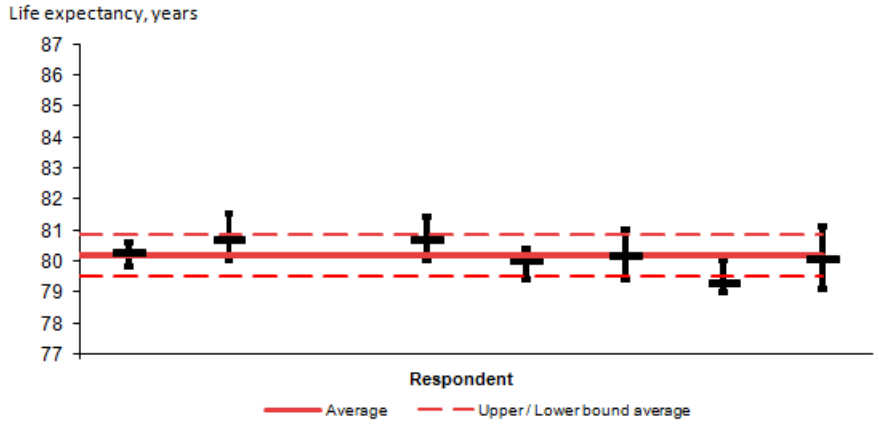


**Figure 1.6: Respondents' estimates of period life expectancy for males in 2020 (and associated 95% confidence intervals), UK**

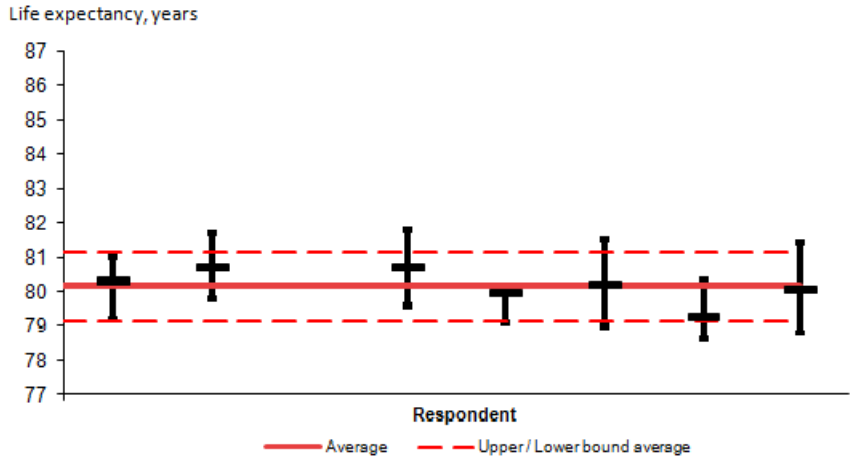



**Figure 1.7: Respondents' estimates of period life expectancy for females in 2020 (and associated 67% confidence intervals), UK**

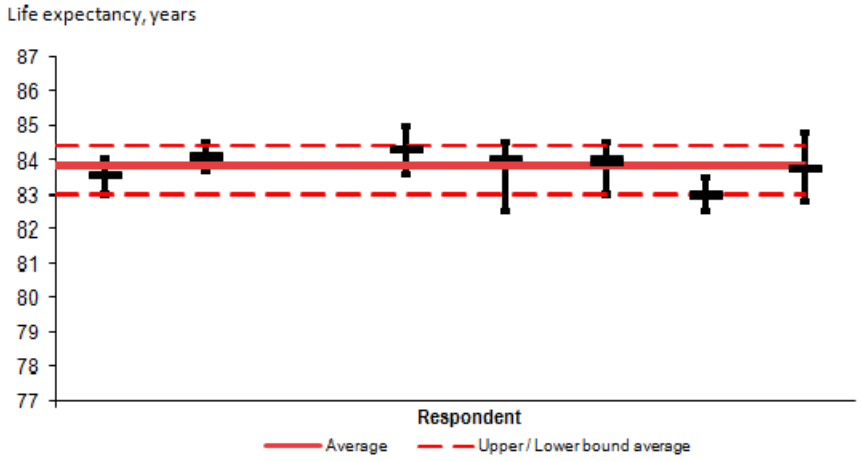
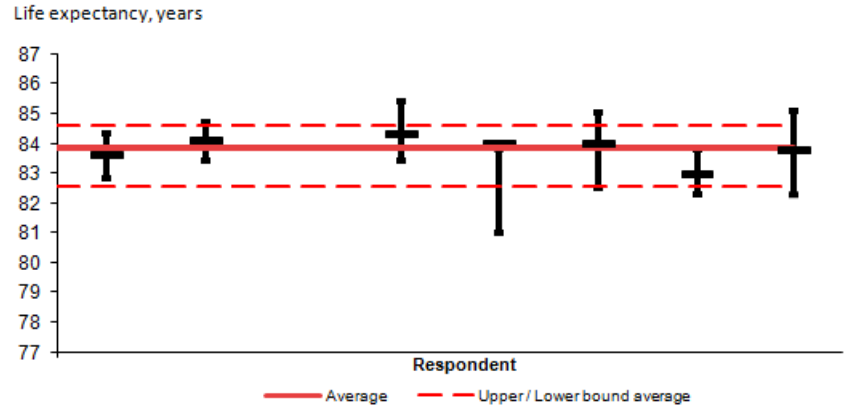



**Figure 1.8: Respondents' estimates of period life expectancy for females in 2020 (and associated 95% confidence intervals), UK**



On average the experts estimated the male expectancy of life at birth would be 84.4 years in 2040 and for females it would be 87.5 years. These values are higher than the 2014-based projected values for 2040 of 84.2 years for males and 87.0 years for females. The average 67% confidence intervals were 82.7 to 85.5 years for males and 85.7 years to 88.4 years for females; and average 95% confidence intervals were 81.3 to 86.8 years for males and 84.3 to 89.4 years for females. One expert did not respond to this question.

**Figure 1.9: Respondents' estimates of period life expectancy for males in 2040 (and associated 67% confidence intervals), UK**

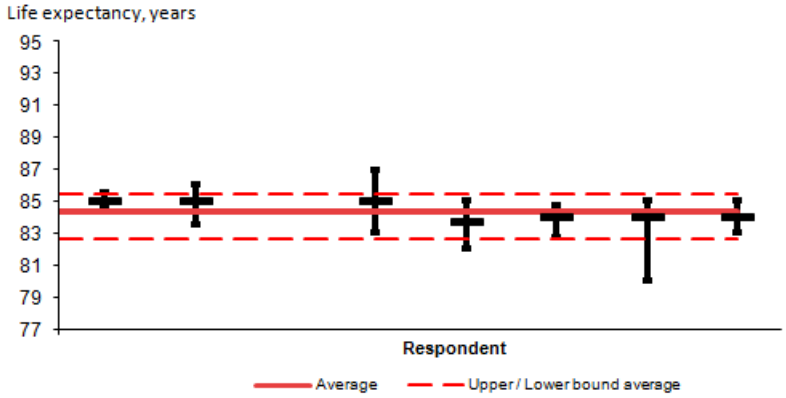



**Figure 1.10: Respondents' estimates of period life expectancy for males in 2040 (and associated 95% confidence intervals), UK**

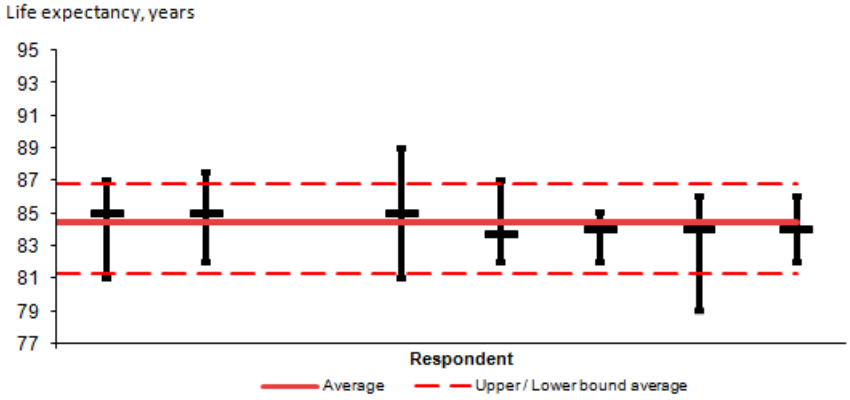


**Figure 1.11: Respondents' estimates of period life expectancy for females 2040 (and associated 67% confidential intervals), UK**

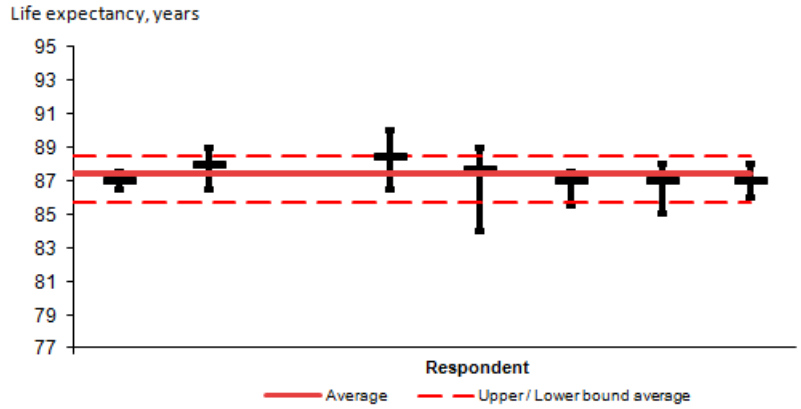
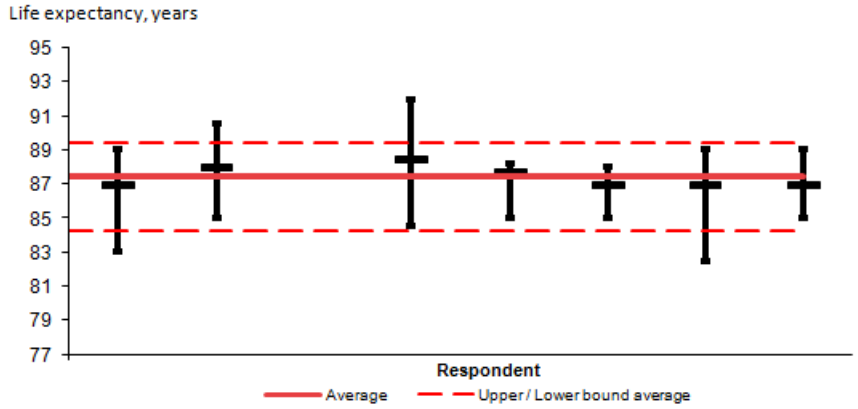



**Figure 1.12: Respondents' estimates of period life expectancy for females in 2040 (and associated 95% confidential intervals), UK**




## Forces likely to affect life expectancy

We asked the experts to assess the main forces that could affect the future path of life expectancy at birth (EOLB) over the next 25 years. The majority opinion was that changes in health-related behaviours and biomedical technology were most likely to result in improvements to EOLB.

Seven out of eight experts thought the resurgence of old diseases and/or new infectious diseases were most likely to result in a decrease to EOLB. Around half thought environmental change, disasters and war, changes in the population composition, and the effectiveness of the health care system would have a downwards effect on EOLB.

Additional factors the experts noted could be important drivers of life expectancy over the next 25 years are access to social care for the elderly and increasing antibiotic resistance.

### Likely improvements to life expectancy

The majority opinion was that the annual rates of improvement assumed for the 25th year should be kept as 1.2% per year as in the 2014-based projections. Some experts felt this rate should be reduced to 1.0%; males (two out of eight) and females (three out of eight).

Five out of eight experts did not feel it was reasonable to assume the annual rates of improvement for the 25th year should be the same for all ages. The main reason expressed was that they believed that for the very old the rate should decrease with increasing age.

The majority thought the rates of mortality improvement for cohorts born between 1925 and 1938 should continue to be higher than the rates of mortality improvement for those born before 1925 or after 1938. Three experts thought the rates of mortality improvement would remain higher, one thought the rates would subsequently decrease in the short term, and two experts thought it would decrease over the medium term (5 to 25 years).

### Obesity levels

The majority of experts thought obesity levels would remain broadly similar or increase over the next 25 years. One expert thought obesity levels would decrease.

The majority opinion was that these predicted changes in obesity levels would result in little change on life expectancy over the next 25 years. Two experts thought it would have a small downwards effect and one thought it would have a small upwards effect.

## Long-term international migration

We asked the experts about their views on the levels of long-term international migration to and from the UK in 2020 and 2040 (five years and 25 years into the future from the 2015 estimates, which were the latest available at the time).

Only seven of the eight experts provided estimates of likely future levels of long-term international migration. In addition, one expert did not provide 67% confidence intervals around their estimated future levels of net migration but did provide 95% confidence levels.

### Long-term international migration in 2020

The experts predicted that, on average, annual long-term immigration to the UK in 2020 would be 516,000, with an average 67% confidence interval of 400,000 to 589,000 and 95% confidence interval of 323,000 to 627,000.

The average annual long-term emigration from the UK in 2020 was predicted to be 313,000, with an average 67% confidence interval of 258,000 to 383,000 and 95% confidence interval of 226,000 to 410,000.

The average annual long-term net migration to the UK in 2020 was predicted to be +221,000, with an average 67% confidence interval of +170,000 to +289,000 and 95% confidence interval of +64,000 to 354,000.

The upper and lower band averages were influenced by two experts’ very wide confidence interval estimates.

**Figure 1.13: Respondents' estimates of net migration in 2020 (and associated 67% confidence intervals), UK**

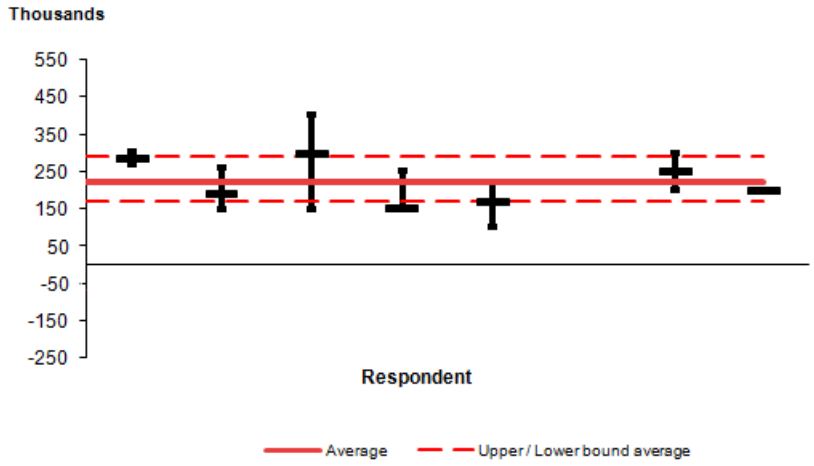
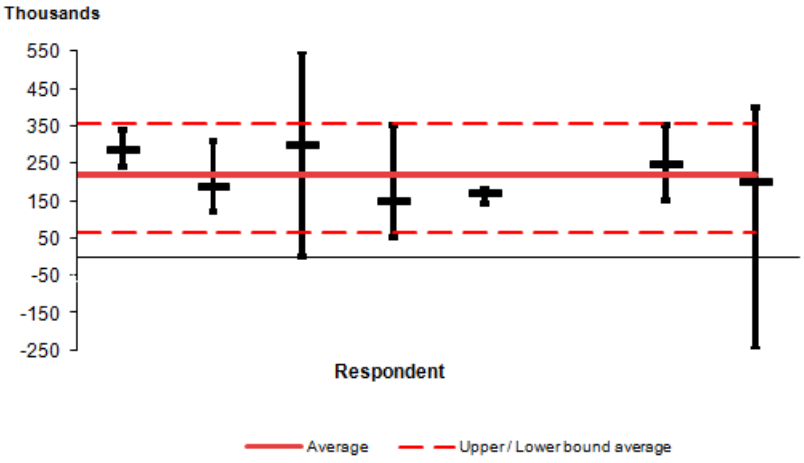



**Figure 1.14: Respondents' estimates of net migration in 2020 (and associated 95% confidence intervals), UK**




## Long-term international migration in 2040

On average the experts estimated annual long-term immigration to the UK in 2040 would be 441,000, with an average 67% confidence interval of 318,000 to 556,000 and 95% confidence interval of 230,000 to 630,000.

For long-term emigration from the UK, on average the experts thought in 2040, 318,000 would leave the UK. The average 67% confidence intervals were 214,000 to 413,000 and 95% confidence intervals were 170,000 to 469,000.

The average annual long-term net migration to the UK in 2040 was predicted to be +144,000; with the average 67% confidence interval of +78,000 to +303,000 and 95% confidence interval of -61,000 to +374,000. This is considerably lower than the longer-term assumption for the 2014-based projection of +185,000 per year.

**Figure 1.15: Respondents' estimates of net migration in 2040 (and associated 67% confidence intervals), UK**

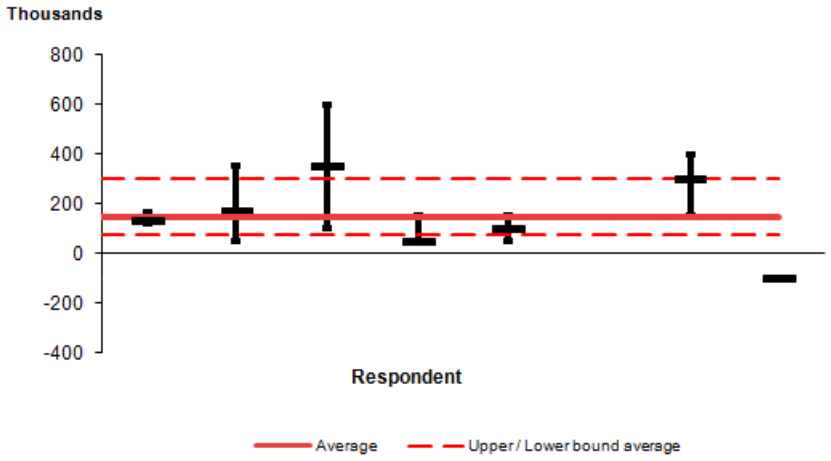
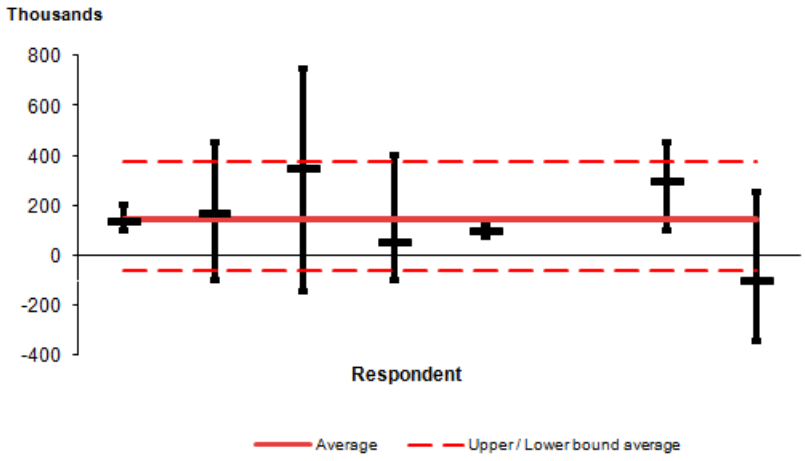



**Figure 1.16: Respondents' estimates of net migration in 2040 (and associated 95% confidence intervals), UK**




We invited the experts to consider four forces that could influence future international migration to the UK and assess the importance of these forces on UK net migration. These forces were:

- the economy
- political instability
- environmental change
- Brexit

## Economy

The experts had mixed views on how the changing global economy would affect UK net migration in both the short and long term.

In the short term, three experts thought it would have a small upwards effect, three thought it would have little or no effect, and two thought it would have a small downwards effect.

In the long term, three thought it would have a small downwards effect, one a large downwards effect, three a small upwards effect, and one thought it would have little or no effect.

Some experts thought possible stagnation of the economy or economic uncertainty would be likely to act as a deterrent for UK immigration.

### Global political instability

In the short term the majority of experts thought global political instability would have a small upwards effect on UK net migration (five out of eight). Three experts thought it would have little or no effect in the short term.

In the long term six out of eight experts thought political instability would have a small upwards effect on UK net migration. Two experts thought it would have little or no effect.

There was consensus from the experts that future political instability would be likely to result in an increase in refugees in both the short and long term; however, the UK's willingness to accommodate them would largely be determined by government policy.

### Environmental change

Half of the experts thought environmental change would cause little or no effect on the levels of UK net migration in the short term. The remainder thought it would have a small downwards effect (one out of eight) or an upwards effect (small: two or large: one) on UK net migration.

In the long term the majority thought environmental change would have a small upwards effect (five out of eight) and one expert thought it would have a large upwards effect on UK net migration.

Some of the experts suggested environmental change is likely to trigger environmental disasters in the long term, which is likely to increase flows in to the UK as a result of displacement. However, the actual immigration numbers would be contingent on governmental policy concerning the accommodation of refugees. Some experts also pointed out that climate change could also contribute to migration flows because of the growing aridity of regions at risk.

### Brexit

In the short term five out of eight experts thought Brexit would result in a small downward effect on UK net migration while one expert thought there would be a large downwards effect. The remaining two experts answered with small upwards and little or no effect respectively.

Similarly, in the long term, five out of eight experts thought Brexit would have a small downward effect while two experts believed it would cause a large downwards effect to UK net migration. One expert thought Brexit would have little or no effect. There was consensus among the experts that both the short- and long-term trends would be strongly influenced by government policy concerning the terms of Brexit.

### Cross-border migration

The main factors that the experts suggested were likely to impact on cross-border migration were possible Scottish independence and the future nature of the border between Northern Ireland and the Republic of Ireland (which may also impact onward movements to the rest of the UK).

### Other factors that could affect international migration

Other factors the experts noted could affect international migration:

- greater immigration restrictions by the US could divert migration flows to other destinations such as the UK
- global education markets – growing numbers of educated young people in developing countries could lead to an increase in international migration to the UK for education
- government policies towards international students
- an ageing population is likely to contribute to a greater demand for immigrants

# 10 . Appendix C: Changes to State Pension age

The following tables show how the legislated increases in State Pension age will be phased in. The published national projections output tables include the projected number and percentage of those of working age and pensionable age based on the phasing detailed in this section.

**Table 1.3: Date State Pension age will be achieved for women born between 6 April 1950 and 5 December 1953, UK**

| Date of birth | Date state pension age reached |
|---|---|
| 6 April 1950 to 5 May 1950 | 6 May 2010 |
| 6 May 1950 to 5 June 1950 | 6 July 2010 |
| 6 June 1950 to 5 July 1950 | 6 September 2010 |
| 6 July 1950 to 5 August 1950 | 6 November 2010 |
| 6 August 1950 to 5 September 1950 | 6 January 2011 |
| 6 September 1950 to 5 October 1950 | 6 March 2011 |
| 6 October 1950 to 5 November 1950 | 6 May 2011 |
| 6 November 1950 to 5 December 1950 | 6 July 2011 |
| 6 December 1950 to 5 January 1951 | 6 September 2011 |
| 6 January 1951 to 5 February 1951 | 6 November 2011 |
| 6 February 1951 to 5 March 1951 | 6 January 2012 |
| 6 March 1951 to 5 April 1951 | 6 March 2012 |
| 6 April 1951 to 5 May 1951 | 6 May 2012 |
| 6 May 1951 to 5 June 1951 | 6 July 2012 |
| 6 June 1951 to 5 July 1951 | 6 September 2012 |
| 6 July 1951 to 5 August 1951 | 6 November 2012 |
| 6 August 1951 to 5 September 1951 | 6 January 2013 |
| 6 September 1951 to 5 October 1951 | 6 March 2013 |
| 6 October 1951 to 5 November 1951 | 6 May 2013 |
| 6 November 1951 to 5 December 1951 | 6 July 2013 |
| 6 December 1951 to 5 January 1952 | 6 September 2013 |
| 6 January 1952 to 5 February 1952 | 6 November 2013 |
| 6 February 1952 to 5 March 1952 | 6 January 2014 |
| 6 March 1952 to 5 April 1952 | 6 March 2014 |
| 6 April 1952 to 5 May 1952 | 6 May 2014 |
| 6 May 1952 to 5 June 1952 | 6 July 2014 |
| 6 June 1952 to 5 July 1952 | 6 September 2014 |
| 6 July 1952 to 5 August 1952 | 6 November 2014 |
| 6 August 1952 to 5 September 1952 | 6 January 2015 |
| 6 September 1952 to 5 October 1952 | 6 March 2015 |
| 6 October 1952 to 5 November 1952 | 6 May 2015 |
| 6 November 1952 to 5 December 1952 | 6 July 2015 |
| 6 December 1952 to 5 January 1953 | 6 September 2015 |
| 6 January 1953 to 5 February 1953 | 6 November 2015 |
| 6 February 1953 to 5 March 1953 | 6 January 2016 |
| 6 March 1953 to 5 April 1953 | 6 March 2016 |
| 6 April 1953 to 5 May 1953 | 6 July 2016 |

| | |
|---|---|
| 6 May 1953 to 5 June 1953 | 6 November 2016 |
| 6 June 1953 to 5 July 1953 | 6 March 2017 |
| 6 July 1953 to 5 August 1953 | 6 July 2017 |
| 6 August 1953 to 5 September 1953 | 6 November 2017 |
| 6 September 1953 to 5 October 1953 | 6 March 2018 |
| 6 October 1953 to 5 November 1953 | 6 July 2018 |
| 6 November 1953 to 5 December 1953 | 6 November 2018 |

Source: Department for Work and Pensions

**Table 1.4: Date State Pension age will be achieved for men and women born between 6 December 1953 and 5 October 1954, UK**

| Date of birth | Date state pension age reached |
|---|---|
| 6 December 1953 to 5 January 1954 | 6 March 2019 |
| 6 January 1954 to 5 February 1954 | 6 May 2019 |
| 6 February 1954 to 5 March 1954 | 6 July 2019 |
| 6 March 1954 to 5 April 1954 | 6 September 2019 |
| 6 April 1954 to 5 May 1954 | 6 November 2019 |
| 6 May 1954 to 5 June 1954 | 6 January 2020 |
| 6 June 1954 to 5 July 1954 | 6 March 2020 |
| 6 July 1954 to 5 August 1954 | 6 May 2020 |
| 6 August 1954 to 5 September 1954 | 6 July 2020 |
| 6 September 1954 to 5 October 1954 | 6 September 2020 |
| 6 October 1954 to 5 April 1960 | 66th birthday |

Source: Department for Work and Pensions

**Table 1.5: Date State Pension age will be achieved for men and women born between 6 April 1960 and 5 March 1961, UK**

| Date of birth | Date state pension age reached |
|---|---|
| 6 April 1960 to 5 May 1960 | 66 years and 1 month |
| 6 May 1960 to 5 June 1960 | 66 years and 2 months |
| 6 June 1960 to 5 July 1960 | 66 years and 3 months |
| 6 July 1960 to 5 August 1960 | 66 years and 4 months (1) |
| 6 August 1960 to 5 September 1960 | 66 years and 5 months |
| 6 September 1960 to 5 October 1960 | 66 years and 6 months |
| 6 October 1960 to 5 November 1960 | 66 years and 7 months |
| 6 November 1960 to 5 December 1960 | 66 years and 8 months |
| 6 December 1960 to 5 January 1961 | 66 years and 9 months (2) |
| 6 January 1961 to 5 February 1961 | 66 years and 10 months (3) |
| 6 February 1961 to 5 March 1961 | 66 years and 11 months |
| 6 March 1961 to 5 April 1977* | 67 |

Notes:

1. A person born on 31st July 1960 is considered to reach the age of 66 years and 4 months on 30th November 2026.

2. A person born on 31st December 1960 is consider to reach the age of 66 years and 9 months on 30th September 2027.

3. A person born on 31st January 1961 is consider to reach the age of 66 years and 10 months on 30th November 2027.

* For people born after 5 April 1969 but before 6 April 1977, under the Pensions Ac t 2007, State Pension age was already 67.

Source: Department for Work and Pensions

**Table 1.6: Date State Pension age will be achieved for men and women born between 6 April 1977 and 5 April 1978, UK**

| Date of birth | Date state pension age reached |
|---|---|
| 6 April 1977 to 5 May 1977 | 6 May 2044 |
| 6 May 1977 to 5 June 1977 | 6 July 2044 |
| 6 June 1977 to 5 July 1977 | 6 September 2044 |
| 6 July 1977 to 5 August 1977 | 6 November 2044 |
| 6 August 1977 to 5 September 1977 | 6 January 2045 |
| 6 September 1977 to 5 October 1977 | 6 March 2045 |
| 6 October 1977 to 5 November 1977 | 6 May 2045 |
| 6 November 1977 to 5 December 1977 | 6 July 2045 |
| 6 December 1977 to 5 January 1978 | 6 September 2045 |
| 6 January 1978 to 5 February 1978 | 6 November 2045 |
| 6 February 1978 to 5 March 1978 | 6 January 2046 |
| 6 March 1978 to 5 April 1978 | 6 March 2046 |
| 6 April 1978 onwards | 68th birthday |

Source: Department for Work and Pensions

Sources: Pensions Act 1995 Chapter 26 Part II Section 126 and Schedule 4; Pensions Act 2007 Chapter 22 Part I Section 13 and Schedule 3; Pensions Act 2011 Part 1 Section 1 and Schedule 1; Pensions Act 2014 Part 3 Section 26 and Section 27.

Compendium

# Summary results

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Next release:
To be announced

## Table of contents

# 1 . Introduction

This article provides a summary of the results of the 2016-based national population projections for the UK and provides additional charts and summary tables illustrating the results of the projections. For discussion of the results see the statistical bulletin.

Included in this report are:

- results, which can also be examined using the interactive population pyramids, which allow comparisons of the projected age structure up to mid-2116
- comparison with the results of the 2014-based national population projections
- estimated and projected total population, year ending mid-1971 to year ending mid-2091
- estimated and projected births and deaths, year ending mid-1971 to year ending mid-2091
- percentage age distribution for the period, year ending mid-1971 to year ending mid-2091
- change in the projected population at 2041 by age and sex compared with the 2014-based projections

This chapter focuses on the principal projection. Discussion of the results of the variant projections can be found in the variants chapter.

# 2 . Summary of results

## Results

The UK population is projected to increase from an estimated 65.6 million in mid-2016 to 72.9 million by mid-2041. Of the projected 7.3 million increase between mid-2016 and mid-2041, approximately 2.8 million (39%) is because of projected natural increase (more births than deaths) while around 4.4 million (61%) is because of net migration.

## Summary results tables

Table 2.1 summarises the projection results by components of change from mid-2016 to mid-2041 for the UK. The equivalent tables for the constituent countries of the UK are found in appendices A to D.

**Table 2.1: Components of change: summary (annual average over period), UK, mid-2016 to mid-2041**

Thousands

| | 2016 to 2017 | 2017 to 2022 | 2022 to 2027 | 2027 to 2032 | 2032 to 2037 | 2037 to 2041 |
|---|---|---|---|---|---|---|
| Population at start | 65,648 | 66,051 | 67,961 | 69,533 | 70,881 | 72,035 |
| Births | 762 | 774 | 768 | 756 | 759 | 782 |
| Deaths | 605 | 598 | 619 | 652 | 693 | 729 |
| Natural change | 157 | 176 | 149 | 104 | 66 | 52 |
| Migration | 246 | 206 | 165 | 165 | 165 | 165 |
| Total change | 403 | 382 | 314 | 269 | 231 | 217 |
| Population at end | 66,051 | 67,961 | 69,533 | 70,881 | 72,035 | 72,905 |

Source: Office for National Statistics

Notes:

1. Figures may not sum because of rounding.

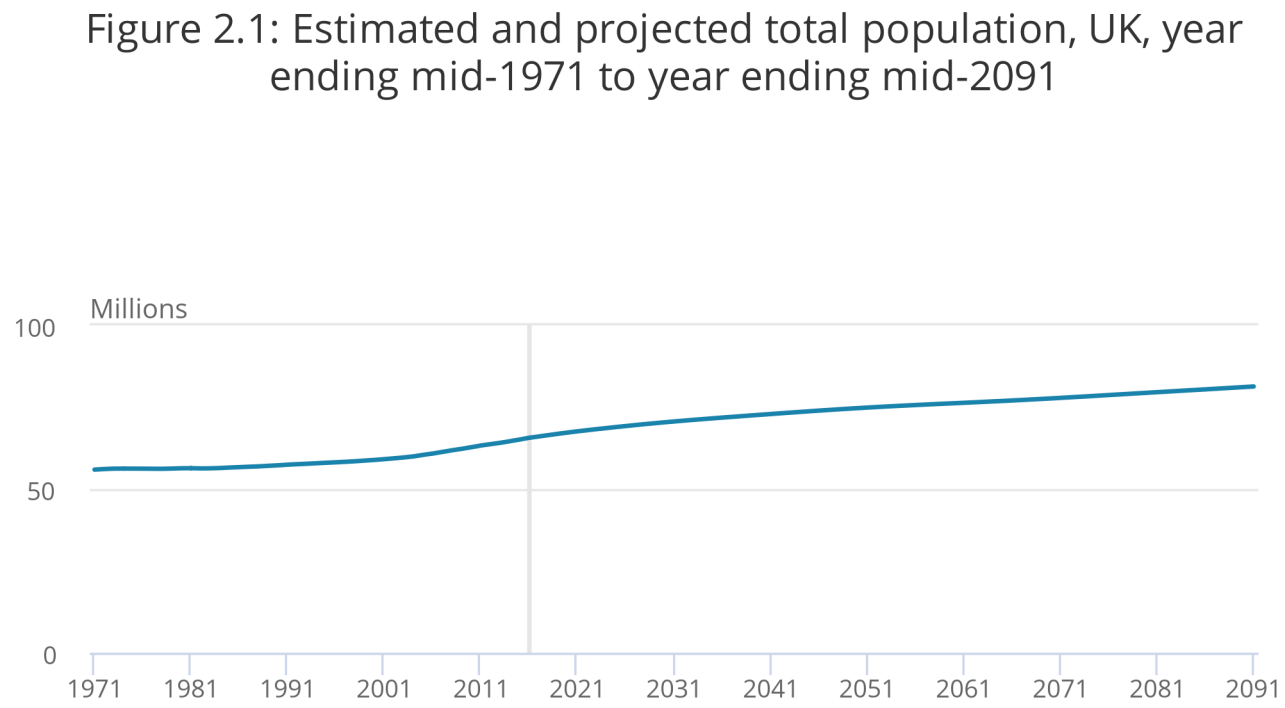
2. Years refer to mid-year to mid-year intervals.

## Charts of summary results

This section presents charts for the UK for the year ending mid-1971 to the year ending mid-2091. The equivalent charts for the constituent countries of the UK are available in the appendices A to D.

Figure 2.1 shows the estimated and projected total population in the UK between mid-1971 and mid-2091. The UK population is projected to continue to rise gradually over the period to mid-2091.

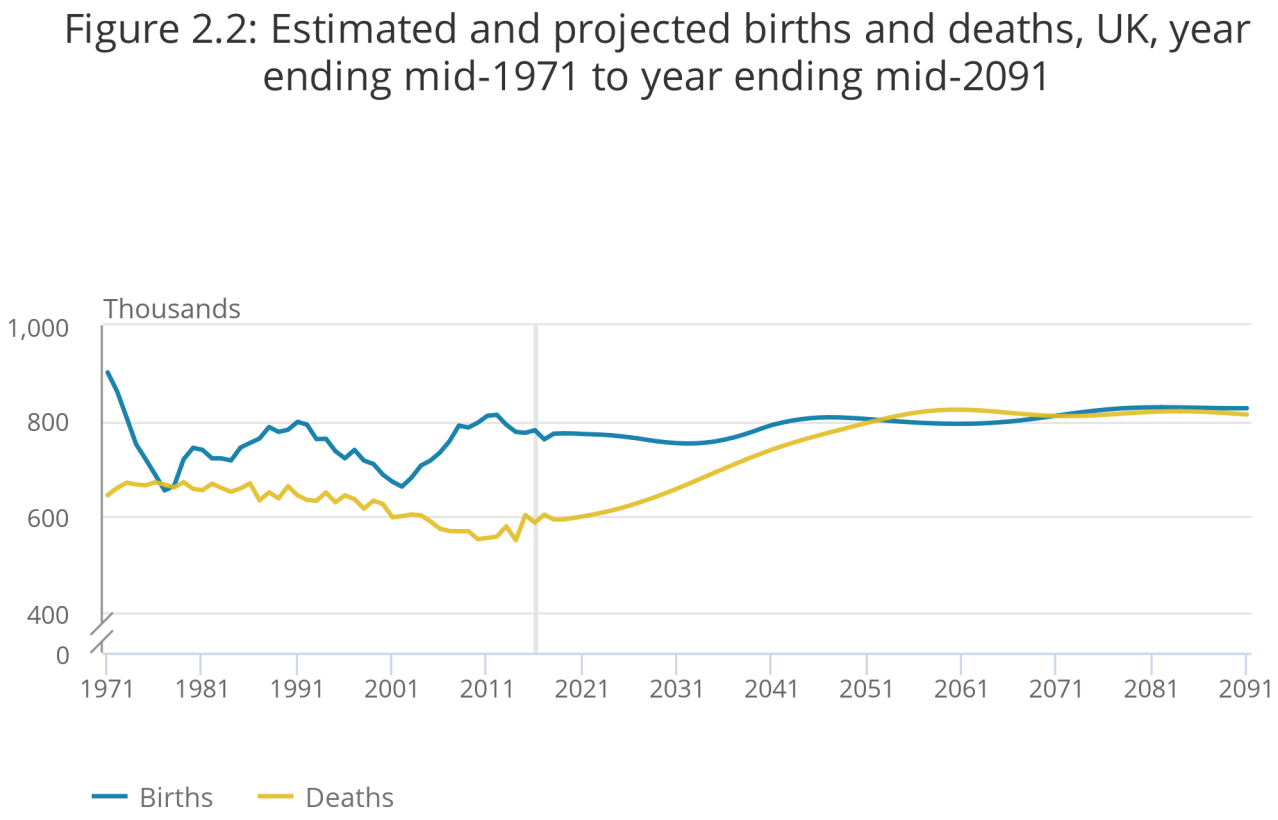
**Figure 2.1: Estimated and projected total population, UK, year ending mid-1971 to year ending mid-2091**




**Source: Office for National Statistics**

Figure 2.2 shows the estimated and projected births and deaths in the UK. The trends seen in the first year of the projection are the result of constraining the projections to the provisional estimates of births and deaths for the year ending mid-2017.

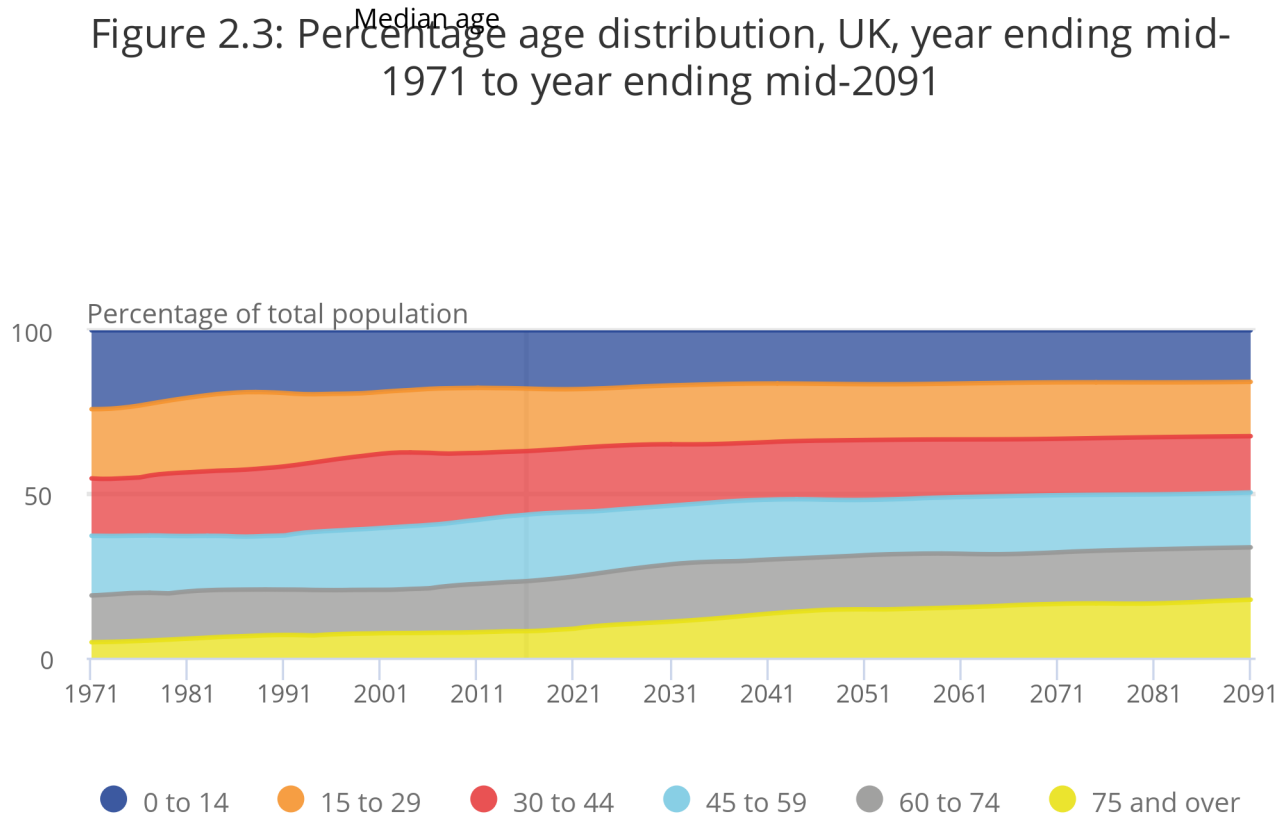
**Figure 2.2: Estimated and projected births and deaths, UK, year ending mid-1971 to year ending mid-2091**




**Source: Office for National Statistics**

Figure 2.3 shows how the age distribution of the UK is projected to change. The median age of the population increases through the projection period.

**Figure 2.3: Percentage age distribution, UK, year ending mid-1971 to year ending mid-2091**




**Source: Office for National Statistics**

# 3 . Comparison with previous projections

## Base population

Overall, the published mid-2016 population estimate for the UK is about 76,000 (0.1%) higher than the 2014-based projection of the population at mid-2016.

## Projected future population

The projected population of the UK at mid-2041 is about 2.0 million (2.6%) lower than in the 2014-based projections. This is because the 2016-based projections assume lower levels of long-term net international migration, a slower rate of increase in life expectancy and a reduction in the long-term assumed number of children born to women compared with the 2014-based projections.

At mid-2041, populations are projected to be lower than in the 2014-based projections for all four countries of the UK. The percentage difference by mid-2041 is greatest for England where the 2016-based projection is 3.0% lower than the 2014-based projections when comparing the principal population projection. For Wales, Scotland and Northern Ireland, the differences by mid-2041 are 0.1%, 0.4% and 0.1% lower respectively.

Compared with the previous projections, the UK population at mid-2041 is also lower in all broad age groups with the exception of the 60 to 74 group where it is 118,000 higher than the 2014-based projections.

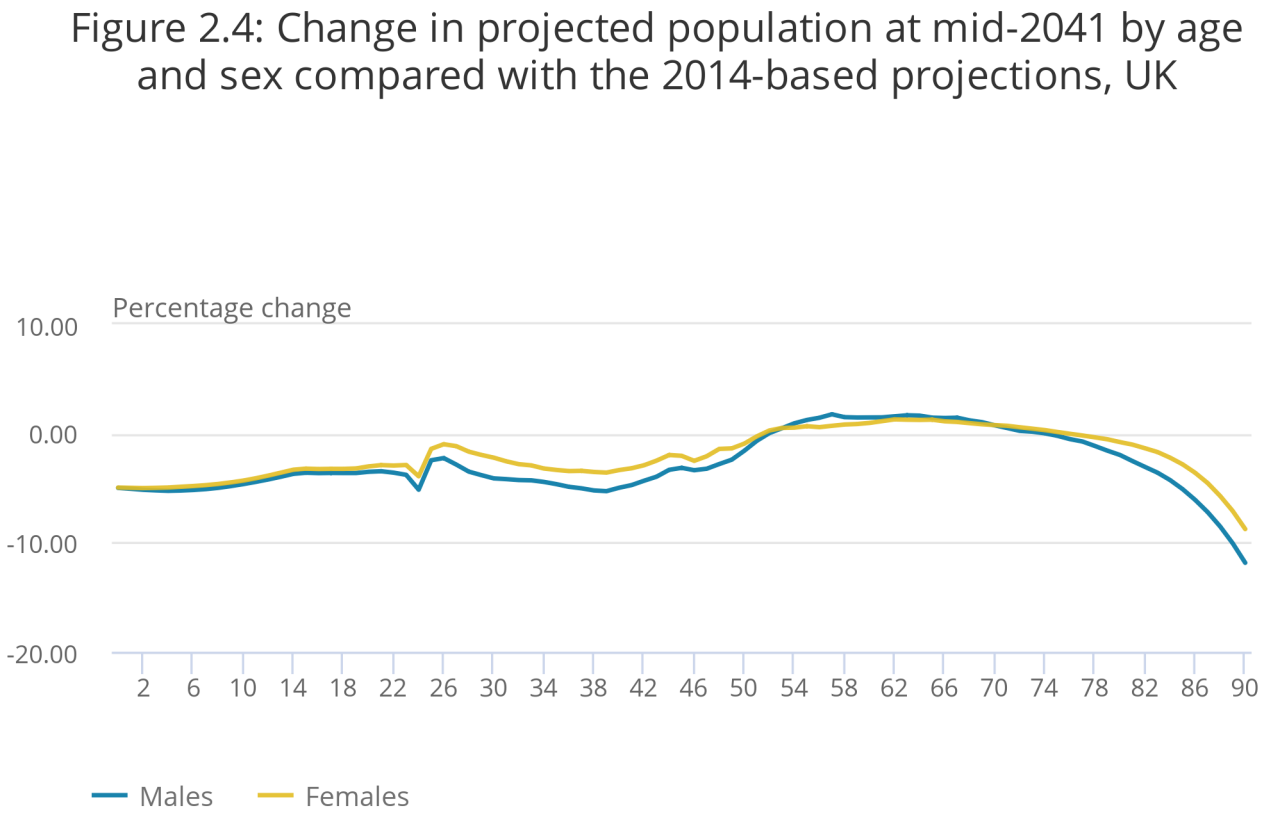
Comparisons with the previous projections (2014-based NPPs) are given in Table 2.2 and illustrated in Figure 2.4

**Table 2.2: Changes in projected population by age compared with 2014-based projections, UK**

| | Mid-2016 | | Mid-2021 | | Mid-2026 | | Mid-2041 | |
|---|---|---|---|---|---|---|---|---|
| Age group | Change (thousands) | Percentage change | Change (thousands) | Percentage change | Change (thousands) | Percentage change | Change (thousands) | Percentage change |
| 0 to 14 | 47.5 | 0.4 | -30.6 | -0.3 | -221.4 | -1.8 | -578.4 | -4.7 |
| 15 to 29 | -26.6 | -0.2 | -105.9 | -0.9 | -131.8 | -1.1 | -411.4 | -3.1 |
| 30 to 44 | 30.8 | 0.2 | 6.4 | 0.0 | -144.3 | -1.1 | -501.2 | -3.8 |
| 45 to 59 | 28.3 | 0.2 | 73.8 | 0.6 | 107.5 | 0.8 | -69.0 | -0.5 |
| 60 to 74 | 10.1 | 0.1 | 17.9 | 0.2 | 33.8 | 0.3 | 117.5 | 1.0 |
| 75 and over | -14.5 | -0.3 | -126.8 | -2.1 | -252.3 | -3.4 | -536.6 | -5.2 |
| All ages | 75.6 | 0.1 | -165.1 | -0.2 | -608.5 | -0.9 | -1979.1 | -2.6 |

Source: Office for National Statistics

**Figure 2.4: Change in projected population at mid-2041 by age and sex compared with the 2014-based projections, UK**




**Source: Office for National Statistics**

**Notes:**

1. Where the percentage change is greater than 0, the 2016-based projection is greater than the 2014-based projection.

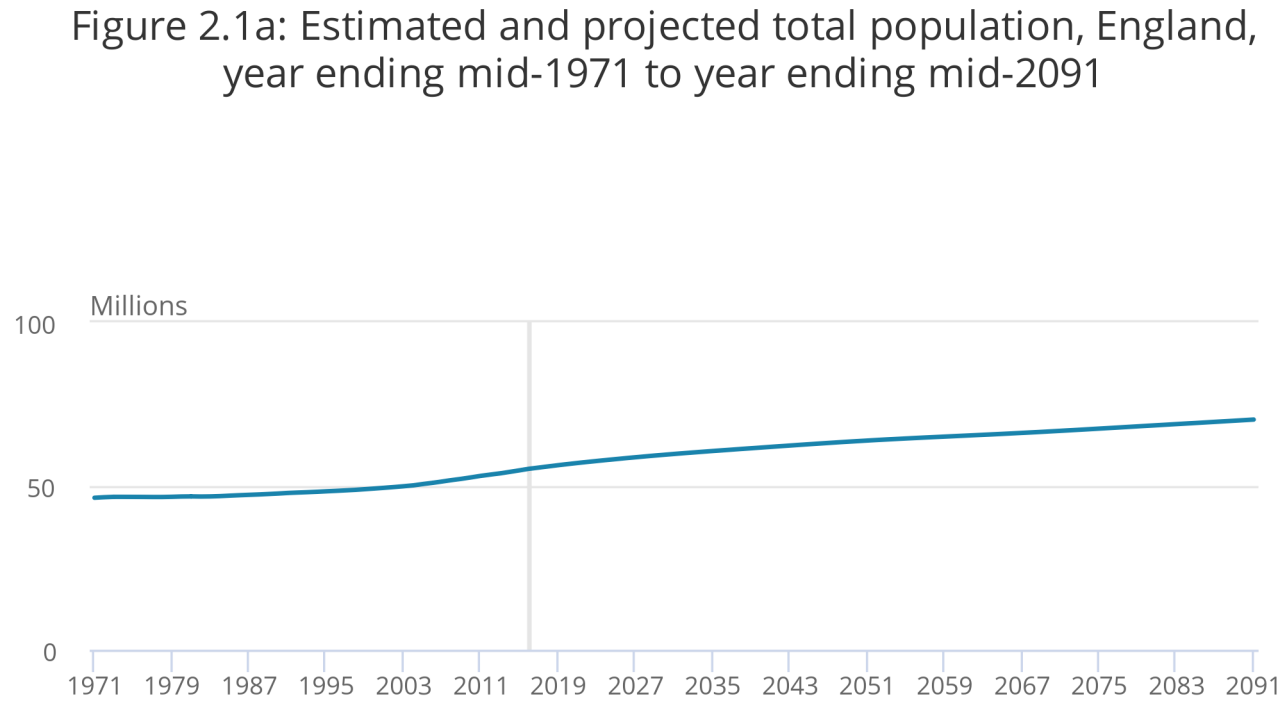
2. Where the percentage change is less than 0, the 2016-based projection is less than the 2014-based projection.

At mid-2041, populations are projected to be lower than in the 2014-based projections in all broad age groups with the exception of those in their early 50s to early 70s.

The equivalent charts for the constituent countries of the UK can be found in the relevant appendices.

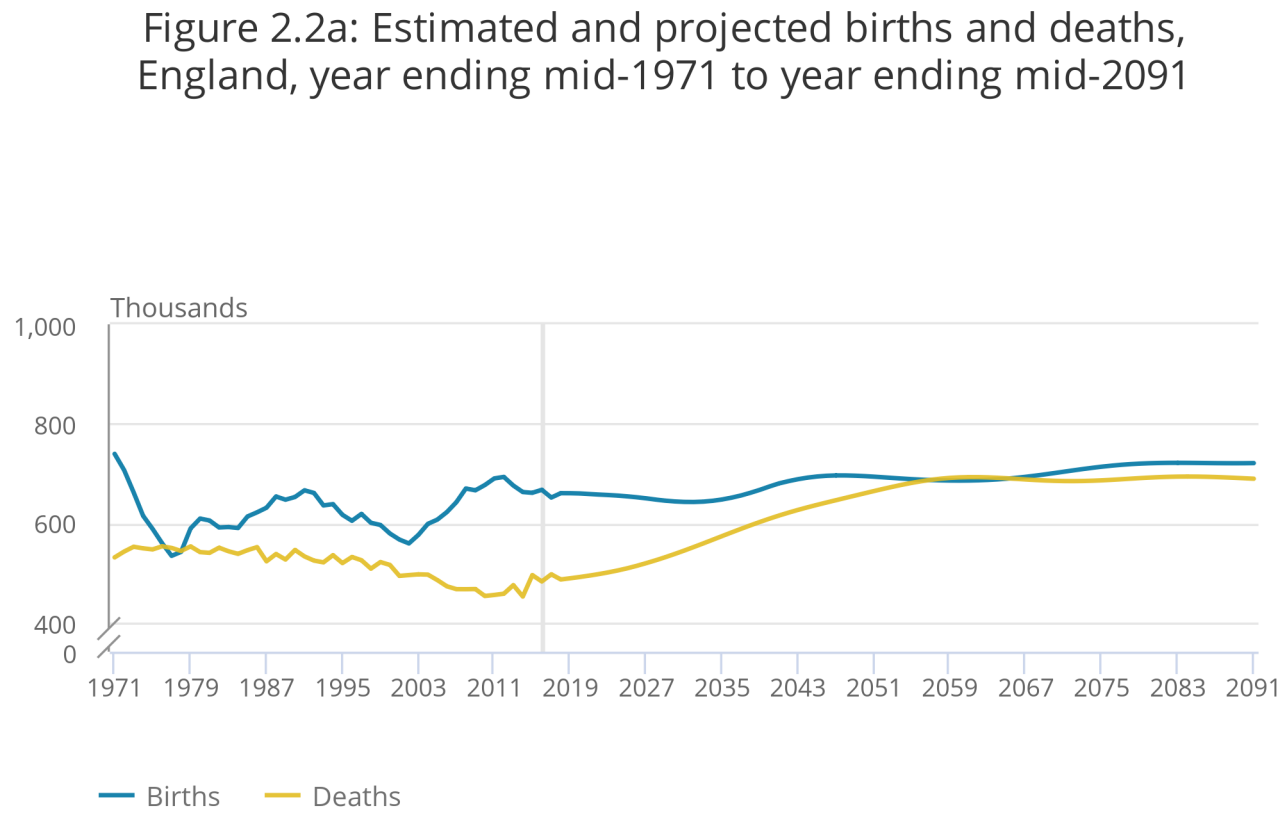
# 4 . Appendix A: England charts

**Figure 2.1a: Estimated and projected total population, England, year ending mid-1971 to year ending mid-2091**



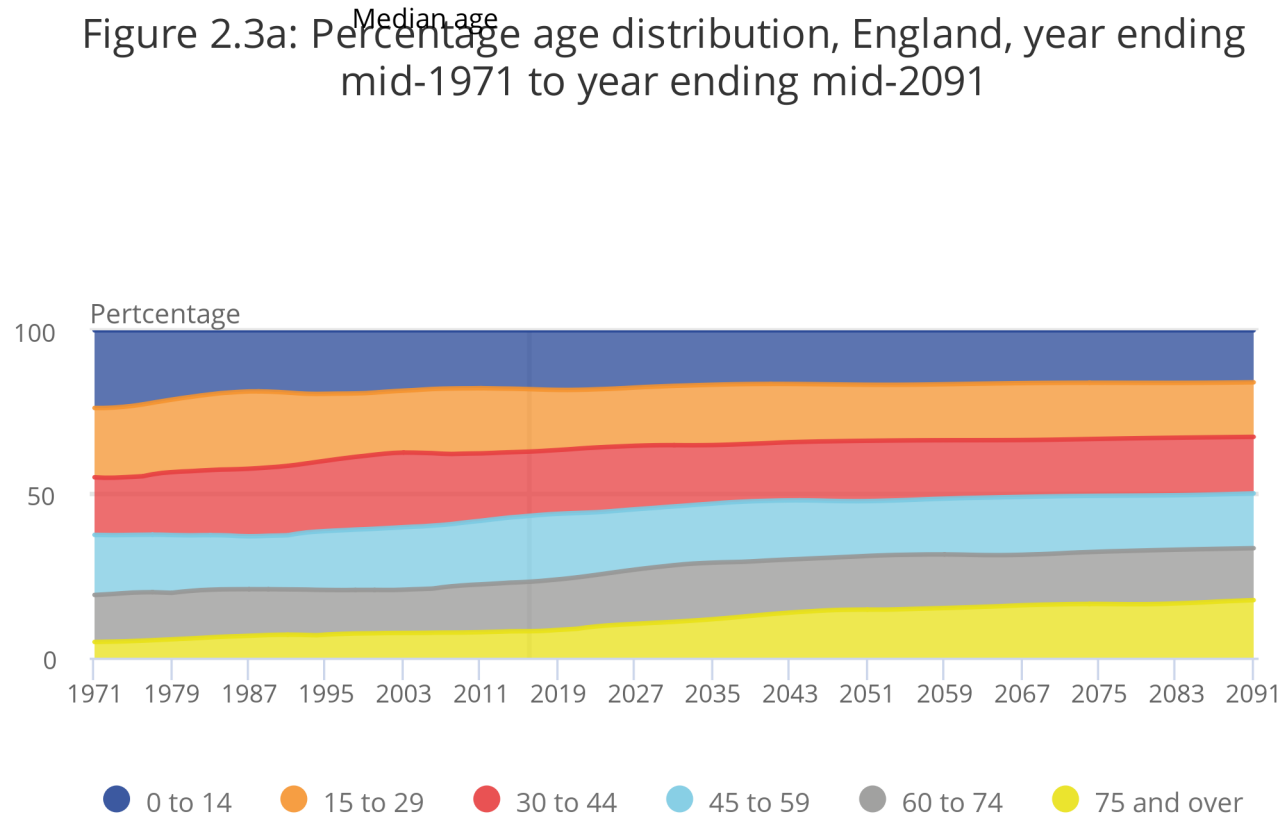

**Source: Office for National Statistics**

**Figure 2.2a: Estimated and projected births and deaths, England, year ending mid-1971 to year ending mid-2091**



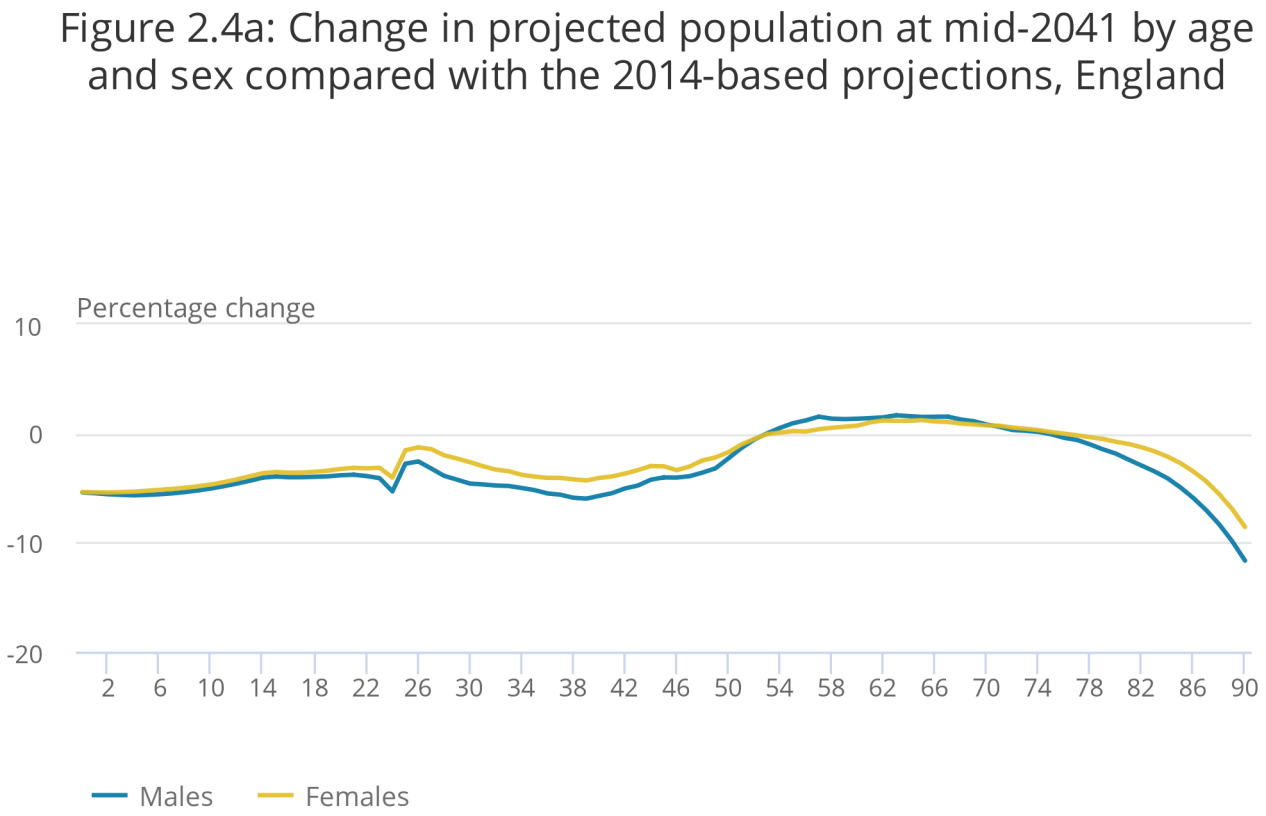

**Source: Office for National Statistics**

**Figure 2.3a: Percentage age distribution, England, year ending mid-1971 to year ending mid-2091**




**Source: Office for National Statistics**

**Figure 2.4a: Change in projected population at mid-2041 by age and sex compared with the 2014-based projections, England**




**Source: Office for National Statistics**

**Notes:**

1. Where the percentage change is greater than 0, the 2016-based projection is greater than the 2014-based projection.

2. Where the percentage change is less than 0, the 2016-based projection is less than the 2014-based projection.

**Table 2.1a: Components of change: summary (annual average over period), England, mid-2016 to mid-2041**

Thousands

| | 2016 to 2017 | 2017 to 2022 | 2022 to 2027 | 2027 to 2032 | 2032 to 2037 | 2037 to 2041 |
|---|---|---|---|---|---|---|
| Population at start | 55,268 | 55,629 | 57,344 | 58,779 | 60,024 | 61,117 |
| Births | 653 | 660 | 655 | 645 | 650 | 672 |
| Deaths | 498 | 493 | 511 | 540 | 575 | 607 |
| Natural change | 154 | 167 | 143 | 106 | 74 | 65 |
| Migration | 206 | 176 | 143 | 143 | 144 | 144 |
| Total change | 360 | 343 | 287 | 249 | 219 | 209 |
| Population at end | 55,629 | 57,344 | 58,779 | 60,024 | 61,117 | 61,952 |

Source: Office for National Statistics

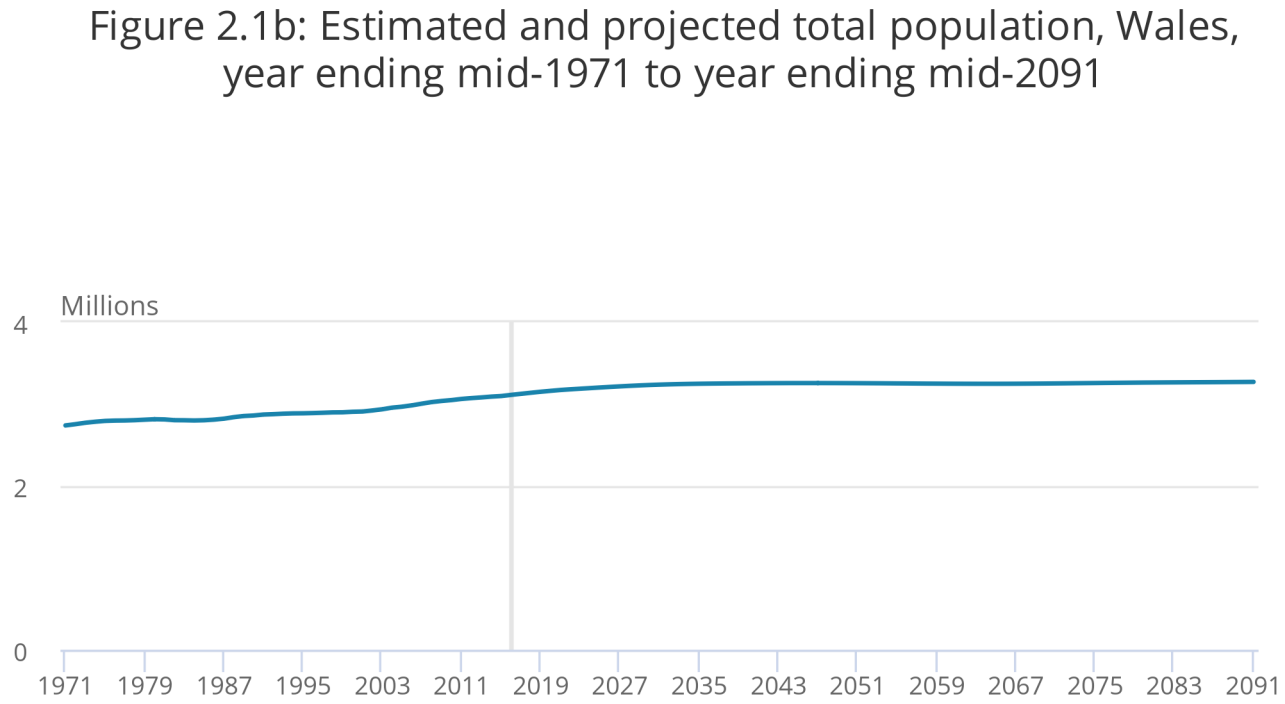
Notes:

1. Figures may not sum because of rounding.

2. Years refer to mid-year to mid-year intervals.

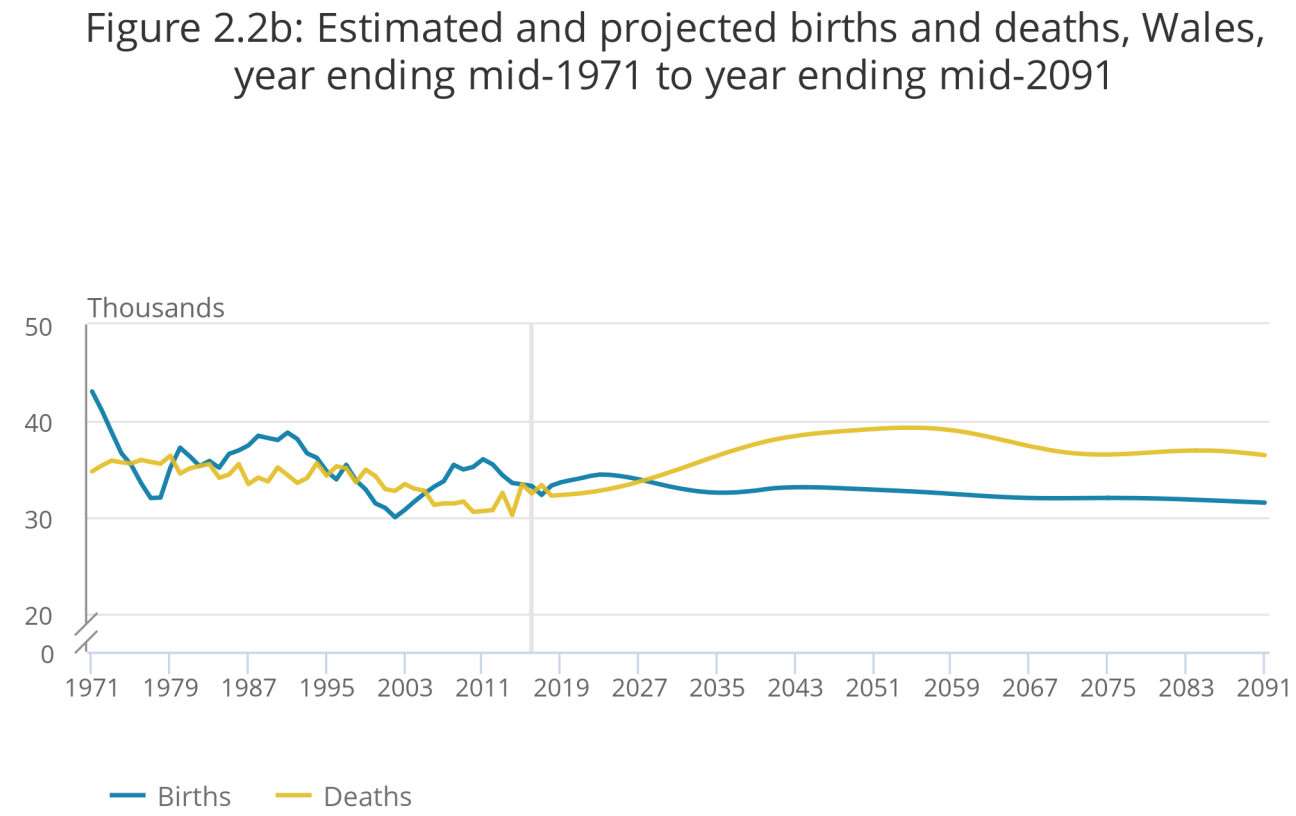
# 5 . Appendix B: Wales charts

**Figure 2.1b: Estimated and projected total population, Wales, year ending mid-1971 to year ending mid-2091**



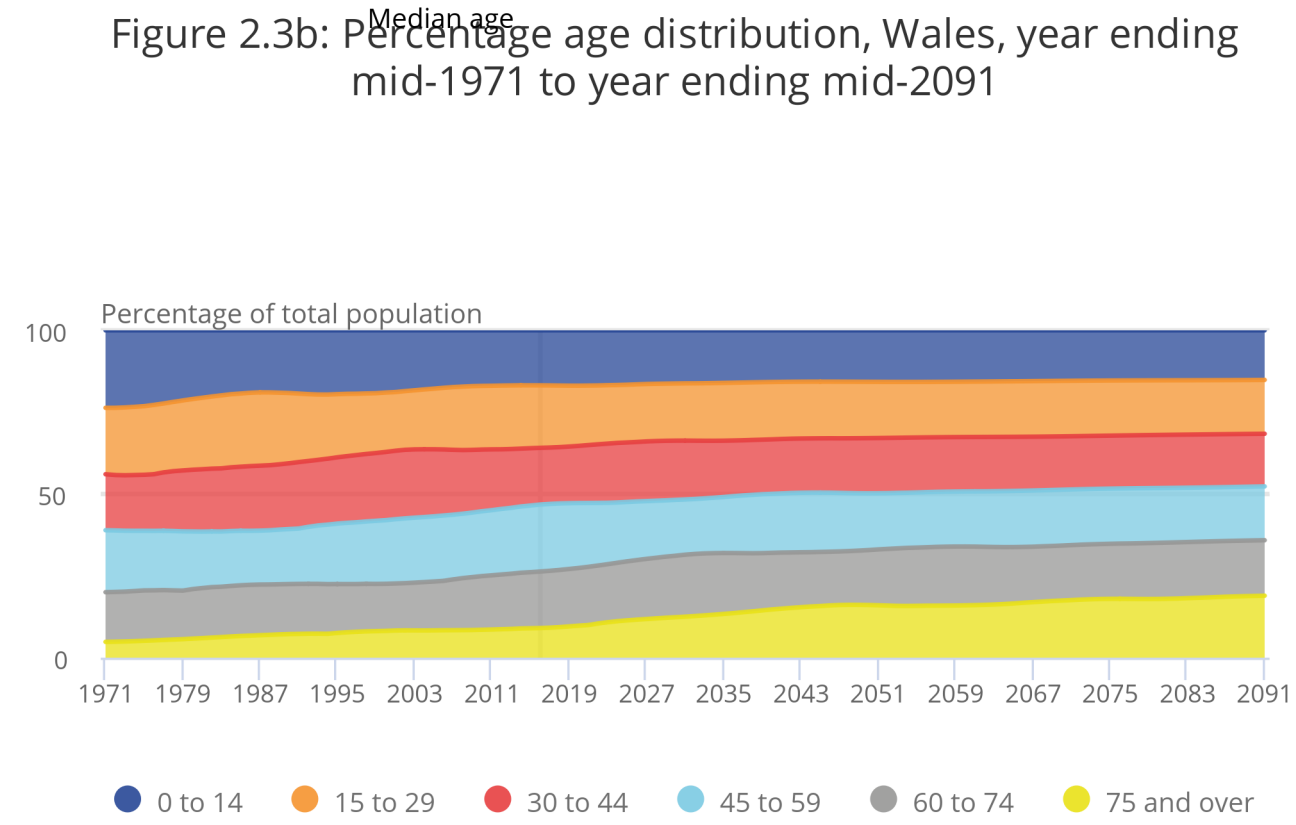

**Source: Office for National Statistics**

**Figure 2.2b: Estimated and projected births and deaths, Wales, year ending mid-1971 to year ending mid-2091**



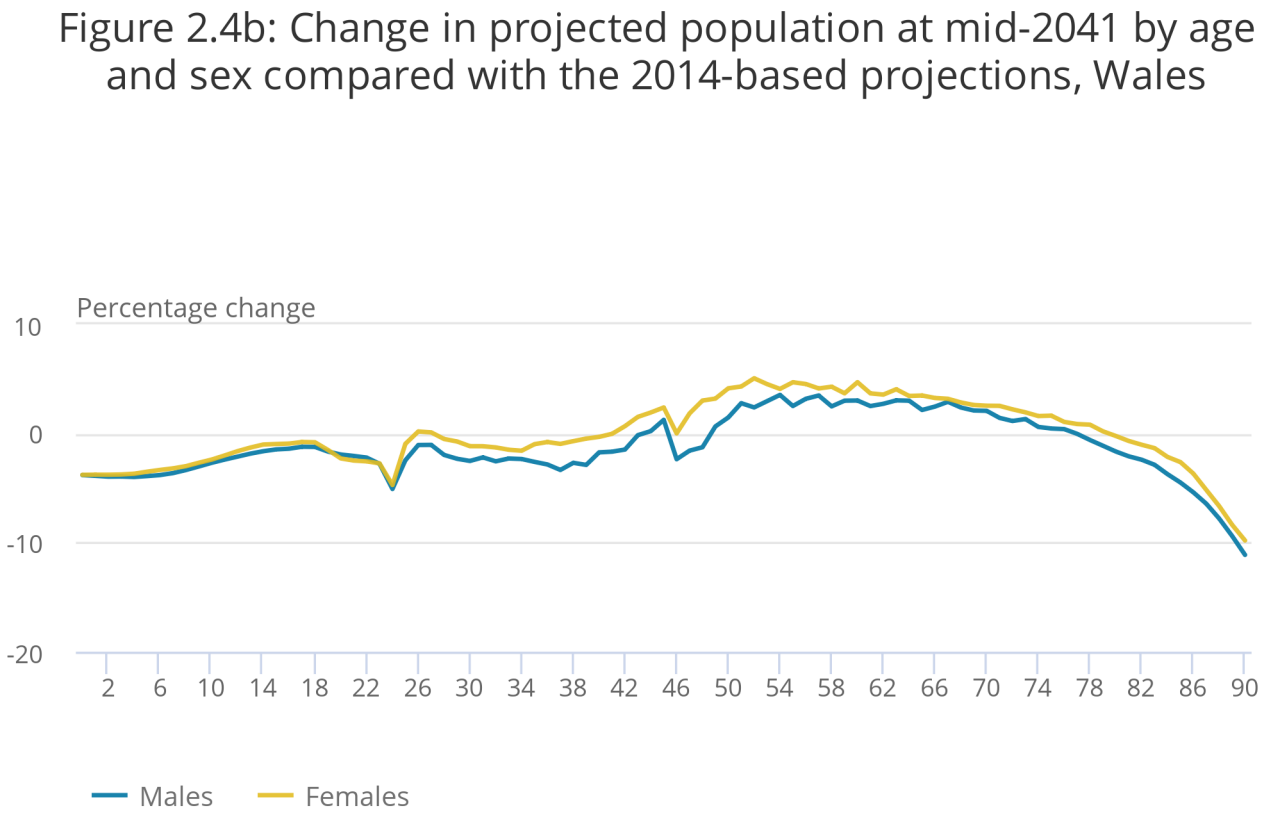

**Source: Office for National Statistics**

**Figure 2.3b: Percentage age distribution, Wales, year ending mid-1971 to year ending mid-2091**




**Source: Office for National Statistics**

**Figure 2.4b: Change in projected population at mid-2041 by age and sex compared with the 2014-based projections, Wales**




**Source: Office for National Statistics**

**Notes:**

1. Where the percentage change is greater than 0, the 2016-based projection is greater than the 2014-based projection.

2. Where the percentage change is less than 0, the 2016-based projection is less than the 2014-based projection.

**Table 2.1b: Components of change: summary (annual average over period), Wales, mid-2016 to mid-2041**

Thousands

| | 2016 to 2017 | 2017 to 2022 | 2022 to 2027 | 2027 to 2032 | 2032 to 2037 | 2037 to 2041 |
|---|---|---|---|---|---|---|
| Population at start | 3,113 | 3,126 | 3,182 | 3,218 | 3,242 | 3,252 |
| Births | 32 | 34 | 34 | 33 | 33 | 33 |
| Deaths | 33 | 32 | 33 | 35 | 36 | 38 |
| Natural change | -1 | 1 | 1 | -1 | -4 | -5 |
| Migration | 14 | 10 | 6 | 6 | 6 | 6 |
| Total change | 13 | 11 | 285 | 5 | 2 | 1 |
| Population at end | 3,126 | 3,182 | 3,218 | 3,242 | 3,252 | 3,256 |

Source: Office for National Statistics

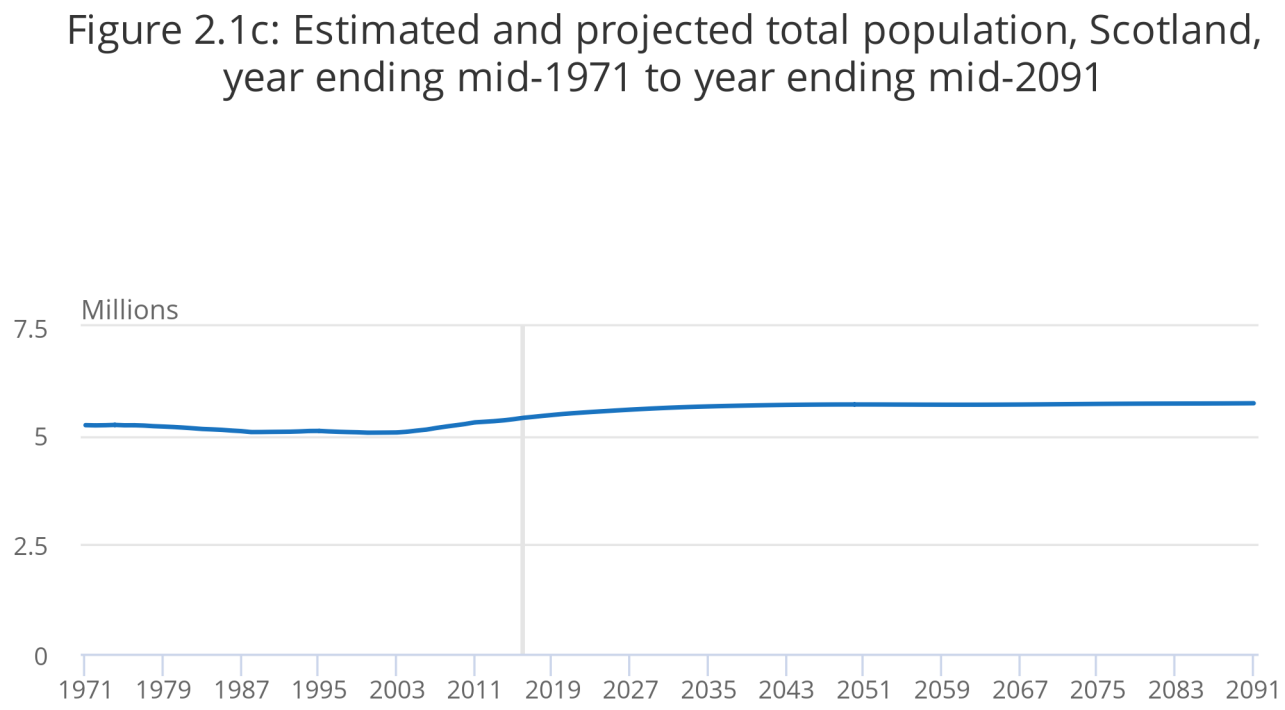
Notes:

1. Figures may not sum because of rounding.

2. Years refer to mid-year to mid-year intervals.

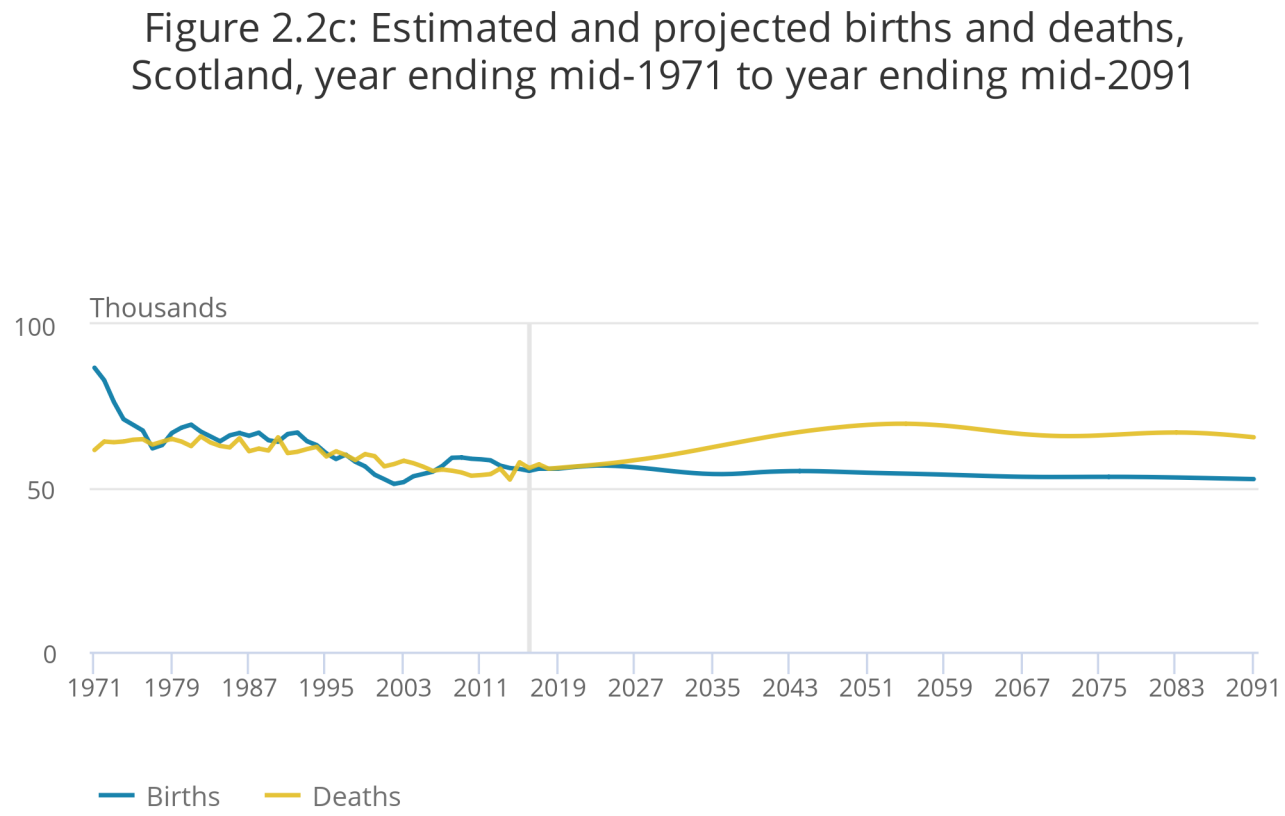
# 6 . Appendix C: Scotland charts

**Figure 2.1c: Estimated and projected total population, Scotland, year ending mid-1971 to year ending mid-2091**



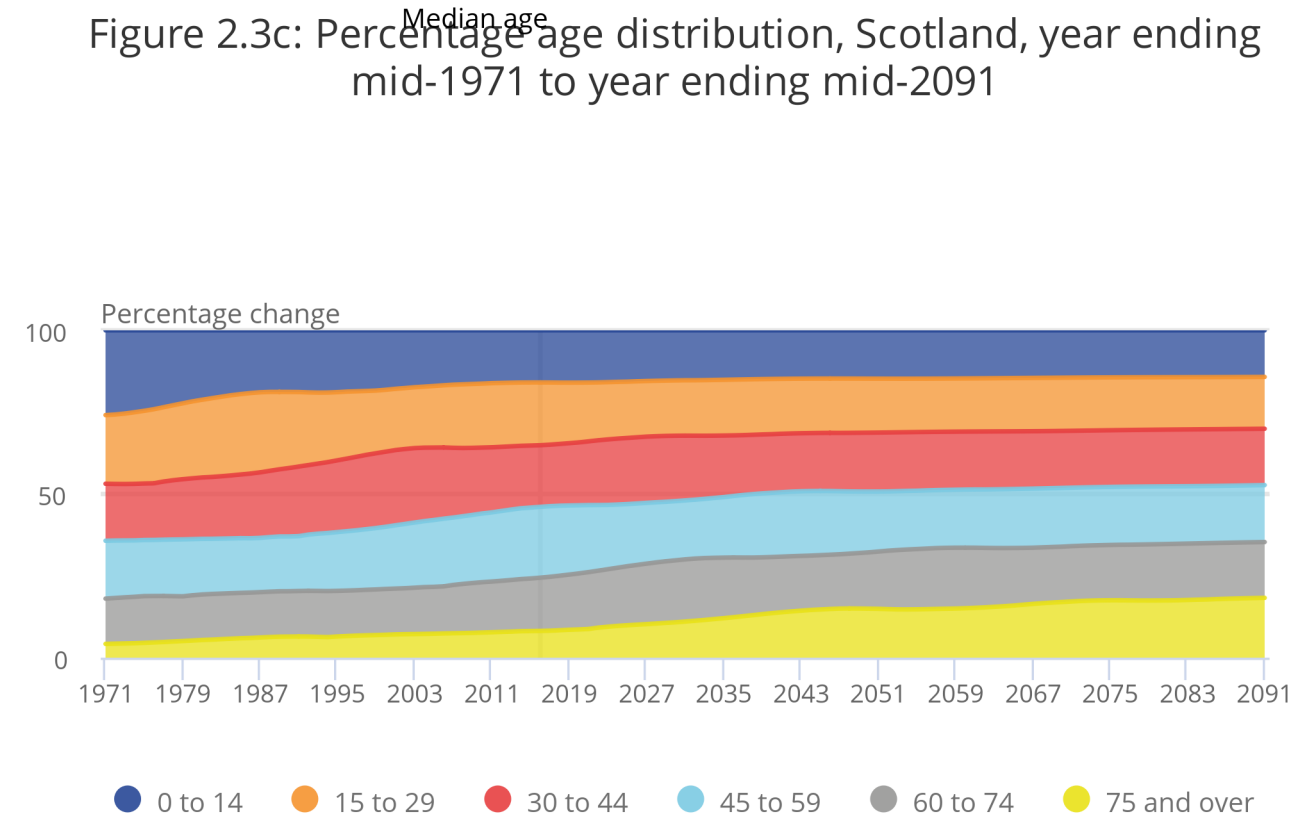

**Source: Office for National Statistics**

**Figure 2.2c: Estimated and projected births and deaths, Scotland, year ending mid-1971 to year ending mid-2091**



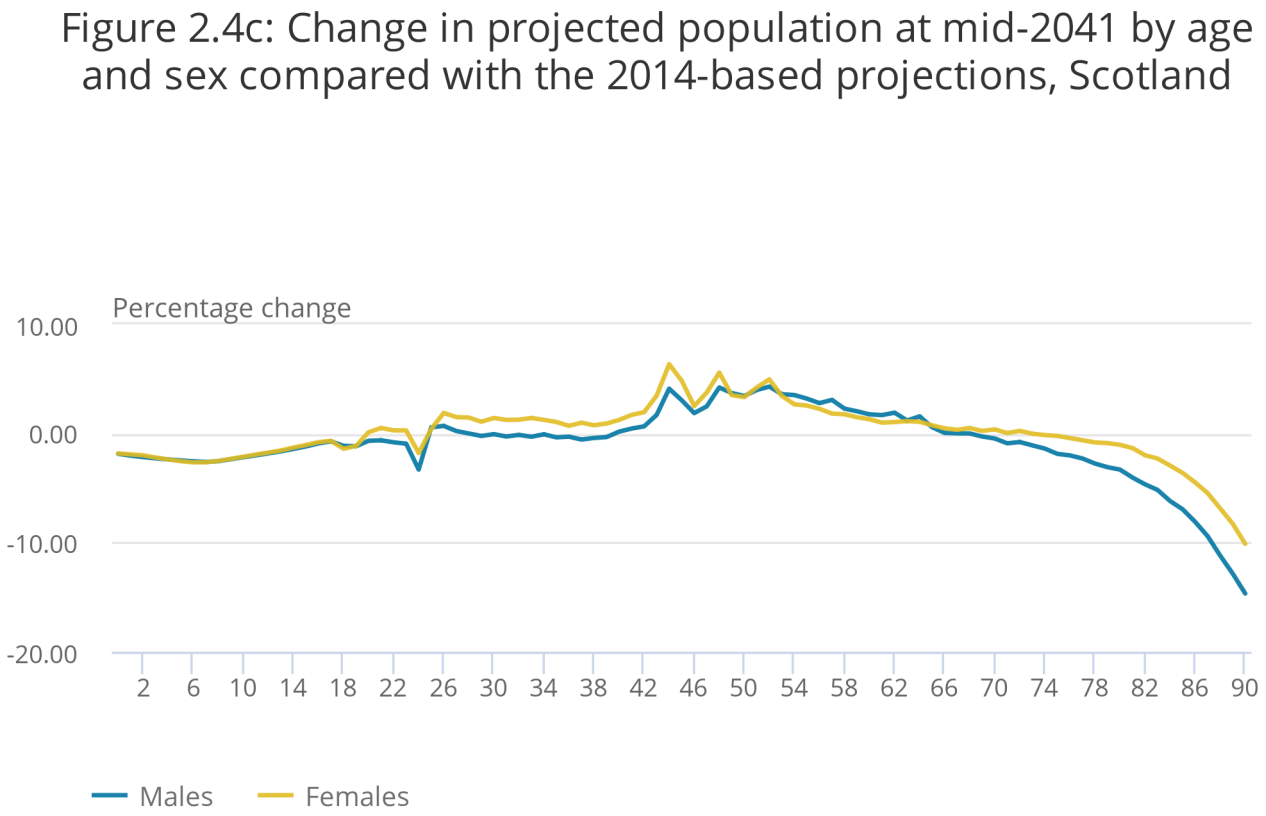

**Source: Office for National Statistics**

**Figure 2.3c: Percentage age distribution, Scotland, year ending mid-1971 to year ending mid-2091**




**Source: Office for National Statistics**

**Figure 2.4c: Change in projected population at mid-2041 by age and sex compared with the 2014-based projections, Scotland**




**Source: Office for National Statistics**

**Notes:**

1. Where the percentage change is greater than 0, the 2016-based projection is greater than the 2014-based projection.

**Table 2.1c: Components of change: summary (annual average over period), Scotland, mid-2016 to mid-2041**

Thousands

| | 2016 to 2017 | 2017 to 2022 | 2022 to 2027 | 2027 to 2032 | 2032 to 2037 | 2037 to 2041 |
|---|---|---|---|---|---|---|
| Population at start | 5,405 | 5,426 | 5,524 | 5,591 | 5,644 | 5,676 |
| Births | 53 | 56 | 57 | 55 | 54 | 55 |
| Deaths | 57 | 56 | 58 | 60 | 62 | 65 |
| Natural change | -4 | -0 | -1 | -4 | -8 | -10 |
| Migration | 25 | 20 | 15 | 15 | 15 | 15 |
| Total change | 21 | 20 | 14 | 10 | 6 | 4 |
| Population at end | 5,426 | 5,524 | 5,591 | 5,644 | 5,676 | 5,693 |

Source: Office for National Statistics

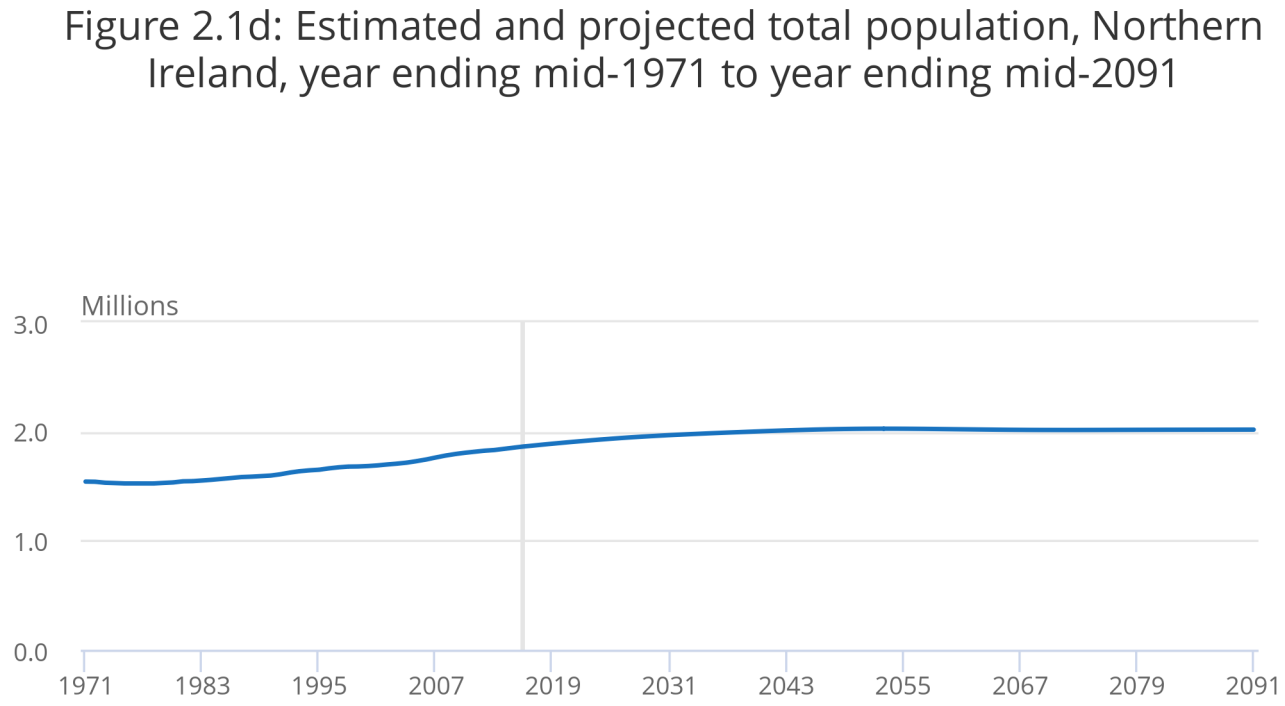
Notes:

1. Figures may not sum because of rounding.

2. Years refer to mid-year to mid-year intervals.

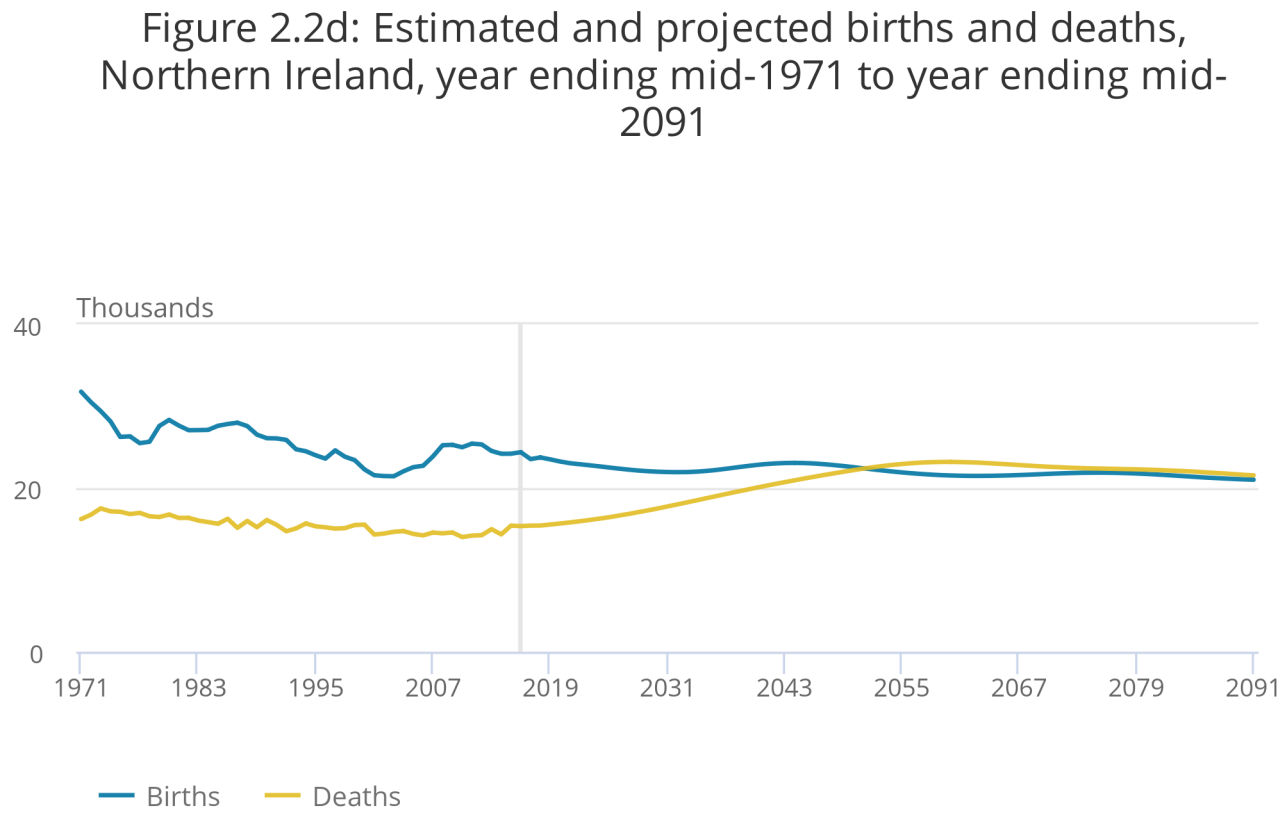
# 7 . Appendix D: Northern Ireland charts

**Figure 2.1d: Estimated and projected total population, Northern Ireland, year ending mid-1971 to year ending mid-2091**



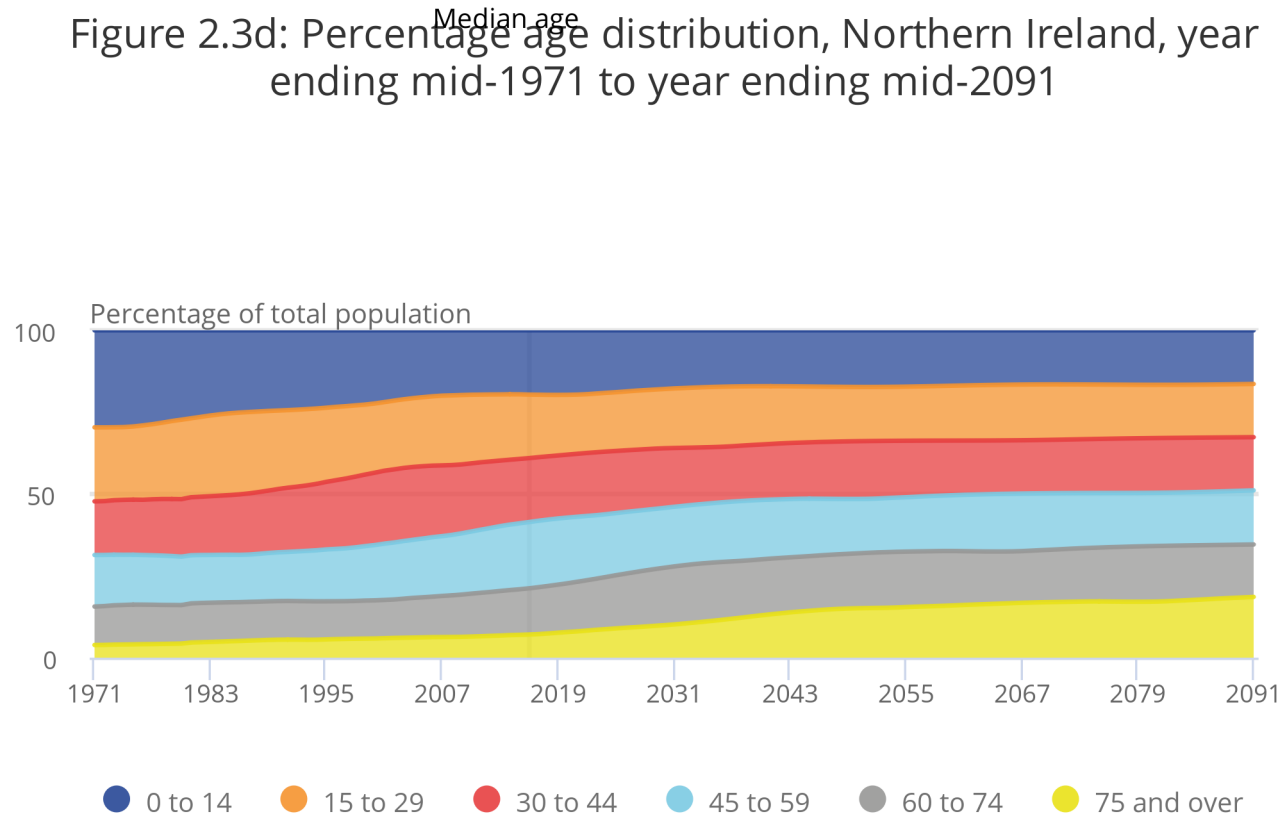

**Source: Office for National Statistics**

**Figure 2.2d: Estimated and projected births and deaths, Northern Ireland, year ending mid-1971 to year ending mid-2091**



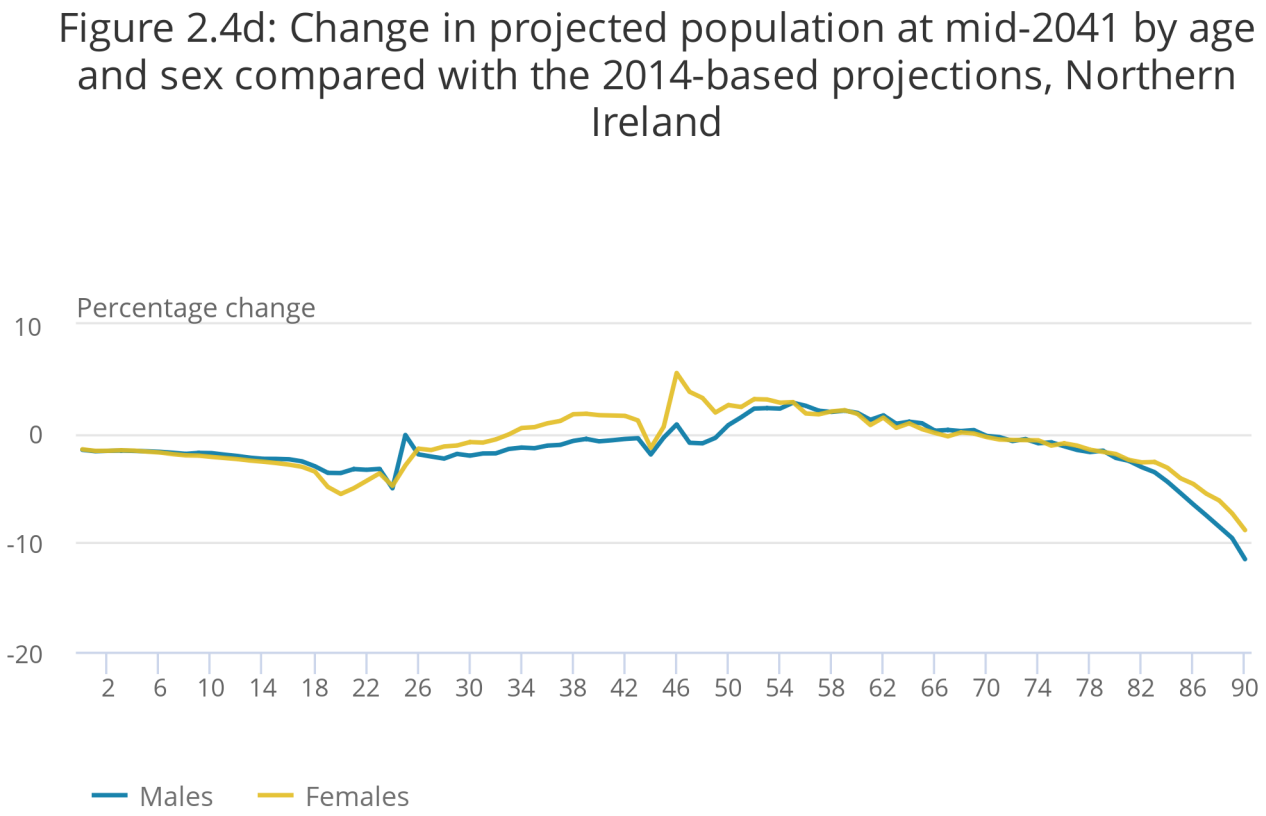

**Source: Office for National Statistics**

**Figure 2.3d: Percentage age distribution, Northern Ireland, year ending mid-1971 to year ending mid-2091**




**Source: Office for National Statistics**

**Figure 2.4d: Change in projected population at mid-2041 by age and sex compared with the 2014-based projections, Northern Ireland**




**Source: Office for National Statistics**

**Table 2.1d: Components of change: summary (annual average over period), Northern Ireland, mid-2016 to mid-2041**

Thousands

| | 2016 to 2017 | 2017 to 2022 | 2022 to 2027 | 2027 to 2032 | 2032 to 2037 | 2037 to 2041 |
|---|---|---|---|---|---|---|
| Population at start | 1,862 | 1,871 | 1,912 | 1,946 | 1,971 | 1,990 |
| Births | 24 | 23 | 23 | 22 | 22 | 23 |
| Deaths | 15 | 16 | 16 | 18 | 19 | 20 |
| Natural change | 8 | 8 | 6 | 5 | 3 | 3 |
| Migration | 0 | 1 | 1 | 0 | 0 | 1 |
| Total change | 9 | 8 | 7 | 5 | 4 | 3 |
| Population at end | 1,871 | 1,912 | 1,946 | 1,971 | 1,990 | 2,003 |

Source: Office for National Statistics

Notes:

1. Figures may not sum because of rounding.

2. Years refer to mid-year to mid-year intervals.

Compendium

# Fertility assumptions

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Next release:
To be announced

## Table of contents

# 1 . Introduction

This article provides detailed information on the principal and variant fertility assumptions used in the 2016-based national population projections. For England and Wales the long-term average completed family size is assumed to be 1.85 children per woman, a decrease of 0.05 from the 2014-based projections. Northern Ireland has seen no change from the 2014-based projections; it is still assumed to be 2.00 children per woman. The assumption for Scotland has been reduced from 1.70 to 1.65, a difference of 0.05 from the 2014-based projections.

Completed family size (CFS) is the average number of live-born children per woman which a group of women born in the same year have had by the end of their childbearing years. In general, measurement and analysis of fertility in terms of women born in a particular year is referred to as cohort fertility.

The age-specific fertility rate (ASFR) is the average number of children per woman, born to a group of women of a particular age in a particular year, normally expressed per thousand women.

The total period fertility rate (TFR) is the average number of children per woman that would be born to a group of women if they experienced the current year's age-specific fertility rates for each year of their childbearing years. This measure is referred to as the total fertility rate, or TFR, in this article.

# 2 . Principal assumptions

The numbers of births for the projections are obtained by applying the appropriate fertility rate to the number of women at each age during each year of the projection period. Because cohort fertility rates are more stable than period rates, the fertility rates used in the projections are derived from assumptions relating to the year in which women were born. Cohort fertility rates are more stable because they are affected only by changes in the total number of children women have and not by the timing of births within women’s lives. Period rates, the total fertility rate, in contrast, may rise or fall if births are brought forward or delayed for any reason.

The assumptions about completed family size are based on family-building patterns to date and other relevant evidence. Discussion papers showing the background information used in setting the fertility assumptions are available. Consultation papers

Tables 3.1 to 3.3 show estimated and assumed: average completed family size, births per 1,000 women, achieved family size and average age at motherhood, by year of birth of woman.

**Table 3.1: Estimated and assumed average completed family size for the constituent countries of the UK, women born 1950 to 2020**

| | Year of birth of woman | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1950** | **1955** | **1960** | **1965** | **1970** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** |
| England | 2.06 | 2.02 | 1.98 | 1.91 | 1.91 | 1.92 * | 1.99 * | 2.00 * | 1.98 * | 1.89 * | 1.85 * | 1.85 * | 1.85 * | 1.85 * |
| Wales | 2.10 | 2.05 | 1.99 | 1.96 | 1.94 | 1.92 * | 1.95 * | 1.99 * | 1.98 * | 1.88 * | 1.85 * | 1.85 * | 1.85 * | 1.85 * |
| Scotland | 2.08 | 1.95 | 1.87 | 1.80 | 1.74 | 1.72 * | 1.75 * | 1.74 * | 1.69 * | 1.62 * | 1.62 * | 1.62 * | 1.64 * | 1.65 * |
| Northern Ireland | 2.87 | 2.65 | 2.42 | 2.22 | 2.11 | 2.00 * | 2.13 * | 2.07 * | 2.04 * | 1.99 * | 1.99 * | 1.99 * | 2.00 * | 2.00 * |
| United Kingdom | 2.09 | 2.03 | 1.98 | 1.91 | 1.91 | 1.91 * | 1.97 * | 1.98 * | 1.96 * | 1.87 * | 1.84 * | 1.84 * | 1.84 * | 1.84 * |

Source:Office for National Statistics

Note :

1. * Figures are partly or wholly projected

**Table 3.2: Estimated and assumed births per 1,000 women by age and year of birth, UK, women born 1950 to 2020**

| | Year of birth of woman | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ages** | **1950** | **1955** | **1960** | **1965** | **1970** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **2020 & later** |
| Under 20 | 231 | 221 | 156 | 133 | 152 | 147 | 154 | 135 | 127 | 88 | 64 * | 60 * | 59 * | 58 * | 58 * |
| 20 - 24 | 699 | 561 | 527 | 457 | 418 | 361 | 346 | 357 | 338 | 266 * | 246 * | 240 * | 238 * | 238 * | 238 * |
| 25 - 29 | 634 | 650 | 630 | 594 | 522 | 469 | 498 | 513 | 492 * | 483 * | 483 * | 483 * | 484 * | 485 * | 485 * |
| 30 - 34 | 365 | 403 | 438 | 454 | 466 | 533 | 556 | 554 * | 572 * | 591 * | 599 * | 602 * | 606 * | 606 * | 606 * |
| 35 - 39 | 132 | 163 | 190 | 216 | 276 | 316 | 332 * | 336 * | 344 * | 353 * | 357 * | 361 * | 361 * | 361 * | 361 * |
| 40 & over | 28 | 36 | 43 | 57 | 71 | 80 * | 86 * | 87 * | 88 * | 90 * | 91 * | 91 * | 91 * | 91 * | 91 * |
| Average Completed Family Size | 2.09 | 2.03 | 1.98 | 1.91 | 1.91 | 1.91 * | 1.97 * | 1.98 * | 1.96 * | 1.87 * | 1.84 * | 1.84 * | 1.84 * | 1.84 * | 1.84 * |

Source:Office for National Statistics

Note :

1. * Figures are partly or wholly projected

**Table 3.3: Estimated and assumed achieved family size by exact age, and average age at motherhood, UK**

| | Year of birth of woman | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ages** | **1950** | **1955** | **1960** | **1965** | **1970** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **202 lat** |
| 20 | 0.23 | 0.22 | 0.16 | 0.13 | 0.15 | 0.15 | 0.15 | 0.14 | 0.13 | 0.09 | 0.06 * | 0.06 * | 0.06 * | 0.06 * | 0. |
| 25 | 0.93 | 0.78 | 0.68 | 0.59 | 0.57 | 0.51 | 0.50 | 0.49 | 0.47 | 0.35 * | 0.31 * | 0.30 * | 0.30 * | 0.30 * | 0. |
| 30 | 1.56 | 1.43 | 1.31 | 1.18 | 1.09 | 0.98 | 1.00 | 1.01 | 0.96 * | 0.84 * | 0.79 * | 0.78 * | 0.78 * | 0.78 * | 0. |
| 35 | 1.93 | 1.84 | 1.75 | 1.64 | 1.56 | 1.51 | 1.55 | 1.56 * | 1.53 * | 1.43 * | 1.39 * | 1.38 * | 1.39 * | 1.39 * | 1. |
| 40 | 2.06 | 2.00 | 1.94 | 1.85 | 1.83 | 1.83 | 1.89 * | 1.90 * | 1.87 * | 1.78 * | 1.75 * | 1.74 * | 1.75 * | 1.75 * | 1. |
| 45 | 2.09 | 2.03 | 1.98 | 1.91 | 1.90 | 1.90 * | 1.97 * | 1.98 * | 1.96 * | 1.86 * | 1.83 * | 1.83 * | 1.83 * | 1.83 * | 1. |
| Average completed family size | 2.09 | 2.03 | 1.98 | 1.91 | 1.91 | 1.91 * | 1.97 * | 1.98 * | 1.96 * | 1.87 * | 1.84 * | 1.84 * | 1.84 * | 1.84 * | 1. |
| Mean age at motherhood (years) | 26.4 | 27.1 | 27.8 | 28.4 | 28.9 | 29.49 * | 29.61 * | 29.69 * | 29.89 * | 30.52 * | 30.80 * | 30.88 * | 30.89 * | 30.90 * | 30. |

Source:Office for National Statistics

Note :

1. * Figures are partly or wholly projected

2. The ages of women are presented in 'exact age'. Therefore figures should be interpreted as the average number of children a woman has had up to that actual birthday.

# 3 . Trends in fertility

For the UK as a whole, completed family size showed a sharp decline from an average of around 2.45 children for women born in the mid-1930s to just over 2 for women born in the 1950’s. Since then, the completed family size has declined gradually, with women born in 1970, effectively the most recent cohort to have completed their fertility, achieving an average of 1.91 children per woman. Completed family size has decreased similarly across all constituent countries. For the 1970 cohort, Scotland had the lowest completed family size at 1.74 with Northern Ireland recording the highest at 2.11.

For the UK, the family sizes to be achieved by women currently in their twenties or younger are highly conjectural, but there is some evidence that suggests falls in cohort fertility could be slowing down. Women born in 1980 have had more children on average by age 30 than those born in 1975 and, because fertility rates at older ages are projected to remain high, the 1980 cohort is projected to have 1.97 children on average, a higher completed family size than women born in the 1970s. It has been assumed that average completed family size for the UK as a whole will fluctuate and fall gradually for women born after 1980, stabilising at 1.84 children for women born from 2000 onwards.

For England, and for Wales, the long-term average completed family size is assumed to be 1.85 children per woman. A higher level of 2.00 is assumed for Northern Ireland and a lower level of 1.65 is assumed for Scotland. These assumptions have reduced by 0.05 for England, Wales and Scotland compared with the 2014-based projections. Northern Ireland has seen no change from the 2014-based projections.

Between 2002 and 2008, total fertility rates increased in all constituent countries of the UK, followed by a dip in 2009 (see Figure 3.1). England, Wales and Northern Ireland showed some recovery from 2010 until 2013, when all the UK countries saw a large decline in total fertility rates. For England, Wales and Northern Ireland total fertility rates continued to decline from 2013 levels.

The Total fertility rate for Scotland continued to decline after 2009 to 1.52 in 2016, the lowest level since 2003.

In 2016 the total fertility rate was 1.81 in England, 1.74 in Wales and 1.95 in Northern Ireland.

For the UK as a whole the total fertility rate reached 1.79 in 2016, a small decline from 1.80 in 2015.

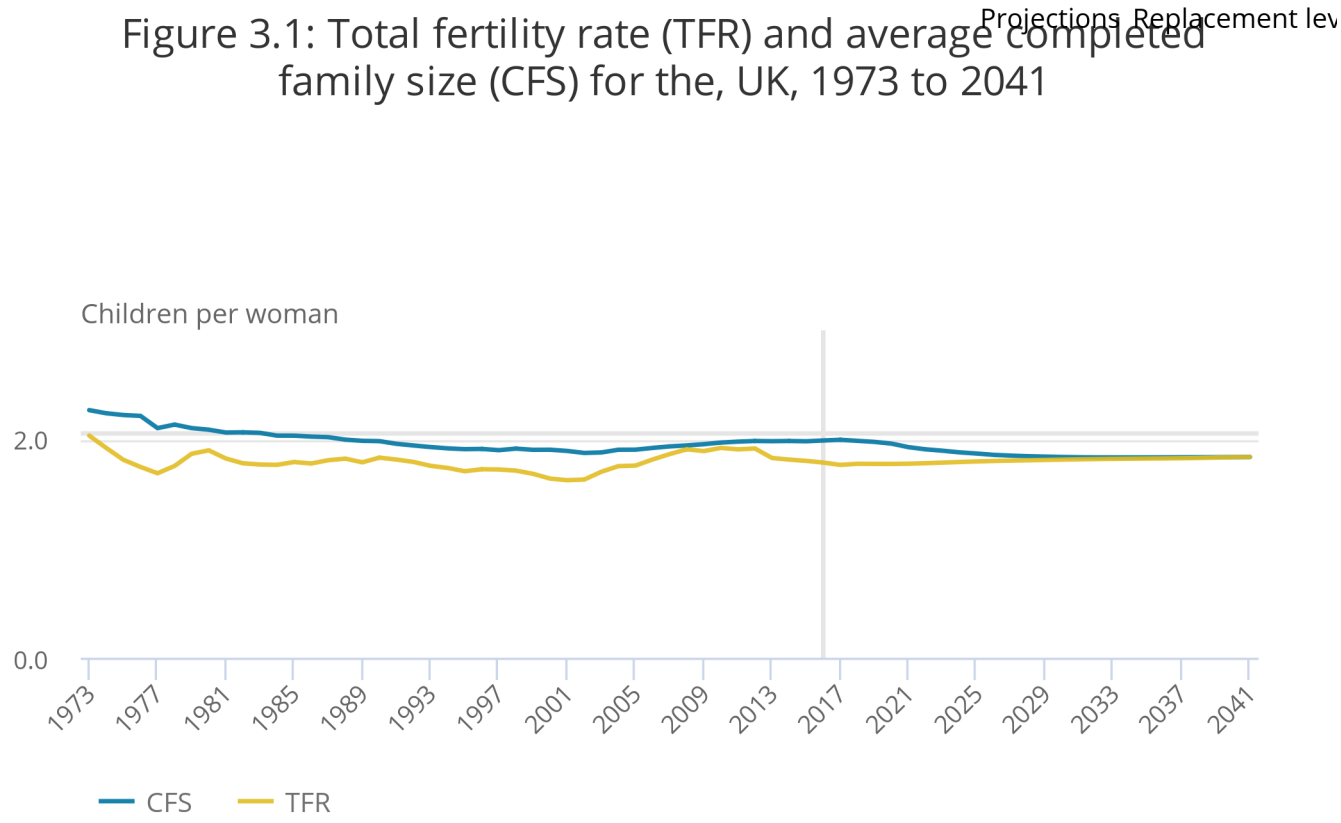
For the latest projections, it is assumed that there will be a gradual upward trend in the UK total fertility rate, following a small short-term decline before it levels out at 1.84 in the long-term.

Figure 3.1 shows that for the UK, the total fertility rate in 2017 (the first year of the projection period, which is controlled using the provisional estimates) is not in line with the projection trajectory into the future. This can also be seen for the constituent countries in Figure 3.4. This pattern has occurred because total fertility rates calculated for 2017, which incorporate the latest observed births data, are lower than originally assumed in the projections. The total fertility rate for 2018 comes back into line with the assumed projection trajectory.

Births per 1,000 women have shown declines for all women aged under 30; this trend is assumed to continue, especially at the youngest ages, for future cohorts. Conversely, births per 1,000 women for women aged 30 and over have increased for each cohort and this is projected to continue for future cohorts (Table 3.2).

Over the past fifteen 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 is projected to increase from 28.9 years for women born in 1970 to a long-term level of 30.9 for women born from 2002 onwards (Table 3.3)

**Figure 3.1: Total fertility rate (TFR) and average completed family size (CFS) for the, UK, 1973 to 2041**




**Source: Office for National Statistics**

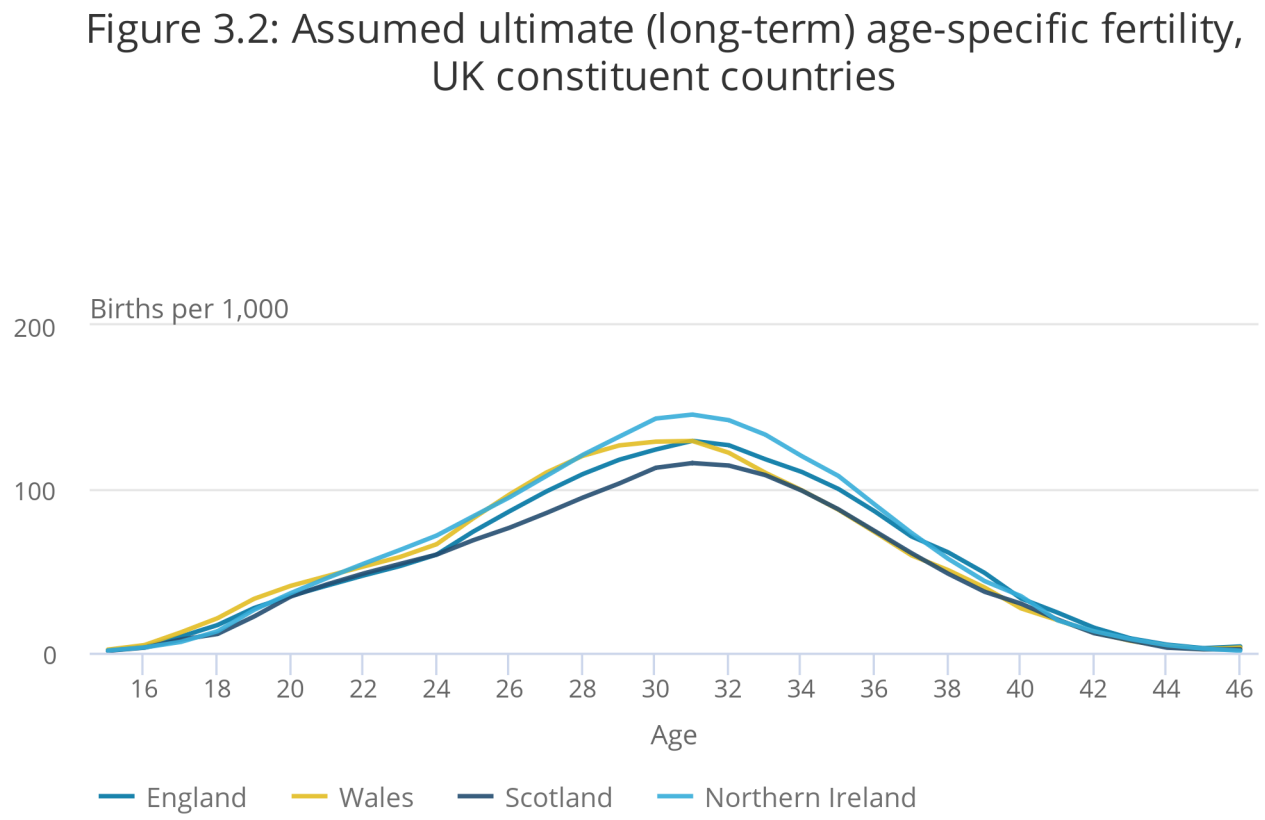
**Notes:**

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

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

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

**Figure 3.2: Assumed ultimate (long-term) age-specific fertility, UK constituent countries**

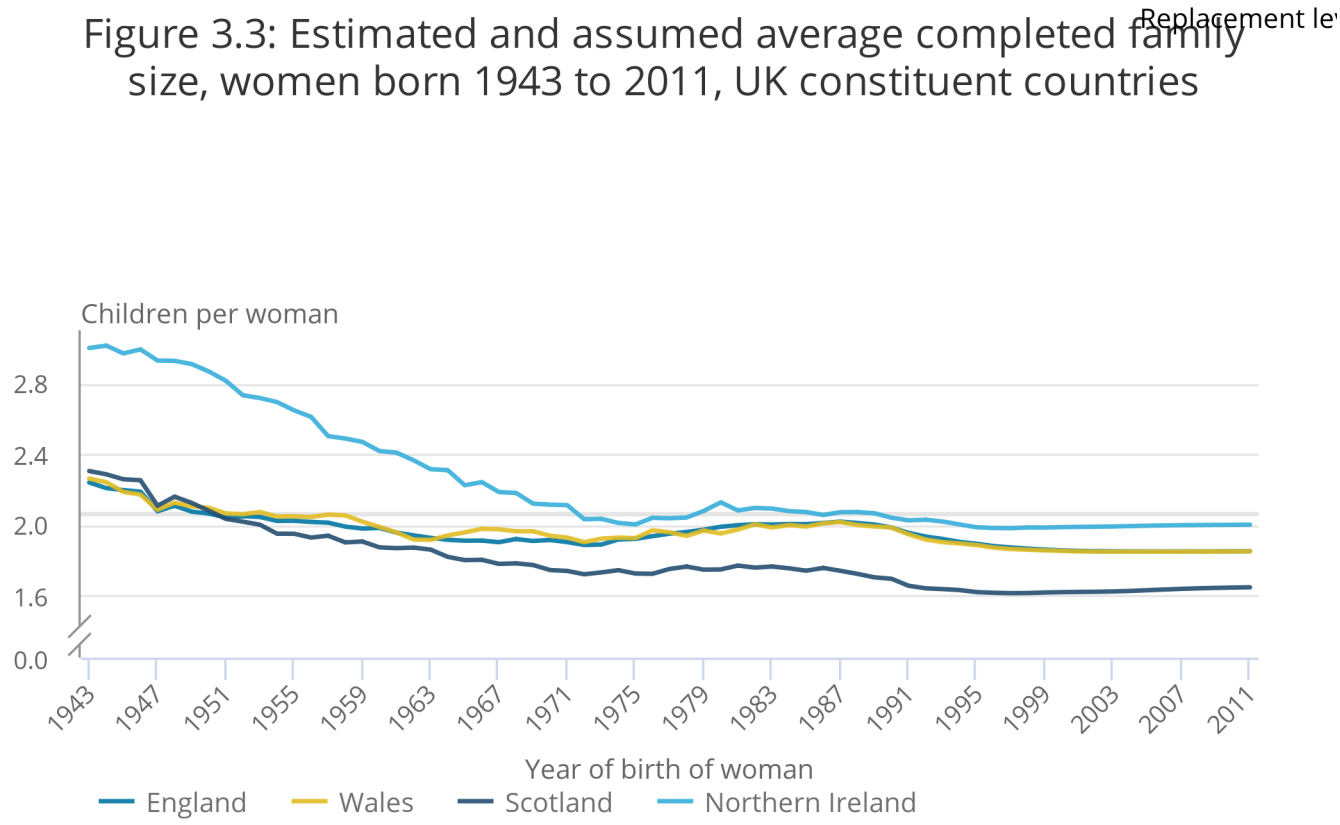



**Source: Office for National Statistics**

**Notes:**

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

**Figure 3.3: Estimated and assumed average completed family size, women born 1943 to 2011, UK constituent countries**



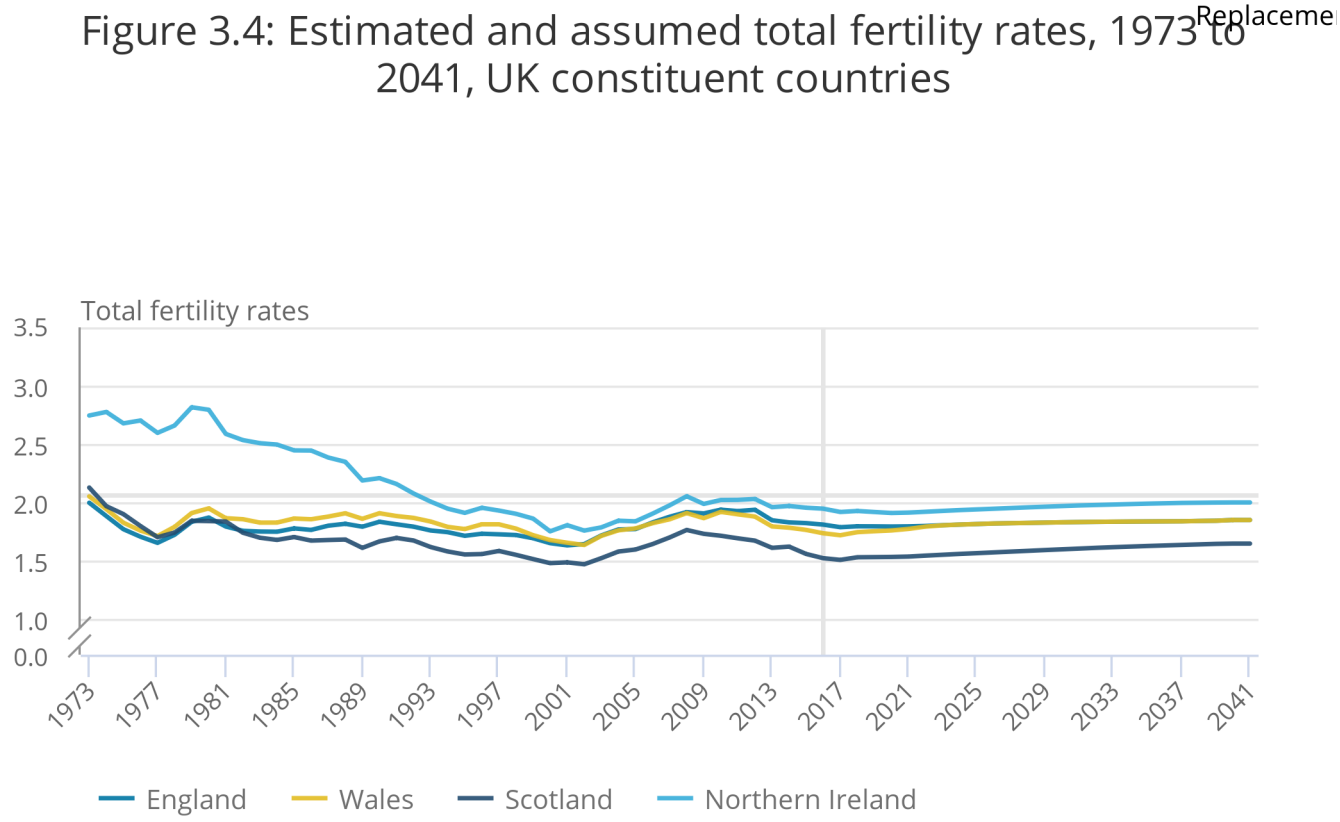

**Source: Office for National Statistics**

**Notes:**

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

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

**Figure 3.4: Estimated and assumed total fertility rates, 1973 to 2041, UK constituent countries**




**Source: Office for National Statistics**

**Notes:**

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

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

**Table 3.4: Assumed long-term total fertility rates for the standard variants**

| | Standard variants | | |
|---|---|---|---|
| Country | High | Principal | Low |
| England | 1.95 | 1.85 | 1.65 |
| Wales | 1.95 | 1.85 | 1.65 |
| Scotland | 1.75 | 1.65 | 1.45 |
| Northern Ireland | 2.10 | 2.00 | 1.80 |
| UK | 1.94 | 1.84 | 1.64 |

Source: Office for National Statistics

# 4 . Assumptions for fertility variants

Standard 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.

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.

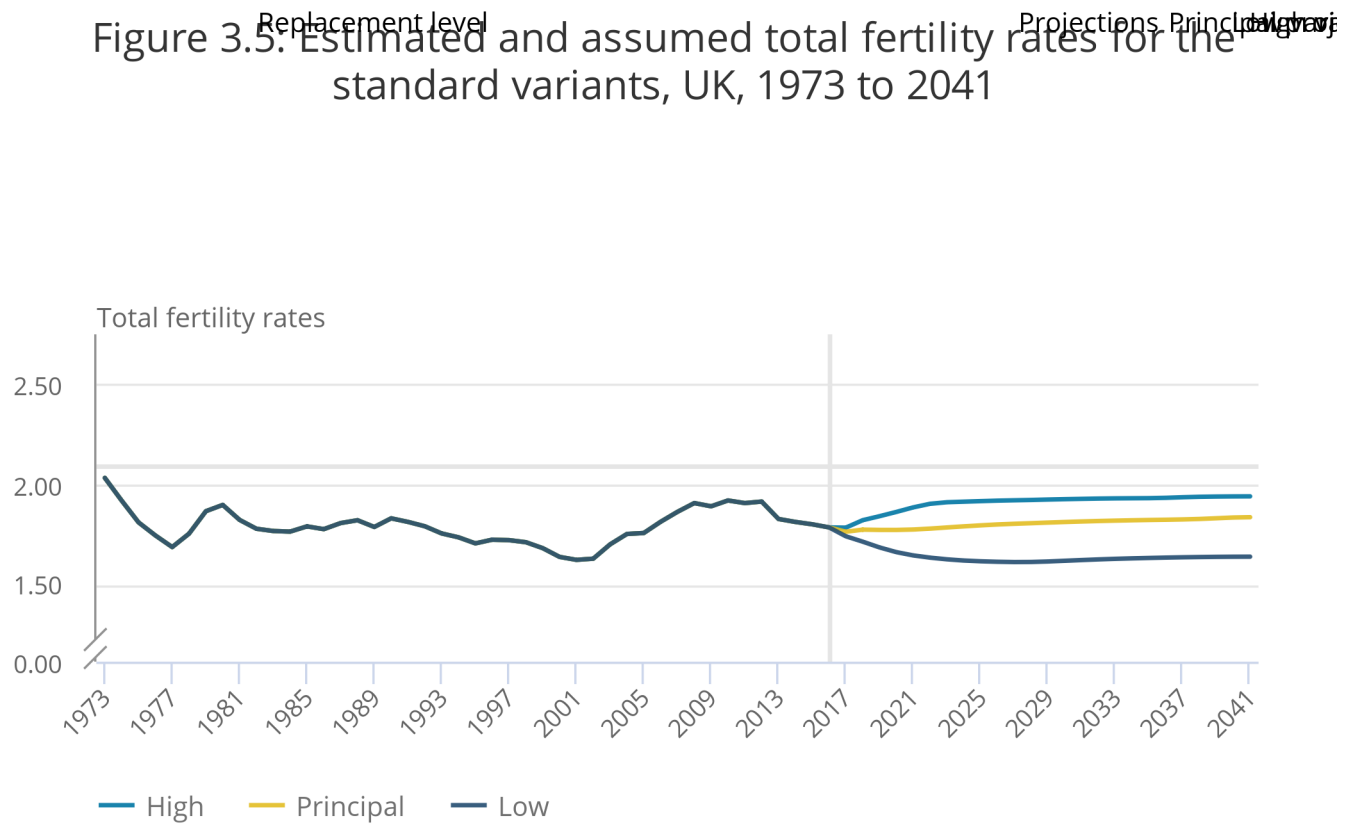
For the standard variants, fertility rates are generally assumed to move gradually from current levels to those assumed for the long term.

The 2016-based projections are the first to use asymmetric variants for the fertility assumptions.

Figure 3.5 shows that the principal projection assumes the total fertility rate for the UK decreases in the short term from the 2016 level of 1.79 to 1.77 in 2017, then increases gradually over the years. In the long term, the high and low fertility variants assume total fertility rates of 1.94 and 1.64 children per woman for the UK.

Figure 3.5 shows estimated and assumed total fertility rates for the UK between 1973 and 2041 for the principal projection and high and low variants.

**Figure 3.5: Estimated and assumed total fertility rates for the standard variants, UK, 1973 to 2041**




**Source: Office for National Statistics**

**Notes:**

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

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

# 5 . Background notes

1. Discussion papers showing the background information used in setting the fertility assumptions are available on our website.

2. Details of the policy governing the release of new data are available from the UK Statistics Authority website.

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

# Mortality assumptions

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Release date:
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Next release:
To be announced

## Table of contents

# 1 . Introduction

This report provides detailed information on the principal and variant mortality assumptions used in the 2016-based national population projections. The long-term mortality assumption for the UK projects period [1] life expectancy at birth to be 83.4 years for men and 86.2 years for women for the year ending mid-2041.

### Notes for: Introduction

1. Period life expectancy is calculated on the basis of the mortality rates for a particular calendar year and, unlike cohort life expectancy, does not allow for future known or assumed changes in mortality rates. Full definitions of period and cohort life expectancy are available on the National Archives website.

# 2 . General approach

When formulating the mortality assumptions for the population projections the focus is on mortality rates and annual percentage changes in 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 and are projected to continue to do so.

Rates of improvement by age and sex for 2016, the base year of the projections, were derived by analysing and projecting trends in mortality improvements derived from data for the period 1961 to 2015. These data were also used to derive assumed age- and sex-specific mortality rates for 2016. The rates of improvement derived for 2016 were then projected into the future and applied successively to the assumed mortality rates by age and sex for 2016 to derive projected mortality rates. The mortality rates for the first year of the projection, from mid-2016 to mid-2017, were adjusted to provide the best estimates that could be made in the autumn of 2017 of the numbers of deaths in 2016 to 2017.

# 3 . Principal assumptions

The assumptions used in the 2016-based projections are that annual rates of improvement in mortality rates would converge to 1.2% for most ages in 2041 (the 25th year of the 2016-based projections), and remain constant at 1.2% a year thereafter. 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, for those born before 1924 the target rate is assumed to decline from 1.1% to 0.1% for those born in 1906 and earlier.

This target rate was based on an analysis of past rates of improvement and expert advice. This differs slightly from the 2014-based projections, where higher rates of improvements were assumed for those born between 1923 and 1938 (also known as the “golden cohort”). These higher rates peaked at 2.5% for those born in 1931 and 1932.

These differentials experienced by the “golden cohort” appear to have reduced or disappeared in the data for the most recent years (see Figure 4.1). Until recently, the clearest cohort effects were for those born in the early 1930s who will be centenarians in 2041; high rates of improvement for these cohorts are likely to be too optimistic an assumption based on current evidence.

Over the 53-year period between 1960 to 1962 and 2013 to 2015, the average rates of improvement in age-standardised mortality rates were around 1.6% per year for males and 1.3% per year for females. These rates of improvement are derived from aggregate mortality rates for ages 0 to 99 calculated using the 2011 population estimates for the UK as the standard population. The rate of improvement over the latter half of this period was higher than over the first half, particularly 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.

The average annual rate of improvement in age-standardised mortality over the whole of the 20th century was around 1.2% for both males and females, although the actual improvement rates vary by age. There is considerable 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.

The transition from current rates of mortality improvement by age and sex, derived from recent trends, to the assumed rates of 1.2% in 2041 is not assumed to take place linearly, but is assumed to converge at the same speed for males and females. There is evidence of generational effects for those born after 1940. Thus, in these projections, convergence to the assumed rate of improvement in 2041 has been calculated by cohort for all those born before 1960. For those born in 1960 and later, 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.

The heat maps (Figures 4.1a and 4.1b) show the resulting historical and projected annual rates of mortality improvement for the UK by age and year. The highest improvements are shown by the areas denoted by 2.5% and 3% per year improvement (shaded orange and red in Figures 4.1a and 4.1b).

**Figure 4.1a: Historic and projected percentage change in smoothed mortality rates, males, UK, 1962 to 2041**

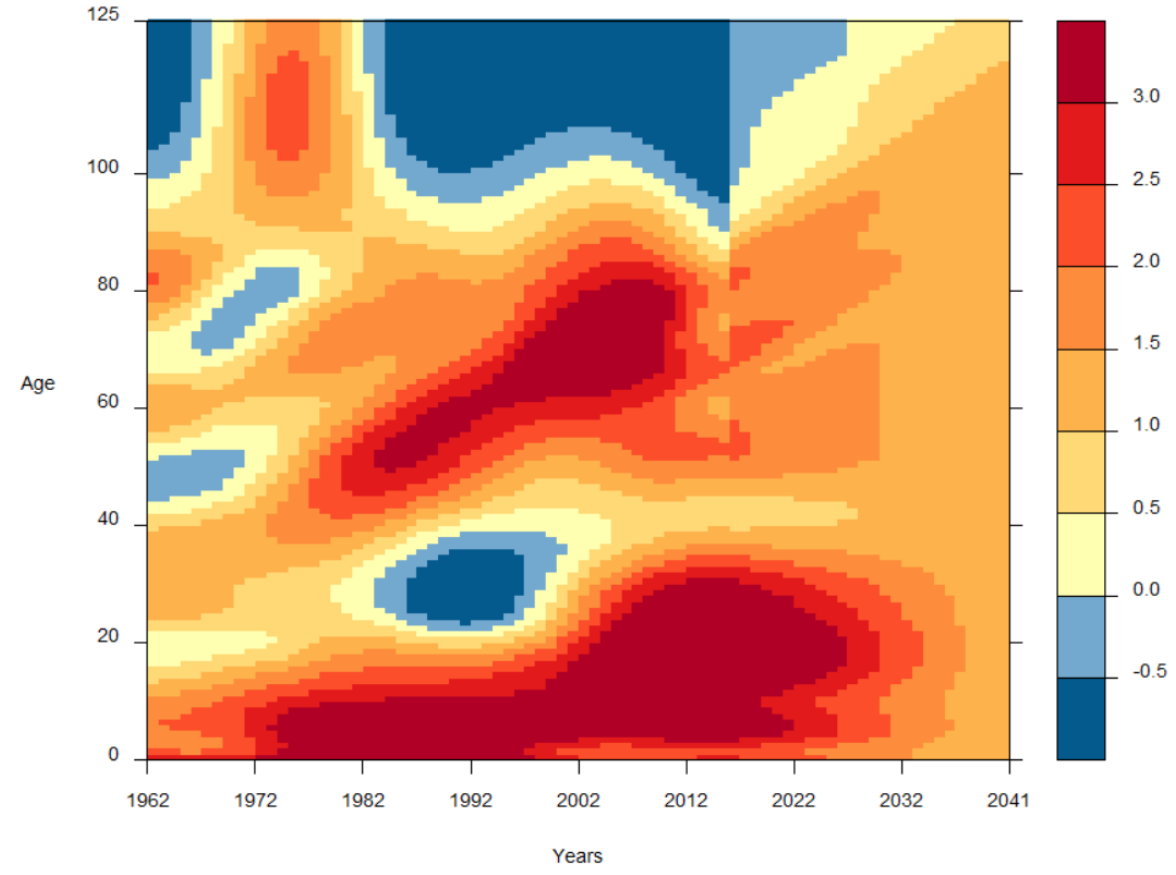
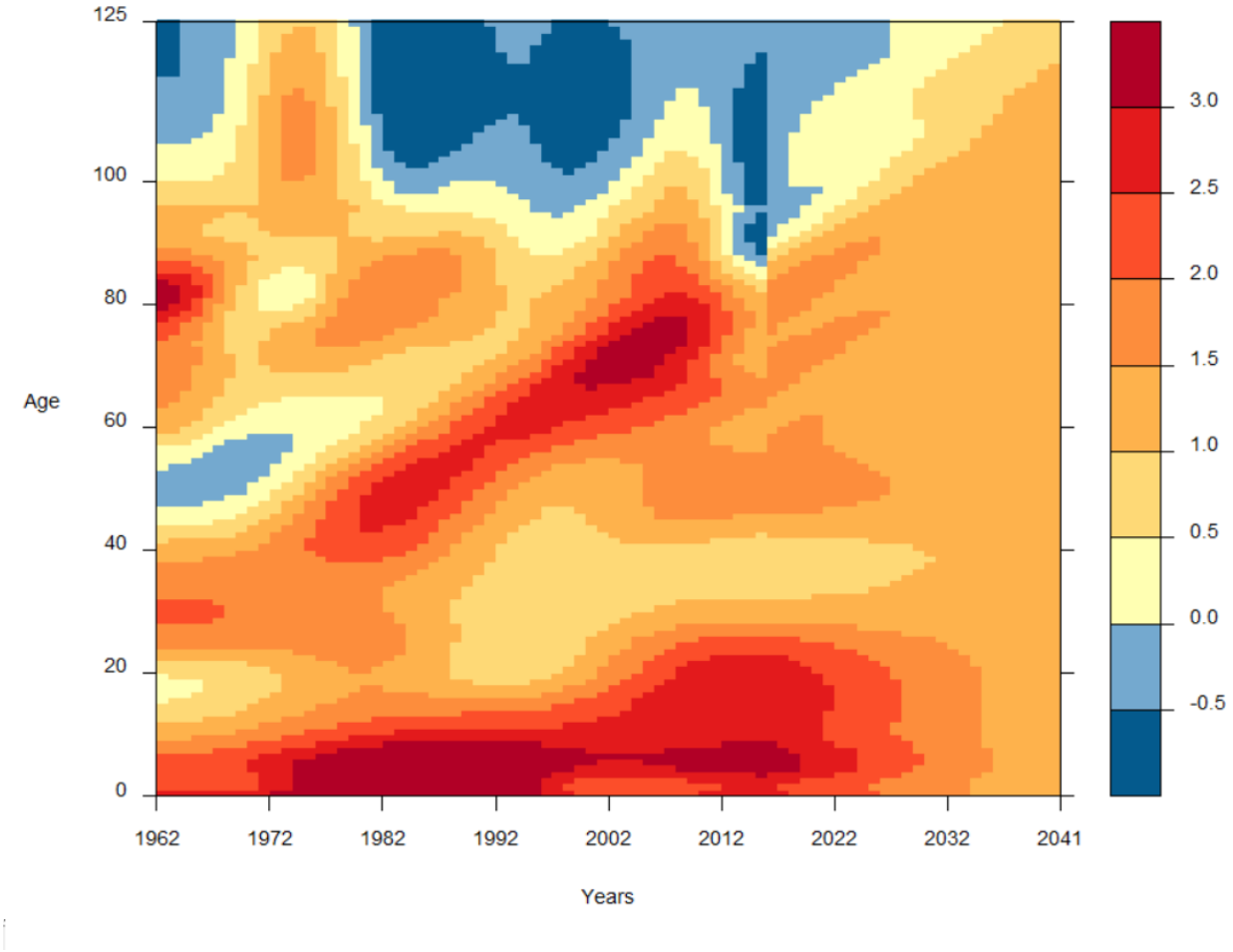


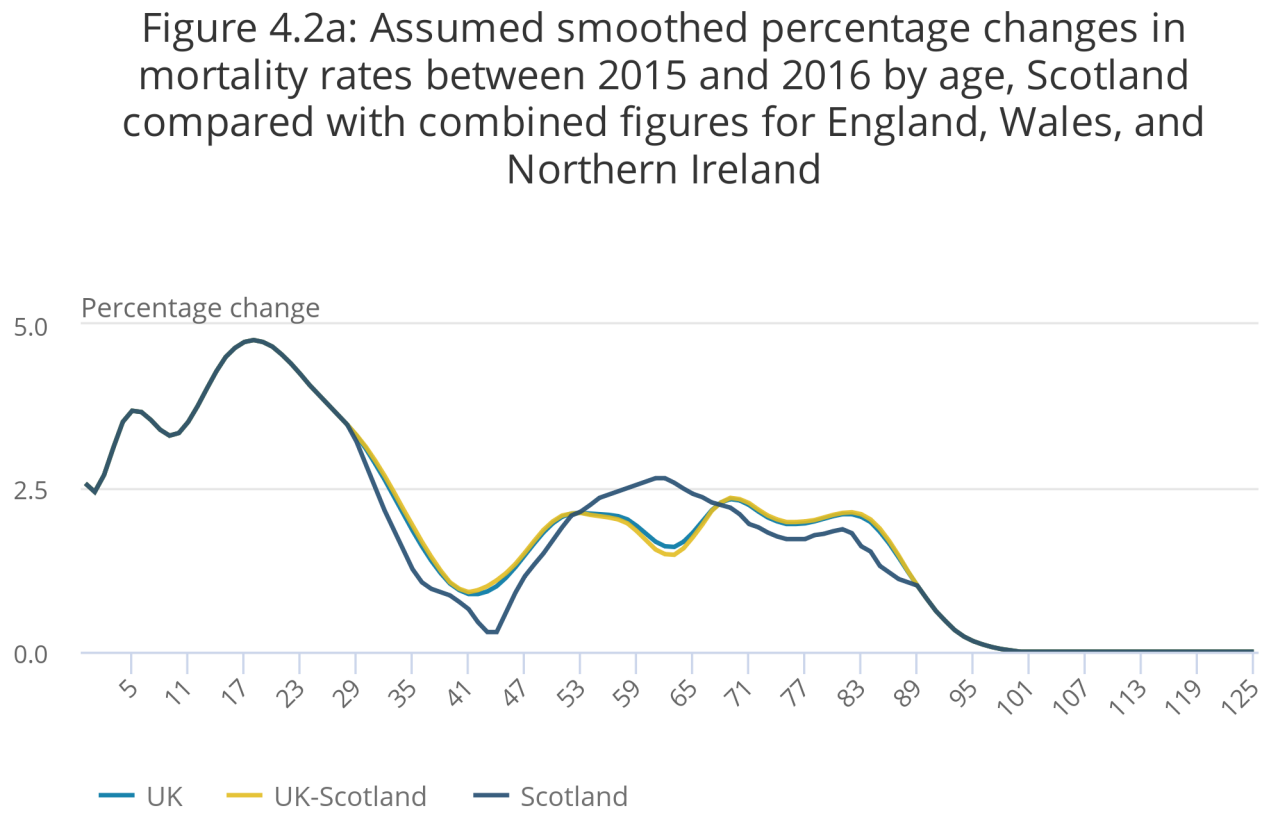
**Figure 4.1b: Historic and projected percentage change in smoothed mortality rates, females, UK, 1962 to 2041**




The rates of improvement after 2041 are assumed to remain constant (by cohort or by age, as described earlier) at the rate assumed in 2041 for each year thereafter. Taking account of the generally higher rates of improvement assumed prior to 2041, this produces average annualised rates of mortality improvement of around 1.3% for males and 1.2% for females over the projection period to 2091 (75 years). This is slightly lower than those experienced over the past 75 years, of around 1.4% per year for both males and females.

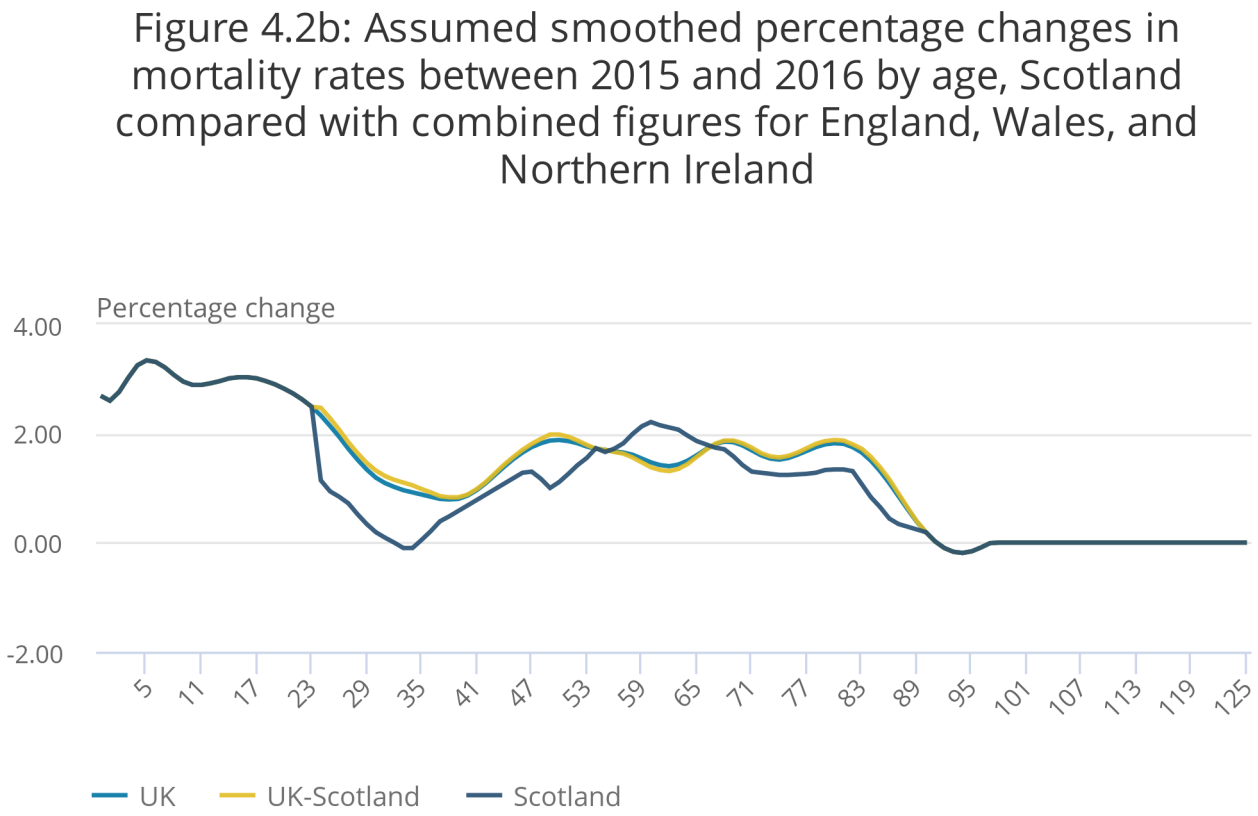
Comparisons of the recent historical rates of improvement experienced in each individual country with those experienced in the UK as a whole suggested that the same assumed initial rates of improvement by age and sex for 2016 could be adopted for each individual country, except for Scotland. Mortality 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 than those derived for the UK were assumed for Scottish males and females at several ages. Lower rates of improvement have been assumed for Scottish males in their 30s, 40s, early 50s and late 60s to early 90s, with higher rates assumed for those aged 53 to 67. For Scottish females, lower rates have been assumed for those aged 24 to 53 and 67 to 89, with higher rates assumed for those aged 54 to 66, than for the rest of the UK. The improvement rates for the other countries were then adjusted so that the weighted country-specific improvements by age were the same as those initially derived for the UK as a whole. The resulting assumed smoothed changes in mortality rates between 2015 and 2016 for each country are shown in Figures 4.2a and 4.2b.

**Figure 4.2a: Assumed smoothed percentage changes in mortality rates between 2015 and 2016 by age, Scotland compared with combined figures for England, Wales, and Northern Ireland**




**Source: Office for National Statistics**

**Figure 4.2b: Assumed smoothed percentage changes in mortality rates between 2015 and 2016 by age, Scotland compared with combined figures for England, Wales, and Northern Ireland**




**Source: Office for National Statistics**

As a result, a slightly different set of future rates of improvements has been assumed for Scotland compared with the other countries of the UK, as was done in recent past projections. These rates generally assume slightly smaller improvements in the period to 2041 at some ages for males and females.

In 2041, period expectation of life at birth for the UK is around 0.9 years lower than in previous projections for both males and females. These differences are mainly due to:

- a combination of the changes in initial rates of mortality improvement and base mortality rates compared with those projected for 2016 in the 2014-based projections
- the change in the target year
- the improvement rates assumed at some ages in the target year

After 2041 the life expectancies for males continue to diverge from those in the 2014-based projections to around 1.2 years lower by 2091, whilst those for females fall to around 1.3 years lower.

Period expectations of life at birth and at age 65, based on the projected mortality rates, are shown for selected future years in Table 4.1. The base year mortality rates for individual countries are shown for selected ages in Table 4.2 and a summary of the assumed percentage rates of mortality reduction for selected years and ages is shown in Tables 4.3 and 4.4.

**Table 4.1 Period expectation of life at birth and at age 65 according to mortality rates assumed for selected years, UK**

Years

| Period expectation of life at birth | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2016 to 2017 | | 2020 to 2021 | | 2030 to 2031 | | 2040 to 2041 | |
| | Males | Females | Males | Females | Males | Females | Males | Females |
| England | 79.6 | 83.2 | 80.7 | 84.0 | 82.3 | 85.3 | 83.6 | 86.4 |
| Wales | 78.5 | 82.5 | 79.8 | 83.2 | 81.5 | 84.5 | 82.8 | 85.7 |
| Scotland | 77.4 | 81.3 | 78.5 | 82.0 | 80.3 | 83.3 | 81.7 | 84.5 |
| Northern Ireland | 79.0 | 82.4 | 79.7 | 83.2 | 81.4 | 84.6 | 82.8 | 85.8 |
| UK | 79.4 | 83.0 | 80.4 | 83.7 | 82.1 | 85.0 | 83.4 | 86.2 |
| **Period expectation of life at age 65** | | | | | | | | |
| | 2016 to 2017 | | 2020 to 2021 | | 2030 to 2031 | | 2040 to 2041 | |
| | Males | Females | Males | Females | Males | Females | Males | Females |
| England | 18.8 | 21.2 | 19.5 | 21.7 | 20.7 | 22.7 | 21.7 | 23.6 |
| Wales | 18.1 | 20.7 | 19.0 | 21.2 | 20.2 | 22.2 | 21.2 | 23.1 |
| Scotland | 17.5 | 19.8 | 18.2 | 20.3 | 19.5 | 21.3 | 20.5 | 22.2 |
| Northern Ireland | 18.6 | 20.6 | 19.0 | 21.2 | 20.2 | 22.2 | 21.2 | 23.2 |
| UK | 18.6 | 21.0 | 19.4 | 21.5 | 20.5 | 22.5 | 21.5 | 23.4 |

Source: Office for National Statistics

**Table 4.2: Assumed base year mortality rates ($m_x$) per 100,000 population, by selected ages, UK, 2016**

| | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|
| Age | England | Wales | Scotland | Northern Ireland | England | Wales | Scotland | Northern Ireland |
| 0 | 413 | 400 | 341 | 539 | 332 | 294 | 303 | 387 |
| 2 | 13 | 12 | 12 | 15 | 11 | 9 | 10 | 11 |
| 12 | 9 | 8 | 10 | 9 | 7 | 7 | 8 | 7 |
| 22 | 48 | 52 | 61 | 77 | 21 | 21 | 25 | 26 |
| 32 | 75 | 100 | 123 | 105 | 41 | 51 | 61 | 45 |
| 42 | 165 | 204 | 253 | 183 | 100 | 109 | 133 | 103 |
| 52 | 346 | 383 | 451 | 372 | 235 | 279 | 313 | 263 |
| 62 | 887 | 972 | 1087 | 947 | 578 | 663 | 710 | 657 |
| 72 | 2259 | 2474 | 2900 | 2444 | 1510 | 1672 | 1956 | 1593 |
| 82 | 6825 | 7227 | 7841 | 7235 | 4999 | 5318 | 5977 | 5266 |
| 92 | 22113 | 23006 | 23480 | 23006 | 18352 | 19163 | 20166 | 19041 |
| 102 | 57690 | 58511 | 59111 | 57764 | 53032 | 53032 | 53705 | 53099 |

Source: Office for National Statistics

**Table 4.3: Assumed percentage reduction in death rates ($m_x$) between calendar years for England, Wales and Northern Ireland**

Percentage

| | 2016 to 2017 | | 2020 to 2021 | | 2030 to 2031 | | 2040 to 2041 | | over 25 years | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age last birthday | Males | Females | Males | Females | Males | Females | Males | Females | Males | Females |
| 0 | 2.5 | 2.62 | 2.25 | 2.34 | 1.66 | 1.7 | 1.2 | 1.2 | 36.4 | 37.3 |
| 2 | 2.63 | 2.69 | 2.35 | 2.39 | 1.7 | 1.72 | 1.2 | 1.2 | 37.3 | 37.8 |
| 12 | 3.63 | 2.84 | 3.15 | 2.52 | 2.05 | 1.77 | 1.2 | 1.2 | 44.3 | 38.9 |
| 22 | 4.25 | 2.55 | 3.65 | 2.29 | 2.27 | 1.67 | 1.2 | 1.2 | 48.2 | 36.8 |
| 32 | 2.62 | 1.15 | 2.34 | 1.16 | 1.7 | 1.18 | 1.2 | 1.2 | 37.3 | 25.7 |
| 42 | 0.95 | 1.12 | 1 | 1.13 | 1.11 | 1.17 | 1.2 | 1.2 | 23.9 | 25.4 |
| 52 | 2.07* | 1.84* | 1.9 | 1.71 | 1.5 | 1.42 | 1.2 | 1.2 | 33.1 | 31.3 |
| 62 | 1.54* | 1.32* | 1.83* | 1.53* | 1.47 | 1.34 | 1.2 | 1.2 | 31.8 | 28.9 |
| 72 | 2.22* | 1.71* | 1.92* | 1.66* | 1.47* | 1.34* | 1.2 | 1.2 | 32.1 | 29.5 |
| 82 | 2.08* | 1.83* | 1.8* | 1.61* | 1.51* | 1.4* | 1.2* | 1.2* | 32.7 | 30.2 |
| 92 | 0.65* | 0.08* | 1.41* | 0.97* | 1.46* | 1.38* | 1.2* | 1.2* | 29.4 | 25.7 |

Source: Office for National Statistics

Note:

1. Projections are made by calendar year, except figures marked with an *, where projections are made by cohort.

**Table 4.4: Assumed percentage reduction in death rates ($m_x$) between calendar years for Scotland**

Percentage Reduction

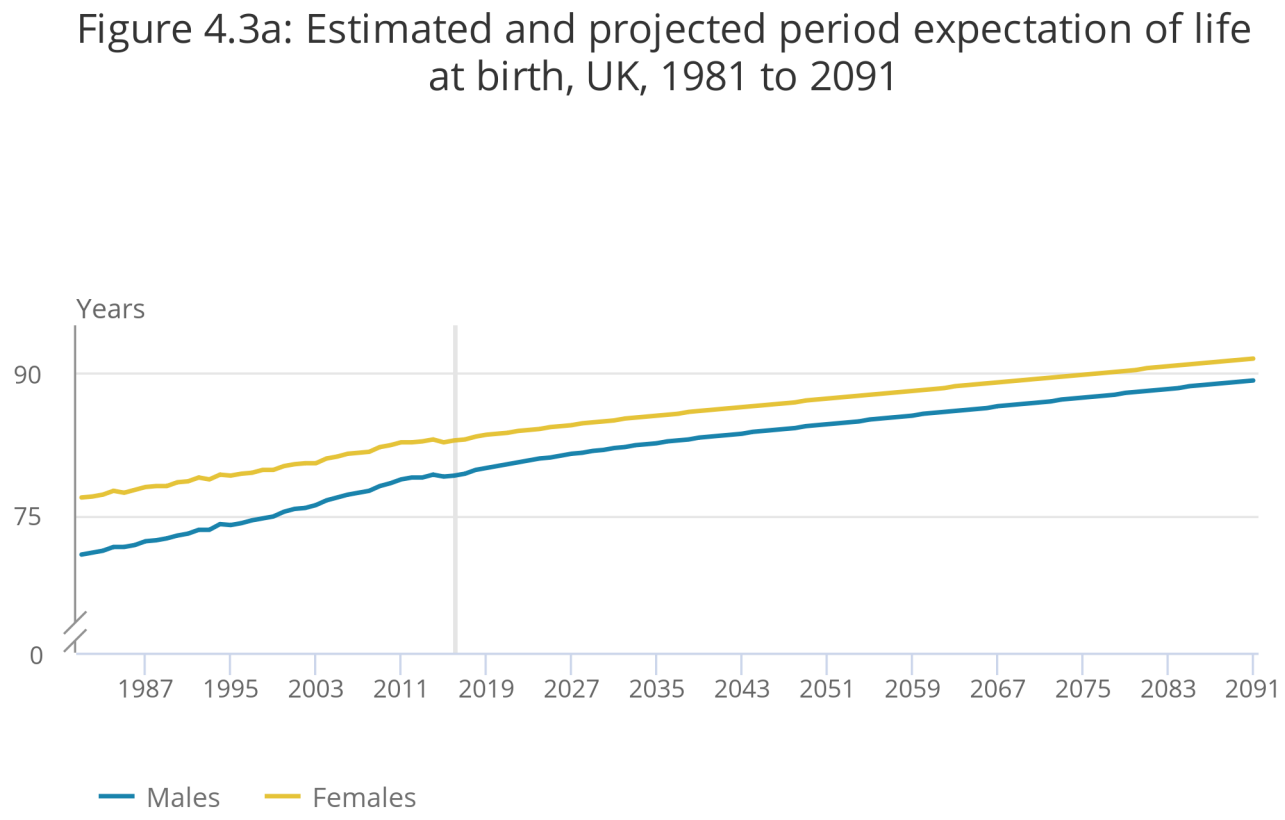
| | 2016 to 2017 | | 2020 to 2021 | | 2030 to 2031 | | 2040 to 2041 | | over 25 years | |
|---|---|---|---|---|---|---|---|---|---|---|
| Age last birthday | Males | Females | Males | Females | Males | Females | Males | Females | Males | Females |
| 0 | 2.5 | 2.62 | 2.25 | 2.34 | 1.66 | 1.7 | 1.2 | 1.2 | 36.4 | 37.3 |
| 2 | 2.63 | 2.69 | 2.35 | 2.39 | 1.7 | 1.72 | 1.2 | 1.2 | 37.3 | 37.8 |
| 12 | 3.63 | 2.84 | 3.15 | 2.52 | 2.05 | 1.77 | 1.2 | 1.2 | 44.3 | 38.9 |
| 22 | 4.25 | 2.55 | 3.65 | 2.29 | 2.27 | 1.67 | 1.2 | 1.2 | 48.2 | 36.8 |
| 32 | 2.11 | 0.06 | 1.93 | 0.28 | 1.52 | 0.8 | 1.2 | 1.2 | 33.5 | 15.7 |
| 42 | 0.49 | 0.9 | 0.63 | 0.96 | 0.95 | 1.09 | 1.2 | 1.2 | 19.7 | 23.4 |
| 52 | 2.04* | 1.41* | 1.87 | 1.37 | 1.49 | 1.27 | 1.2 | 1.2 | 32.9 | 50.6 |
| 62 | 2.58* | 2.1* | 2.16* | 1.68* | 1.62 | 1.41 | 1.2 | 1.2 | 35.9 | 31.7 |
| 72 | 1.91* | 1.3* | 2.03* | 1.61* | 1.62* | 1.41* | 1.2 | 1.2 | 35 | 30.7 |
| 82 | 1.84* | 1.33* | 1.59* | 1.25* | 1.56* | 1.38* | 1.2* | 1.2* | 31.9 | 27.8 |
| 92 | 0.65* | 0.08* | 1.13* | 0.54* | 1.37* | 1.22* | 1.2* | 1.2* | 27.3 | 22.2 |

Source: Office for National Statistics

Note:

1. Projections are made by calendar year, except figures marked with an *, where projections are made by cohort.

**Figure 4.3a: Estimated and projected period expectation of life at birth, UK, 1981 to 2091**

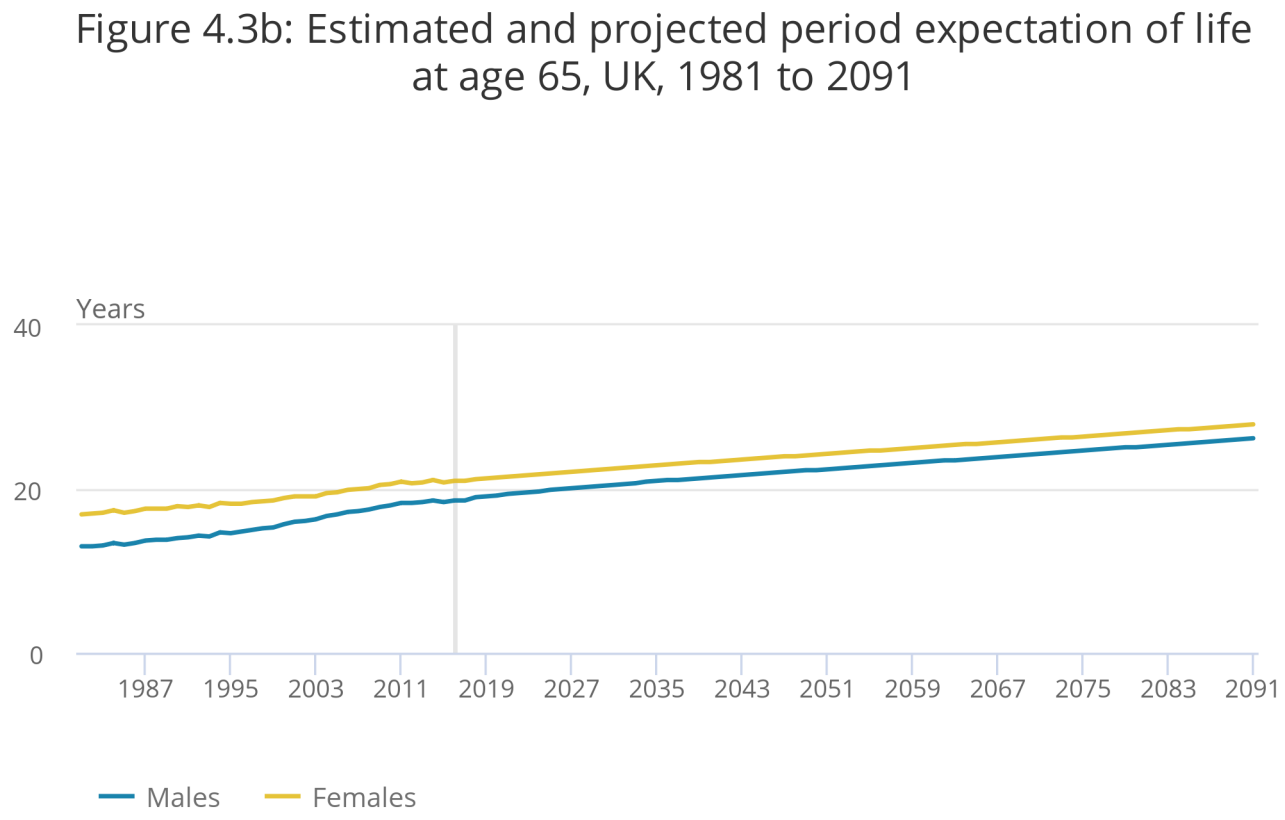



**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

**Figure 4.3b: Estimated and projected period expectation of life at age 65, UK, 1981 to 2091**

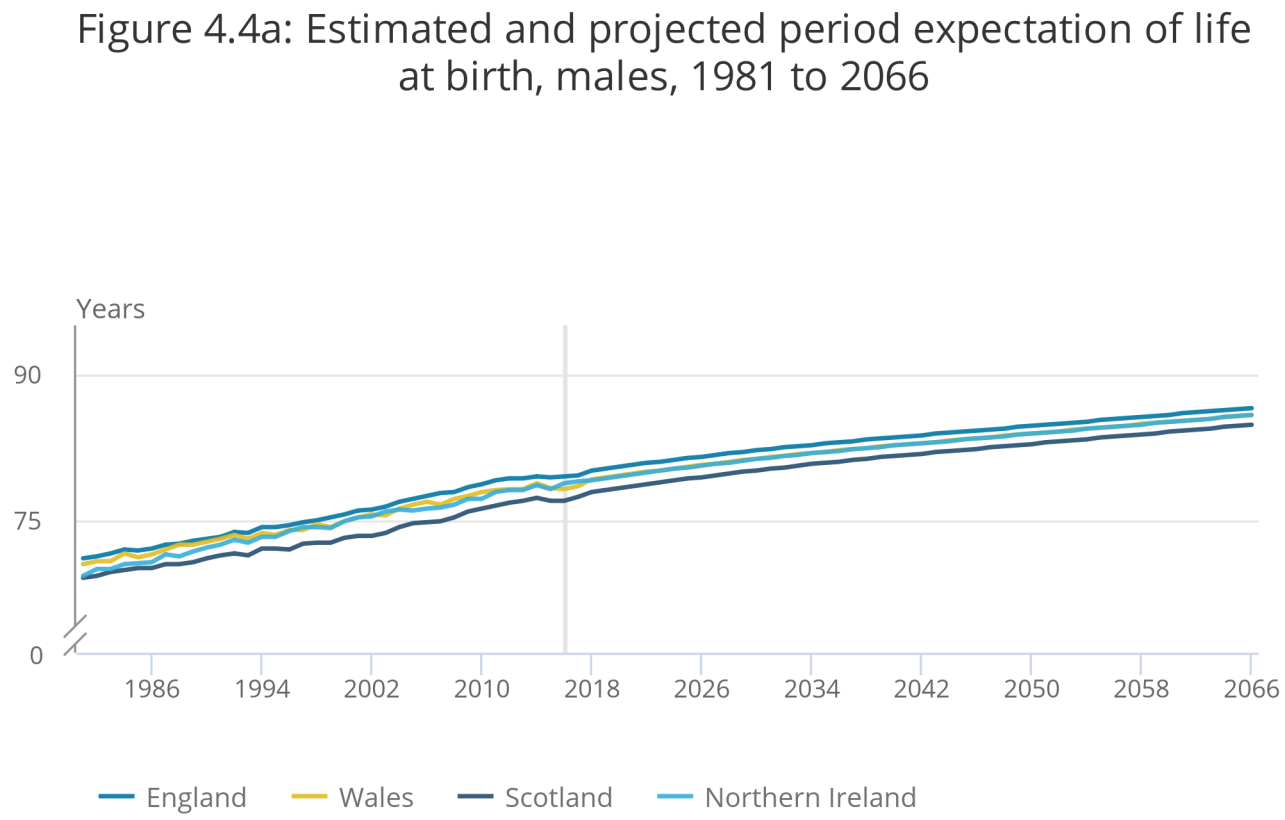



**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

**Figure 4.4a: Estimated and projected period expectation of life at birth, males, 1981 to 2066**

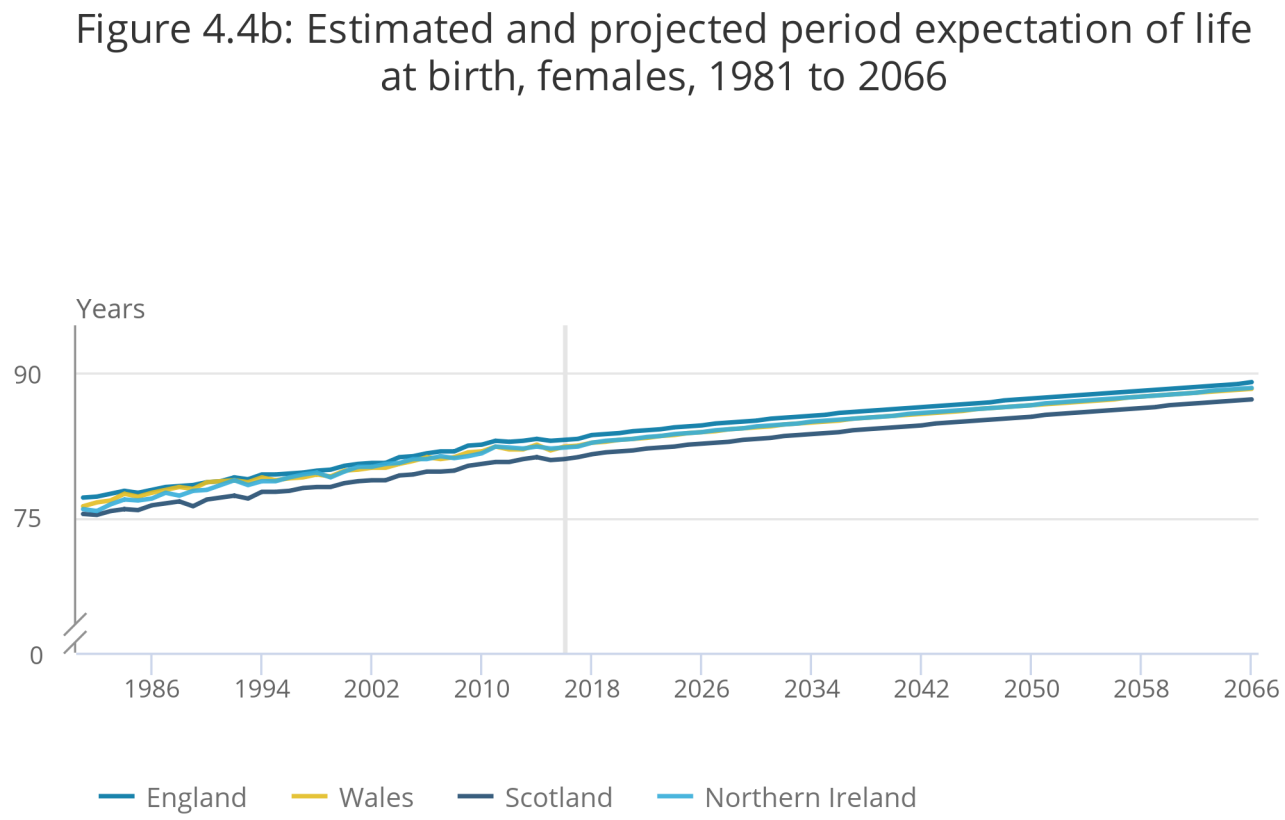



**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

**Figure 4.4b: Estimated and projected period expectation of life at birth, females, 1981 to 2066**




**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

# 4 . Assumptions for mortality variants

Current annual improvements in mortality rates vary considerably by age and sex. For mortality, it is assumed that for most ages these improvements will gradually converge to common "target rates" of improvement, at each age and for both sexes, by the year 2041, and continue to improve at that constant rate thereafter. In contrast to previous years' projections it is no longer assumed that those born in the years after 1922 and before 1939 (cohorts which have consistently experienced relatively high rates of mortality improvement over the last 25 years) will experience higher rates of mortality improvement than the rest of the population after 2041.

The target rate assumptions for the variant mortality projections for the UK and its constituent countries are as follows:

High variant: 1.9% annual improvement at 2041, thereafter annual improvement remaining at 1.9%. For those born before 1924 the target rate is assumed to decline from 1.9% to 0.8% for those born in 1906 and earlier.

Moderately high variant: 1.6% annual improvement at 2041, thereafter annual improvement remaining at 1.6%. For those born before 1924 the target rate is assumed to decline from 1.6% to 0.5% for those born in 1906 and earlier.

Principal projection: 1.2% annual improvement at 2041, thereafter annual improvement remaining at 1.2%. For those born before 1924 the target rate is assumed to decline from 1.2% to 0.1% for those born in 1906 and earlier.

Moderately low variant: 0.6% annual improvement at 2041, thereafter annual improvement remaining at 0.6%. For those born before 1924 the target rate is assumed to decline from 0.6% to 0.1% for those born in 1906 and earlier.

Low variant: 0% annual improvement at 2041, thereafter mortality rates remaining constant (improvements at 0%) for all ages.

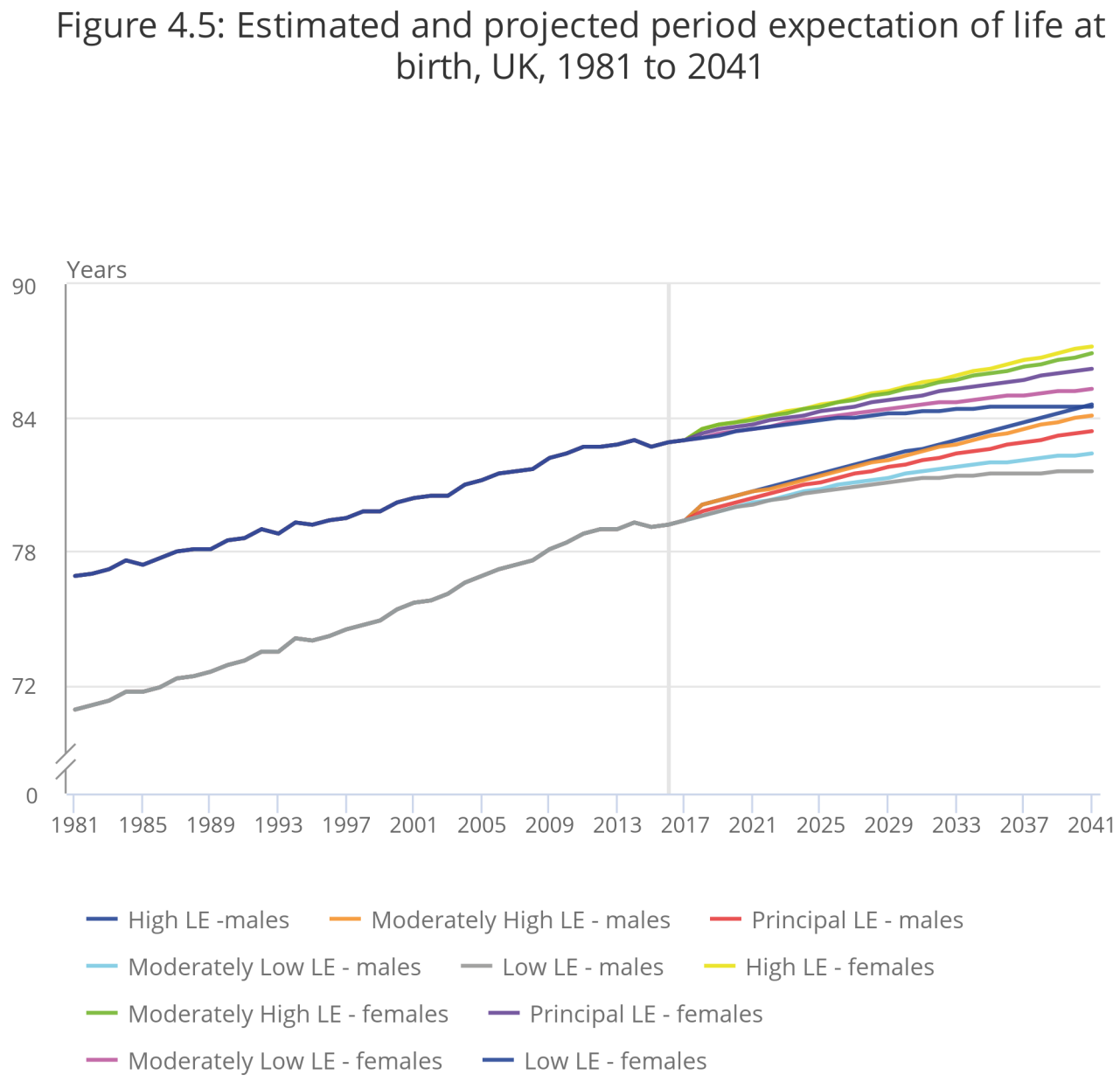
Table 4.5 shows period expectation of life at birth in 2041 that result from the principal and variant assumptions.

**Table 4.5 Period expectation of life at birth in the year ending mid-2041 for the standard variants, UK**

| | High | Moderately high | Principal | Moderately low | Low |
|---|---|---|---|---|---|
| **Males** | | | | | |
| England | 84.8 | 84.4 | 83.6 | 82.6 | 81.8 |
| Wales | 84 | 83.6 | 82.8 | 81.8 | 80.9 |
| Scotland | 82.9 | 82.5 | 81.7 | 80.6 | 79.8 |
| Northern Ireland | 84 | 83.5 | 82.8 | 81.7 | 80.9 |
| UK | 84.6 | 84.1 | 83.4 | 82.4 | 81.6 |
| **Females** | | | | | |
| England | 87.4 | 87.1 | 86.4 | 85.5 | 84.8 |
| Wales | 86.8 | 86.4 | 85.7 | 84.8 | 84 |
| Scotland | 85.6 | 85.2 | 84.5 | 83.6 | 82.8 |
| Northern Ireland | 86.8 | 86.4 | 85.8 | 84.8 | 84.1 |
| UK | 87.2 | 86.9 | 86.2 | 85.3 | 84.5 |

Source: Office for National Statistics

**Figure 4.5: Estimated and projected period expectation of life at birth, UK, 1981 to 2041**




**Source: Office for National Statistics**

**Notes:**

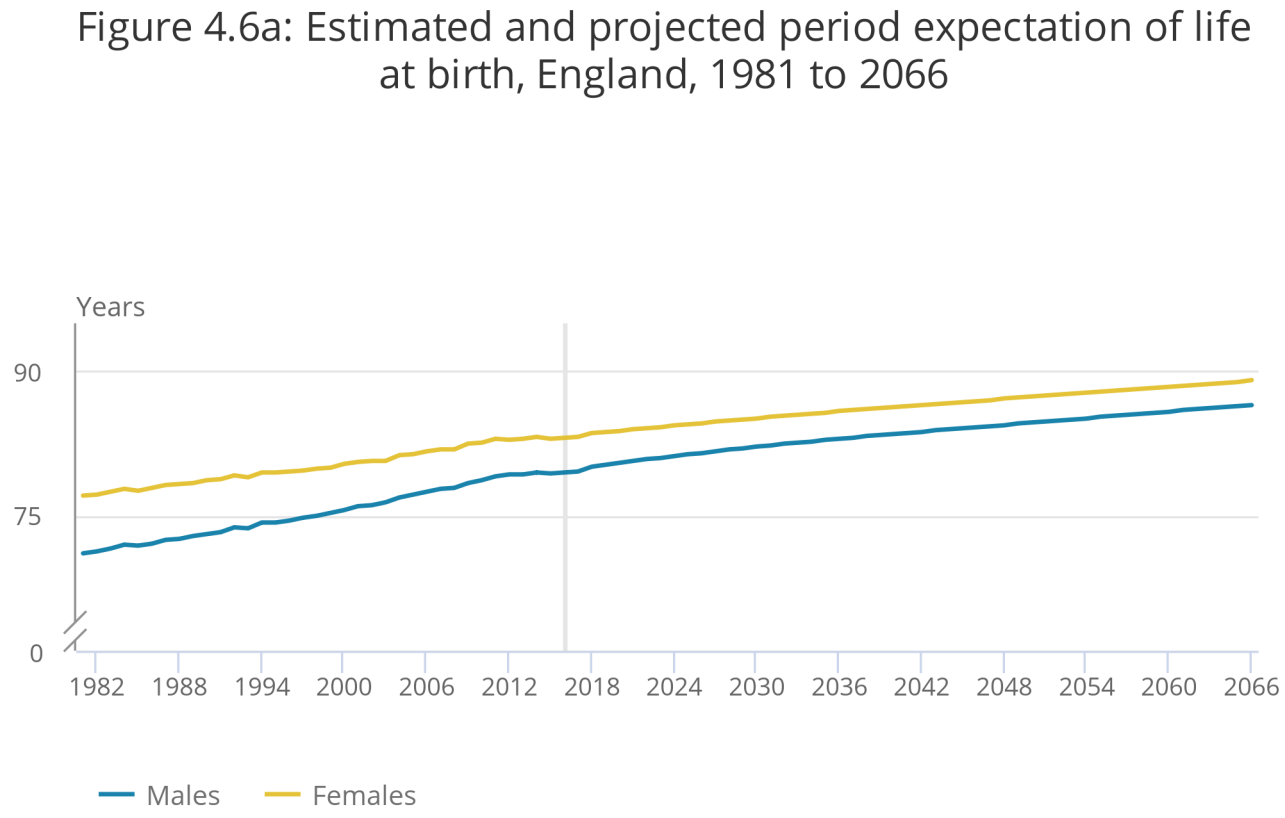
1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

# 5 . Links to further information

- More detailed information on the method used to set the mortality assumptions as well as discussion of historical trends in mortality can be found in the mortality consultation papers.
- The latest trends in period life expectancy for the UK and constituent countries are presented in the 2014 to 2016 National life tables.
- All life expectancy figures given within this release are period life expectancies. Projected cohort life expectancies are due to be published in our Past and projected life tables publication in early December.

# 6 . Appendix A: England charts

**Figure 4.6a: Estimated and projected period expectation of life at birth, England, 1981 to 2066**

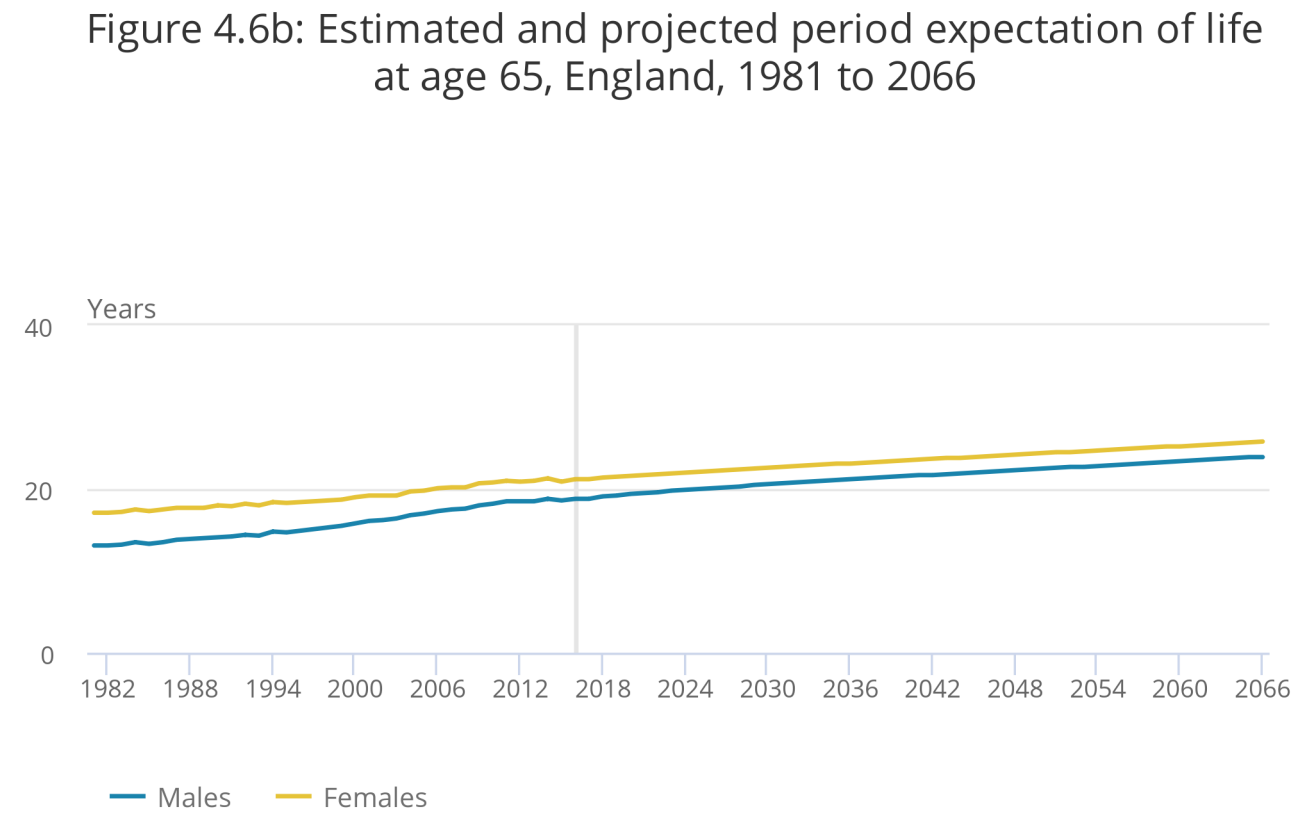



**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

**Figure 4.6b: Estimated and projected period expectation of life at age 65, England, 1981 to 2066**



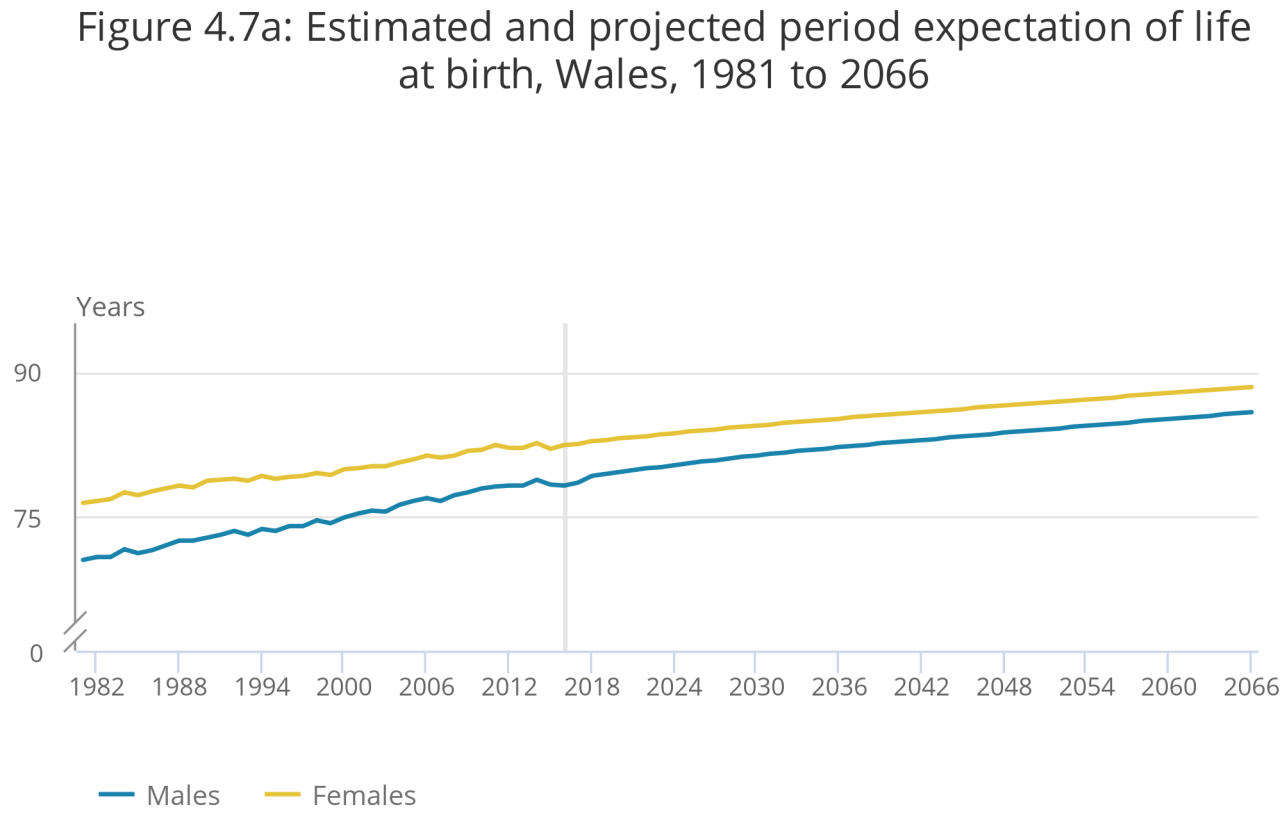

**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

# 7 . Appendix B: Wales charts

**Figure 4.7a: Estimated and projected period expectation of life at birth, Wales, 1981 to 2066**

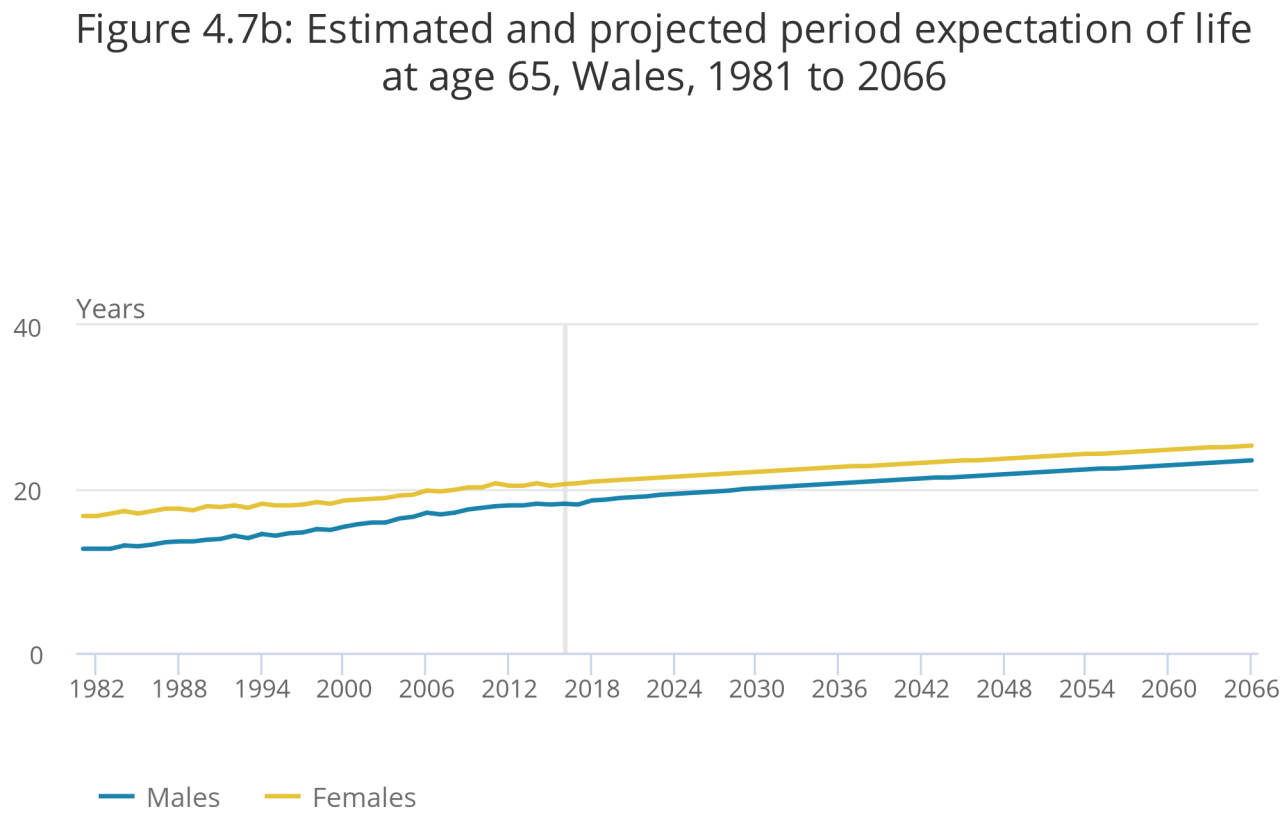



**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

**Figure 4.7b: Estimated and projected period expectation of life at age 65, Wales, 1981 to 2066**



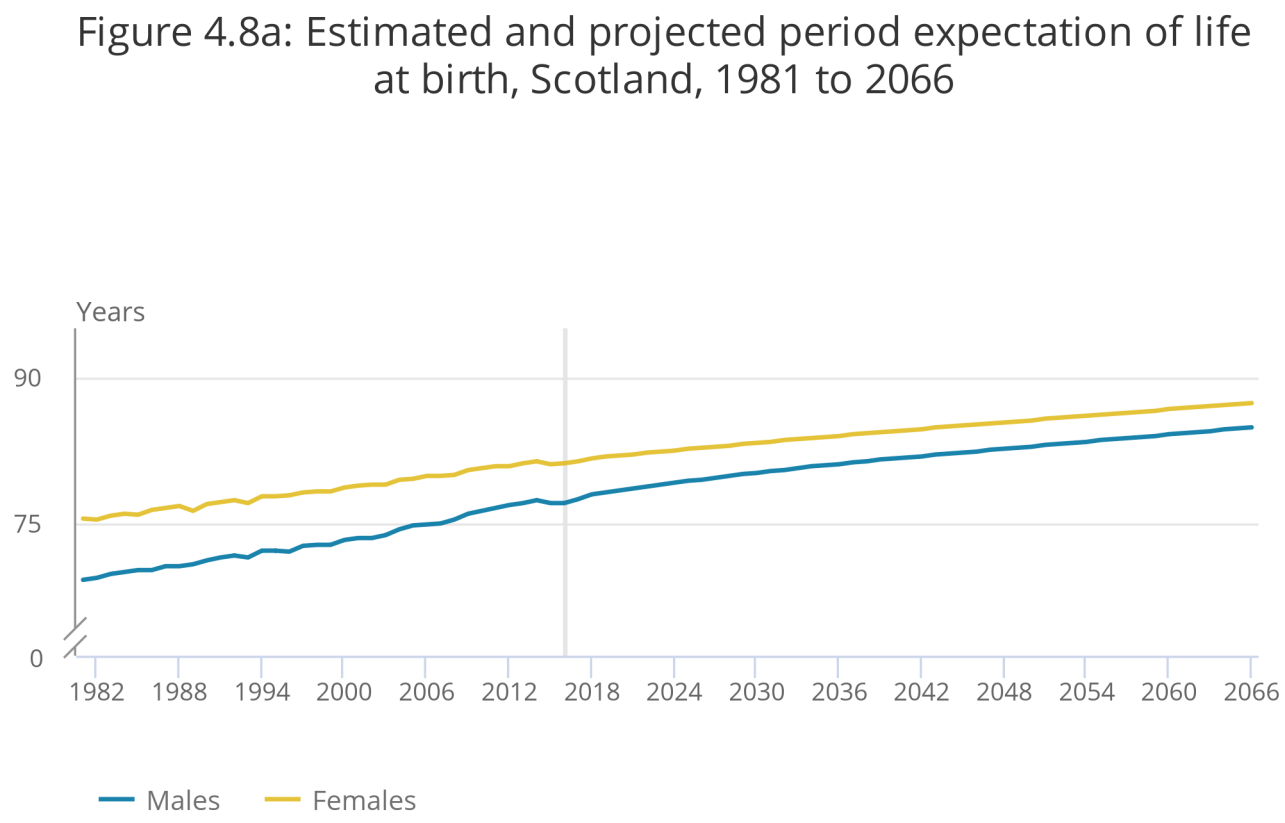

**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

# 8 . Appendix C: Scotland charts

**Figure 4.8a: Estimated and projected period expectation of life at birth, Scotland, 1981 to 2066**

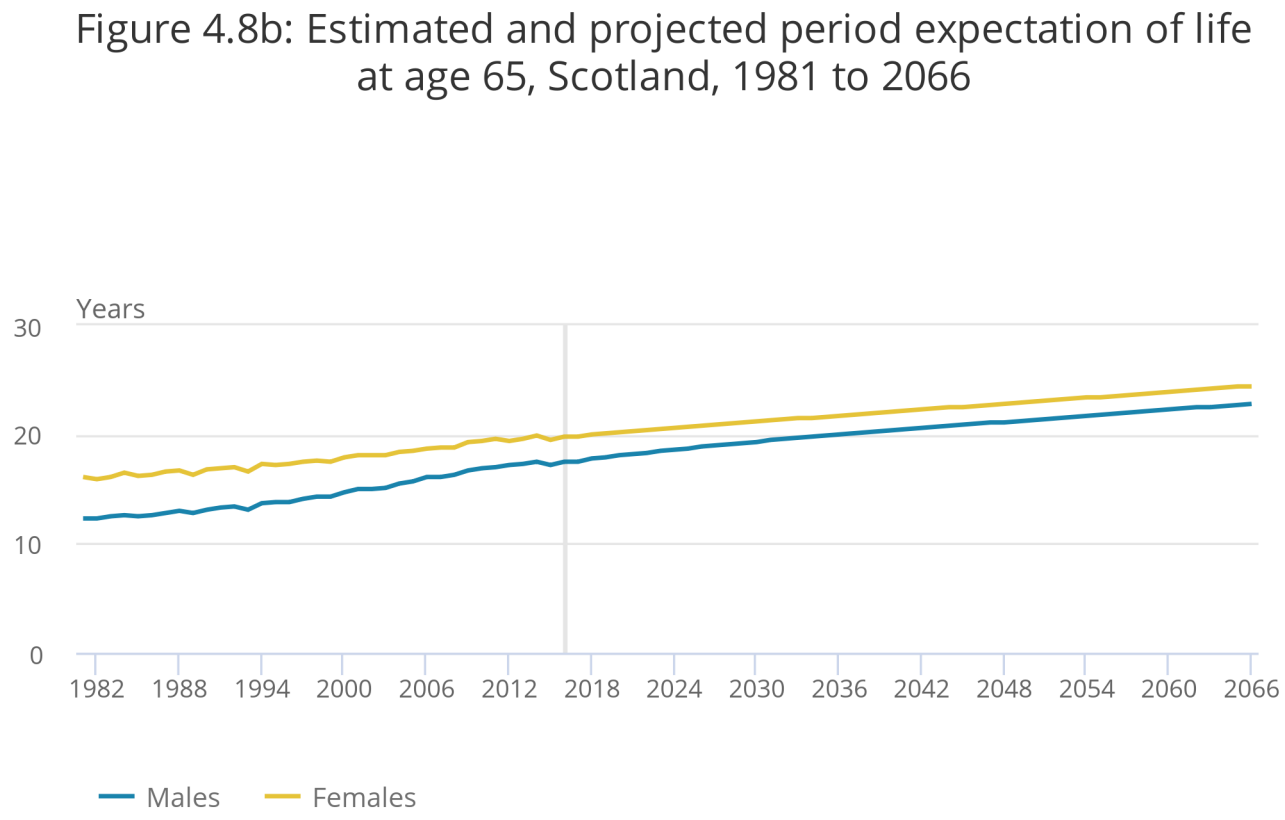



**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

**Figure 4.8b: Estimated and projected period expectation of life at age 65, Scotland, 1981 to 2066**



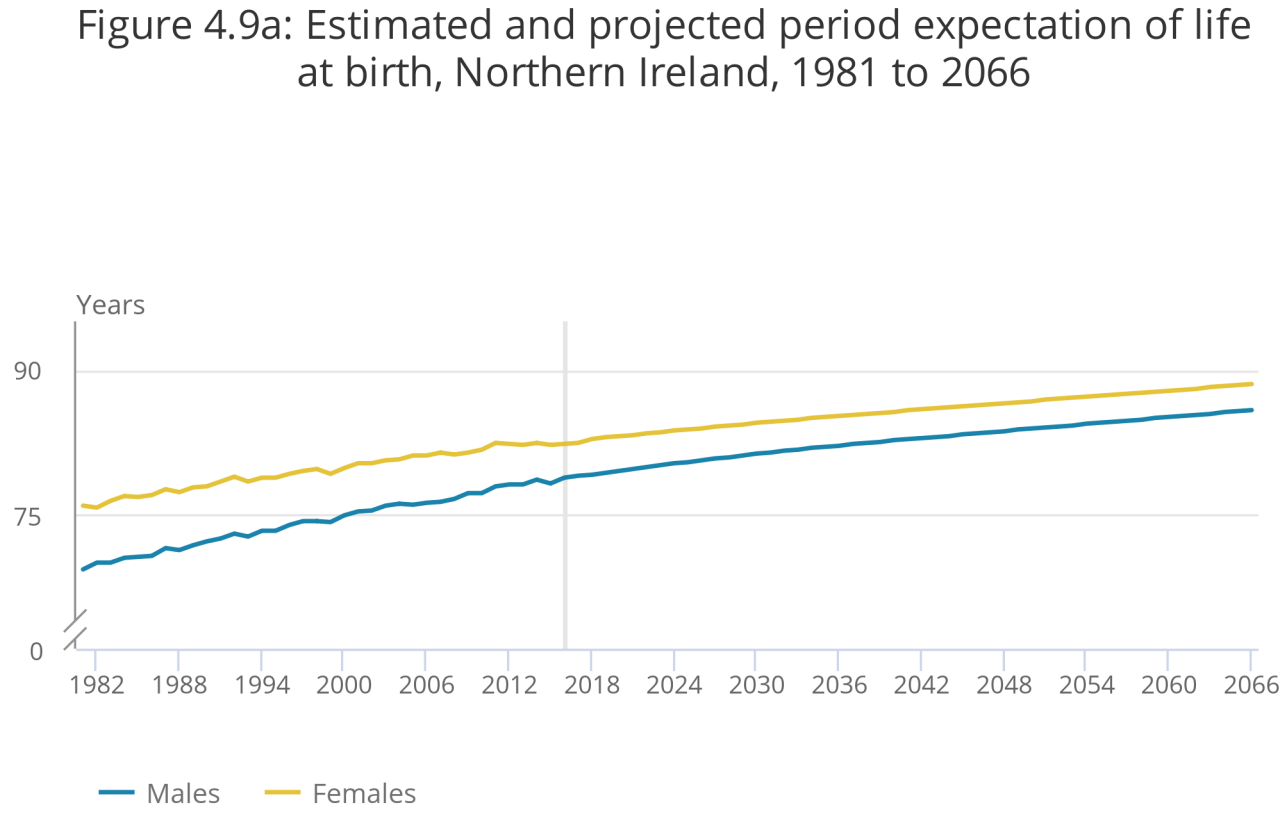

**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

# 9 . Appendix D: Northern Ireland charts

**Figure 4.9a: Estimated and projected period expectation of life at birth, Northern Ireland, 1981 to 2066**

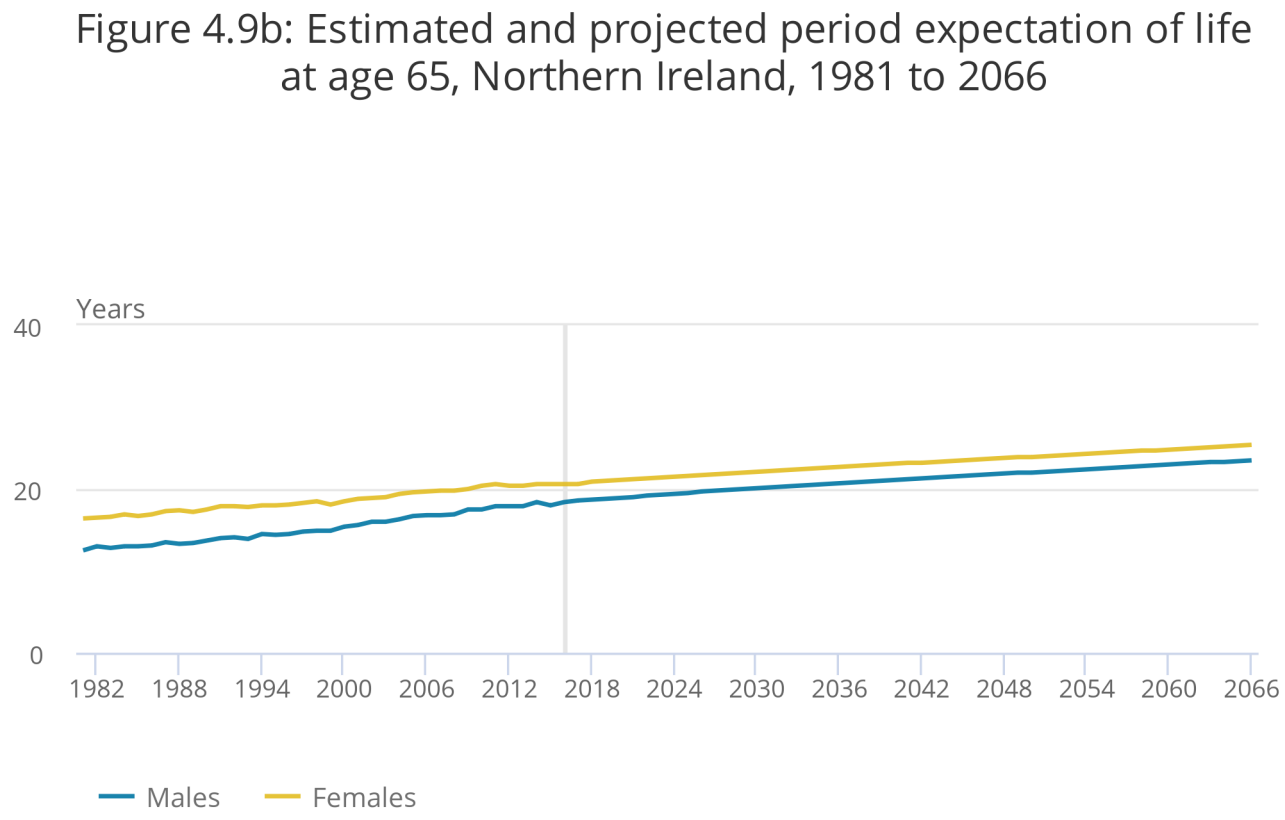



**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

**Figure 4.9b: Estimated and projected period expectation of life at age 65, Northern Ireland, 1981 to 2066**




**Source: Office for National Statistics**

**Notes:**

1. Historic estimates are displayed on a calendar year basis while projected assumptions are displayed on a mid-year to mid-year basis

Compendium

# Migration assumptions

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Release date:
26 October 2017

Next release:
To be announced

## Table of contents

# 1 . Introduction

This article provides detailed information on the principal and variant migration assumptions used in the 2016-based national population projections (NPPs). The new long-term assumption for net migration to the UK is +165,000 each year, compared with +185,000 in the 2014-based projections.

All figures in this report are rounded to the nearest hundred.

“Long-term” international migration assumptions refers to assumptions from the year ending mid-2023 onwards and “Short-term” international migration assumptions refers to assumptions made for the year ending mid-2017 up to the year ending mid-2023. These terms are not in any way references to the UN definitions of long- and short-term international migrants, they refer exclusively to assumptions of future levels of migration flows.

All migration assumptions made in the NPPs are for “long-term international migrants” under the UN definition: “A person who moves to a country other than that of his or her usual residence for a period of at least a year (12 months), so that the country of destination effectively becomes his or her new country of usual residence”. No assumptions are made for short-term international migrants.

# 2 . Migration assumptions, data sources and methodology

## International migration

Long-term assumptions of future international migration are derived through the extrapolation of historical time series data in civilian migration to and from each country of the UK.

Historical time series data on international migration 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 intended 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.

The IPS also excludes most, but not all people seeking asylum. Estimates of the flows of asylum seekers (and their dependants) not captured by the IPS are obtained from Home Office data as are the number of people from Syria granted humanitarian protection under the Vulnerable Persons Resettlement Scheme (VPRS). Data on the number of returning Home Armed Forces from Germany are obtained from British Forces Germany.

## Cross-border migration

The 2016-based national population projections (NPPs) continue to use the improved methodology first implemented in the 2014-based NPPs for producing cross-border migration assumptions.

The assumptions for flows between the countries of the UK are set as rates which are based on the latest five years of mid-year population estimates (MYE) and National Health Service Central Register (NHSCR) data (mid-2012 to mid-2016).

It should be noted, however, that the Central Health Register Inquiry System (CHRIS) was closed in February 2016 so, as a result, no complete NHSCR data are available beyond 2015. ONS subsequently determined that it was more optimal to re-apply the data for the year ending (YE) mid-2015 for YE mid-2016 in the 2016-based projections rather than relying on partial 2016 data.

The main advantage of applying rates for cross-border migration is that migrant flows are linked to the changing underlying population size and age structure. This means that the projection cannot produce implausible values such as negative population stocks.

Lastly, an adjustment is applied to the rates to take the population of the country of destination into account, ensuring that net migration levels between countries of the UK are stabilised over the course of the projection. More detail can be found in the cross-border methodology (339Kb Pdf) document on our website.

### Northern Ireland

Office for National Statistics (ONS) migration estimates no longer use IPS data for Northern Ireland from 2008 onwards and instead use data from the Northern Ireland Statistics and Research Agency (NISRA). In order to obtain the longest possible continuous time series for the production of national population projections, Northern Ireland data back to 1992 are obtained directly from NISRA.

## 3 . International migration assumptions

### Long-term assumptions

The long-term international migration assumptions in the 2016-based projections take effect from the year ending mid-2023 and are held constant for each subsequent year.

The new long-term assumption for net international migration to the UK is +165,000 a year compared with +185,000 a year in the previous projections. The 2016-based assumption was derived through a 25-year average using the 25 most recent years of international migration data (mid-1992 to mid-2016) and a 10-year average of the most recent asylum seeker data.

The annual net international migration figure of +165,000 is higher than the expectation of the expert advisory panel (an average estimate of +144,000 in the longer-term). It should be noted that there was considerable variation between the experts when providing an estimate for long-term international migration to the UK. Please see Section 3 of the migration assumptions consultation paper for further details and a full summary of the expert panel questionnaire responses.

The breakdown of the long-term net international migration assumptions for the four countries of the UK is shown in Table 5.1. This table does not include the assumptions for cross-border migration between the constituent countries of the UK since these vary over the course of the projection because they were produced using a rates-based method. The cross-border flows are considered separately.

**Table 5.1: Long-term annual international migration assumptions by country year ending mid-2023 onwards**

| | 2016-based | 2014-based | Difference |
|---|---|---|---|
| International net migration | | | |
| England | 152,000 | 170,500 | -18,500 |
| Wales | 4,500 | 4,000 | 500 |
| Scotland | 7,000 | 9,500 | -2,500 |
| Northern Ireland | 1,500 | 1,000 | 500 |
| UK | 165,000 | 185,000 | -20,000 |

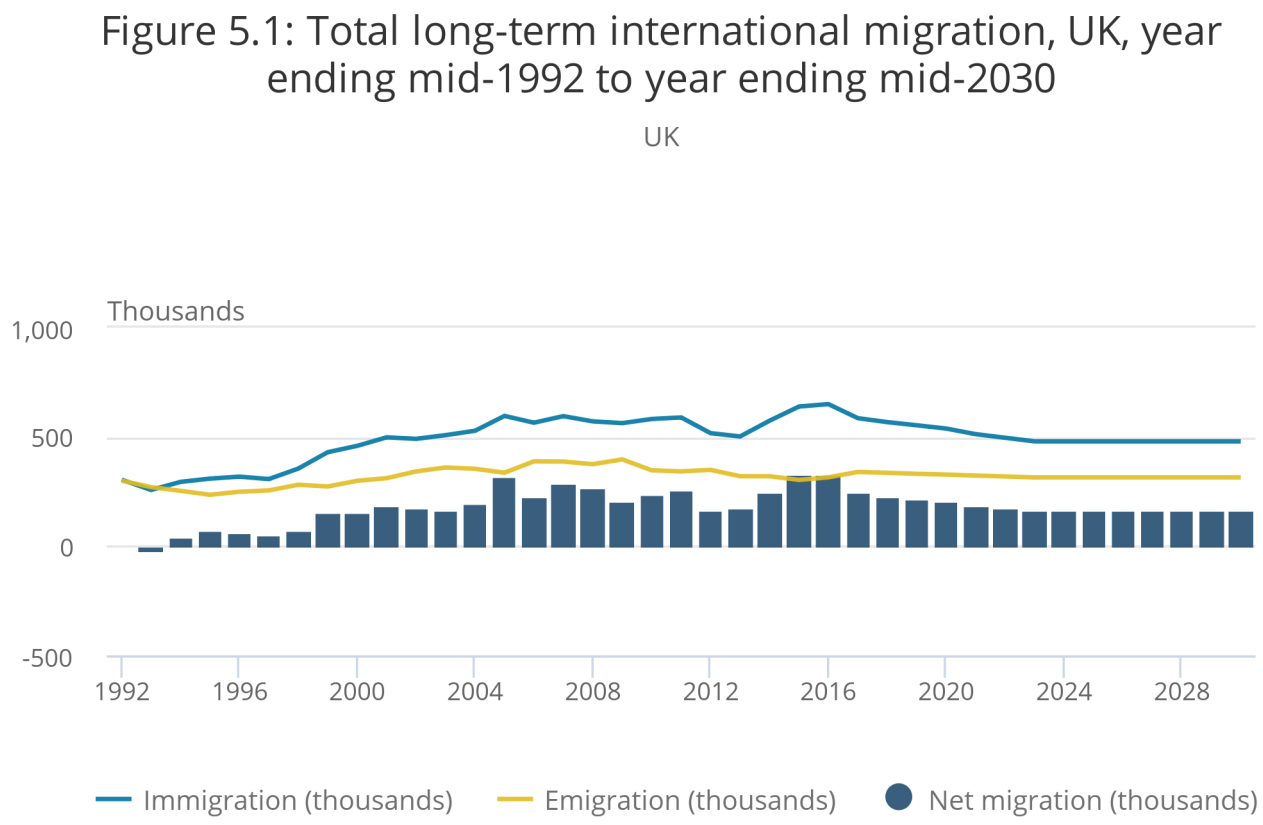
Source: Office for National Statistics

Notes:

1. Figures are rounded to the nearest hundred.

**Figure 5.1: Total long-term international migration, UK, year ending mid-1992 to year ending mid-2030**

**UK**




**Source: Office for National Statistics**

**Notes:**

1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

## Short-term assumptions

Short-term international migration assumptions (shown in Table 5.2) are created for the projection period of mid-2017 to mid-2022 to allow for a smooth transition from the latest mid-year international migration estimates to the long-term international migration assumptions. These assumptions also account for the planned return of Home Armed Forces (HAF) personnel and their dependants from Germany, as well as people granted humanitarian protection who come to the UK from Syria through the Vulnerable Persons Resettlement Scheme (VPRS).

Additionally, a special adjustment was made to the international migration assumptions for England, Wales and Scotland in the first year (mid-2017) of their respective projections following the release of the most recent Migration Statistics Quarterly Report in August 2017.

Specifically, the year ending March 2017 long-term international migration (LTIM) estimates at the UK level were used as the international migration flow assumption (which excludes asylum seekers, HAF and persons arriving through the VPRS) for the year ending mid-2017 in the projections.

This new UK-level assumption was then proportioned to each country in the UK based on their share of total international migration over the last five years for which data are available (2012 to 2016).

No adjustment was made to the original migration assumption for Northern Ireland as medical card data suggested that migration flows to and from Northern Ireland for the year ending mid-2017 will remain at similar levels to the year ending mid-2016, hence the adjustments were only applied to England, Wales and Scotland.

The adjustment originally intended for Northern Ireland was applied to England in order to maintain consistency with year ending March 2017 LTIM estimates at the UK level.

## Trajectory of short-term assumptions

From mid-2017 to mid-2022, the short term assumptions for England, Wales and Scotland follow a linear trajectory to the long-term international migration assumption in 2023. For Northern Ireland, this linear trajectory starts from mid-2016 as no special adjustment was made to their mid-2017 international migration assumption.

## Syrian Vulnerable Persons Resettlement Scheme (VPRS)

In 2015, the Government made significant extensions to the Syrian Vulnerable Persons Resettlement Scheme (VPRS). Under the scheme, 20,000 Syrians granted humanitarian protection will be resettled in the UK by 2020.

The 2016-based projections assume that a total of 4,100 people will migrate to the three Great Britain countries (England, Wales and Scotland) through the VPRS each year until mid-2020. The assumption for Northern Ireland is set to zero as people arriving through the VPRS are included and modelled with their international migration flows.

The assumptions for the Great Britain countries are calculated by taking away the number of people who have already arrived through the VPRS at the UK level from the pledged figure of 20,000 and assuming that the remaining migrants will arrive evenly up to mid-2020.

Assumed migrants arriving under the scheme are then proportioned to each UK country based on their distributions calculated using the latest available VPRS data from the Home Office. The assumption for Northern Ireland is subsequently set to zero as explained earlier.

**Table 5.2: Short-term annual net international migration assumptions, UK and constituent countries, year ending mid-2017 onwards**

Thousands

| | UK | England | Wales | Scotland | Northern Ireland |
|---|---|---|---|---|---|
| Total net international migration | | | | | |
| 2016 to 2017 | 246.1 | 214.5 | 12.7 | 17.4 | 1.5 |
| 2017 to 2018 | 232.1 | 204.0 | 10.7 | 15.9 | 1.5 |
| 2018 to 2019 | 222.1 | 197.0 | 9.7 | 13.9 | 1.5 |
| 2019 to 2020 | 210.6 | 187.5 | 8.7 | 12.9 | 1.5 |
| 2020 to 2021 | 189.5 | 170.0 | 7.5 | 10.5 | 1.5 |
| 2021 to 2022 | 177.0 | 162.0 | 5.5 | 8.0 | 1.5 |
| Long-term assumption (2022 to 2023 onwards) | 165.0 | 152.0 | 4.5 | 7.0 | 1.5 |
| Net international migration (excludes HAF and VPRS) | | | | | |
| 2016 to 2017 | 240.0 | 210.0 | 12.5 | 16.0 | 1.5 |
| 2017 to 2018 | 227.5 | 201.0 | 10.5 | 14.5 | 1.5 |
| 2018 to 2019 | 215.5 | 192.0 | 9.5 | 12.5 | 1.5 |
| 2019 to 2020 | 202.0 | 180.5 | 8.5 | 11.5 | 1.5 |
| 2020 to 2021 | 189.5 | 170.0 | 7.5 | 10.5 | 1.5 |
| 2021 to 2022 | 177.0 | 162.0 | 5.5 | 8.0 | 1.5 |
| Long-term assumption (2022 to 2023 onwards) | 165.0 | 152.0 | 4.5 | 7.0 | 1.5 |
| Returning armed forces from Germany (including dependants) | | | | | |
| 2016 to 2017 | 2.0 | 2.0 | 0.0 | 0.0 | 0.0 |
| 2017 to 2018 | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 |
| 2018 to 2019 | 2.5 | 2.5 | 0.0 | 0.0 | 0.0 |
| 2019 to 2020 | 4.5 | 4.5 | 0.0 | 0.0 | 0.0 |
| 2020 to 2021 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2021 to 2022 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Long-term assumption (2022 to 2023 onwards) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Migration through VPRS | | | | | |
| 2016 to 2017 | 4.1 | 2.5 | 0.2 | 1.4 | 0.0 |
| 2017 to 2018 | 4.1 | 2.5 | 0.2 | 1.4 | 0.0 |
| 2018 to 2019 | 4.1 | 2.5 | 0.2 | 1.4 | 0.0 |
| 2019 to 2020 | 4.1 | 2.5 | 0.2 | 1.4 | 0.0 |
| 2020 to 2021 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2021 to 2022 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Long-term assumption (2022 to 2023 onwards) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

Source: Office for National Statistics

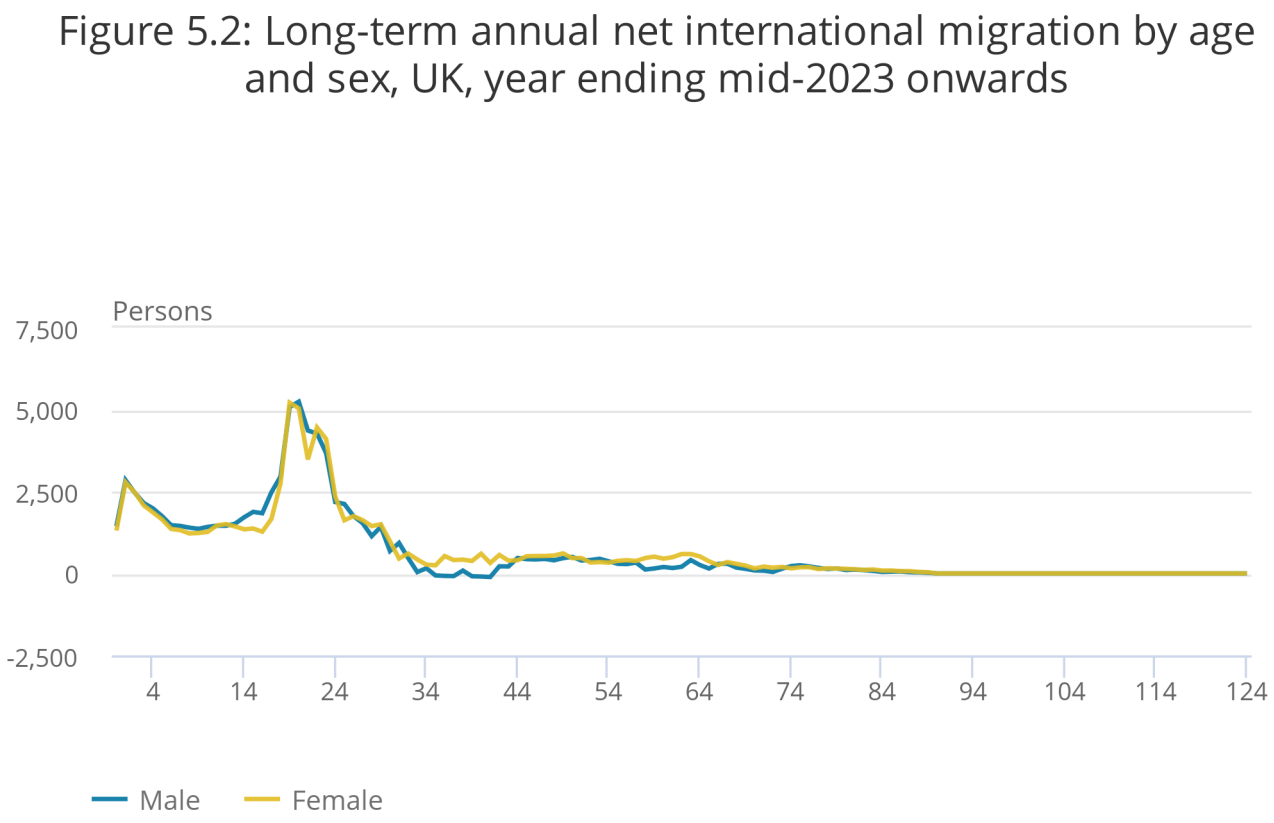
Notes:

1. International migration includes IPS flows with allowance for migrant and visitor switchers, asylum seekers and flows to and from the Republic of Ireland.

## Age and sex distributions

Figure 5.2 shows assumed long-term annual net international migration by age and sex for the UK from the year ending mid-2023 onwards. The international distributions are derived from an average of five years' historical international migration data from the mid-year population estimates.

**Figure 5.2: Long-term annual net international migration by age and sex, UK, year ending mid-2023 onwards**




**Source: Office for National Statistics**

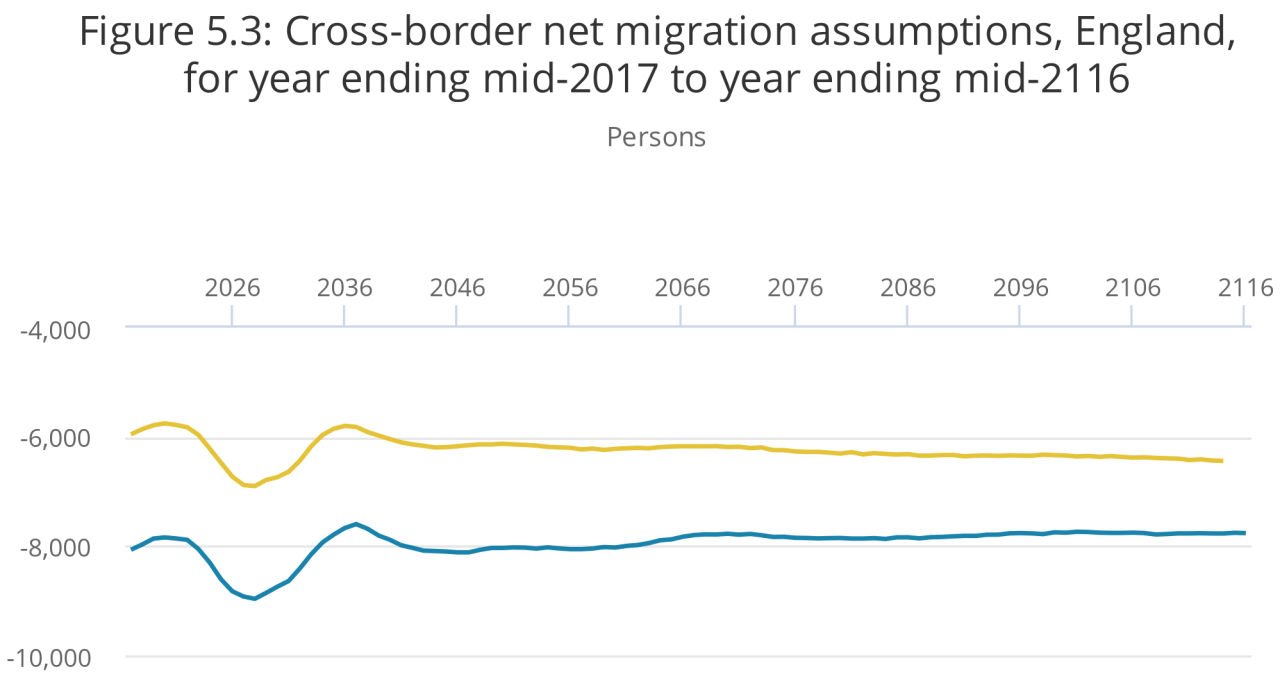
# 4 . Cross-border migration assumptions

The assumptions for the flows between the countries of the UK are set as rates rather than fixed numbers of migrants. Annual age and sex-specific migration rates for each cross-border flow are calculated as the number of migrants at the end of the year divided by the population of the country of origin at the start of the year. An average of rates for the last five years of actual data (year ending mid-2012 to year ending mid-2016) is then taken and applied to the population of the country of origin at the beginning of each projection year to calculate the projected number of migrants for each flow.

The underlying age and sex distributions for cross-border migration are based on data from Northern Ireland Statistics and Research Agency (NISRA), National Records of Scotland (NRS) and Office for National Statistics (ONS).

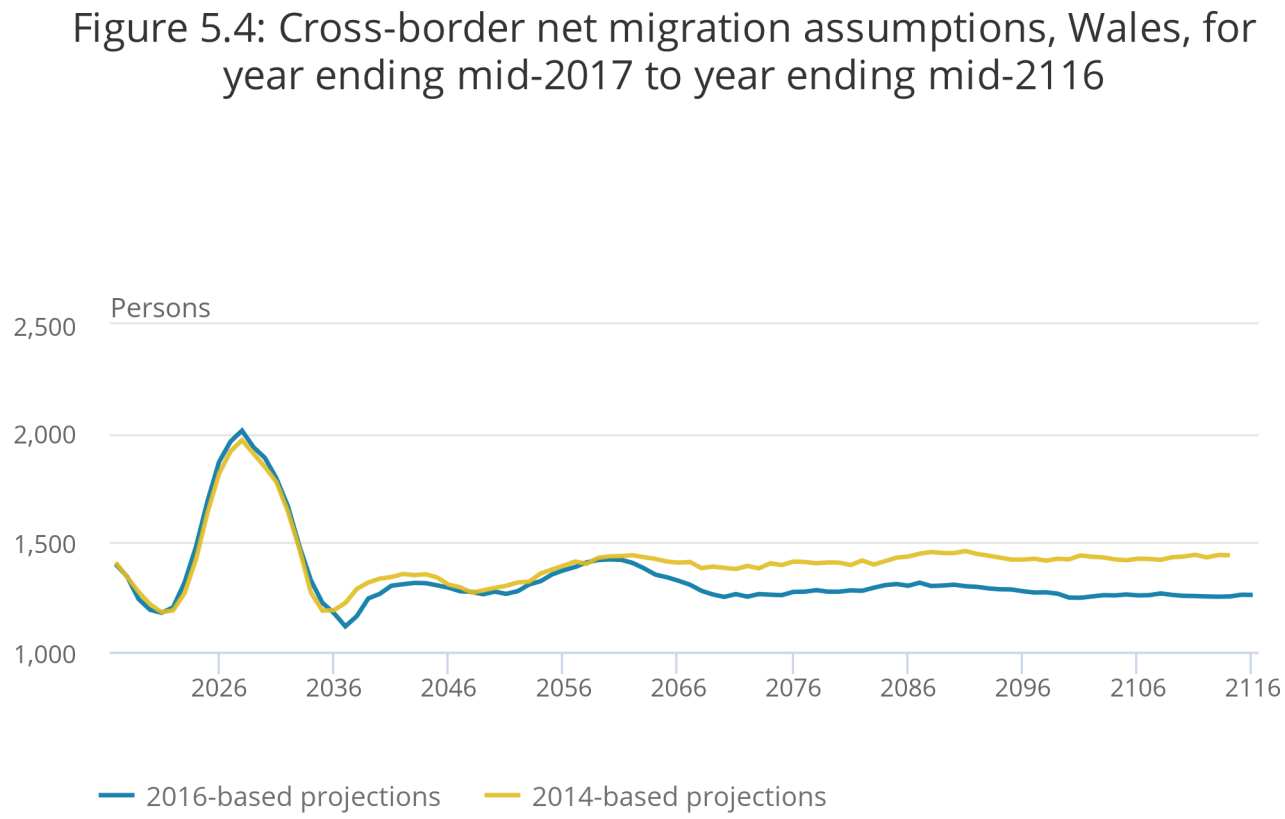
**Figure 5.3: Cross-border net migration assumptions, England, for year ending mid-2017 to year ending mid-2116**

**Persons**



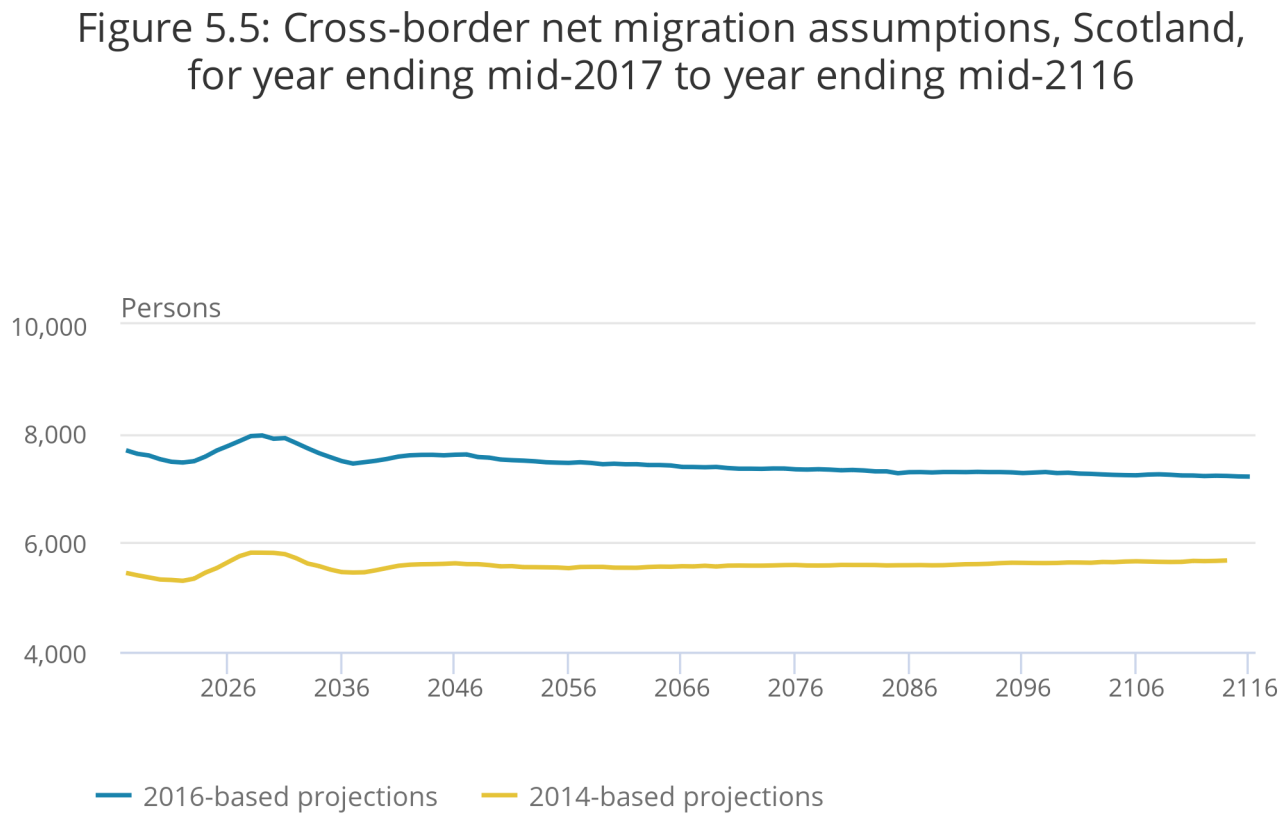

**Source: Office for National Statistics**

**Figure 5.4: Cross-border net migration assumptions, Wales, for year ending mid-2017 to year ending mid-2116**




**Source: Office for National Statistics**

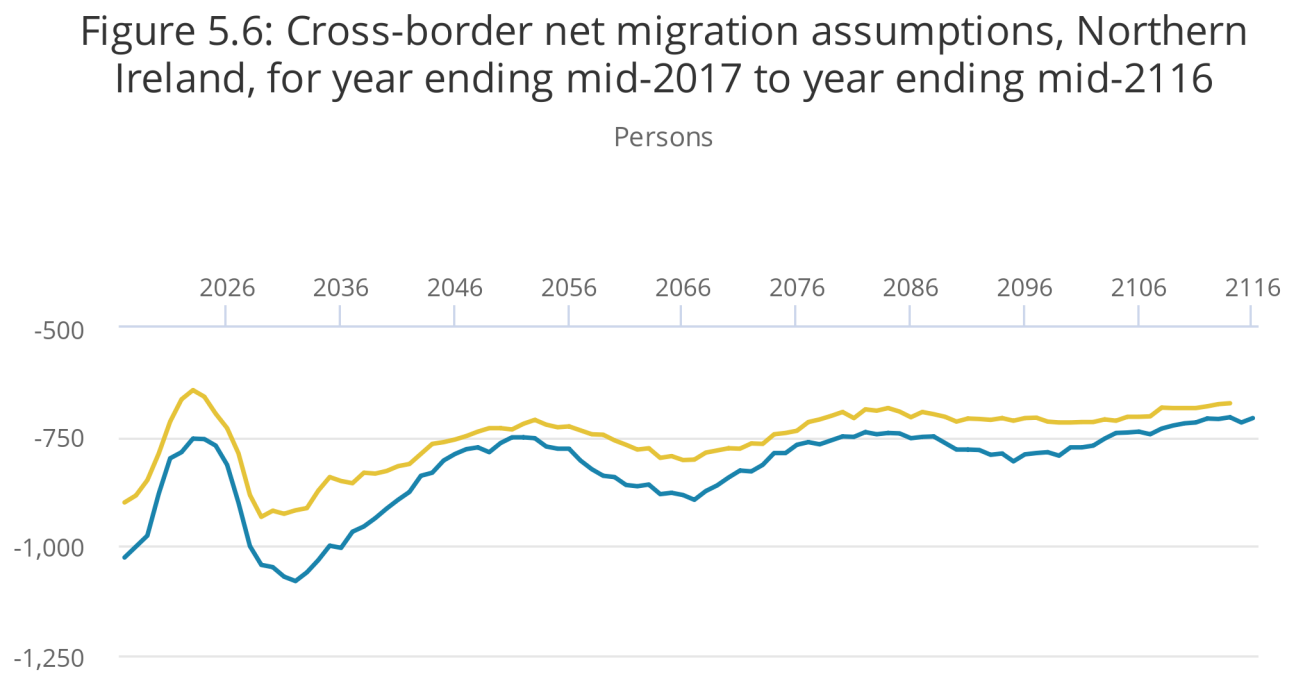
**Figure 5.5: Cross-border net migration assumptions, Scotland, for year ending mid-2017 to year ending mid-2116**




**Source: Office for National Statistics**

**Figure 5.6: Cross-border net migration assumptions, Northern Ireland, for year ending mid-2017 to year ending mid-2116**

**Persons**




**Source: Office for National Statistics**

# 5 . Migration variant assumptions

## Standard migration variants

The standard high and low migration variants are produced by varying the international in and out flow assumptions and using the principal assumptions for fertility and mortality. The assumptions are additive such that the UK-level assumptions are equal to the sum of the four individual countries.

The 2016-based high and low migration variant projection net migration assumptions increase or reduce the UK principal net migration assumption by 80,000. In the first projected year (mid-2017) the variants only assume half of the long-term width (40,000 higher or lower than the principal assumption), to allow for a smoother transition.

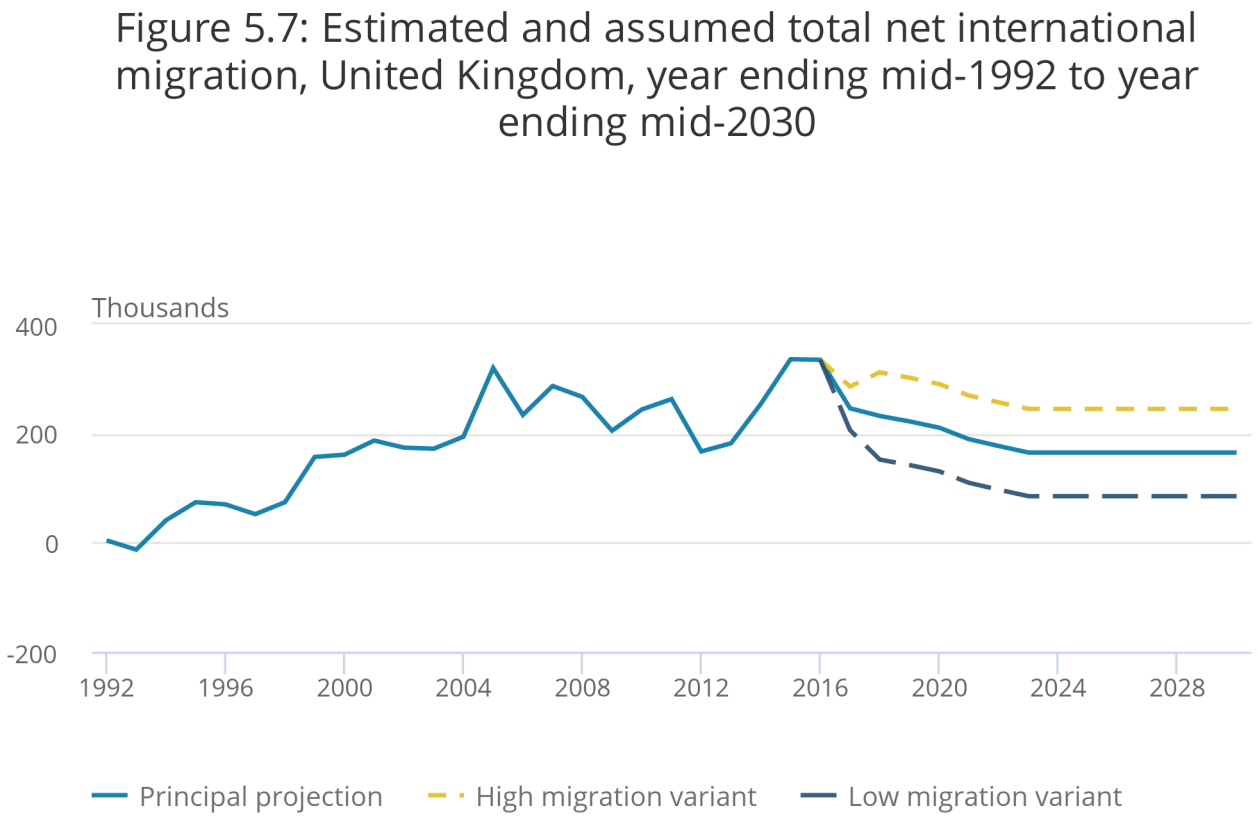
Table 5.3 and Figure 5.7 show the assumed long-term annual net migration for the standard variants for the UK and its constituent countries.

**Table 5.3: Assumed long-term annual net international migration for the standard variants, UK**

| | High | Principal | Low |
|---|---|---|---|
| England | 214,500 | 152,000 | 89,500 |
| Wales | 9,000 | 4,500 | 0 |
| Scotland | 15,500 | 7,000 | -1,500 |
| Northern Ireland | 6,000 | 1,500 | -3,000 |
| UK | 245,000 | 165,000 | 85,000 |

Source: Office for National Statistics

**Figure 5.7: Estimated and assumed total net international migration, United Kingdom, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

## Northern Ireland variants

Northern Ireland alternative scenario migration assumptions were created at the request of the Northern Ireland Statistics and Research Agency (NISRA).

The moderate high migration variant assumes long-term net international migration to Northern Ireland to be +3, 000 per year; other countries of the UK follow the high migration assumption.

The moderate low migration variant follows the low migration variant assumptions for England, Scotland and Wales. It is assumed long-term international migration for Northern Ireland will be -1,500 per year.

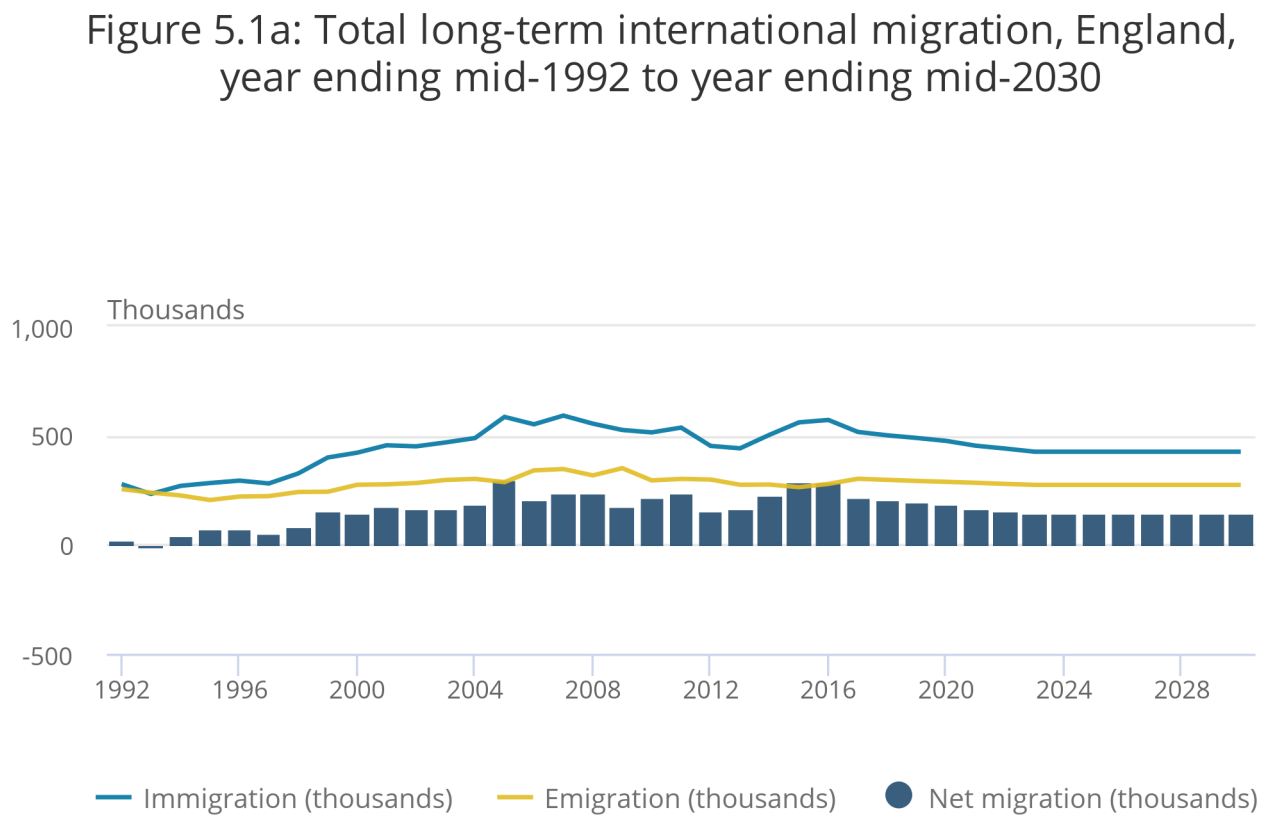
## EU variants

The 0% future EU migration, 50% future EU migration and 150% future EU migration variant assumptions are created by applying percentage changes by single year of age and sex to the principal international migration assumption. The percentage changes are calculated using the last three years of long-term international migration estimates and are applied to the principal projections from mid-2019 onwards.

These variant projections are not classed as National Statistics, because they have not been created using a standard projections method. They were created on request to fulfil specific stakeholder requirements.

# 6 . Appendix A: England charts

**Figure 5.1a: Total long-term international migration, England, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

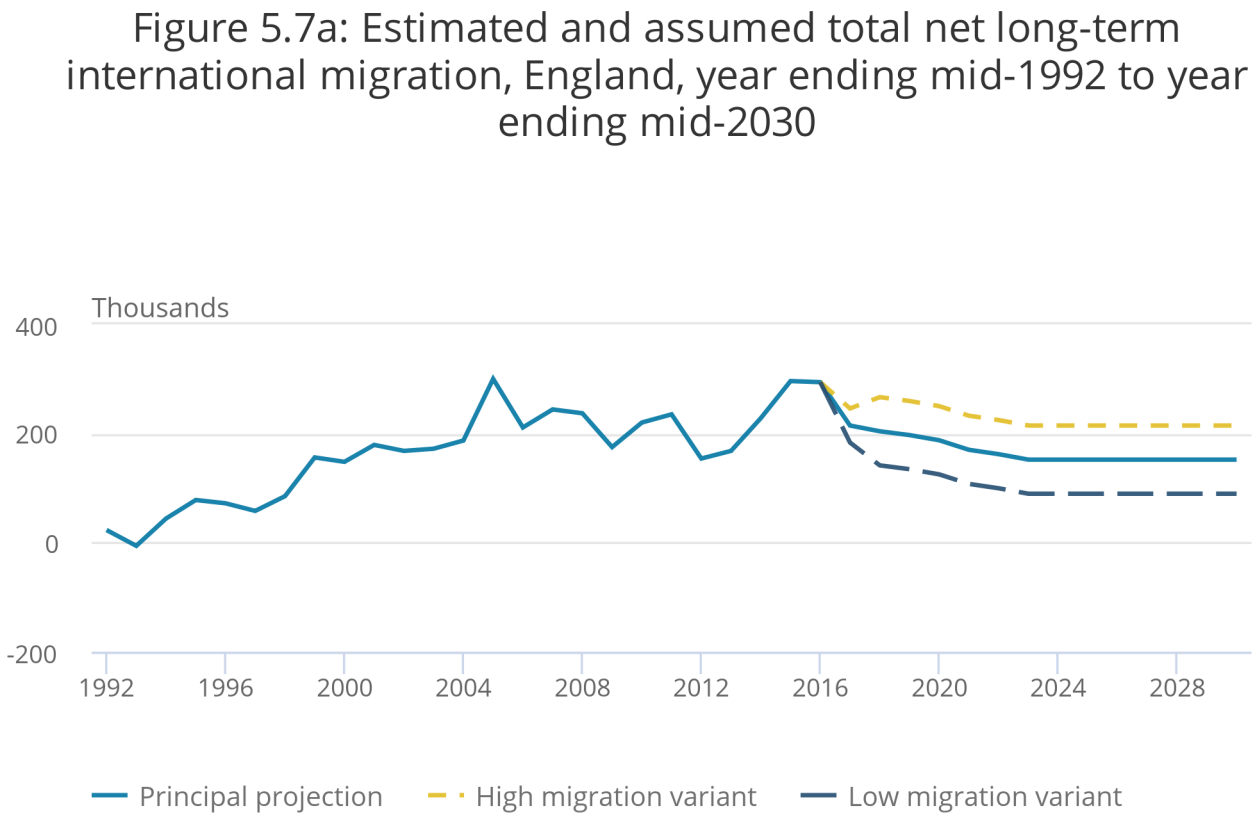
1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

**Figure 5.7a: Estimated and assumed total net long-term international migration, England, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

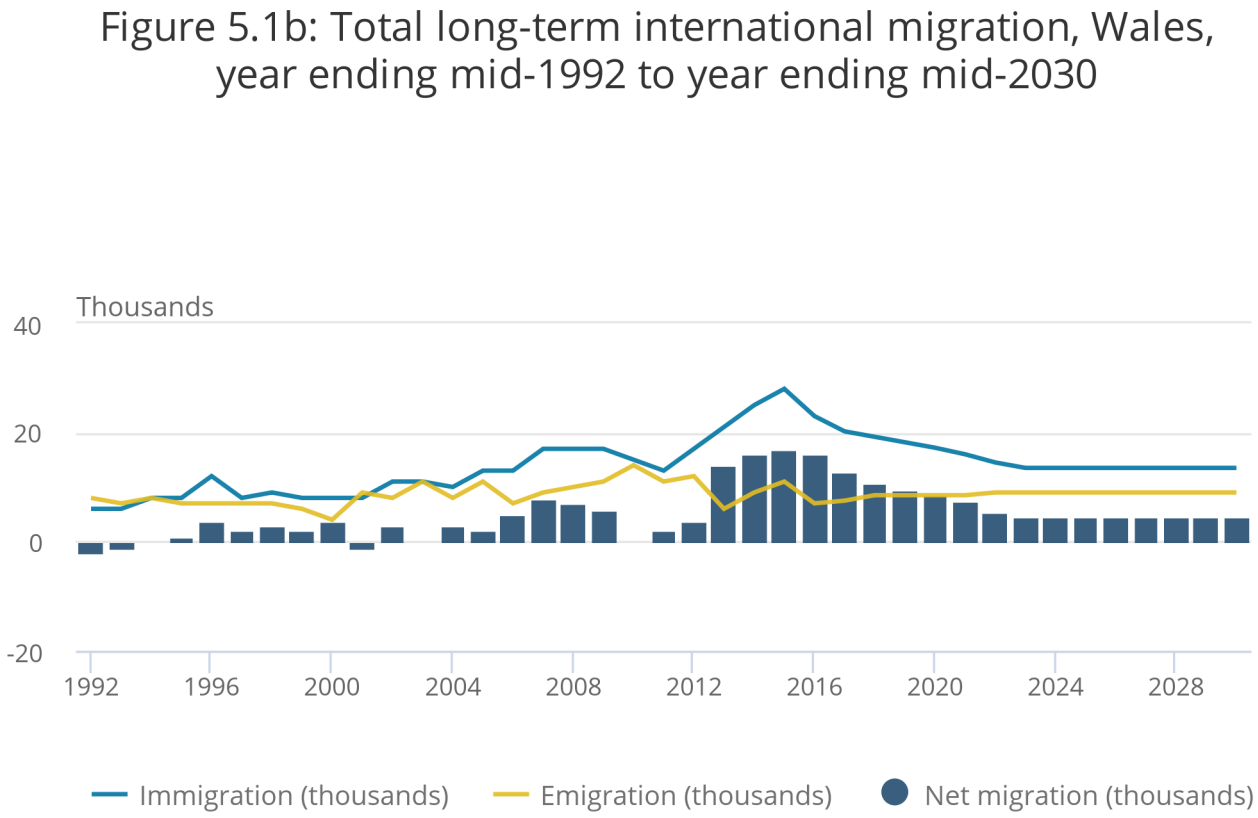
2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

# 7 . Appendix B: Wales charts

**Figure 5.1b: Total long-term international migration, Wales, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

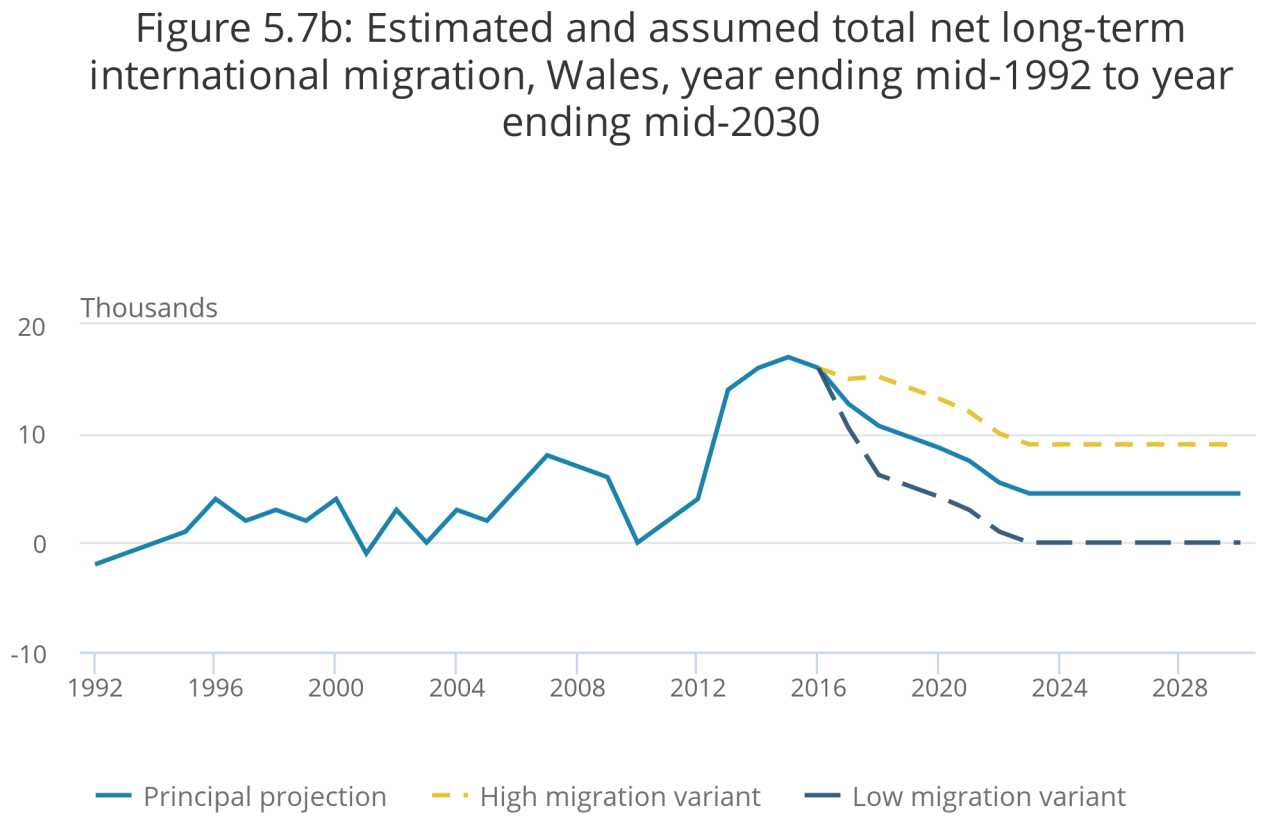
1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

**Figure 5.7b: Estimated and assumed total net long-term international migration, Wales, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

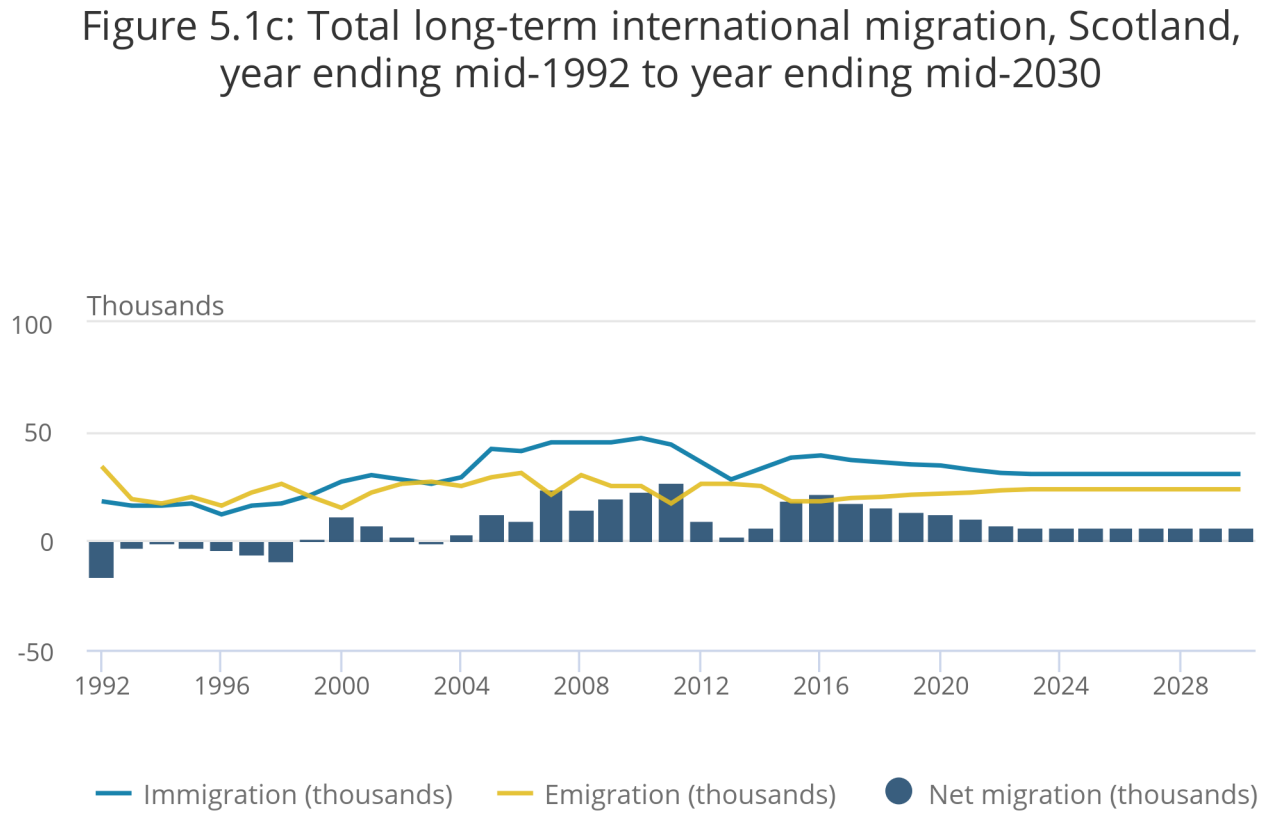
2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

# 8 . Appendix C: Scotland charts

**Figure 5.1c: Total long-term international migration, Scotland, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

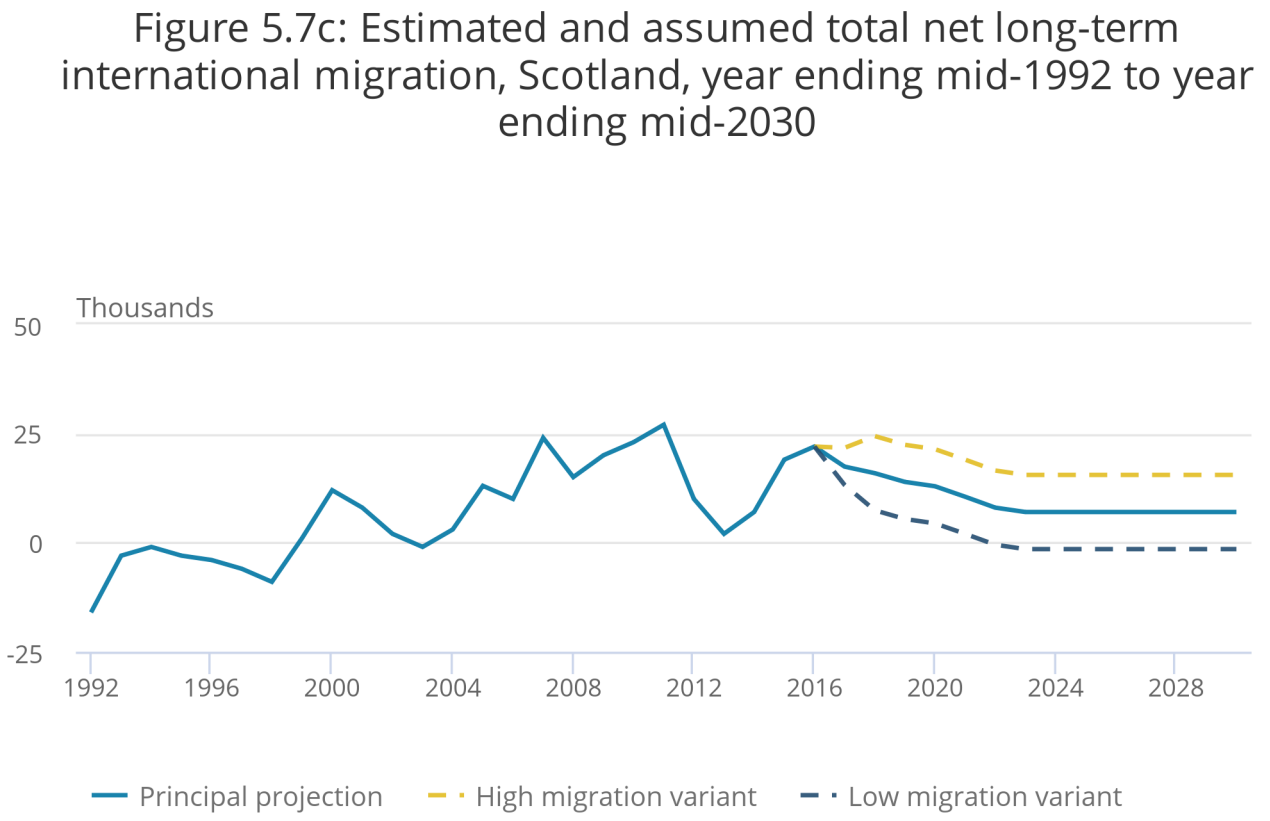
1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

**Figure 5.7c: Estimated and assumed total net long-term international migration, Scotland, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

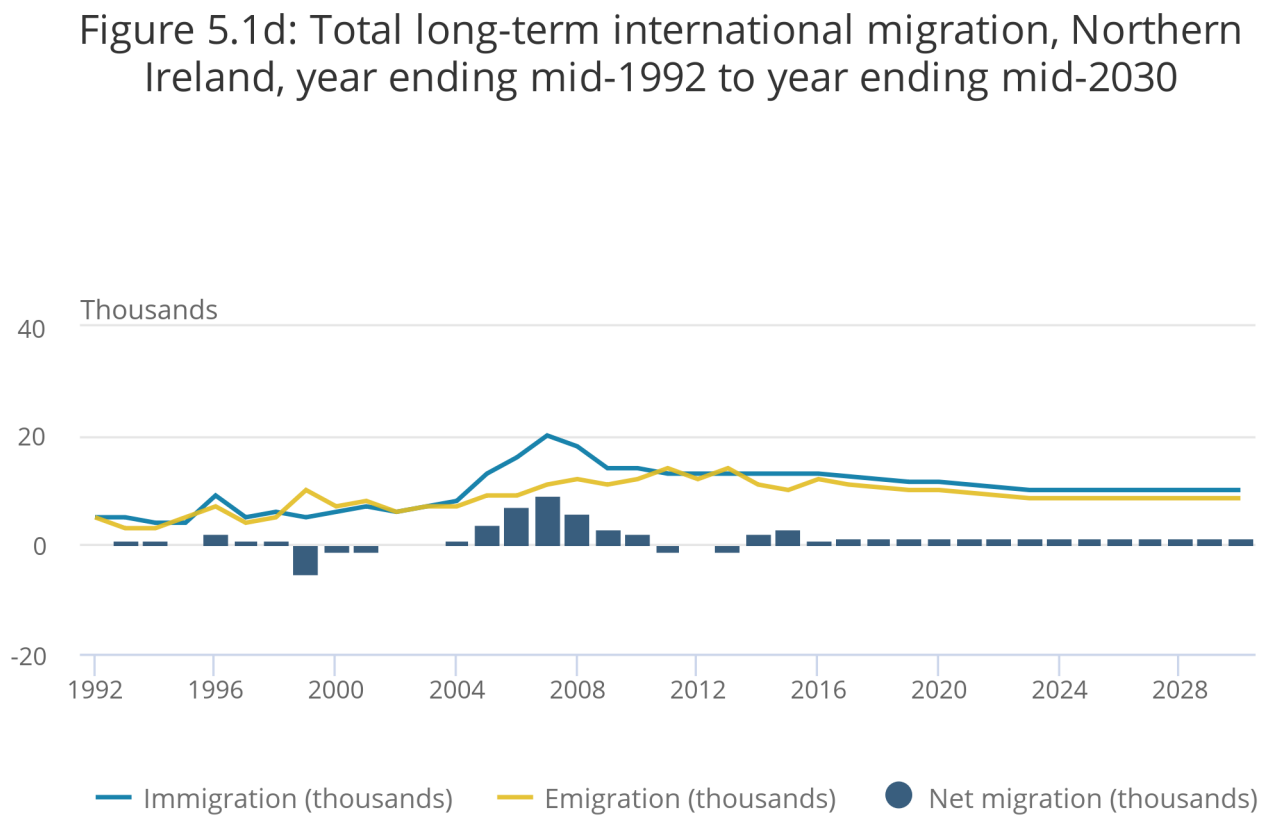
1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

# 9 . Appendix D: Northern Ireland charts

**Figure 5.1d: Total long-term international migration, Northern Ireland, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

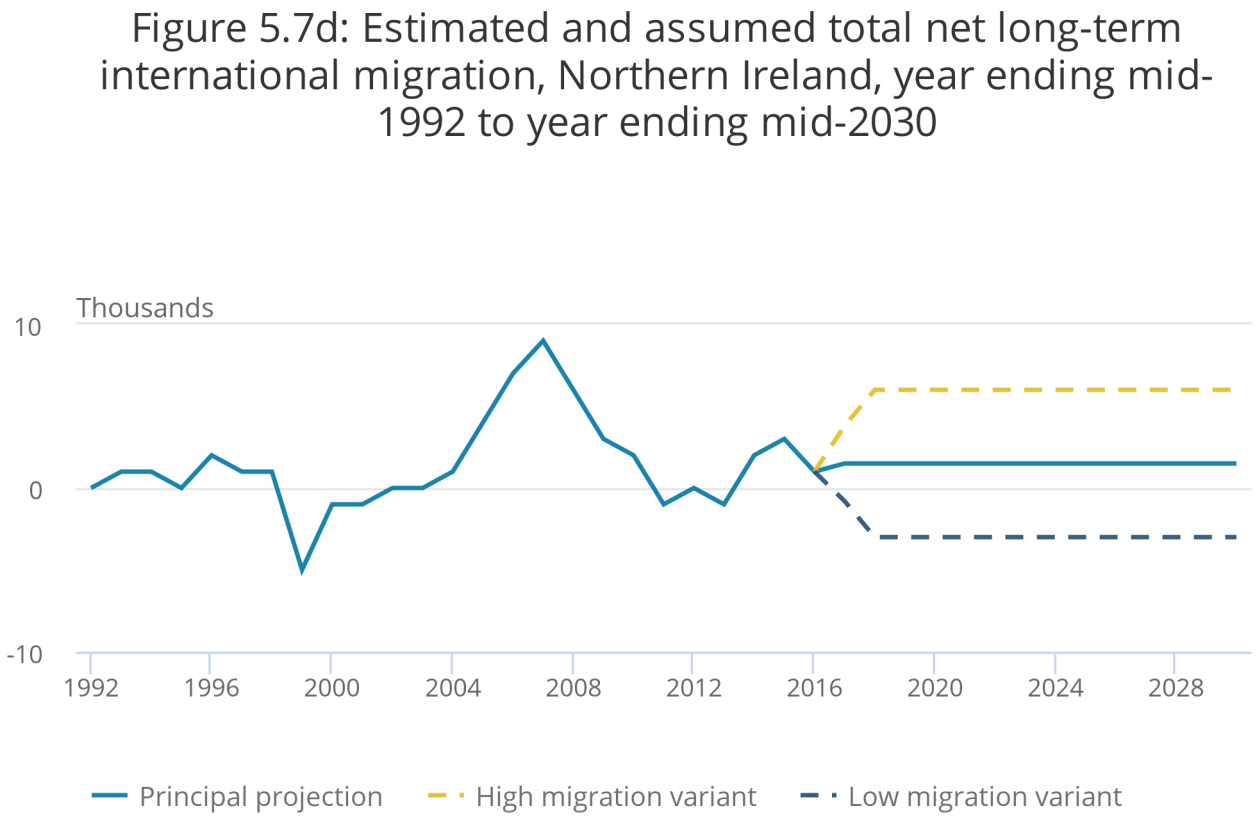
1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

**Figure 5.7d: Estimated and assumed total net long-term international migration, Northern Ireland, year ending mid-1992 to year ending mid-2030**




**Source: Office for National Statistics**

**Notes:**

1. Historical international migration figures for England, Scotland and Wales are primarily based on International Passenger Survey data and Northern Ireland figures are obtained directly from NISRA. The figures in this chart will differ from published calendar year long-term international migration (LTIM) estimates.

2. 2002 to 2010 immigration and emigration figures reflect revisions made in light of the results of the 2011 Census; therefore the figures may differ from the published LTIM estimates.

3. Historical migration figures are rounded to the nearest 1,000.

4. Data for year ending mid-2017 and onwards are projections.

# 10. Background notes

1. Discussion papers showing the background information used in setting the migration assumptions are available on our website.

2. Details of the policy governing the release of new data are available from the UK Statistics Authority website or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

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

Compendium

# Variants

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Release date:
26 October 2017

Next release:
To be announced

## Table of contents

# 1 . Introduction

We produce population projections as a basis for understanding possible changes in the structure of the population. They're based on assumptions considered to best reflect demographic patterns at the time they're adopted. However, because of the inherent uncertainty of demographic behaviour, any projection will inevitably differ to a greater or lesser extent from actual future population change.

Because of the uncertainty surrounding our projections, in addition to the principal projection we also produce variant projections based on alternative assumptions of fertility, mortality and migration. These provide an indication of uncertainty and sensitivity to alternative assumptions but don't represent upper or lower limits of future demographic behaviour.

On 26 October 2017, we published nine standard types of variant projection, which look at the effect of varying one or more assumptions. They are grouped as follows:

- six single component variants, which observe the effect of varying one assumption, such as fertility, while keeping other assumptions in line with the principal projection
- two combination variants, which look at the effect of varying two or more assumptions, such as the high population scenario (high fertility, high life expectancy and high migration)
- one special case variant, which looks at a zero net migration scenario

We have also produced eight additional variants to meet the specific requirements of stakeholders.

Table 6.1 summarises the assumptions underlying each variant. A further description of the new additional variants can be found in the appendix.

A small number of extra variants will be published on 28 November 2017.

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

**Table 6.1: List of variants available for the 2016-based national population projections**

| Table reference [1] | Variant | Geography | Fertility assumption | Life expectancy assumption | Migration assumption |
|---|---|---|---|---|---|
| A | Principal | UK, Great Britain, England and Wales, England, Wales, Scotland, Northern Ireland | Principal | Principal | Principal |
| Standard Single Variants | | | | | |
| B | High fertility | UK, England, Wales, Scotland, Northern Ireland | High | Principal | Principal |
| C | Low fertility | UK, England, Wales, Scotland, Northern Ireland | Low | Principal | Principal |
| D | High life expectancy | UK, England, Wales, Scotland, Northern Ireland | Principal | High | Principal |
| E | Low life expectancy | UK, England, Wales, Scotland, Northern Ireland | Principal | Low | Principal |
| F | High migration | UK, Great Britain, England, Wales, Scotland, Northern Ireland | Principal | Principal | High |
| G | Low migration | UK, Great Britain, England, Wales, Scotland, Northern Ireland | Principal | Principal | Low |
| J | Zero net migration | UK, Great Britain, England, Wales, Scotland, Northern Ireland | Principal | Principal | Zero |
| Standard Combination Variants | | | | | |
| H | High population | UK, England, Wales, Scotland, Northern Ireland | High | High | High |
| I | Low population | UK, England, Wales, Scotland, Northern Ireland | Low | Low | Low |
| New requested variants | | | | | |
| XA | Moderately high life expectancy | UK, England, Wales, Scotland, Northern Ireland | Principal | Moderately high | Principal |
| XB | Moderately low life expectancy | UK, England, Wales, Scotland, Northern Ireland | Principal | Moderately low | Principal |
| XC | 0% future EU migration | UK, Great Britain, England, Wales, Scotland, Northern Ireland | Principal | Principal | 0% future EU migration from year ending mid-2019 onwards |
| XD | 50% future EU migration | UK, Great Britain, England, Wales, Scotland, Northern Ireland | Principal | Principal | 50% future EU migration from year ending mid-2019 onwards |
| XE | 150% future EU migration | UK, Great Britain, England, Wales, Scotland, Northern Ireland | Principal | Principal | 150% future EU migration from year ending mid-2019 onwards |
| XF | Northern Ireland medium high migration | Northern Ireland | Principal | Principal | Net long-term migration 3,000 per year |

| | | | | | |
|---|---|---|---|---|---|
| XG | Northern Ireland medium low migration | Northern Ireland | Principal | Principal | Net long-term migration negative 1,500 per year |

Source: Office for National Statistics

Note:

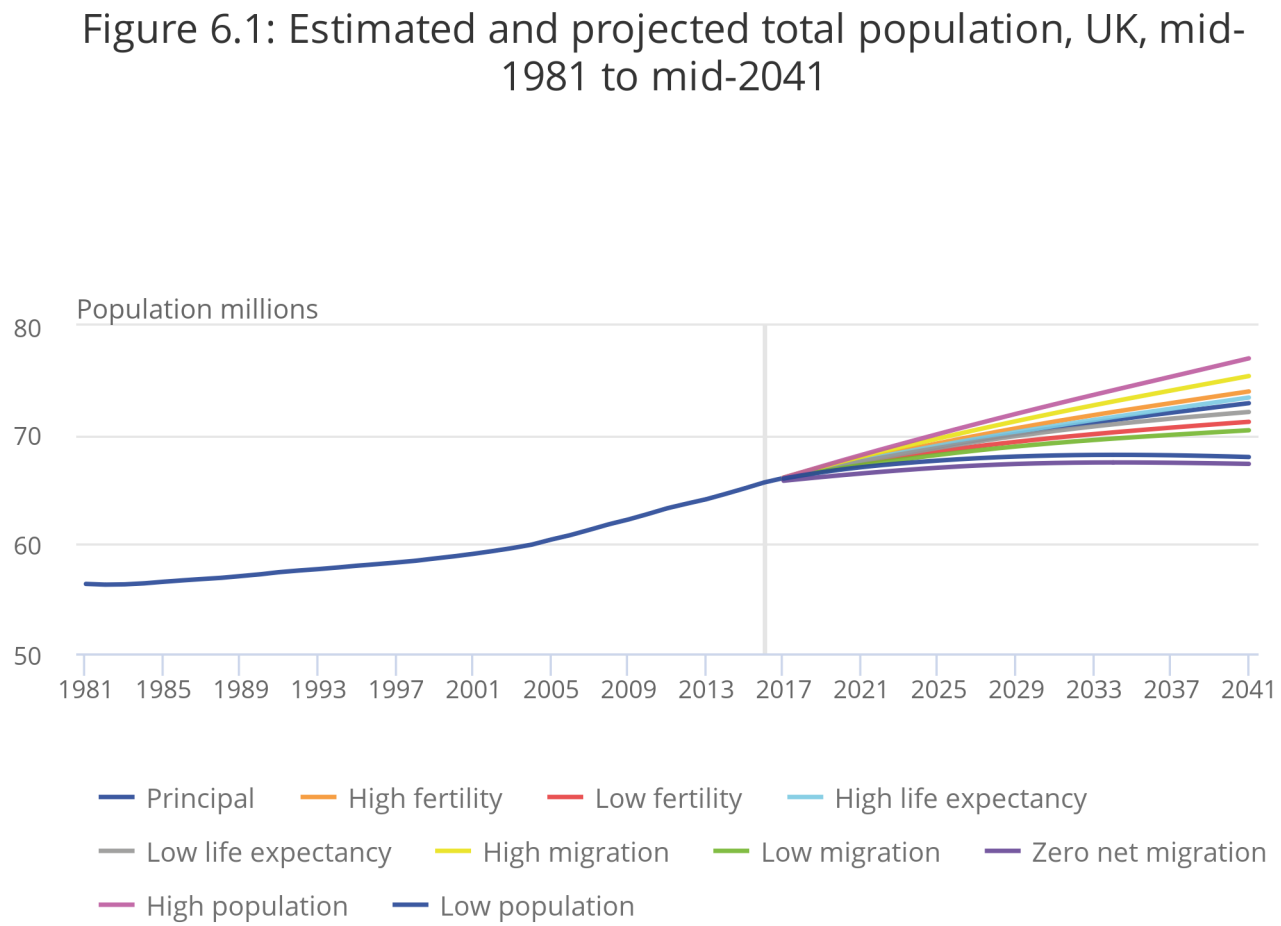
1. The table reference letter is included in the numbering of tables published on the website

# 2 . General overview of variants

In this section, we present a general overview of the different variants and compare them with the principal projection. In particular, we compare projected population sizes for mid-2041 and growth rates over the period from mid-2016 to mid-2041.

Figure 6.1 and Table 6.2 show the differences in projected population size for the UK for the principal projection and under alternative variant scenarios.

**Figure 6.1: Estimated and projected total population, UK, mid-1981 to mid-2041**




**Source: Office for National Statistics**

**Table 6.2: Projected population increase, UK, mid-2016 to mid-2041**

| Variants | Mid-2041 population (millions) | Population change (millions) | Percentage change |
|---|---|---|---|
| Principal | 72.9 | 7.3 | 11.1 |
| High fertility | 74.0 | 8.3 | 12.7 |
| Low fertility | 71.2 | 5.5 | 8.5 |
| High life expectancy | 73.4 | 7.8 | 11.8 |
| Low life expectancy | 72.1 | 6.5 | 9.8 |
| High migration | 75.4 | 9.7 | 14.8 |
| Low migration | 70.4 | 4.8 | 7.3 |
| Zero net migration | 67.3 | 1.7 | 2.6 |
| High population | 77.0 | 11.4 | 17.3 |
| Low population | 68.0 | 2.3 | 3.5 |

Source: Office for National Statistics

## Fertility variants

Projecting a course for fertility is important for government planning. For example, changes in fertility rates are critical to determining resource allocation to services such as childcare and education. Therefore, in addition to the principal projection, we also produce two alternative variant scenarios for fertility, one assuming a higher total fertility rate and one with a lower rate. For the 2016-based variant projections, we assumed a long-term total fertility rate for the UK of 1.84 in the principal projection, 1.94 in the high fertility variant and 1.64 in the low fertility variant. Assumptions for generations who have not yet entered childbearing ages, or who have done so only recently, are necessarily highly speculative.

In the principal projection we project the UK population to grow by 11% between mid-2016 and mid-2041, reaching 72.9 million by mid-2041. In the high fertility scenario, the population is projected to increase to 74.0 million by mid-2041. In the low fertility variant, growth is projected to be lower than in the principal, with a projected population of 71.2 million in mid-2041.

## Life expectancy variants

Changes in mortality help us to understand prospects for future longevity, which is especially relevant for government planning in terms of pensions planning and care in old age. For this reason, we also produce four mortality variants, two of which are covered in this chapter. These help give an indication of uncertainty to alternative assumptions, which are based on varying long-term improvement rates. For the 2016-based projections, the principal projection has an annual improvement rate of 1.2% from mid-2041; over the same time period the high life expectancy variant has an annual improvement of 1.9% in mortality rate, while in the low life expectancy variant this rate is 0%. Over the period up to mid-2041 the mortality rates converge to these rates.

In the principal projection, the UK population reaches 72.9 million by mid-2041. In the high life expectancy variant, growth is higher than in the principal, with the population increasing to 73.4 million. In the low life expectancy variant, growth is lower than in the principal population, with a projected population of 72.1 million. Overall, over the period from mid-2016 to mid-2041, the life expectancy variants have a small effect on the original projection and much less of an impact than the fertility variants.

## Migration variants

Changes in international migration help us to think in the longer term about the population structure and the consequent impact on government planning. In the 2016-based principal projection, the long-term assumption for international net migration to the UK is 165,000 each year from the year ending mid-2023 onwards. We also produce high and low migration variants, in which we assume annual net migration to be 40,000 higher or lower than the principal projection in the first year. For all subsequent years we assume net migration to be 80,000 higher or lower. This results in the high and low annual net migration assumptions to the UK being 245,000 and 85,000 people per year, respectively.

In the principal projection, the population is projected to reach 72.9 million by mid-2041. In the high migration scenario, population growth is considerably higher than in the principal, with the population projected to increase to 75.4 million by mid-2041. In the low migration scenario, growth is lower than in the principal, with the population set to reach 70.4 million by the end of the reporting period. Overall, the migration variants have the largest effect on the principal projection, when compared with the fertility and life expectancy variants.

## Combined variants

For particular applications, users may also be interested in combining two or more of these variant scenarios. For example, we produce two combined scenarios including a high population variant, in which we assume high fertility, high life expectancy and high migration, and a low population variant, which is the reverse of the former assumptions. For example, in the principal projection the population is projected to grow by 11% from mid-2016, reaching 72.9 million by mid-2041. In the high population variant, growth is projected to be 6.2 percentage points higher than in the principal, with the population expected to reach 77.0 million by mid-2041. In the low population variant, growth is projected to be 7.5 percentage points lower than in the principal, with the population expected to reach 68.0 million by mid-2041.

## Special case variants

For some of our users, it can be useful to project special case scenarios or “what if” projections to illustrate the consequences of a particular set of assumptions. For this reason, we also produce a number of special case variants. The only standard special case variant in this release is the zero net migration variant which explores a scenario under which international immigration and emigration and cross-border inflows and outflows are balanced, resulting in no net gain or loss. In Figure 6.1, we can see this variant clearly results in the lowest population growth and lowest total size by mid-2041 compared with all the other projection scenarios. In the principal projection we project the UK population to reach 72.9 million, while in the zero net migration variant growth we project the population to reach 67.3 million by mid-2041.

# 3 . Projected population by age

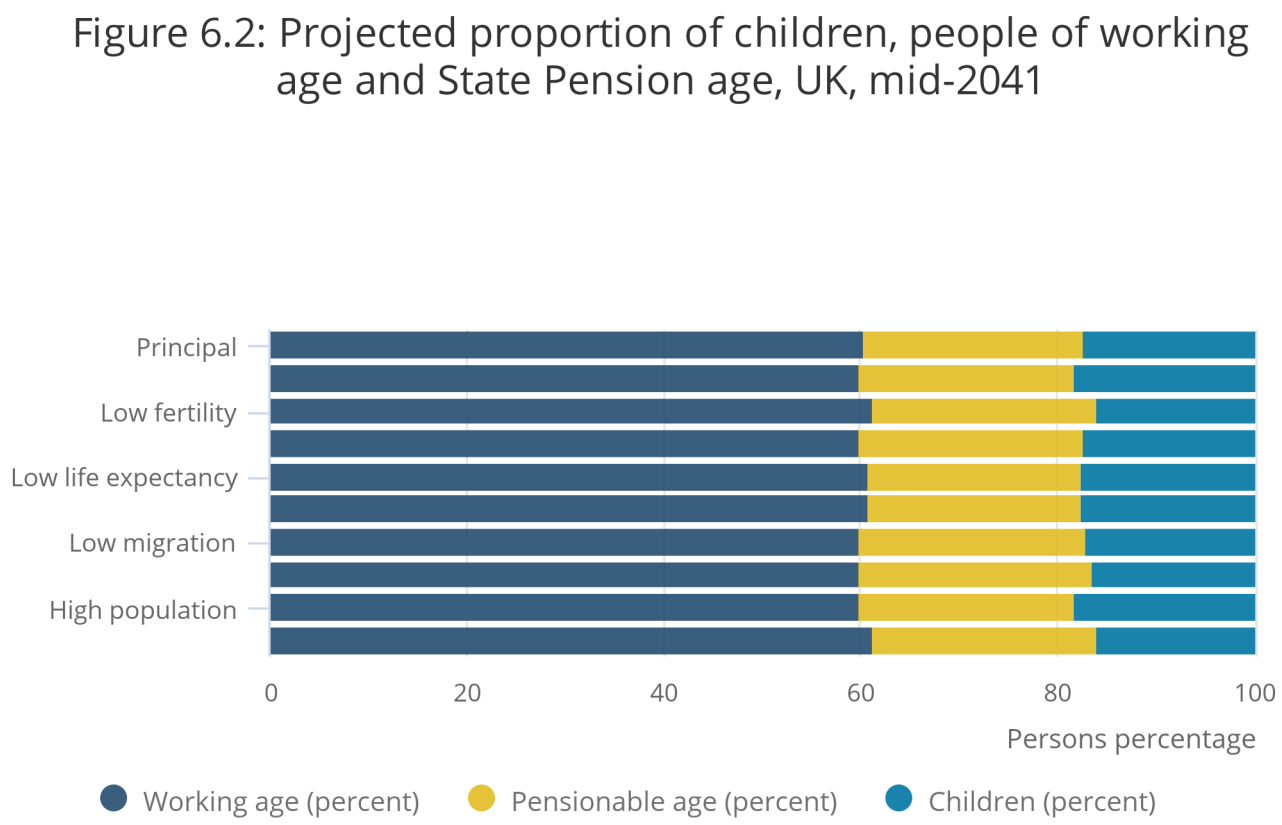
When we vary the assumptions feeding into the projections, this affects the future age structure of the population. For example, a high fertility assumption will increase the number of children in the short-term, and will subsequently increase the number of people of working age and the number of women of childbearing age, resulting in increased births.

The interactive population pyramid allows comparisons of the age and sex structure of the main (principal) and variant projections through time.

In Figure 6.2, we compare the projected proportion of children, people of working age, and the population of State Pension age (SPA), 25 years on from the mid-2016 estimate under different projection scenarios.

Children are defined as those aged 0 to 15. Working age and pensionable age populations are based on SPA for the stated year.

**Figure 6.2: Projected proportion of children, people of working age and State Pension age, UK, mid-2041**




**Source: Office for National Statistics**

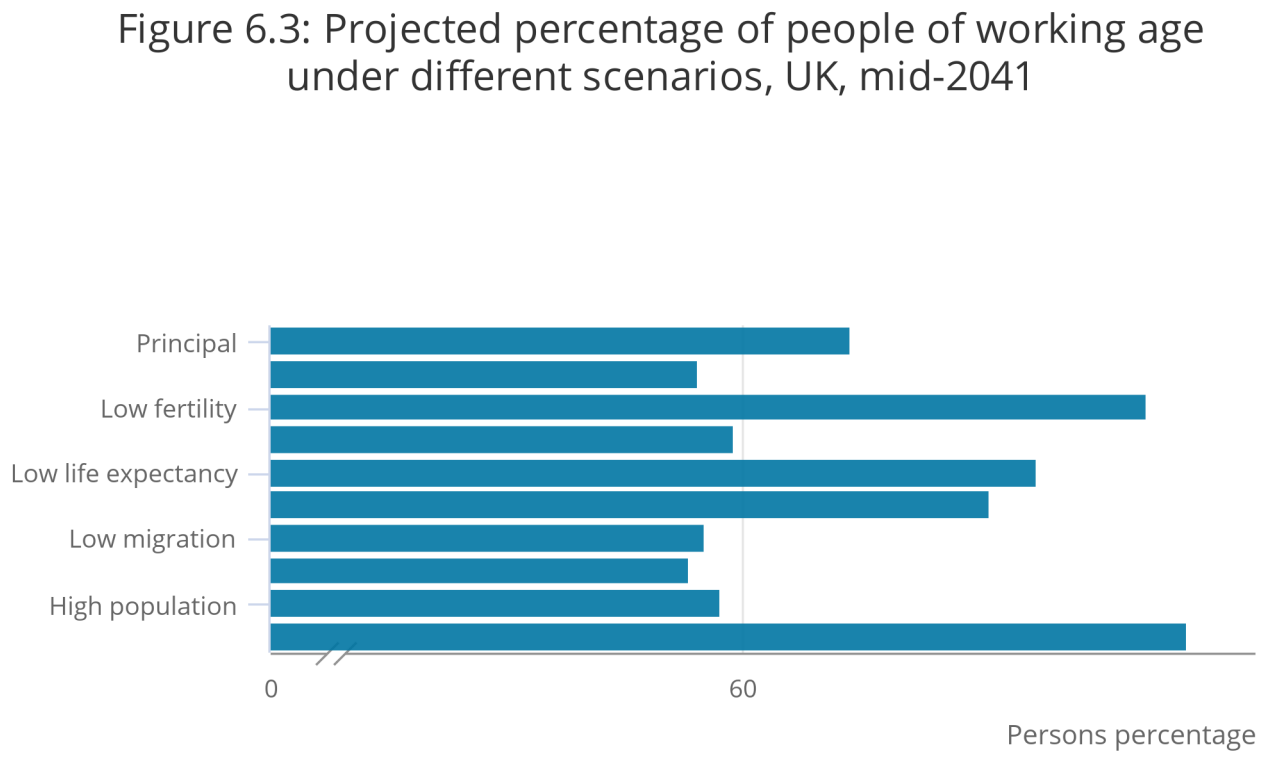
**Notes:**

1. Children are defined as those aged 0 to 15. Working age and pensionable age populations are based on State Pension age (SPA) for the stated year. Under current legislation SPA in mid-2041 will be 67 for both sexes.

# 4 . Working age population and births: examining different variant scenarios

Changes to fertility, life expectancy and migration assumptions affect the demographic characteristics of the UK population and, consequently, impact upon the makeup of our society and economy. Therefore, it can be particularly helpful to national and local policymakers to compare how different projection scenarios could affect the population structure. In this section, we look at how different variants affect the size of the working age population and the number of births in the UK.

**Figure 6.3: Projected percentage of people of working age under different scenarios, UK, mid-2041**



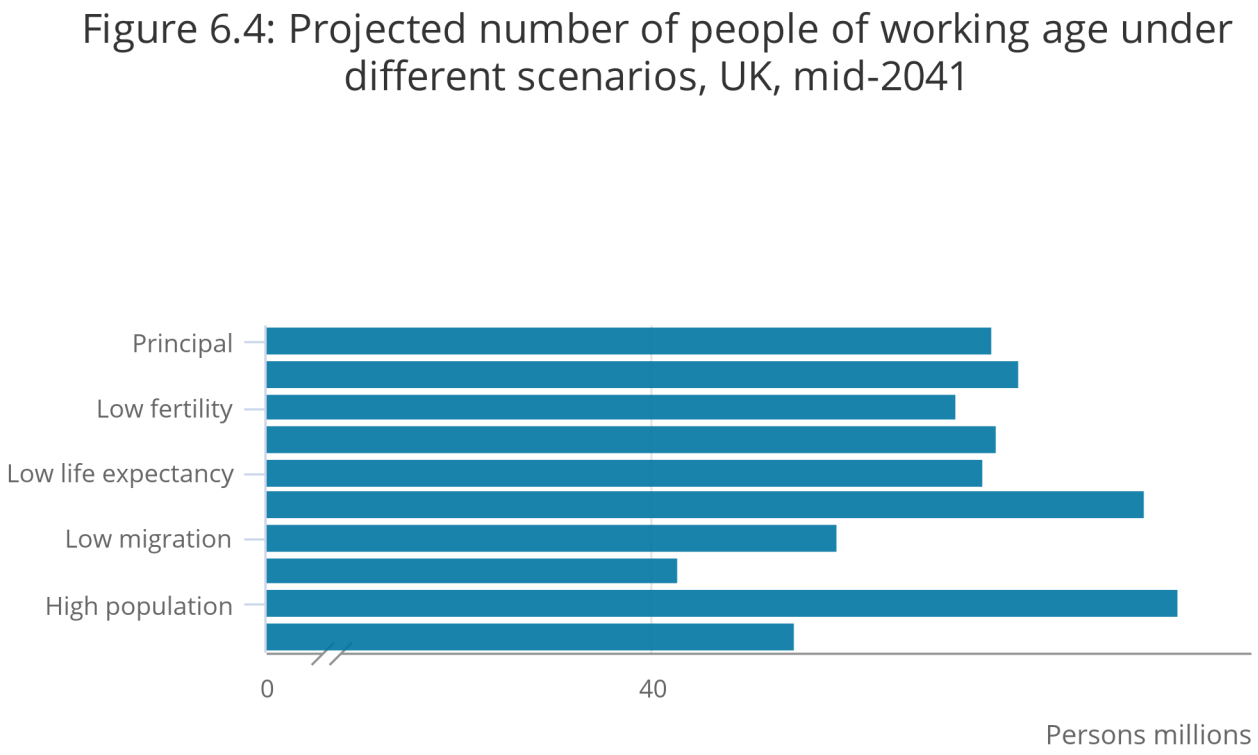

**Source: Office for National Statistics**

**Notes:**

1. Working age population is based on State Pension age (SPA) for the stated year. Under current legislation all those under the age of 67 will be of working age for both sexes.

In mid-2016, there were an estimated 40.8 million working age individuals in the UK, accounting for around 62.2% of the total population. By mid-2041, all of the scenarios project a decrease in the proportion of working age individuals making up the UK population (see Figure 6.3). The biggest drop is expected under zero net migration assumptions (minus 2.3%) and the smallest drop is recorded in the low population variant (negative 0.9%).

**Figure 6.4: Projected number of people of working age under different scenarios, UK, mid-2041**



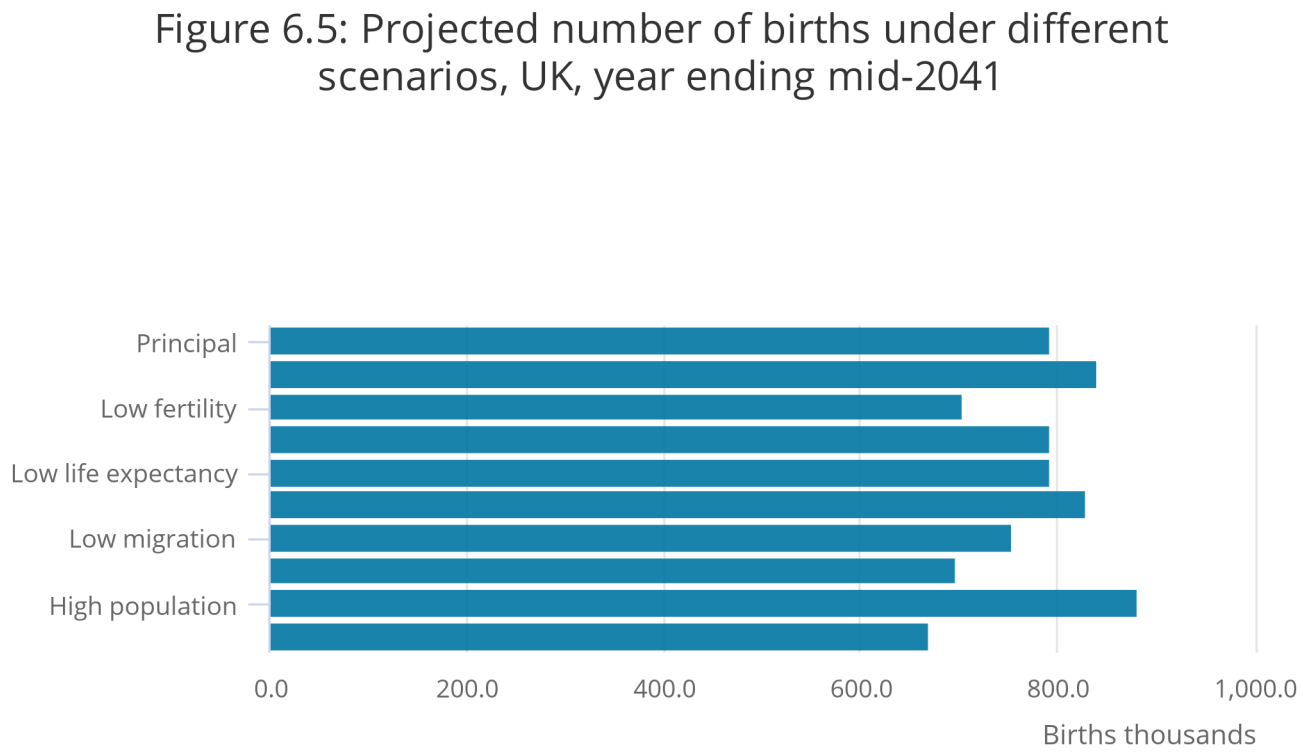

**Source: Office for National Statistics**

**Notes:**

1. Working age population is based on State Pension age (SPA) for the stated year. Under current legislation all those under the age of 67 will be of working age for both sexes.

It's also interesting to compare the numbers of working age individuals across the different scenarios (see Figure 6.4). In the principal projection, we project the working age population to reach 44.0 million by mid-2041; this is 60.3% of the total population. In the high and low migration variants we project the working age population to reach 45.8 million (60.7%) and 42.2 million (59.9%) respectively. When comparing the percentages we see that the differences aren't as great as the numbers may suggest. One factor is that more migrants also means more migrant women of childbearing age, resulting in more births and hence an increased number of children. In Figure 6.5, we compare the different variant scenarios and the principal projection's effect on the number of UK births 25 years on from the original estimate. The provisional estimate of the number of births in the UK in 2016 is 775,000.

**Figure 6.5: Projected number of births under different scenarios, UK, year ending mid-2041**



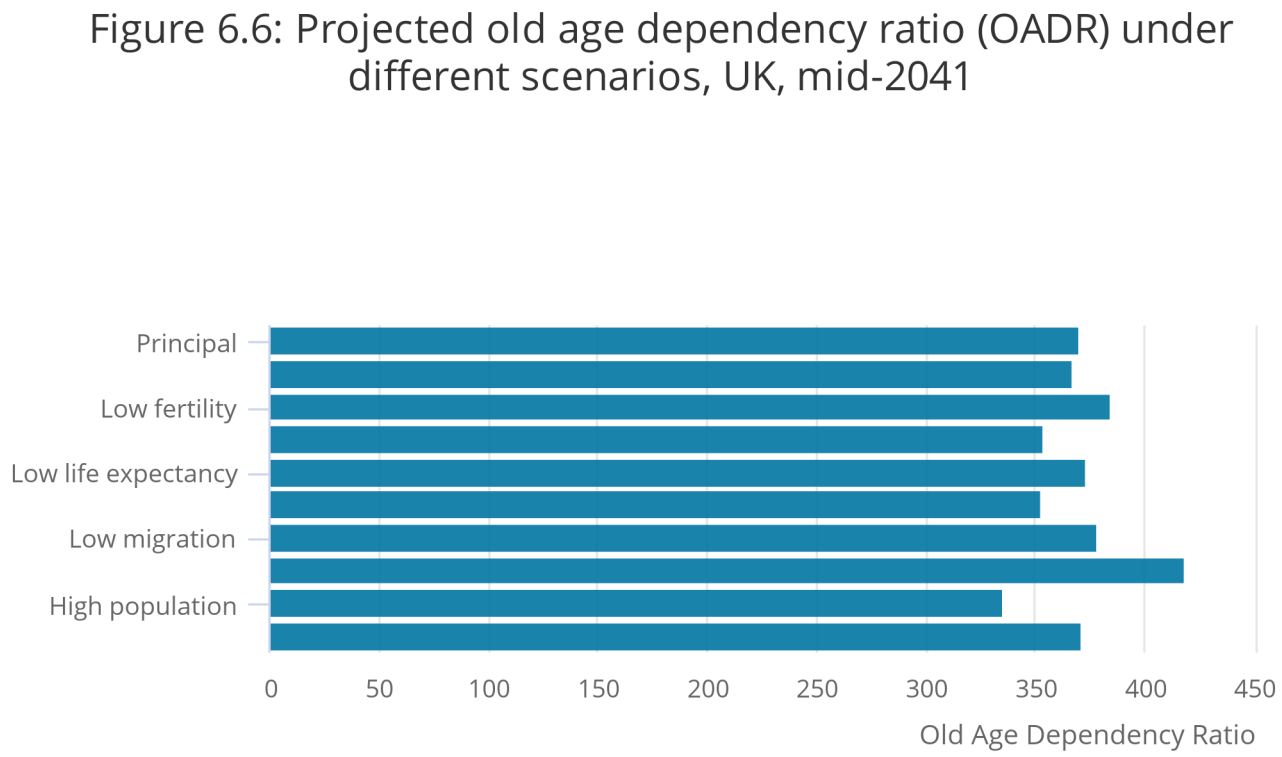

**Source: Office for National Statistics**

In the principal projection, we project births to reach close to 792,000 by mid-2041, an increase of 2.2% from 2016 estimate. By mid-2041, there is a decrease of 13.7% in the low population variant which is the lowest figure observed compared with the other variants. Births for the zero net migration variant also decreased by 10.0%. The high population variant increased by 13.6%, the highest scenario observed.

# 5 . Ageing society: examining different variant scenarios

The latest trends in the UK population show that the number of older people is growing. In the principal projection, we expect the proportion of those aged 85 and over to double over the next 25 years. In light of the ageing population, it could be interesting to see how the different variants affect the number of those of pensionable age and the old age dependency ratio (OADR). The OADR is defined as the number of people of pensionable age for every thousand people of working age.

**Figure 6.6: Projected old age dependency ratio (OADR) under different scenarios, UK, mid-2041**




**Source: Office for National Statistics**

**Notes:**

1. The old age dependency ratio is defined as the number of people of pensionable age for every thousand people of working age.

2. Working age and pensionable age populations are based on State Pension age (SPA) for the stated year. Under current legislation SPA in mid-2041 will be 67 for both sexes.

In Figure 6.6, we compare the projected OADR for the UK across the principal projection and different variants by mid-2041. This is 25 years on from mid-2016 estimates, in which there were an estimated 12.4 million people of pensionable age (18.9% of the total population) with an OADR of 305. In the principal projection, the pensionable population is projected to grow by 31% over the 25 year period, reaching 16.3 million by mid-2041 with an OADR of 370. In all scenarios, the pensionable population and OADR is projected to increase noticeably from the original estimate for mid-2016. For example, even in the low life expectancy variant the population of State Pension age is projected to grow by 26.0%, reaching 15.6 million with an OADR of 355 by mid-2041. The highest change is found in the zero net migration variant, in which the pensionable age population rises to 16.0 million and the OADR is 396.

# 6 . Quality and methodology

The national population projections Quality and Methodology Information document contains important information on:

- the strengths and limitations of the data and how it compares with related data
- uses and users of the data
- how the output was created
- the quality of the output including the accuracy of the data

We have also published a number of other methodological documents, and more background detail on each of fertility, mortality and migration assumptions (consultation papers).

# 7 . Appendix

## Definitions of additional variants

0% future EU migration, which uses the principal fertility, mortality and cross-border migration assumptions. The international migration figures have been created by proportionally reducing the principal assumptions, based on the proportion of migration which was by (non-UK) EU citizens between 2014 and 2016, to reflect a scenario of no future migration to and from the UK by EU citizens, from the year ending mid-2019 onwards. This projection is provided to fulfill specific stakeholder requirements and does not have National Statistics status.

50% future EU migration, which uses the principal fertility, mortality and cross-border migration assumptions. The international migration figures have been created by proportionally reducing the principal assumptions, based on the proportion of migration which was by (non-UK) EU citizens between 2014 and 2016, to reflect a scenario of 50% future migration to and from the UK by EU citizens, from the year ending mid-2019 onwards. This projection is provided to fulfill specific stakeholder requirements and does not have National Statistics status.

150% future EU migration, which uses the principal fertility, mortality and cross-border migration assumptions. The international migration figures have been created by proportionally increasing the principal assumptions, based on the proportion of migration which was by (non-UK) EU citizens between 2014 and 2016, to reflect a scenario of increasing the level of future migration to and from the UK by EU citizens by 50%, from the year ending mid-2019 onwards. This projection is provided to fulfill specific stakeholder requirements and does not have National Statistics status.

Moderately high life expectancy, which combines principal fertility and migration assumptions with rates of mortality improvement higher than the principal but lower than the high life expectancy assumption.

Moderately low life expectancy, which combines principal fertility and migration assumptions with rates of mortality improvement higher than the low life expectancy assumption but lower than the principal.

Northern Ireland medium high migration (available for Northern Ireland only), which assumes long term net international migration to Northern Ireland of 3,000 per year.

Northern Ireland medium low migration (available for Northern Ireland only), which assumes long term net international migration from Northern Ireland of negative 1,500 per year.

# Frequently asked questions

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To be announced

## Table of contents

# 1 . Introduction

This article answers likely questions on the 2016-based national population projections, published on 26 October 2017.

# 2 . What are the national population projections?

The national population projections (NPPs) provide statistics on the potential future size and age structure of the UK and its constituent countries. They are based on the estimated population at 30 June 2016. They are produced using the internationally accepted cohort component methodology, which accounts for the impact over time of births, deaths and migration.

The main purpose of the NPPs is to support national planning in a number of different fields – for example fiscal planning, pensions, education and health.

Our main (principal) projection is based on assumptions considered to best reflect recent patterns of fertility, life expectancy and migration. These are derived from analysis of data, as well as expert advice. However, it is not possible to know how these patterns may change in future. To reflect this uncertainty we also produce a number of variant population projections, based on alternative future scenarios.

# 3 . What are the main messages of the projections?

We have summarised the main messages from the projections at the start of our statistical bulletin, which then looks at the statistics in more detail.

# 4 . What population is covered by the projections?

The projections cover usually resident population. This 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.

# 5 . How far ahead do the projections go?

Because projections become increasingly uncertain further into the future, our bulletin only focuses on the first 25 years up to mid-2041. Some users require projections over a longer period for modelling purposes so we have published the principal projection and all variants for a 100 year period up to mid-2116. However, we urge great caution when using projections this far into the future.

# 6 . What assumptions underlie the latest projections?

For the 2016-based principal population projection we have assumed:

- a long-term assumption of annual net migration to the UK of 165,000 per year (from the year ending mid-2023 onwards)
- a long-term average completed family size of 1.84 children per woman
- period life expectancy at birth in 2041 of 83.4 years for men and 86.2 years for women, with constant rates of mortality improvement assumed thereafter

The long-term assumptions above are complemented by short-term assumptions designed to allow a realistic convergence to the long-term assumption. Detailed information on the assumptions is available in the methodology compendium.

## 7 . Net international migration has been high since the previous projection, so why have you reduced the long-term assumption?

In the 2014-based projections we assumed that, in the long term, net migration to the UK would be 185,000 per year. We derived this value using a rolling 25-year average, which gave more weight to values later in the series.

For the 2016-based projections we moved to using a straight 25-year average. This is a simpler approach and also avoids the assumption that the most recent values are necessarily the strongest informants of the future. This leads to our new long-term net migration assumption of 165,000 per year. We assume this level from the year ending mid-2023 onwards.

## 8 . Do the assumptions take Brexit into account?

These are projections, not forecasts. This means we do not attempt to predict the impact of future political or economic changes, not least because it is very difficult to be sure of even the broad demographic impact.

In simple terms, therefore, we do not take Brexit into account. However, because the shorter-term international migration assumptions use the very latest demographic information, they do reflect the decline in net international migration that has occurred since the Brexit vote in June 2016.

## 9 . Is the projected growth in the population because there are more births than deaths, or because of migration?

The projected growth is caused by both these factors. This is a complex area and more detail is provided in the “How do births, deaths and migration affect the projections?” section of the bulletin.

## 10 . What changes have been made to the methodology?

In broad terms the methods are the same as previously, although the values of the assumptions have changed. However:

- the long-term international migration assumptions are now based on a straight 25 year average over the period mid-1991 to mid-2016, rather than the previous rolling average

- we no longer assume a faster rate of increase in life expectancy for those born between 1923 and 1938 (also known as the “golden cohort”)

## 11 . Do your international migration assumptions divide migrants by part of the world?

No. Our assumptions are based purely on total international migration. We have published EU migration variants to serve known research interests but these use non-standard methods and are not classed as National Statistics.

## 12 . What do the latest projections show regarding population ageing?

The population is projected to rise most quickly for the oldest age groups. The number of people aged 85 or more is projected to double over the next 25 years. The Old Age Dependency Ratio (number of people of pensionable age for every 1,000 of working age) is projected to rise from 305 in mid-2016 to 370 in mid-2041, even with the scheduled increases in State Pension age. If State Pension age were to remain at mid-2016 levels the ratio in mid-2041 would be 442.

## 13 . Will the life expectancies in the projections inform State Pension age?

No, not directly. All life expectancy figures given within this release are period life expectancies. Projected cohort life expectancies are scheduled to be published in our past and projected life tables publication in early December. For the purposes of informing the Government reviews of State Pension age, the Government considers that cohort life expectancies are the appropriate measure to use, as detailed in the Department for Work and Pensions background note on the core principle underpinning future State Pension age rises, announced in the Autumn Statement 2013. The article Period and cohort life expectancy explained details the distinction between the two measures.

## 14 . How do the 2016-based projections compare with the 2014-based?

The UK population growth rate is slower than in the 2014-based projections: the projected population is 0.6 million less in mid-2026 and 2.0 million less in mid-2041. This is because of lower assumptions about future levels of fertility and international migration, and an assumption of a slower rate of increase in life expectancy. More information is available in the bulletin and methods documents.

## 15 . How accurate have past projections been?

Strictly speaking a projection, if calculated correctly, can never be wrong, because it is not an attempt to predict. Nevertheless, it is useful to know how close to eventual outcomes past projections have been. In 2015 we published an analysis of the past accuracy of national population projections. This considered the 1955-based to 2012-based projections and compared them with estimates of the UK population up to mid-2013. The analysis found that the mean absolute error of the projected total UK population 20 years ahead was about 2.7 per cent overall. The largest differences between projected and actual populations were found to be for the youngest and oldest ages. However, as methods and demographic circumstances change, we cannot be certain how large future errors are likely to be.

## 16 . What are the confidence intervals/error margins around the projections?

We do not publish confidence intervals around the projections. The projections are inherently uncertain and become more so the further they are carried forward in time. Variant projections are produced to provide an indication of uncertainty by allowing users to consider the impact of differing future levels of fertility, life expectancy and migration.

## 17 . When is the UK population projected to reach 70 million?

The UK population is now projected to reach 70 million by mid-2029, two years later than in the 2014-based projections. There is no special demographic significance to 70 million, but as a “round number” it may be viewed as a numerical milestone. The UK population is estimated to have reached 50 million in 1948 and 60 million by mid-2005. It is projected that the population will rise from 60 to 70 million over a period of 24 years, compared with the 57 years over which it rose from 50 to 60 million.

## 18 . Will the UK population go on growing forever?

Under the principal projection assumptions, the size of the UK population is projected to continue increasing over the projection period. However projections are uncertain and become increasingly so the further they are carried forward. Growth is not inevitable – for example, there were several years between the mid-1970s and early 1980s when the UK population fell.

## 19 . When will projections for subnational areas be available?

We are planning to publish 2016-based projections for subnational areas in England (down to local authority and Clinical Commissioning Group level) in May or June 2018. Subnational projections for areas in Wales, Scotland and Northern Ireland are produced by the Welsh Government, National Records of Scotland and Northern Ireland Statistics and Research Agency respectively.

## 20 . How do future changes to the UK population compare with other countries?

Comparisons with and links to projections by the European Union (EU) statistical office (Eurostat) and the United Nations are provided in our bulletin.

## 21 . How were the assumptions underlying the projections agreed?

The assumptions about future levels of fertility, life expectancy and net migration were agreed in liaison with the devolved administrations – the Welsh Government, National Records of Scotland and Northern Ireland Statistics and Research Agency – following consultation with leading users of projections in each country and advice from an expert advisory panel. Details of the membership of the panel and minutes of the meeting are included in the "Background and Methodology" section of the methodological compendium.

## 22 . Do you produce population projections by ethnicity, nationality or religion?

Our population projections cover the population as a whole by age and sex but we do not provide further breakdowns. This means we do not cover topics such as ethnicity, nationality or religion.

However, the ETHPOP database provides projections by ethnicity using a 2011 base. ETHPOP is created and maintained by population experts in academia, and is not an ONS product.

## 23 . What if I can't find what I want?

If you have any difficulty finding the information you require please contact the team at pop.info@ons.gov.uk, Tel: +44 (0)1329 444661.