Office for National Statistics

Compendium

Variants, 2012-based NPP Reference Volume

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1 . Introduction

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

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

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

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

2 . Assumptions for fertility variants

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

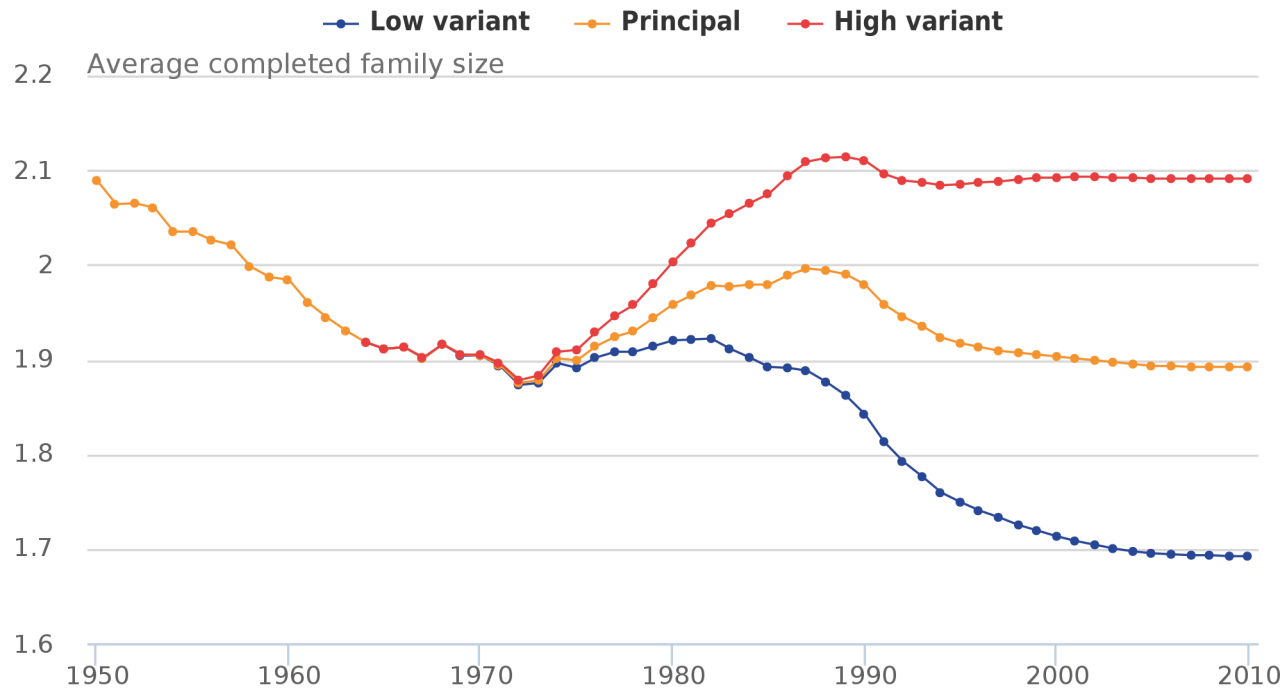
Cohorts of women who have already completed their childbearing have shown a wide range of completed family sizes. Therefore, assumptions for generations who have not yet entered the childbearing ages, or who have done so only recently, are necessarily highly speculative.

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

Figure 6-1 and Table 6-1 show the assumed completed family sizes for the principal, high fertility and low fertility variants for the UK. For the principal projection, the average completed family size is seen to rise for successive cohorts between 1975 and 1987, before falling to an ultimate level of 1.89 for women born from 2010 onwards. For the low fertility variant, the average completed family size is projected to start to fall from the 1983 cohort onwards to an ultimate level of 1.69. The high fertility variant is projected to become stable from the 1995 cohort onwards to an average completed family size of 2.09 children.

Over the past ten years, fertility rates have generally been rising faster among women in their thirties and forties than for women in their twenties, so mean age at childbirth has continued to rise. The average age at motherhood for the UK as a whole is projected to increase from 28.4 years for women born in 1965 to its long-term level of 30.2 years for those born from 2010 onwards.

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



Source: Office for National Statistics

Notes:

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

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

		Average number of children born to women at ages:					
	Average family size	Under 20	20–24	25–29	30–34	35–39	40 and over
Actual values							
1950	2.1	0.2	0.7	0.6	0.4	0.1	0.0
1955	2.0	0.2	0.6	0.7	0.4	0.2	0.0
1960	2.0	0.2	0.5	0.6	0.4	0.2	0.0
1965	1.9	0.1	0.5	0.6	0.5	0.2	0.1
High variant							
1970	1.9	0.2	0.4	0.5	0.5	0.3	0.1
1975	1.9	0.1	0.4	0.5	0.5	0.3	0.1
1980	2.0	0.2	0.3	0.5	0.6	0.3	0.1
1985	2.1	0.1	0.4	0.5	0.6	0.4	0.1
1990	2.1	0.1	0.4	0.6	0.6	0.4	0.1
1995	2.1	0.1	0.3	0.6	0.6	0.4	0.1
2000	2.1	0.1	0.4	0.6	0.6	0.4	0.1
2005	2.1	0.1	0.4	0.6	0.6	0.4	0.1
2010 and later	2.1	0.1	0.4	0.6	0.6	0.4	0.1
Principal projection							
1970	1.9	0.2	0.4	0.5	0.5	0.3	0.1
1975	1.9	0.1	0.4	0.5	0.5	0.3	0.1
1980	2.0	0.2	0.3	0.5	0.6	0.3	0.1
1985	2.0	0.1	0.4	0.5	0.6	0.3	0.1
1990	2.0	0.1	0.3	0.5	0.6	0.3	0.1
1995	1.9	0.1	0.3	0.5	0.6	0.3	0.1
2000	1.9	0.1	0.3	0.5	0.6	0.3	0.1
2005	1.9	0.1	0.3	0.5	0.6	0.3	0.1
2010 and later	1.9	0.1	0.3	0.5	0.6	0.3	0.1
Low variant							
1970	1.9	0.2	0.4	0.5	0.5	0.3	0.1
1975	1.9	0.1	0.4	0.5	0.5	0.3	0.1
1980	1.9	0.2	0.3	0.5	0.6	0.3	0.1
1985	1.9	0.1	0.4	0.5	0.5	0.3	0.1
1990	1.8	0.1	0.3	0.5	0.5	0.3	0.1
1995	1.7	0.1	0.3	0.4	0.5	0.3	0.1
2000	1.7	0.1	0.3	0.4	0.5	0.3	0.1
2005	1.7	0.1	0.3	0.4	0.5	0.3	0.1
2010 and later	1.7	0.1	0.3	0.4	0.5	0.3	0.1

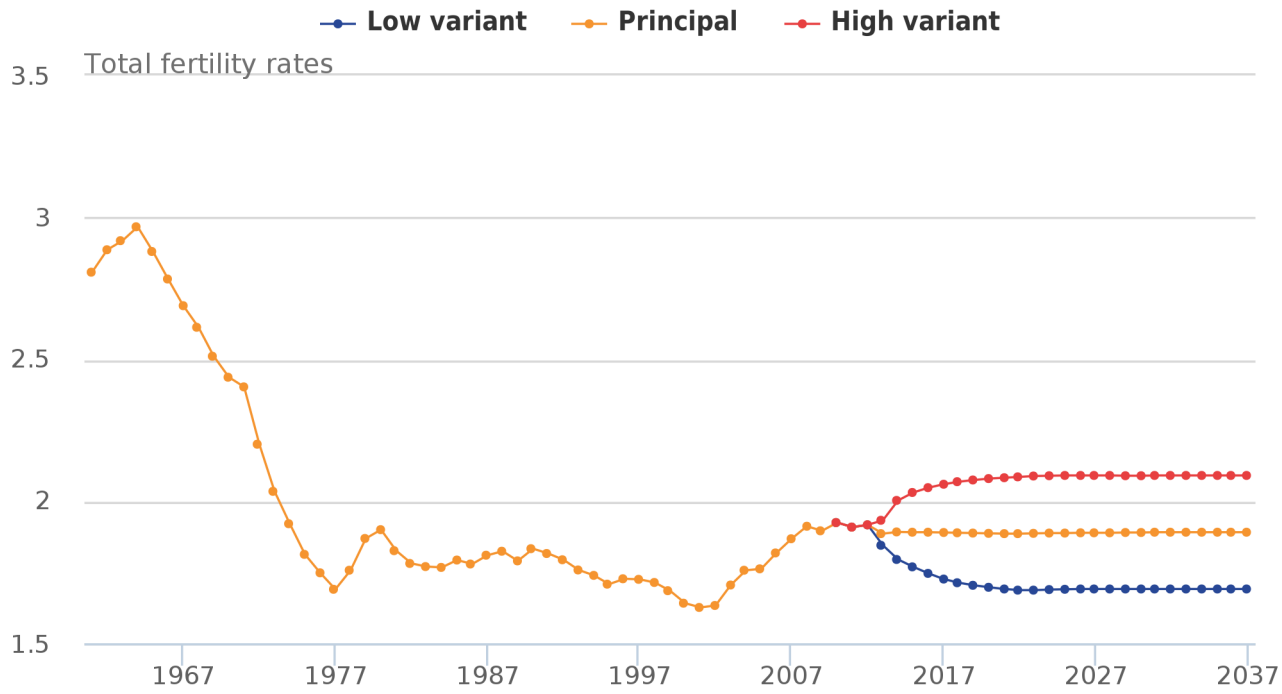
Note: Figures have not been rebased to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection.

Total fertility rates and numbers of births

The assumed total fertility rates and projected numbers of births resulting from these alternative assumptions of future fertility levels are shown in Figures 6-2 and 6-3. History shows that there can be quite sudden changes in period fertility. It is therefore important to demonstrate the effect of significant short-term changes, as well as the long-term effects that would result from sustained levels of fertility significantly above or below that assumed in the principal projection.

Figure 6-2 shows that the principal projection assumes the total fertility rate for the UK decreases slightly from mid-2012 to mid-2013 then stabilises at 1.89 from then on. Longer term, the high and low fertility variants assume total fertility rates of 0.2 children higher or lower than the principal assumptions, that is, 2.09 and 1.69 children per woman for the UK.

Figure 6-2: Actual and assumed total fertility rates, United Kingdom, 1961 to 2037



Source: Office for National Statistics

Notes:

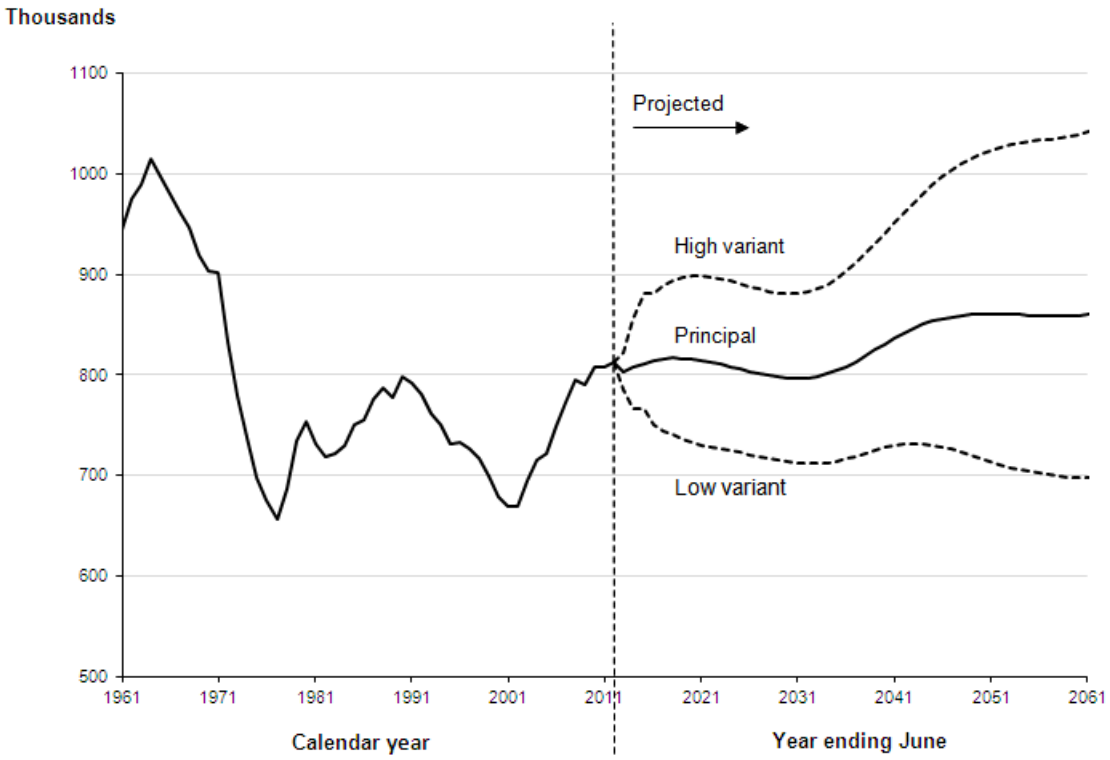
1. Figures have not been rebased to take account of the 2011 Census for Scotland. Revised population estimates for Scotland and the UK for 2002-2010 were not available at the time of projection

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

Figure 6-3 shows that under the high fertility variant, the number of births is projected to rise year on year from around 813,000 in the year to mid-2012 to around 899,000 in mid-2021, dropping slightly to 881,000 in mid-2030 before rising to a level of 1,045,000 by mid-2062. However, under the low fertility variant, the number of births is projected to fall to approximately 712,000 by mid-2032 before increasing slightly to 732,000 in mid-2043, before starting to steadily decline. Under the principal projection, the number of births is projected to fluctuate in the short term but from mid-2032 is projected to increase year on year (less sharply than for the high fertility variant), to 861,000 births in mid-2051. After this point, projected births are expected to start to level out.

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

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



Source: Office for National Statistics

Effect of fertility variants on population size

The differences between the projected population according to the high and low fertility variant projections and the principal projection are summarised in Table 6-2. Under the alternative fertility assumptions, the population would be 1.9 million higher or 1.9 million lower than the principal projection by mid-2037. In the high fertility variant, the projected population at mid-2037 would be 75.2 million compared with 73.3 million in the principal projection, while in the low fertility variant it would be 71.4 million.

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

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

Thousands

	All ages	0–4	5–9	10–14	15–19	20–24
Difference between high fertility variant and principal projection						
2017	230	230	-	-	-	-
2022	635	405	229	-	-	-
2032	1,477	419	424	405	229	-
2037	1,928	452	419	424	405	229
Difference between low fertility variant and principal projection						
2017	-208	-208	-	-	-	-
2022	-607	-399	-207	-	-	-
2032	-1,440	-417	-416	-399	-207	-
2037	-1,882	-444	-417	-416	-399	-207

Source: Office for National Statistics

Notes:

1. Figures may not sum due to rounding

3 . Assumptions for mortality variants

The mortality chapter discusses the current wide range of views about prospects for future longevity. To give some indication of these uncertainties, variant projections have been produced based on target improvement rates in mortality by mid-2037. The low life expectancy variant assumes slower improvements in mortality rates than in the principal projection and the high life expectancy variant assumes faster improvements. In addition a no mortality improvement variant projection has also been produced. This holds mortality rates at the same level as those used for 2012-2013.

Current annual improvements in mortality rates vary considerably by age and sex. In each of these variants it is assumed that, for most ages, the improvements will gradually converge to common 'target rates' of improvement at each age and by both sexes by 2037, and continue to improve at that constant rate thereafter. However, as with the principal projection, these variant mortality projections also assume that those born between 1925 and 1938 (cohorts which have consistently experienced relatively higher rates of mortality improvement over the last 25 years than those born either side) will continue to experience higher rates of mortality improvement than the rest of the population.

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

High life expectancy variant

Annual improvement at 2037 is 2.4%, thereafter annual improvement will remain at 2.4%. For those born between 1925 and 1938 rates of annual improvement in and after 2037 will rise to a peak of 3.7% a year for those born in 1931 and 1932 and then decline back to 2.4% a year of those born in 1939 or later.

Principal projection

Annual improvement at 2037 is 1.2%, thereafter annual improvement will remain at 1.2%. For those born between 1925 and 1938 rates of annual improvement in and after 2037 will rise to a peak of 2.5% a year for those born in 1931 and 1932 and then decline back to 1.2% a year for those born in 1939 and later.

Low life expectancy variant

Annual improvement of 0% at 2037, thereafter mortality rates will remain constant. For those born between 1925 and 1938 rates of annual improvement in and after 2037 will rise to a peak of 1.3% a year for those born in 1931 and 1932 and then decline back to 0% a year for those born in 1939 or later.

No mortality improvement

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

Because of fluctuations in annual mortality rates, there is always some uncertainty about establishing the 'real' current rate of mortality improvement. Further, epidemics (there have been no major ones in recent years), or hard winters[1,2,3], can have a considerable effect on the number of deaths, although this may be partially offset by fewer deaths than normal in the following year.

Expectations of life at birth and numbers of deaths

The resulting expectations of life at birth in the variant mortality projections are summarised in Table 6-3 and shown in Figure 6-4. These are period expectations of life, calculated on the basis of the mortality rates for a given calendar year. The projected number of deaths resulting from these different expectations of life at birth are shown in Figure 6-5.

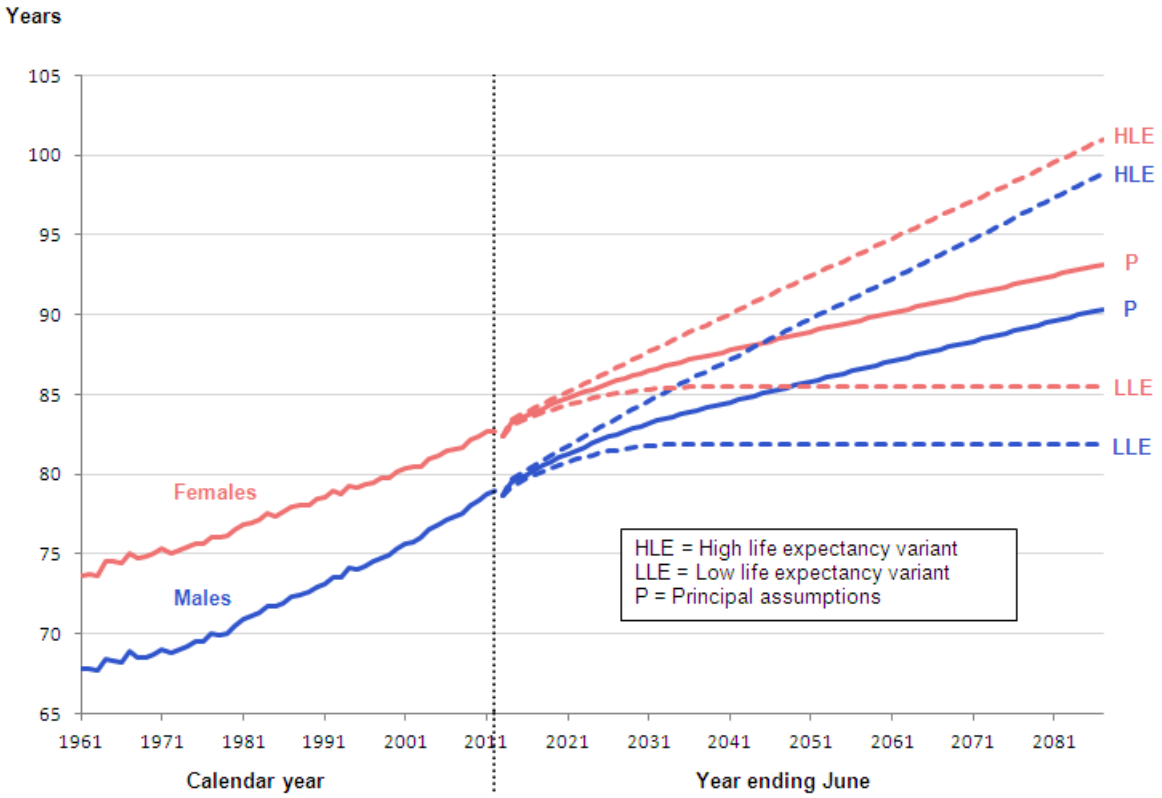
Table 6-3: Period expectation of life at birth according to mortality rates assumed for selected years. Variant mortality projections, United Kingdom, years to mid-2037

Years

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

Source: Office for National Statistics

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

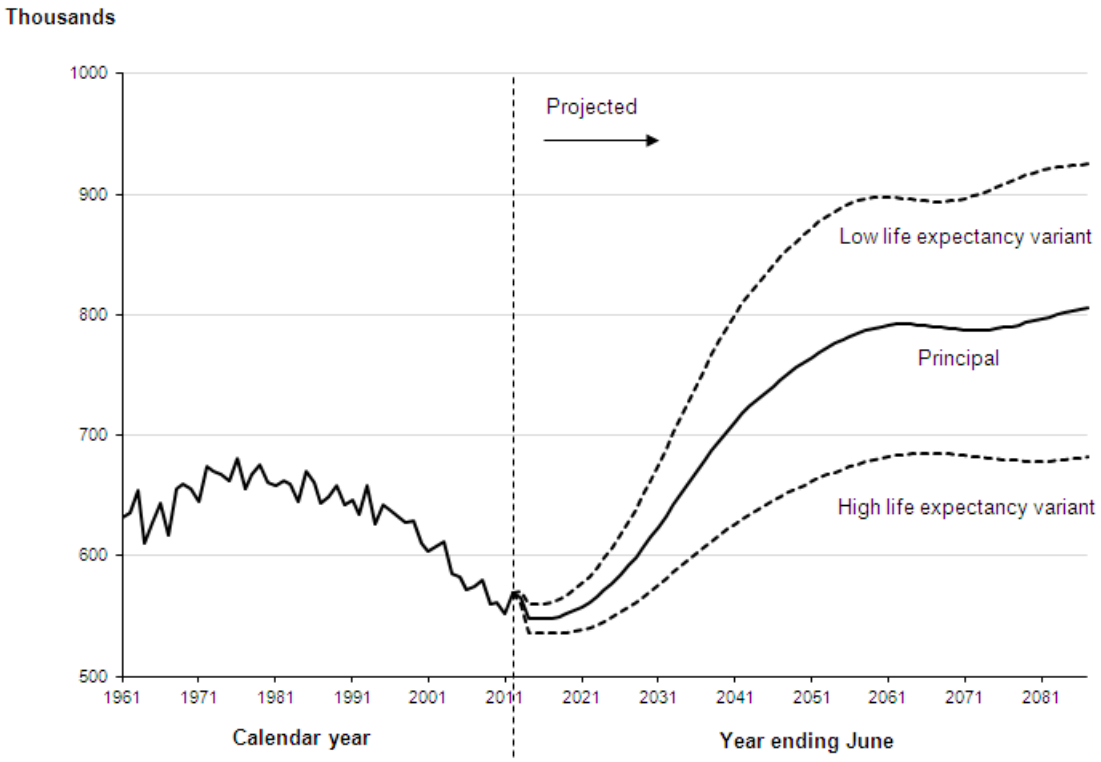


Source: Office for National Statistics

Notes:

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

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



Source: Office for National Statistics

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

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

Effect of mortality variants on total population size

The differences between the projected populations according to the high and low life expectancy variant projections and the principal projections are summarised in Table 6-4.

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

Table 6-4: Population differences between mortality variant projections and principal projection by age, United Kingdom, mid-2017 to mid-2037

Thousands

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

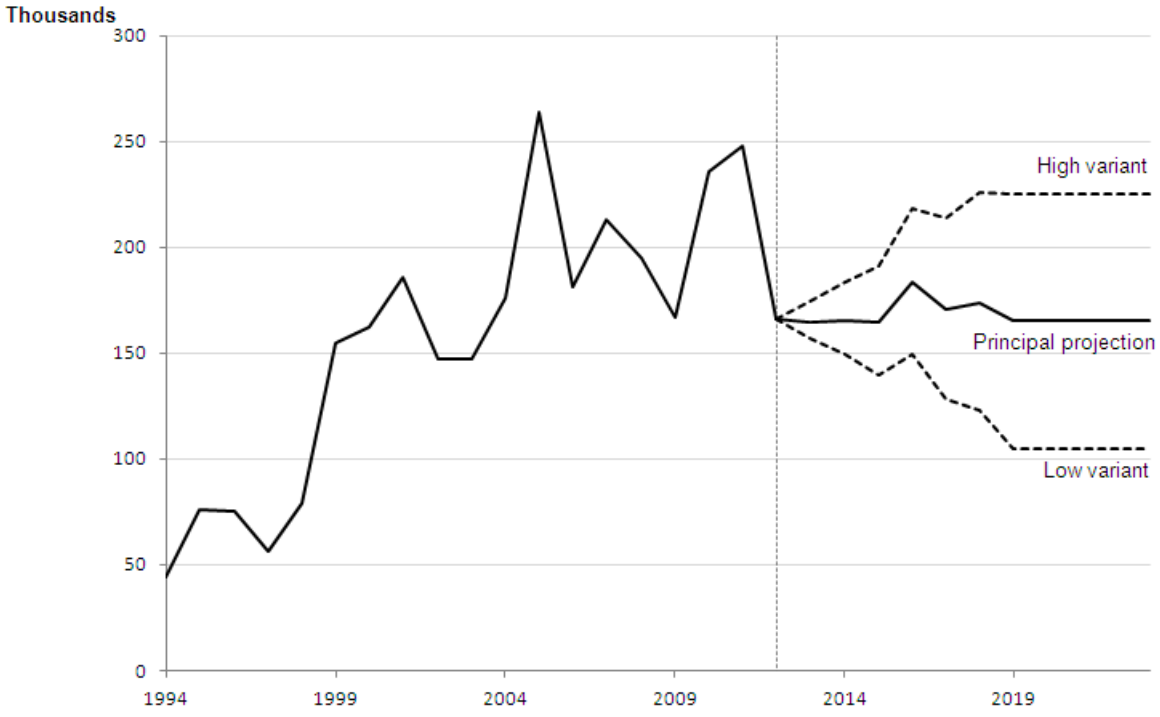
4 . Assumptions for migration variants

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

In addition, two special case scenario projections are available. The zero net migration projection uses the principal assumptions of fertility and mortality and assumes that there will be zero net migration (for every age for each sex). The long-term balanced net migration projection (available at UK level only) assumes that net migration will decline to zero in the long-term, with in-migration and out-migration total flows being equal from the year ending mid-2034 onwards.

Special assumptions have been applied for the first few years of the projections (mid-2013 to mid-2018). The short-term run-in has been formulated to represent a smooth transition from the last year of actual data to the long-term assumptions. A short-term armed forces flow has also been included between mid-2014 and mid-2018 to account for the planned return of home armed forces personnel and their dependants from Germany. The variant assumptions are shown in Figure 6-6.

Figure 6-6: Actual and assumed total net migration, United Kingdom, year ending mid-1994 to year ending mid-2023



Source: Office for National Statistics

Notes:

1. All data are displayed on a mid year basis

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

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

Effect of migration variants on total population size

The differences between the population according to the high and low migration variant projections and the principal projection are summarised in Table 6-5. Unlike the fertility and mortality variants, the migration variants are broadly symmetrical with respect to the principal projection.

With annual net migration assumed to be 60,000 a year more (or fewer) than the principal projection after the first year, this would lead to just under 1.5 million more (or fewer) migrants over the next 25 years. Because migration is concentrated at young adult ages, there is also a significant second generation effect with the different number of migrants changing the number of women of childbearing age and hence the future number of births. The effect on the number of deaths over this period is considerably smaller as migrants are predominantly young.

Table 6-5: Population differences between variant migration projections and principal projection by age, United Kingdom, mid-2017 to mid-2037

Thousands

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

Source: Office for National Statistics

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

An interesting feature of these migration variants is that, although it is assumed that migration will continue to be concentrated at working ages, there is comparatively little effect on long-term dependency ratios. In the principal projection, the 'pensionable age dependency ratio' [4] (defined as the number of persons of pensionable age per 1,000 persons of working age[5]), would be 365 per 1,000 at mid-2037. But this ratio is not greatly different under the alternative migration assumptions; in the high and low migration variants, the ratios at mid-2037 are 356 and 374 per 1,000 persons of working age respectively.

Previous work has shown that any realistic assumption of future migration could only have a very limited effect on population ageing[6]. In contrast, the raising of State Pension age has a much greater effect. If State Pension age remained at 65 for men and 60 for women, the pensionable age dependency ratio at mid-2037 would be 487 per 1,000 persons of working age rather than 365.

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

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

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

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

5 . Combination variants

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

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

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

	Total population (000s)		% of population aged under 16		% of population aged 65 & over		Dependants per 1,000 population of working age	
	(2012 = 63,705)		(2012 = 18.8)		(2012 = 17.0)		(2012 = 615)	
Projection	2037	2062	2037	2062	2037	2062	2037	2062
Principal projection	73,272	79,904	17.7	17.4	24.3	26.4	659	684
SINGLE COMPONENT VARIANTS								
High fertility	75,200	85,554	19.1	19.4	23.7	24.6	682	696
Low fertility	71,390	74,645	16.3	15.4	24.9	28.2	636	673
High life expectancy	74,068	83,162	17.5	16.7	25.0	29.0	673	742
Low life expectancy	72,443	76,529	17.9	18.1	23.5	23.6	644	626
High migration	74,952	83,882	17.8	17.4	23.8	25.8	650	669
Low migration	71,606	75,942	17.6	17.3	24.8	27.0	668	700
COMBINATION VARIANTS								
High population	77,717	93,012	19.0	18.7	23.9	26.6	687	736
Low population	68,935	67,540	16.4	16.0	24.7	25.9	629	626
Young age structure	76,083	86,239	19.4	20.1	22.5	21.6	659	631
Old age structure	70,552	74,037	16.0	14.7	26.1	31.7	660	757
SPECIAL CASE SCENARIOS								
Replacement fertility	75,300	85,550	19.0	19.3	23.6	24.6	678	693
Constant fertility	73,157	79,566	17.6	17.3	24.3	26.5	658	683
No mortality improvement	70,462	73,750	18.4	18.7	21.7	21.2	608	580
Zero net migration (natural change only)	67,477	66,248	16.8	16.4	26.3	30.1	684	763
No change	70,346	73,415	18.3	18.6	21.8	21.3	606	578
Long-term balanced net migration (UK only)	71,080	71,222	17.6	16.8	25.0	29.0	672	734

Source: Office for National Statistics

Notes:

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

Special case scenarios

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

- Replacement fertility
- Constant fertility
- No mortality improvement
- Zero net migration (natural change only)
- No change
- Long-term balanced net migration (UK only)

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

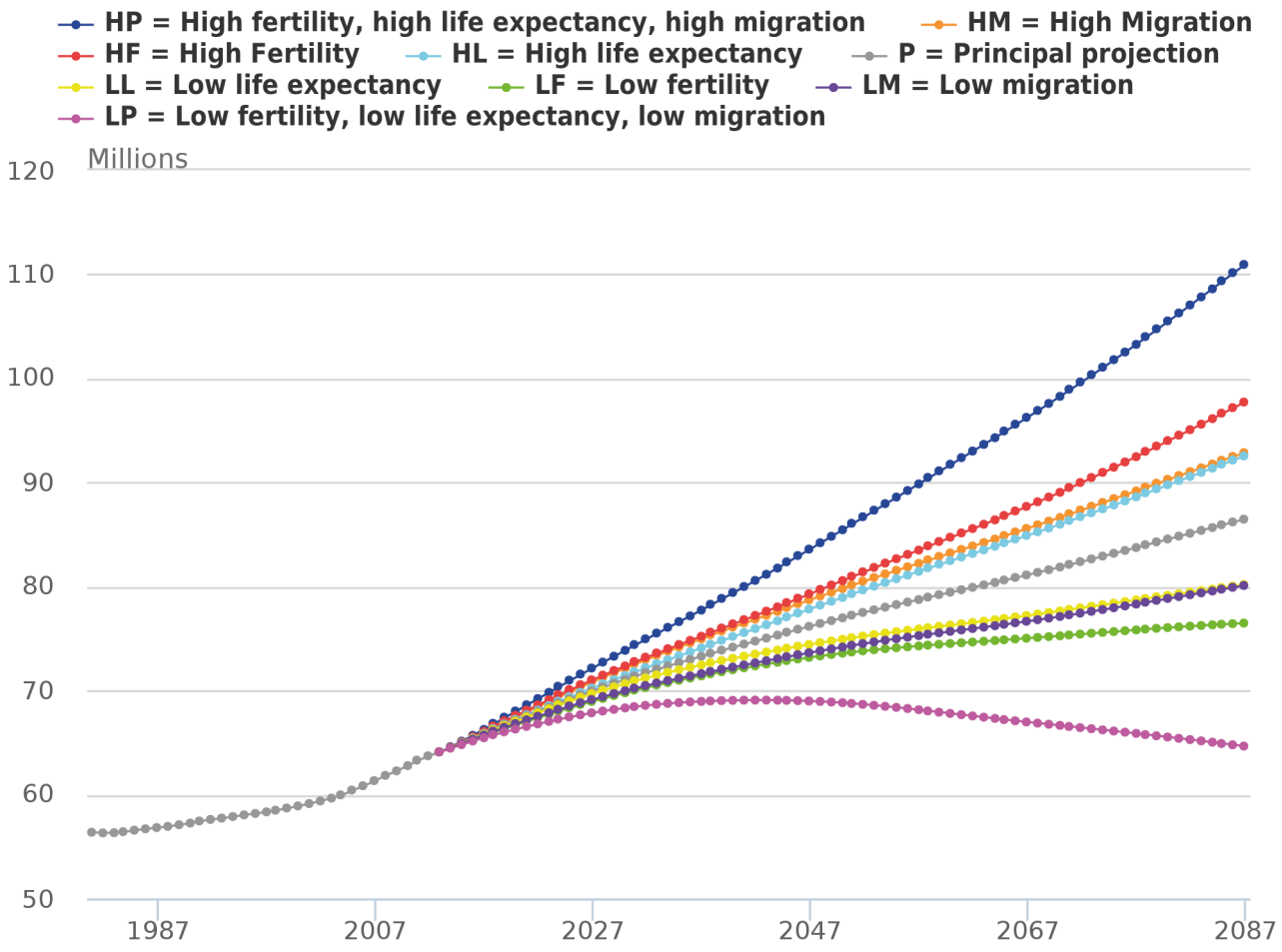
6 . Comparison of variant projections

Total population size

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

In the principal projection, the high population combination variant and all the single combination variants, the total population of the UK is projected to continue growing throughout the projection period. However, the low population variant shows that continuing population growth is not inevitable. Under this combination of assumptions, the UK population would peak in size by the mid 2040s.

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



Source: Office for National Statistics

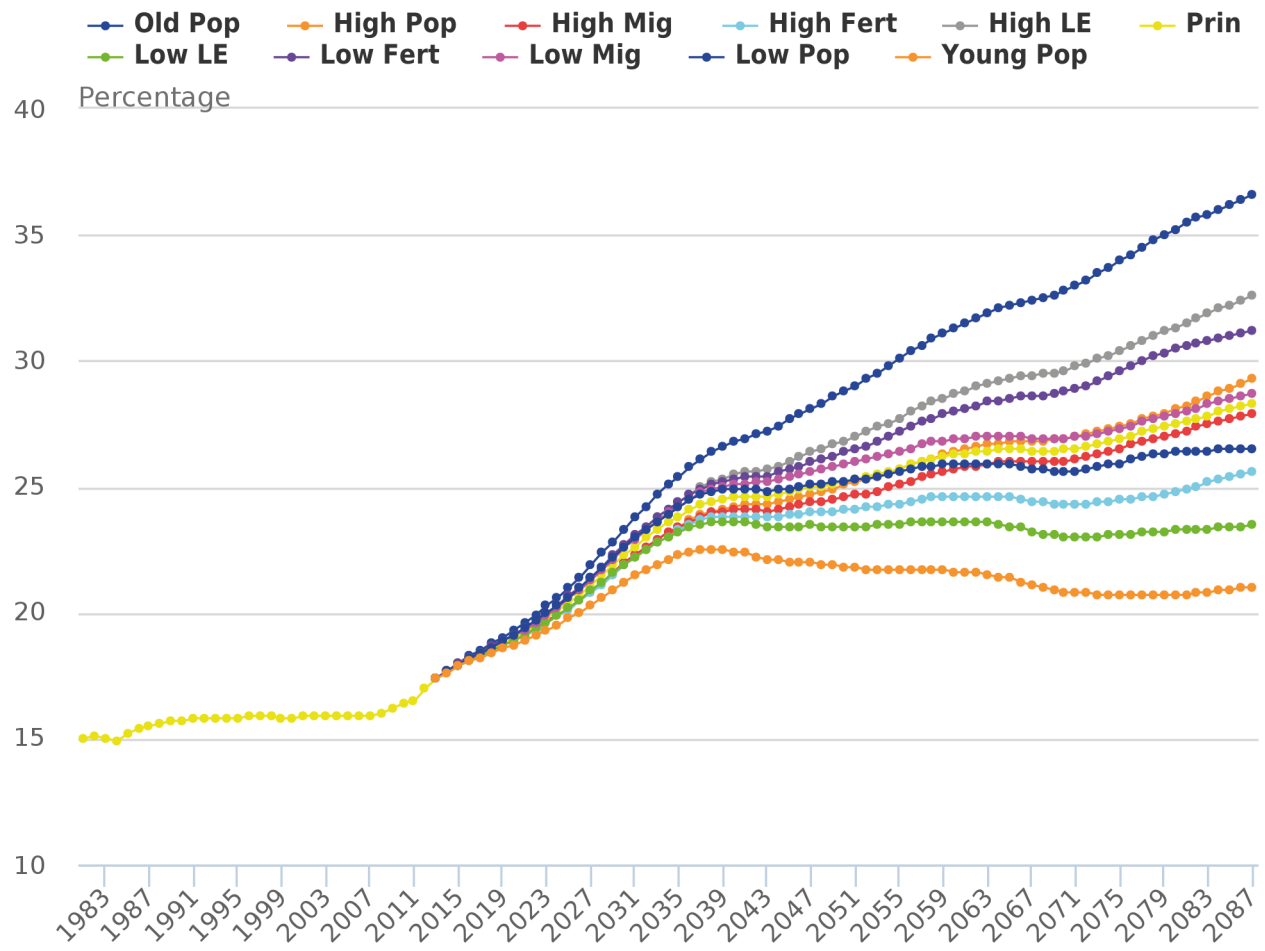
The equivalent figures for the constituent countries of the UK can be found in the results report published on 6th November 2013, under appendices A-D.

Population aged 65 and over

Figure 6-8 shows the projected proportion of the population aged 65 and over under various alternative assumptions. In this case, as well as the single component variants, the chart also shows the results of the 'old age structure' and 'young age structure' combination variants.

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

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



Source: Office for National Statistics

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

7 . Probabilistic interpretation of population projections

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

Relative uncertainties of fertility, mortality and migration

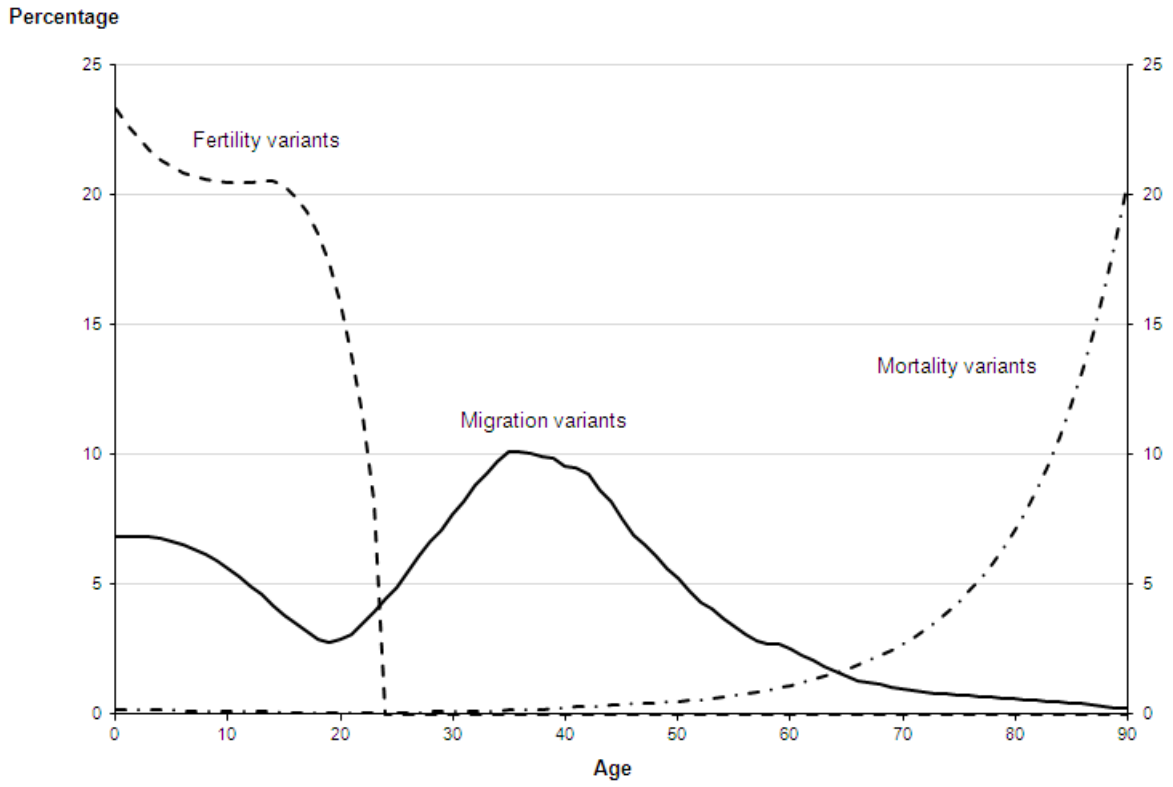
Because precise probability statements cannot be ascribed to the variant assumptions, strictly the indications of uncertainty given for fertility, mortality and migration are not directly comparable. Nevertheless, it is possible to make some general comments about the relative importance of fluctuations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

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

Another way of indicating uncertainty is to consider the accuracy of previous sets of projections. A detailed study of the accuracy of past UK national population projections has been published[8]. The analysis was based on the extensive database of past national projections. This UK study was followed by an analysis of how UK projections compared with those for other European countries[9]. These articles concluded that in the UK, as in most other countries, fertility had tended to be over projected while life expectancy and net inward migration had generally been under projected. Compared with other countries, fertility errors were somewhat larger in UK projections, but mortality errors were smaller. Migration errors in UK projections were around the European average.

Figure 6-9 gives an indication of the relative importance of the assumptions regarding fertility, mortality and migration for the population at each age in mid-2037. It shows (for each component) the difference between the populations in the high and low variant projections at each age, expressed as a percentage of the population in the principal projection. The greatest cause of uncertainty at younger ages is fertility. Migration is the most important variable in determining the size of the working age population in 25 years time, while mortality only begins to become the dominant factor after age 65.

Figure 6-9: Population differences between high and low variants as a percentage of the population in the principal projection by age, United Kingdom, mid-2037



Source: Office for National Statistics

8. References

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

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

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

4. 2012-based projected pensionable age dependency ratios are available in the 'components of change and summary indicators' reference tables available to download via the Interactive Download Table Tool: http://www.ons.gov.uk/ons/interactive/2012-npp/index.html

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

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7. ONS (Q3 2009). Progress report on developing stochastic population forecasts for the United Kingdom. Available at: http://www.ons.gov.uk/ons/guide-method/method-quality/imps/updates-and-reports/historical/2009/progress-report-on-developing-stochastic-population-forecasts-for-the-uk---august-2009.pdf

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9. Keilman N (2007). UK national population projections in perspective: How successful compared to those in other European countries? Population Trends 129. pp 20-30: http://www.ons.gov.uk/ons/rel/population-trends-rd/population-trends/no--129--autumn-2007/index.html

9. Background notes

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

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

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