Office for National Statistics

Article

National Population Projections: 2014-based extra variants report

Population projections are uncertain and become increasingly so the further they are carried forward in time. In addition to the principal (main or central) projection, variant projections are therefore produced based on alternative assumptions of future fertility, mortality and net migration. In order to publish the principal and main variants as early as possible, publication is separated into 2 releases.

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Next release:
To be announced

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1 . Introduction

Further to the publication of the 2014-based national population projections for the UK and constituent countries on 29 October 2015, this release presents the data for another 7 variant projections based on alternative assumptions of future fertility, mortality and migration.

In order to publish the principal and main variants as early as possible, the publication of the projections is separated into 2 releases.

These extra variant projections provide alternative future scenarios of population change and can be used to illustrate uncertainty and sensitivity to alternative assumptions in future planning and policy formation. For example, the Office for Budget Responsibility use them to inform their long-term fiscal projections published in the fiscal sustainability report.

2 . Background of variant projections

National population projections are produced for the UK and its constituent countries every 2 years. These projections are based on the 2014 mid-year population estimates and a set of underlying demographic assumptions regarding future fertility, mortality and migration. These terms are explained in the Statistical Bulletin for the first release of these projections. The assumptions are based on the best statistical evidence available at the time and are agreed in liaison with the devolved administrations – Welsh Government, National Records of Scotland (NRS) and Northern Ireland Statistics and Research Agency (NISRA) - following consultation with the main users of projections in each country and advice from an expert academic advisory panel.

In 2014 a new method for setting and applying the cross-border (intra-UK) migration assumptions as rates, rather than fixed numbers of migrants, was introduced and has been applied for the 2014-based projections. More detail is available on these new methods for incorporating cross border migration rates into the UK National Population Projections. (399 Kb Pdf)

Papers outlining the fertility, mortality and migration assumptions adopted for the 2014-based national population projections were published as part of the 29 October 2015 release.

Due to the inherent uncertainty of demographic behaviour, any set of projections will inevitably be proved wrong, to a greater or lesser extent, as a forecast of future demographic events or population structure. In addition to the principal (main or central) projection, variant projections are produced based on alternative assumptions of future fertility, mortality and migration. These variant projections are intended to provide an indication of uncertainty and sensitivity to alternative assumptions; they do not represent upper or lower limits of future demographic behaviour.

Variants can be grouped into 3 types. Single component variants look at the effect of varying 1 assumption at a time from the principal projection. For example, the high fertility variant uses mortality and migration assumptions consistent with the principal projections but assumes a higher rate of fertility. Combination variants assume alternative rates for 2 or more of the assumptions. For instance, the young population variant assumes high fertility, low life expectancy and high net migration, which results in projections with a younger age profile than the principal projection. It is also sometimes useful to prepare special case scenarios or "what if" projections, to illustrate the consequences of a particular, but not necessarily realistic, set of assumptions, such as zero net migration (natural change only) or no change.

A full list of variants with their associated assumptions is available in Appendix A.

Underlying data for all variant projections in this release can be found in the reference tables and open data tables .

The report on quality and methodology (290.9 Kb Pdf) has more information on how our population projections meet user needs and their fitness for purpose, which includes strengths and limitations.

3 . Variants available for the 2014-based projections

The principal projection and 9 standard variant projections were published on 29 October 2015. These included 6 possible "single component" variants, 2 "combination" variants producing the largest and smallest total population size, and 1 special case scenario of zero net migration (natural change only).

Variant and principal projections are available for the UK, England, Wales, Scotland and Northern Ireland. The principal projections are also produced for Great Britain and England and Wales as a whole. The high migration, low migration, zero net migration (natural change only), young, and old age population projections are also available at the Great Britain level.

The following 7 additional standard "combination" variant projections and special case scenarios are included in this release.

Standard "combination" variants:

- old age structure
- young age structure

Special case scenarios:

- replacement fertility projection
- constant fertility projection
- no mortality improvement projection
- no change projection
- long-term balanced net migration projection (available for the UK only)

Appendix A has the full list of variants available and their publication dates.

4 . Description of variants

Standard "combination" variants

Old age structure

This projection combines assumptions of low fertility, high life expectancy and low net migration. This results in fewer babies being born, an increase in the number of older persons and a reduction in net migration, which impacts the younger adult age groups the most. This leads to a population with an older age structure than the principal projection.

Young age structure

This projection combines assumptions of high fertility, low life expectancy and high net migration. This results in an increase in babies being born, a reduction in the number of older persons and an increase in net migration, which impacts the younger adult age groups the most. This leads to a population with a younger age profile than the principal projection.

The other standard combination variants, high population and low population, were published with the 2014-based national population projections on 29 October 2015.

Special case scenarios

Replacement fertility projection

Replacement fertility is the level of fertility required for the population to replace itself in size in the long-term, given constant mortality rates and in the absence of migration. Replacement level is around 2.075 in the UK, that is, women would need to have, on average, 2.075 children each to ensure the long-term "natural" replacement of the population.

The replacement level is based on analysis published in the article Replacement fertility, what has it been and what does it mean? in Population Trends 119 in spring 2005. We recently recalculated the replacement fertility level but it was decided not to make a change since the impact on the resulting projections would be minimal. More information on this is available in the fertility discussion paper. (1.33 Mb Pdf)

The replacement fertility projection combines assumed replacement level fertility with the principal assumptions of mortality and migration.

In the 2014-based projections, UK replacement fertility rates are calculated additively, based on summing the births and population figures for the constituent countries. Replacement fertility rates for the UK may vary slightly from 2.075 due to rounding.

Constant fertility projection

This projection assumes that age specific fertility rates will remain constant at the values assumed for the first year (mid-2014 to mid-2015) of the principal projection. Although actual age-specific fertility rates for that year were not known when the principal projection was carried out, the assumed rates were consistent with provisional estimates of total births for the year. The constant fertility projection combines assumed constant level fertility with the principal assumptions of mortality and migration.

The total fertility rate in the constant fertility projection for the UK , at 1.81, is lower than the long-term assumption for the principal projection (1.89). Therefore, for this round of projections, projected population figures for the constant fertility variant are slightly lower than the principal projections.

In the 2014-based projections, UK constant fertility rates are calculated additively based on summing the births and population figures for the constituent countries. Constant fertility rates for the UK may vary slightly year on year due to rounding.

Table 1.1 shows the assumed long-term total fertility rates assumed for the standard variants compared with assumptions based on replacement and constant fertility.

Table 1.1: Assumed long-term total fertility rates for the standard variants and special case scenarios, UK and constituent countries

Country	Standard variants			Special case scenarios	
	High	Principal	Low	Replacement fertility	Constant fertility
England	2.10	1.90	1.70	2.08	1.82
Wales	2.10	1.90	1.70	2.08	1.78
Scotland	1.90	1.70	1.50	2.08	1.59
Northern Ireland	2.20	2.00	1.80	2.08	1.95
United Kingdom	2.09	1.89	1.69	2.08	1.81

Source: Office for National Statistics

Notes:

1. Constant fertility is taken from the 2014-15 total fertility rate and applied throughout the projection period.

No mortality improvement projection

This projection assumes that the combined age/sex specific mortality rates will remain constant at the values assumed for the first year (mid-2014 to mid-2015) of the principal projection. Although actual age/sex specific mortality rates for that year were not known when the principal projection was carried out, the assumed rates were consistent with provisional estimates of total deaths for the year. This projection combines an assumption of no mortality improvement with the principal assumptions of fertility and migration.

In the 2014-based projections, "no mortality improvement" mortality rates for the UK are calculated additively based on summing the deaths and population figures for the constituent countries. Therefore "no mortality improvement" mortality rates and expectation of life figures for the UK may vary slightly year on year due to rounding.

Table 1.2 shows the effect on period expectation of life at birth in the year to mid-2039 with no mortality improvement compared to principal, high and low standard variants.

The no mortality improvement variant is different from the low life expectancy variant. The former assumes that mortality rates remain at the rates assumed from provisional data in the year ending mid-2015. The latter assumes that there is some improvement in mortality in the short-term, but that there is no improvement after 2039.

Table 1.2: Period expectation of life at birth year to mid-2039, for the standard variants and special case scenario, UK and constituent countries

	Standard variants			Special case scenario
	High	Principal	Low	No improvement
Males				
England	86.2	84.3	82.4	79.2
Wales	85.4	83.4	81.4	78.1
Scotland	84.3	82.3	80.2	76.6
Northern Ireland	85.3	83.3	81.3	78.2
United Kingdom	86.0	84.1	82.2	78.9
Females				
England	88.9	87.1	85.4	82.7
Wales	88.2	86.4	84.7	81.8
Scotland	86.8	85.0	83.1	80.7
Northern Ireland	88.2	86.5	84.7	82.1
United Kingdom	88.7	86.9	85.2	82.5

Source: Office for National Statistics

Zero net migration (natural change only) projection (published 29 October 2015)

This projection uses the principal assumptions of fertility and mortality and assumes that there will be zero net migration (for every age for each sex). It therefore shows the consequences of the principal assumptions of fertility and mortality in the absence of migration, or where migration inflows and outflows are exactly equal at every age.

When compared to the principal projection, the zero net migration (natural change only) projection allows the impact of the principal net migration assumption on the projected population to be assessed.

No change projection

This projection shows what would happen if fertility, mortality and net migration were to remain constant at current levels. It assumes the fertility rates from the constant fertility projection and the mortality rates from the no mortality improvement projection. However, given the fluctuating nature of net migration, it is much more difficult to define what is meant by the current level of net migration. So the principal migration assumptions have been used for the no change projection.

Long-term balanced net migration projection

The long-term balanced net migration variant assumes that net migration will decline to zero in the long-term (between 2022 and 2036), with in-migration and out-migration total flows being equal. However, although long-term total inflows and outflows are assumed to be equal, inflows and outflows are not necessarily assumed to be equal for each individual age or sex (so a net inflow at one age might be offset by a net outflow at another age). For the 2014-based projections the variant follows the assumptions of the low migration variant, as published 29 October 2015, in the run-in period to the long-term assumption (from the year ending mid-2015 to year ending mid-2021). In previous projections it followed the principal assumption. However, feedback at consultation showed users required the long-term balanced net migration to follow a lower level of migration. This variant is only produced for the UK.

5 . Results

Table 1.3 presents projections of the total population under the principal projection, single component variants, combination variants and special case scenarios for the UK in mid-2039 and compares this to the mid-2014 estimate.

Table 1.3: Measures of population structure under the principal projection, standard variant projections and special case scenarios, UK, mid-2039

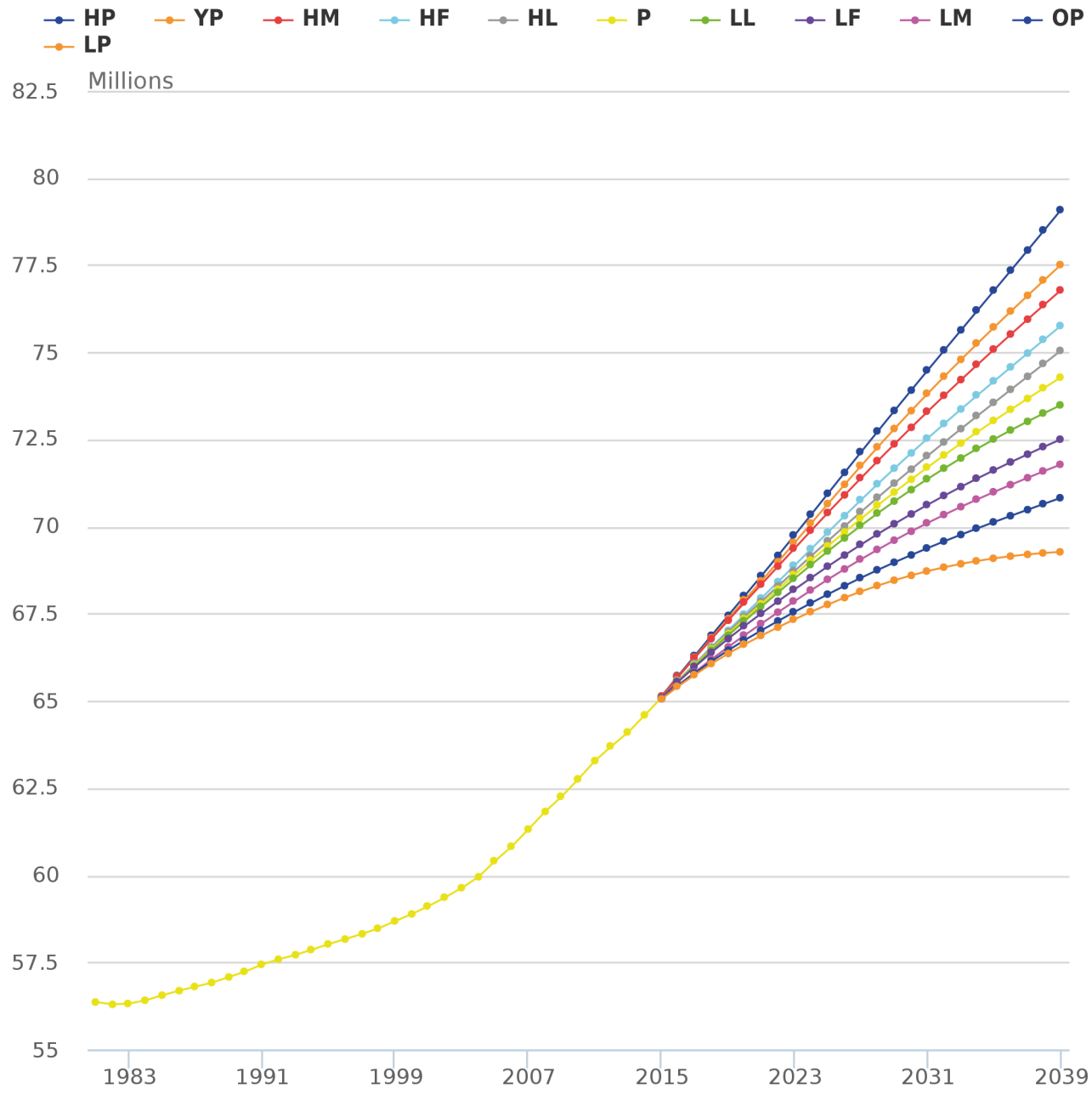
Projection	Total population (thousands) (2014 = 64,597)
Principal projection	74,284
Single Component Variants	
High fertility	75,765
Low fertility	72,504
High life expectancy	75,051
Low life expectancy	73,488
High migration	76,786
Low migration	71,783
Combination Variants	
High population (high fertility, high life expectancy, high migration)	79,090
Low population (low fertility, low life expectancy, low migration)	69,273
Young age structure (high fertility, low life expectancy, high migration)	77,514
Old age structure (low fertility, high life expectancy, low migration)	70,825
Special Case Scenarios	
Replacement fertility	76,600
Constant fertility	73,637
No mortality improvement	71,568
Zero migration (natural change only)	67,658
No change (constant fertility, no mortality improvement)	70,921
Long-term balanced net migration	70,419

Source: Office for National Statistics

Equivalent tables for the constituent countries and 3 additional measures, the percentage of the population under 16, percentage of population 65 and over and dependants per 1000 persons of working age (dependency ratios), are available in the data download.

Figure 1.1 illustrates how the total population is projected to change over the next 25 years for the principal, single component and combination variant projections.

Figure 1.1: Estimated and projected population of the UK, mid-1981 to mid-2039



Source: Office for National Statistics

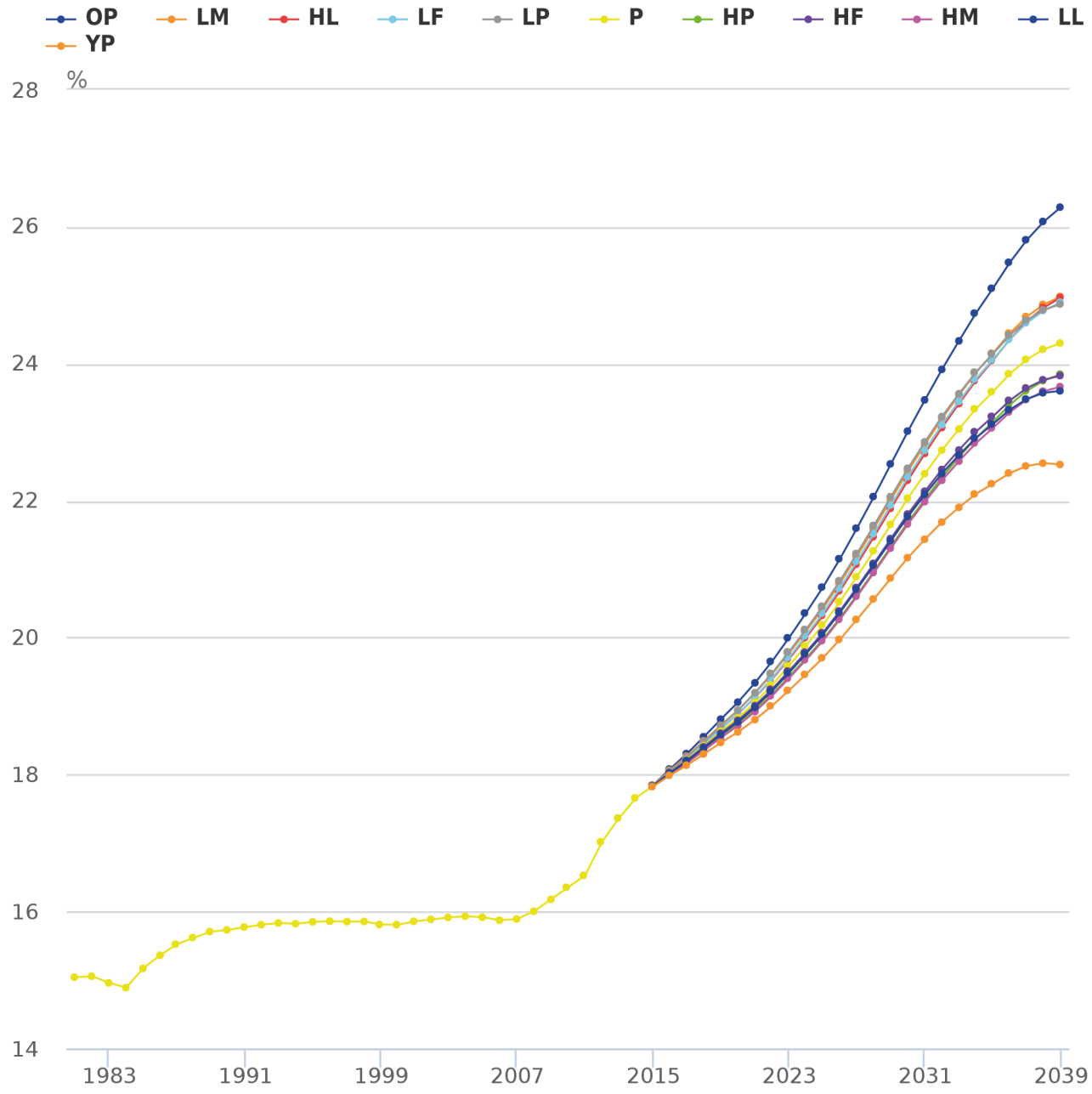
Notes:

1. HP = High fertility, high life expectancy, high migration YP = High fertility, low life expectancy, high migration HM = High migration HF = High fertility HL High life expectancy P = Principal projection LL = Low life expectancy LF = Low fertility LM = Low migration OP = Low fertility, high life expectancy, low migration LP = Low fertility, low life expectancy, low migration

The equivalent charts for the constituent countries of the UK can be found in Appendix B.

Figure 1.2 shows the estimated and projected percentage of the UK population aged 65 and over between mid-1981 and mid-2039 for the principal projection and selected standard variants.

Figure 1.2: Estimated and projected percentage of the population aged 65 and over, UK, mid-1981 to mid-2039



Source: Office for National Statistics

Notes:

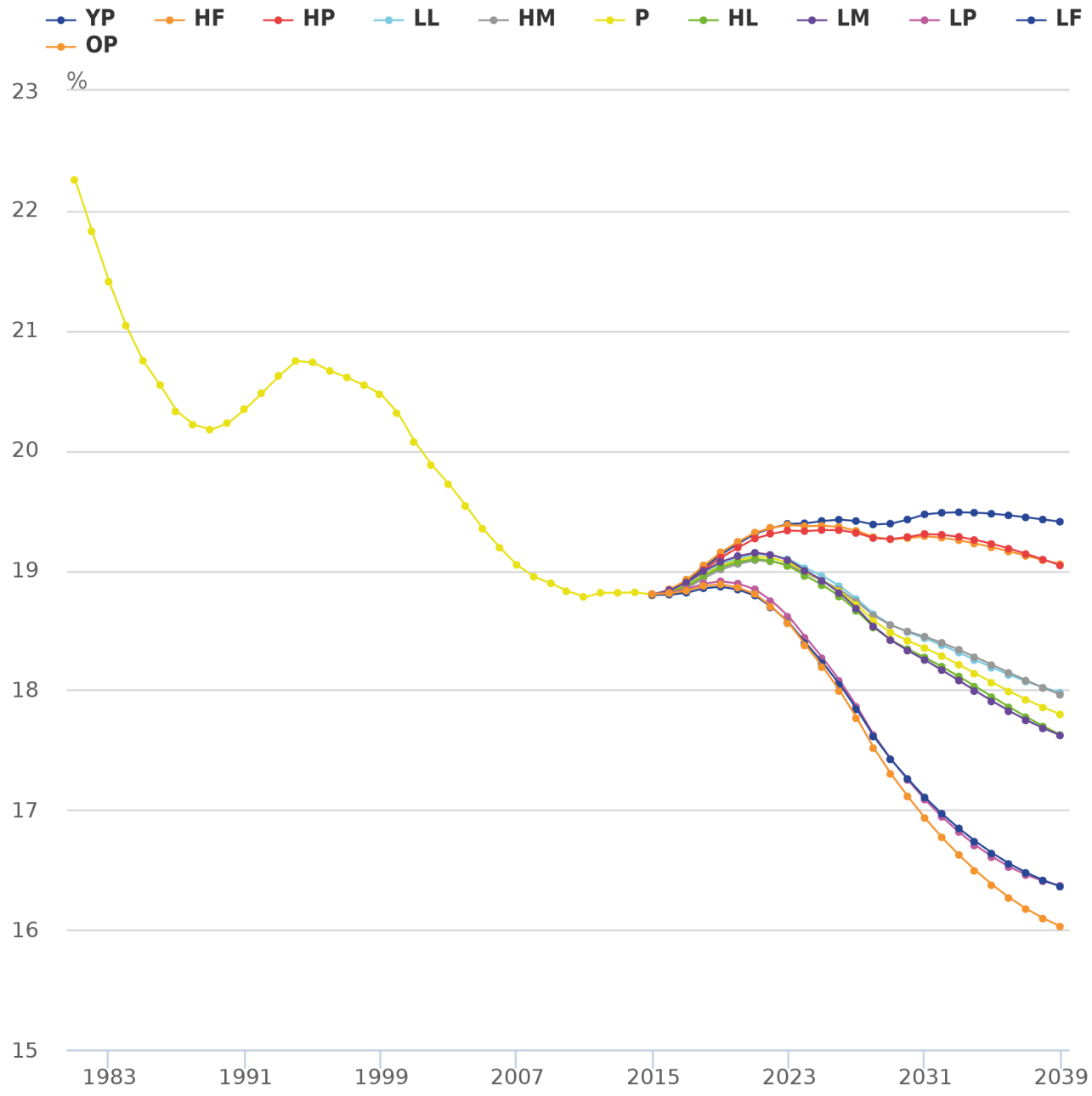
1. OP = Low fertility, high life expectancy, low migration LM = Low migration HL High life expectancy LF = Low fertility LP = Low fertility, low life expectancy, low migration P = Principal projection HP = High fertility, high life expectancy, high migration HF = High fertility HM = High migration LL = Low life expectancy YP = High fertility, low life expectancy, high migration

All variants show an increase in the percentage of the total population in the UK aged 65 and over compared with the mid-2014 estimate (17.7%). The old population variant (assuming low fertility, high life expectancy and low net migration) projects the highest percentage across all variants for this age group with 26.3% of the UK population expected to be aged 65 and over by mid-2039.

The equivalent charts for the constituent countries of the UK can be found in Appendix C.

Figure 1.3 shows the estimated and projected percentage of the UK population aged under 16 between mid-1981 and mid-2039.

Figure 1.3: Estimated and projected percentage of the population aged under 16, UK, mid-1981 to mid-2039



Source: Office for National Statistics

Notes:

1. YP = High fertility, low life expectancy, high migration HF = High fertility HP = High fertility, high life expectancy, high migration LL = Low life expectancy HM = High migration P = Principal projection HL High life expectancy LM = Low migration LP = Low fertility, low life expectancy, low migration LF = Low fertility OP = Low fertility, high life expectancy, low migration

In contrast to the percentage of the population aged 65 and over, there is more consistency between the variants for the percentage of the population aged under 16. The young population variant (assuming high fertility, low life expectancy and high net migration) projects the highest percentage across all variants for this age group to be 19.4% in mid-2039, compared with 18.8% in mid-2014. In the long term, only the young population, high fertility, and high population variants project higher percentages of under 16s than at present.

The equivalent charts for the constituent countries of the UK can be found in Appendix D.

6. Background notes

1. National Statistics are produced to high professional standards as set out in the Code of Practice for Official Statistics. They undergo regular quality assurance reviews to ensure that they meet customer needs. They are produced free from any political interference.

2. National population projections are prepared by the Office for National Statistics (ONS) on behalf of the National Statistician and the Registrars General of Scotland and Northern Ireland. The assumptions are agreed in liaison with the devolved administrations, following consultation with main users of projections in each country and advice from an expert academic advisory panel.

3. The projections for the UK and its constituent countries are based on estimates of the population at 30 June 2014.

4. Projections are made of the resident population of the UK and its constituent countries, as defined for the mid-year population estimates. The population includes all usually resident persons, 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 also included, as are any accompanying dependants.

5. Information on the quality of the projections, including information on an error in the population estimates for Scotland which has a very small effect on the projections, is provided in the Quality and Methodology Information document (290.9 Kb Pdf) . More detail on these Mid-year population estimates - age distribution errors is also available on the National Records of Scotland website.

6. Information on previous sets of projections from 1954 to 2004 and projections between 2006 and 2012 is available on our website.

7. A description of the methodology used, and guidance on using projections , is provided on our website.

8. Any errors or need for revising the projections will be dealt with in accordance with the Population Statistics Revisions Policy (54 Kb Pdf) .

9. There is no pre-publication access available with this release.

10. The main focus of the projections is on the 25 year period to mid-2039. The principal projection is also published for the 100 year period to 2114. Variants for the extended 100 year period can be requested using the statistical contact details below.

11. In 2011, the United Kingdom Statistics Authority designated these statistics as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the Code of Practice for Official Statistics. The statistics were re-assessed in 2015 and their National Statistics status is subject to confirmation once all the requirements in the assessment report have been met.

    Designation can be broadly interpreted to mean that the statistics:

    - meet identified user needs
    - are well explained and readily accessible
    - are produced according to sound methods

- are managed impartially and objectively in the public interest

Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed.

12. News on our population statistics can be obtained by subscribing to the quarterly newsletter (email your request to projections@ons.gsi.gov.uk) or following the Twitter account @paulvickers_ONS

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

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

7. Appendix A: Principal and variant projections with associated assumptions and availability

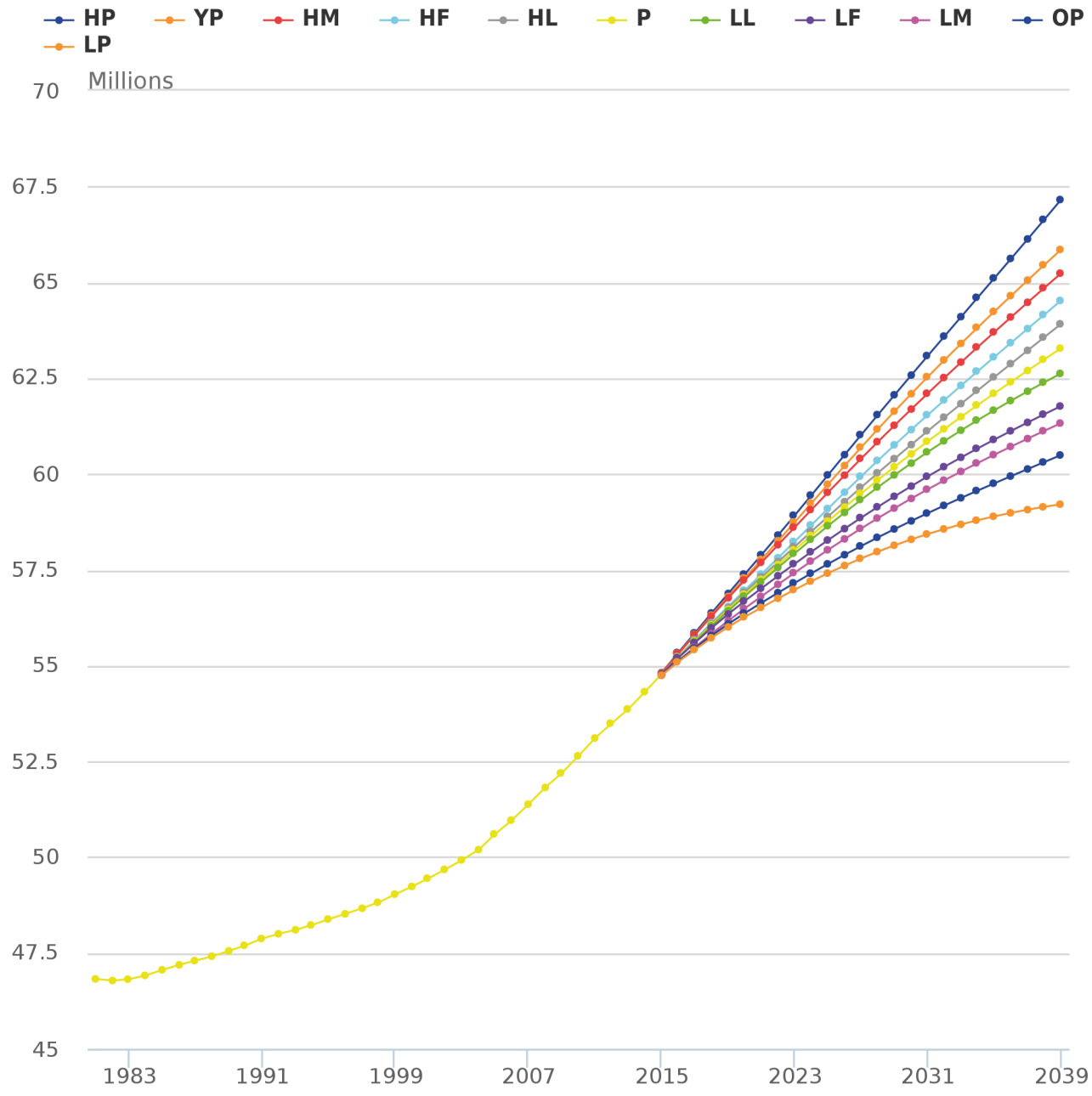
Table 1.4: Principal and variant projections with associated assumptions and availability

	Fertility	Life expectancy	Net migration	Availability
A Principal projection	Principal	Principal	Principal	29 Oct 2015
Standard ‘single component’ variants				
B High fertility	High	Principal	Principal	29 Oct 2015
C Low fertility	Low	Principal	Principal	29 Oct 2015
D High life expectancy	Principal	High	Principal	29 Oct 2015
E Low life expectancy	Principal	Low	Principal	29 Oct 2015
F High migration	Principal	Principal	High	29 Oct 2015
G Low migration	Principal	Principal	Low	29 Oct 2015
Standard ‘combination’ variants				
H High population	High	High	High	29 Oct 2015
I Low population	Low	Low	Low	29 Oct 2015
K Young age structure	High	Low	High	26 Nov 2015
L Old age structure	Low	High	Low	26 Nov 2015
Special case scenarios				
O Replacement fertility	Replacement	Principal	Principal	26 Nov 2015
P Constant fertility	Constant	Principal	Principal	26 Nov 2015
Q No mortality improvement	Principal	No improvement	Principal	26 Nov 2015
J Zero net migration (natural change only)	Principal	Principal	Zero	29 Oct 2015
R No change	Constant	No improvement	Principal	26 Nov 2015
U Long-term balanced net migration (UK only)	Principal	Principal	Long-term balanced	26 Nov 2015

Source: Office for National Statistics

8. Appendix B: Charts - Total population for the constituent countries

Figure 1.1a: Estimated and projected population of England, mid-1981 to mid-2039

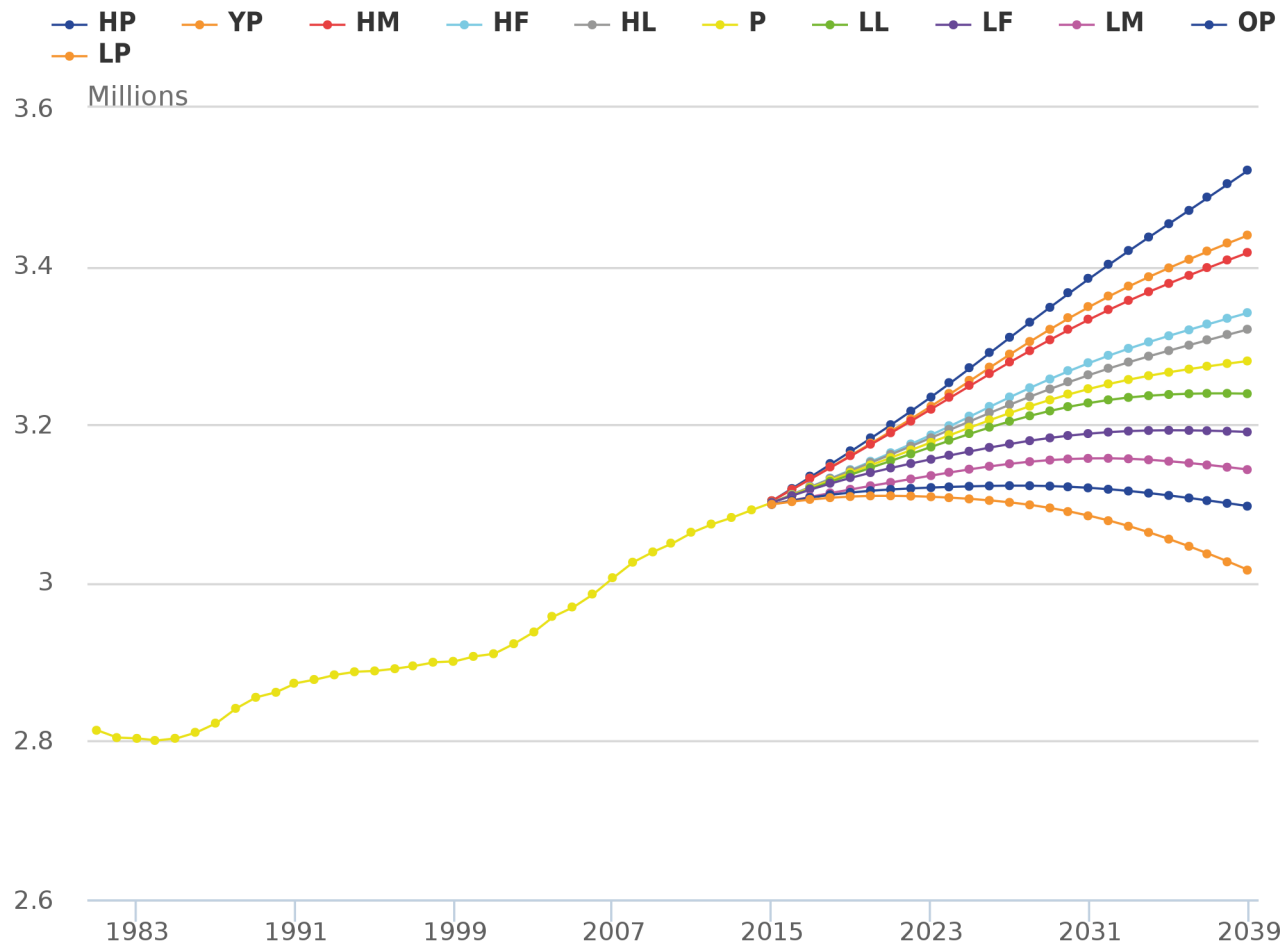


Source: Office for National Statistics

Notes:

1. HP = High fertility, high life expectancy, high migration YP = High fertility, low life expectancy, high migration HM = High migration HF = High fertility HL High life expectancy P = Principal projection LL = Low life expectancy LF = Low fertility LM = Low migration OP = Low fertility, high life expectancy, low migration LP = Low fertility, low life expectancy, low migration

Figure 1.1b: Estimated and projected population of Wales, mid-1981 to mid-2039

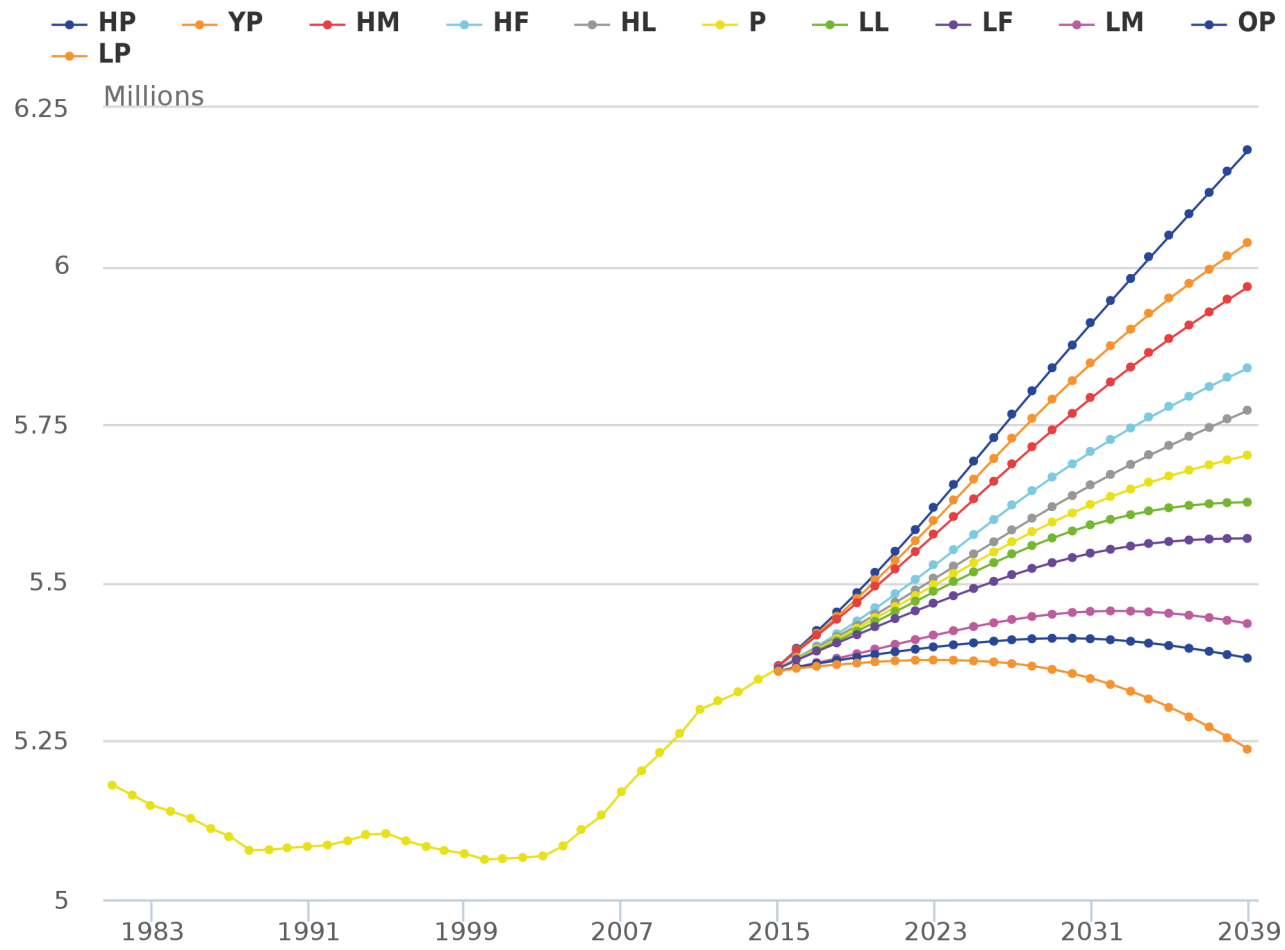


Source: Office for National Statistics

Notes:

1. HP = High fertility, high life expectancy, high migration YP = High fertility, low life expectancy, high migration HM = High migration HF = High fertility HL High life expectancy P = Principal projection LL = Low life expectancy LF = Low fertility LM = Low migration OP = Low fertility, high life expectancy, low migration LP = Low fertility, low life expectancy, low migration

Figure 1.1c: Estimated and projected population of Scotland, mid-1981 to mid-2039

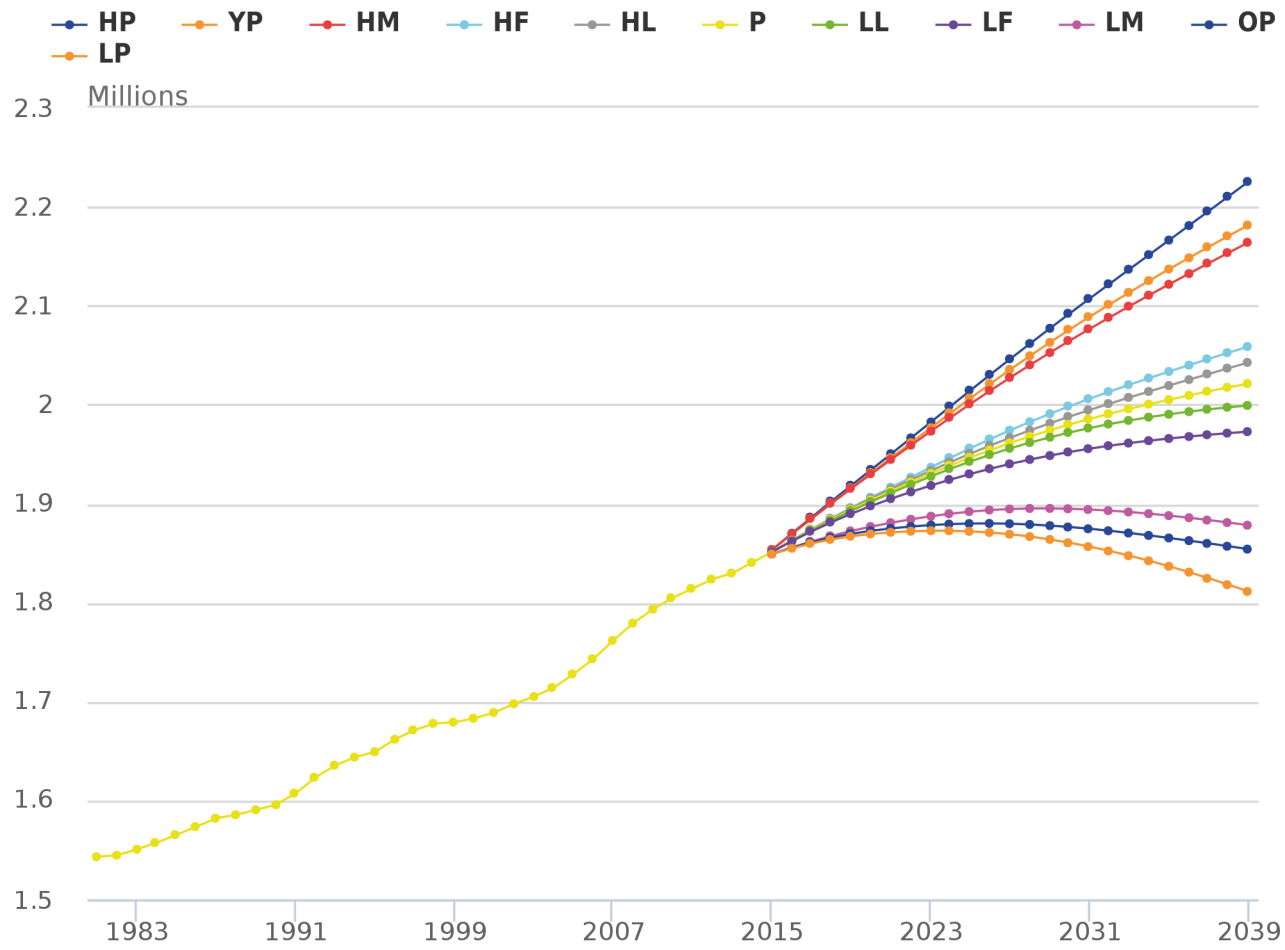


Source: Office for National Statistics

Notes:

1. HP = High fertility, high life expectancy, high migration YP = High fertility, low life expectancy, high migration HM = High migration HF = High fertility HL High life expectancy P = Principal projection LL = Low life expectancy LF = Low fertility LM = Low migration OP = Low fertility, high life expectancy, low migration LP = Low fertility, low life expectancy, low migration

Figure 1.1d: Estimated and projected population of Northern Ireland, mid-1981 to mid-2039



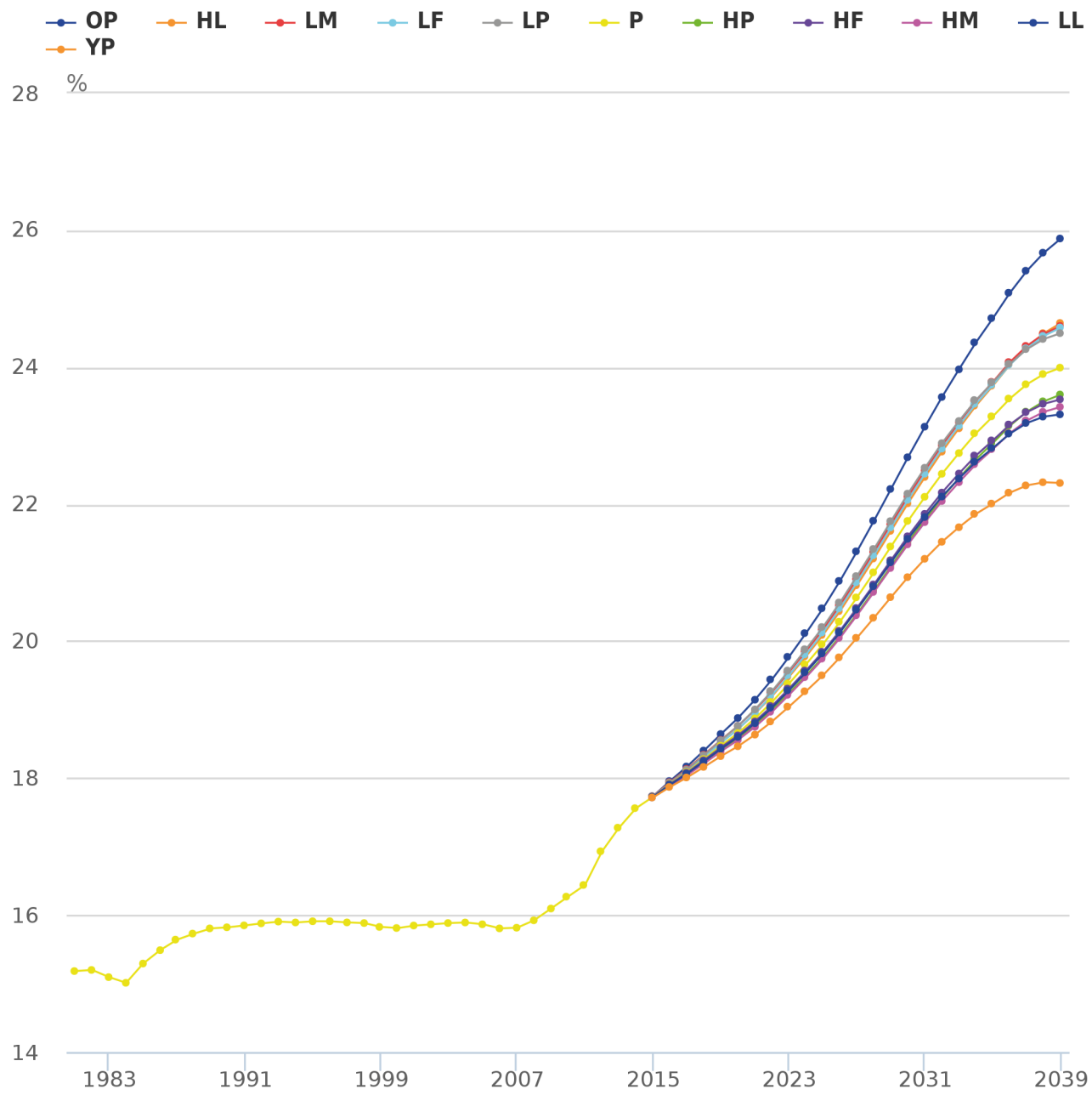
Source: Office for National Statistics

Notes:

1. HP = High fertility, high life expectancy, high migration YP = High fertility, low life expectancy, high migration HM = High migration HF = High fertility HL High life expectancy P = Principal projection LL = Low life expectancy LF = Low fertility LM = Low migration OP = Low fertility, high life expectancy, low migration LP = Low fertility, low life expectancy, low migration

9. Appendix C: Charts - Population aged 65 and over for the constituent countries

Figure 1.2a: Estimated and projected percentage of the population aged 65 and over, England, mid-1981 to mid-2039

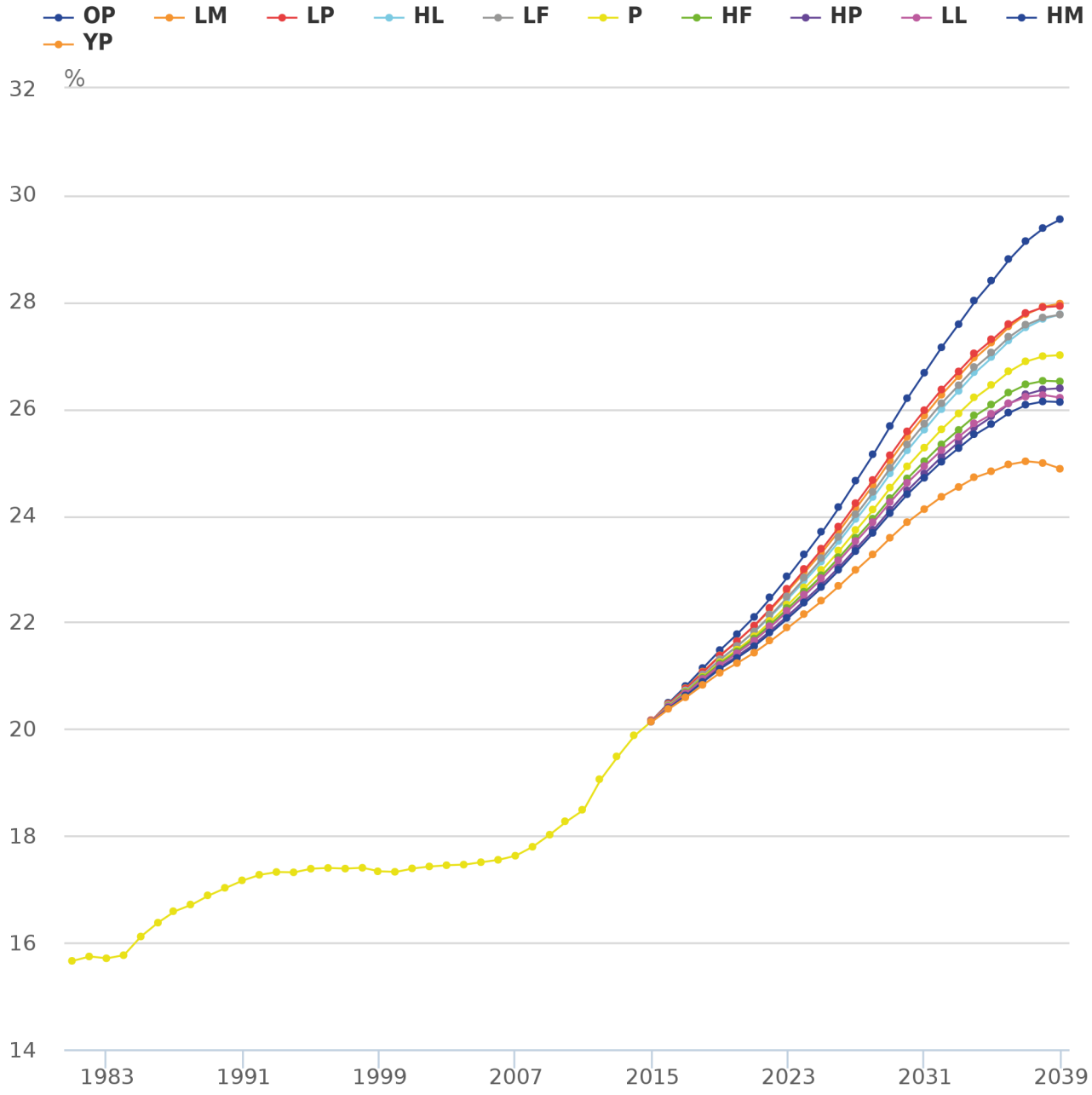


Source: Office for National Statistics

Notes:

1. OP = Low fertility, high life expectancy, low migration HL High life expectancy LM = Low migration LF = Low fertility LP = Low fertility, low life expectancy, low migration P = Principal projection HP = High fertility, high life expectancy, high migration HF = High fertility HM = High migration LL = Low life expectancy YP = High fertility, low life expectancy, high migration

Figure 1.2b: Estimated and projected percentage of the population aged 65 and over, Wales, mid-1981 to mid-2039

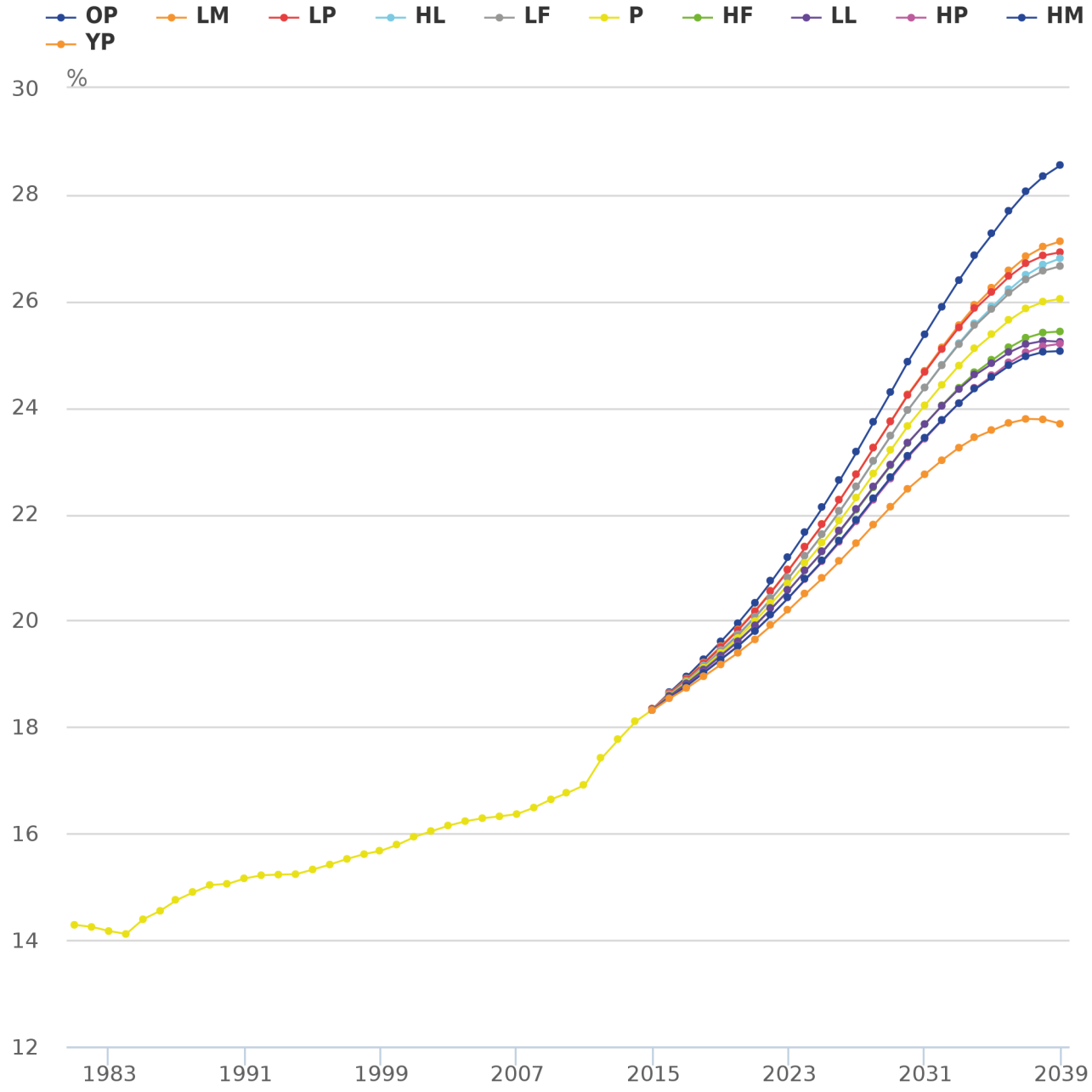


Source: Office for National Statistics

Notes:

1. OP = Low fertility, high life expectancy, low migration LM = Low migration LP = Low fertility, low life expectancy, low migration LF = Low fertility HL High life expectancy P = Principal projection HF = High fertility HP = High fertility, high life expectancy, high migration LL = Low life expectancy HM = High migration YP = High fertility, low life expectancy, high migration

Figure 1.2c: Estimated and projected percentage of the population aged 65 and over, Scotland, mid-1981 to mid-2039

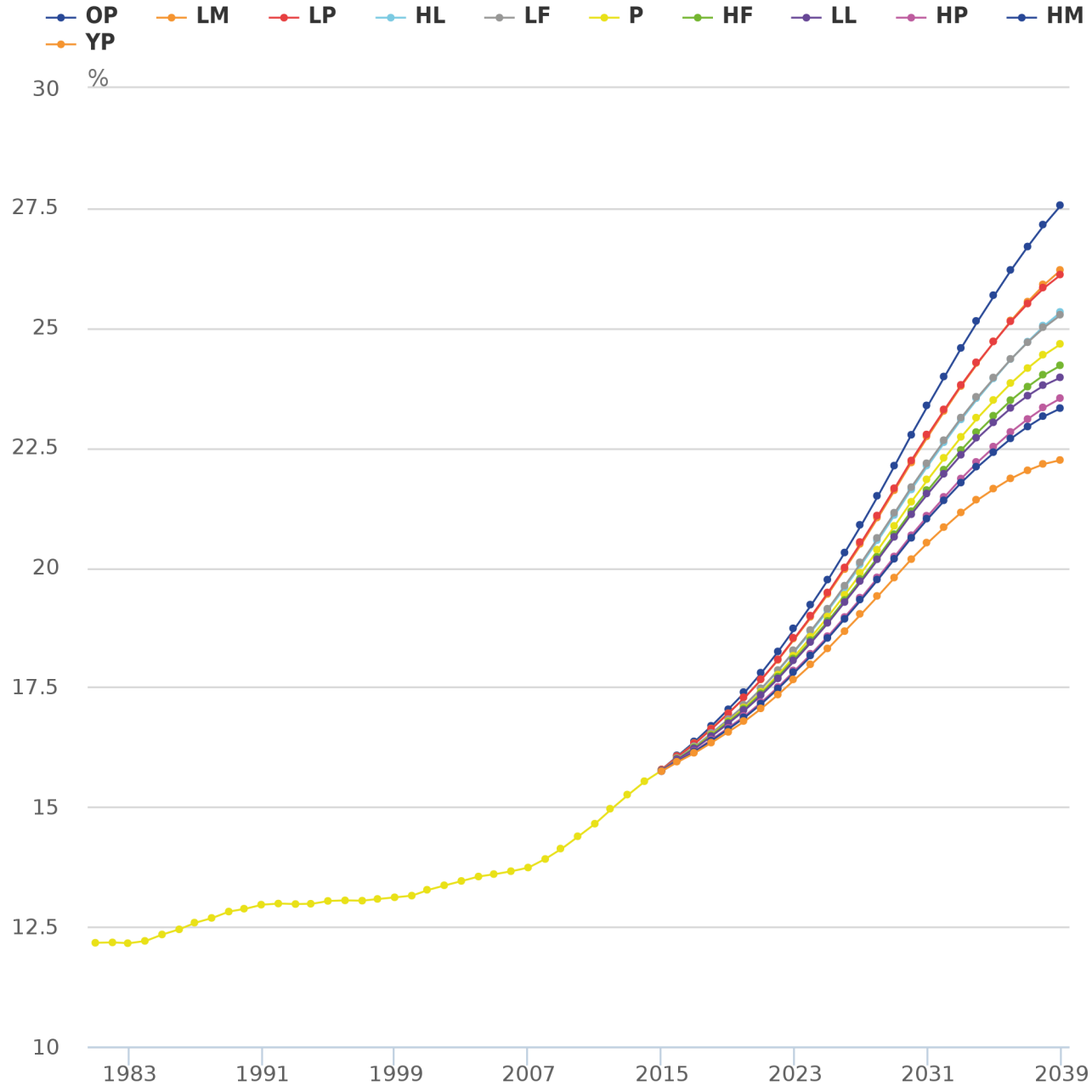


Source: Office for National Statistics

Notes:

1. OP = Low fertility, high life expectancy, low migration LM = Low migration LP = Low fertility, low life expectancy, low migration HL High life expectancy LF = Low fertility P = Principal projection HF = High fertility LL = Low life expectancy HP = High fertility, high life expectancy, high migration HM = High migration YP = High fertility, low life expectancy, high migration

Figure 1.2d: Estimated and projected percentage of the population aged 65 and over, Northern Ireland, mid-1981 to mid-2039



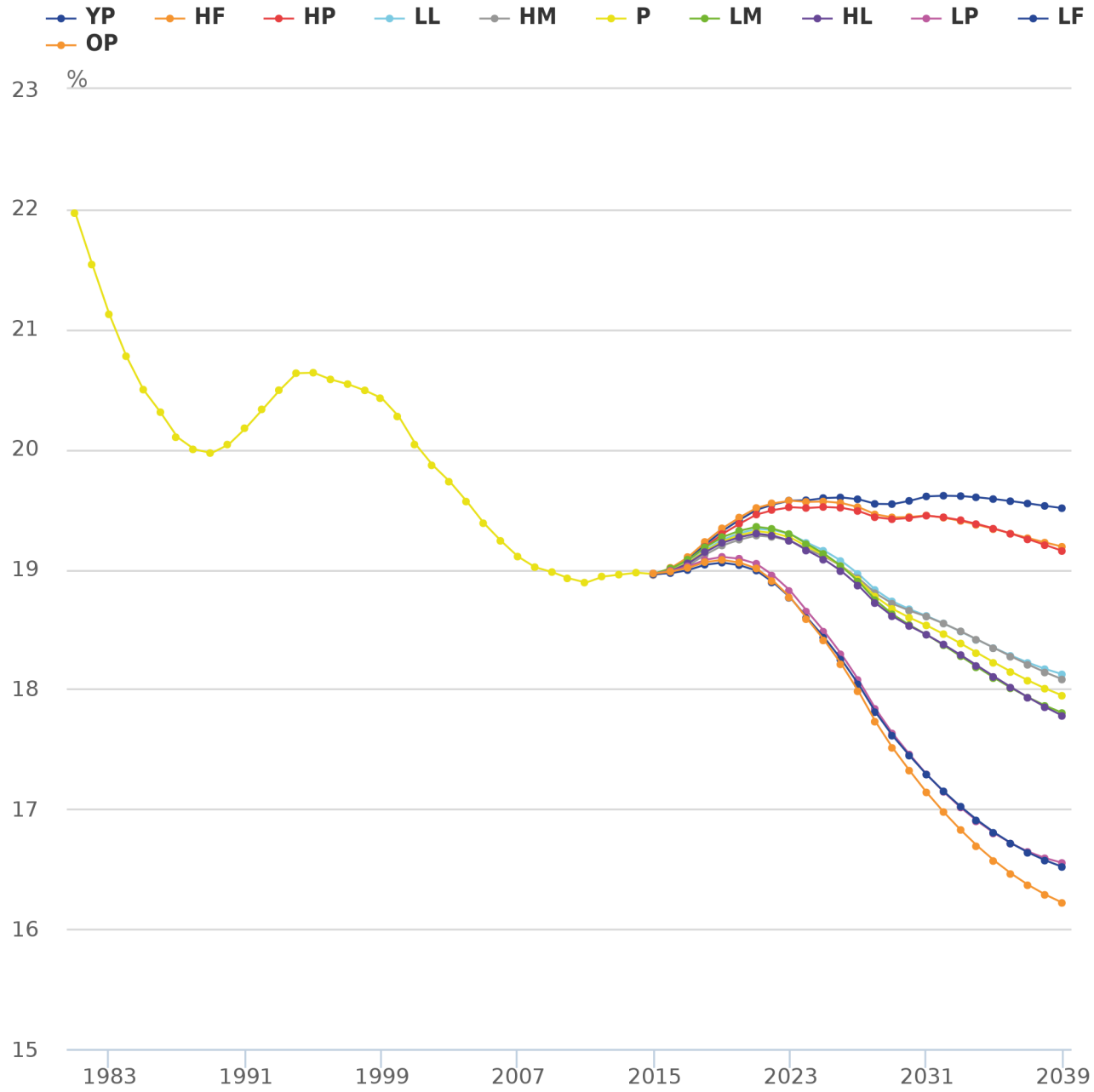
Source: Office for National Statistics

Notes:

1. OP = Low fertility, high life expectancy, low migration LM = Low migration LP = Low fertility, low life expectancy, low migration HL High life expectancy LF = Low fertility P = Principal projection HF = High fertility LL = Low life expectancy HP = High fertility, high life expectancy, high migration HM = High migration YP = High fertility, low life expectancy, high migration

10. Appendix D: Charts - Population aged under 16 for the constituent countries

Figure 1.3a: Estimated and projected percentage of the population aged under 16, England, mid-1981 to mid-2039

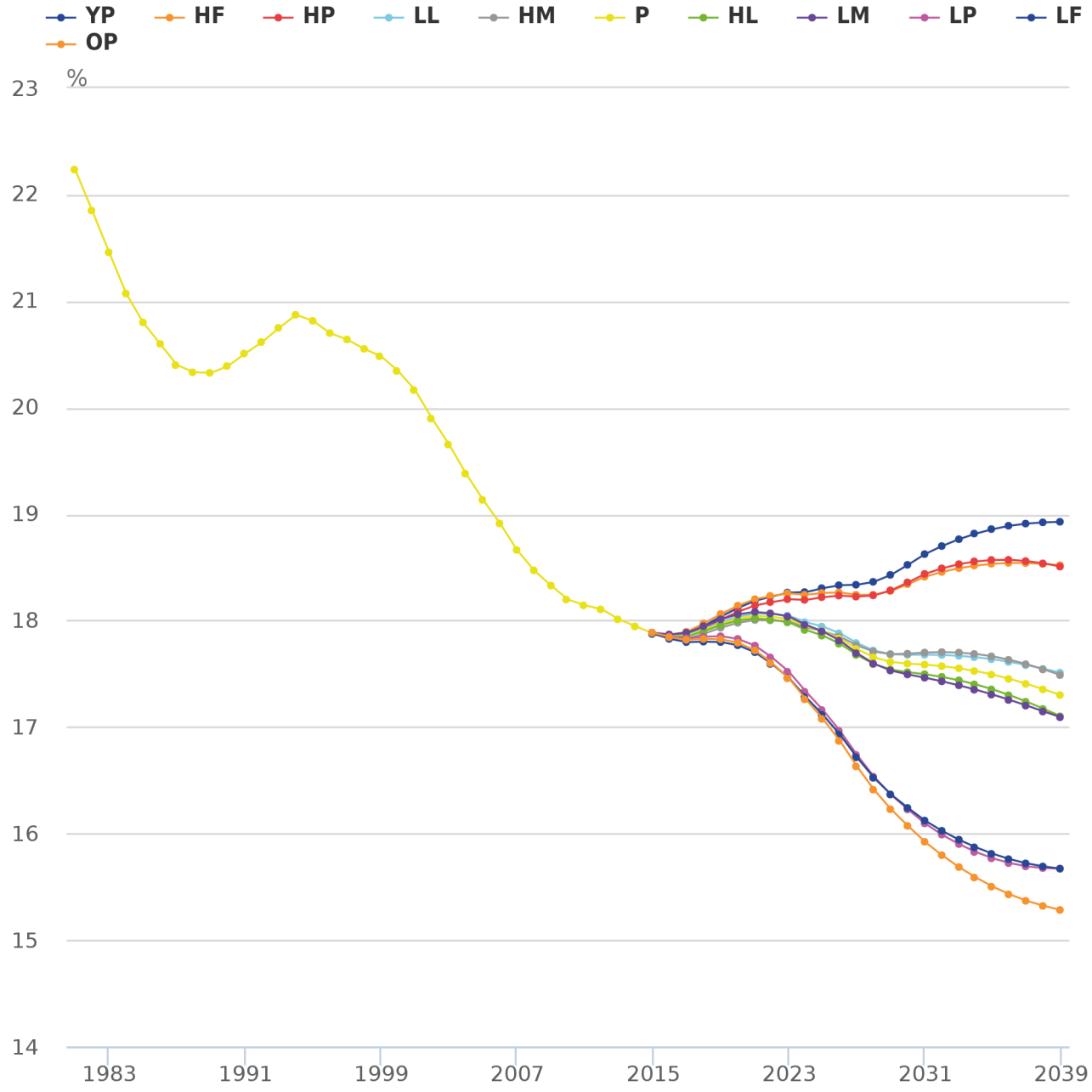


Source: Office for National Statistics

Notes:

1. YP = High fertility, low life expectancy, high migration HF = High fertility HP = High fertility, high life expectancy, high migration LL = Low life expectancy HM = High migration P = Principal projection LM = Low migration HL High life expectancy LP = Low fertility, low life expectancy, low migration LF = Low fertility OP = Low fertility, high life expectancy, low migration

Figure 1.3b: Estimated and projected percentage of the population aged under 16, Wales, mid-1981 to mid-2039

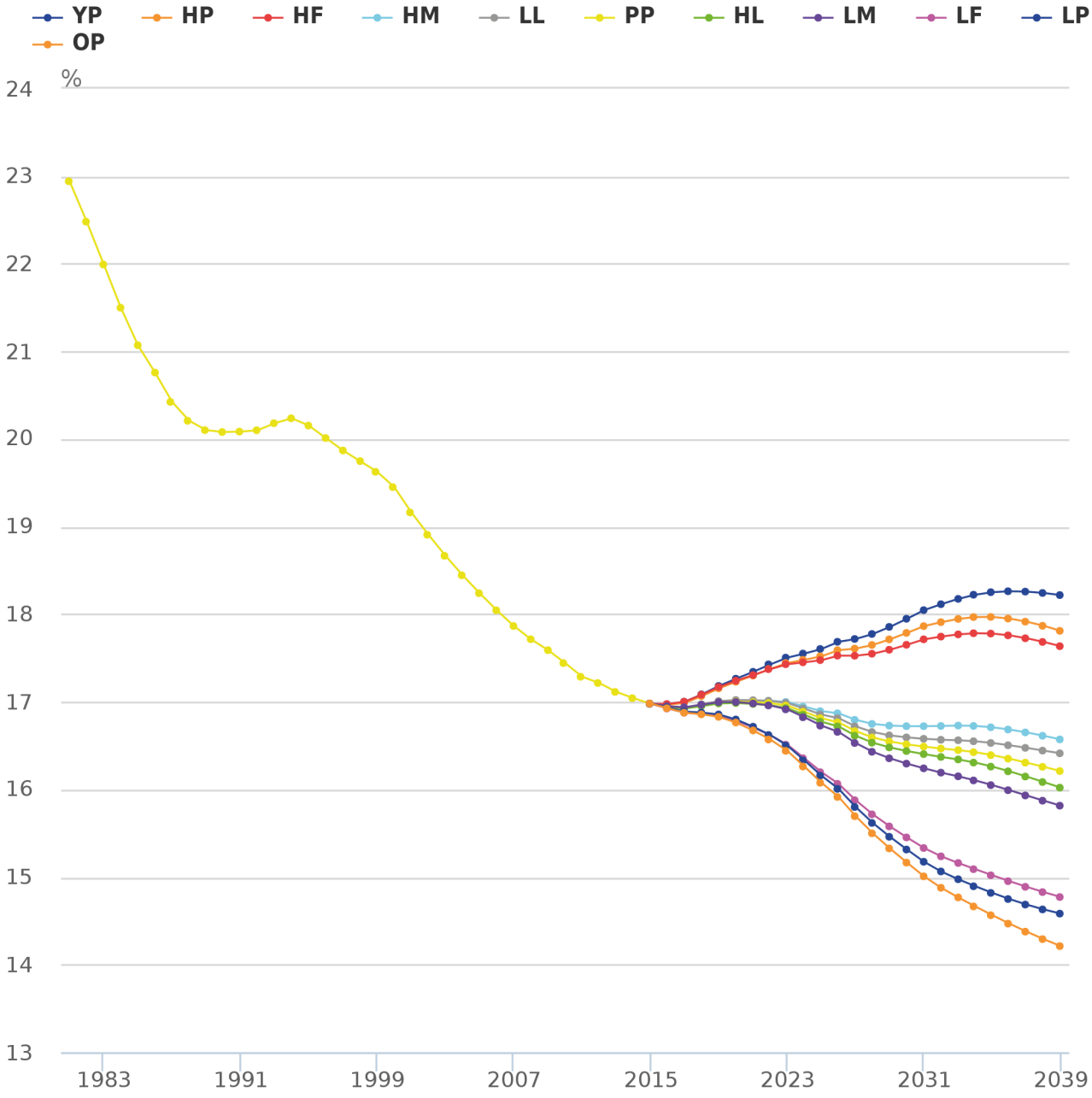


Source: Office for National Statistics

Notes:

1. YP = High fertility, low life expectancy, high migration HF = High fertility HP = High fertility, high life expectancy, high migration LL = Low life expectancy HM = High migration P = Principal projection LM = Low migration HL High life expectancy LP = Low fertility, low life expectancy, low migration LF = Low fertility OP = Low fertility, high life expectancy, low migration

Figure 1.3c: Estimated and projected percentage of the population aged under 16, Scotland, mid-1981 to mid-2039

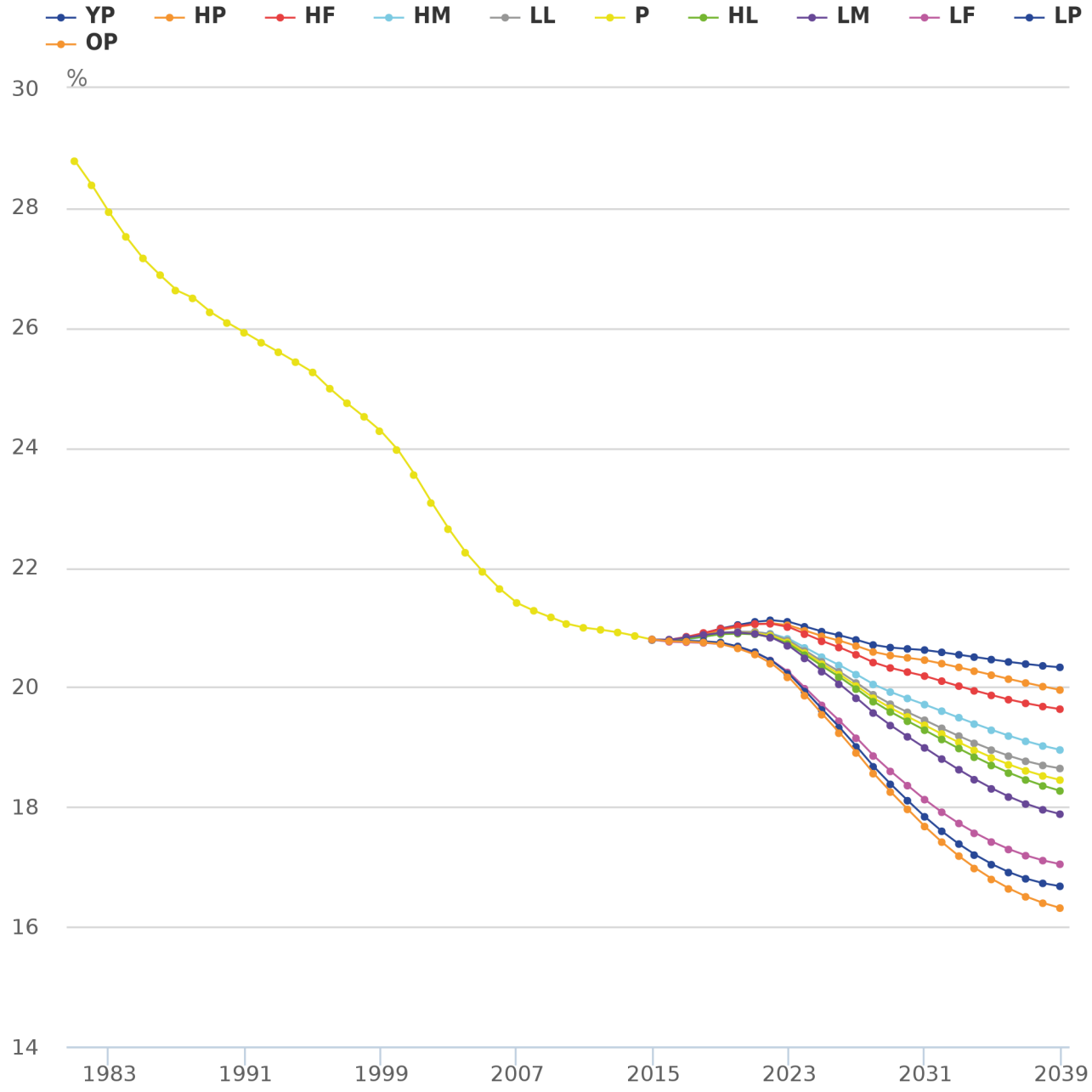


Source: Office for National Statistics

Notes:

1. YP = High fertility, low life expectancy, high migration HP = High fertility, high life expectancy, high migration HF = High fertility HM = High migration LL = Low life expectancy P = Principal projection HL High life expectancy LM = Low migration LF = Low fertility LP = Low fertility, low life expectancy, low migration OP = Low fertility, high life expectancy, low migration

Figure 1.3d: Estimated and projected percentage of the population aged under 16, Northern Ireland, mid-1981 to mid-2039



Source: Office for National Statistics

Notes:

1. YP = High fertility, low life expectancy, high migration HP = High fertility, high life expectancy, high migration HF = High fertility HM = High migration LL = Low life expectancy P = Principal projection HL High life expectancy LM = Low migration LF = Low fertility LP = Low fertility, low life expectancy, low migration OP = Low fertility, high life expectancy, low migration