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Book

Norway's 2018 population projections : main results, methods and assumptions

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and Marianne Tønnessen*

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Preface

This report presents the main results from the 2018 population projections and provides an overview of the underlying assumptions. It also describes how Statistics Norway produces the Norwegian population projections, using the BEFINN and BEFREG models. The population projections are usually published biennially. More information about the population projections is available at https://www.ssb.no/en/befolkning/statistikker/folkfram.

Statistics Norway, June 18, 2018

Brita Bye

Abstract

Lower population growth, pronounced aging in rural areas and a growing number of immigrants characterize the main results from the 2018 population projections. According to the main alternative, the population of Norway will increase throughout the century, and surpass 6 million inhabitants around the year 2040. The population growth will be most pronounced in central areas, while many rural municipalities will experience a population decline. The growth in the number of elderly, both in absolute and relative terms, will be substantial: in about 15 years there will be more elderly than children and young people in Norway for the first time ever.

In our main alternative (low and high in parentheses), we assume that the total fertility rate will continue to decline for a few more years, reaching 1.6 in 2020 before stabilizing at around 1.8 in 2060. Life expectancy will continue to increase from today's 81 years for men and 84 years for women, reaching about 88 (86-90) and 90 (88-92) years respectively in 2060. The increase is largely a result of an increase in remaining life expectancy in older age groups. Internal migration is expected to follow the trends we have observed over the last decade. Consequently, centralization is expected to continue, especially among young adults. Immigration will continue, albeit at a slower pace. In 2017, the number of immigrations to Norway was 56 400, and this is expected to fall to 49 000 (36 400-91 200) by 2060. The projected number of emigrations partly depends on the number of immigrations, and net migration is expected to decline slightly in the main alternative, from the current 21 000 to around 17 000 in 2060.

This report also documents how Statistics Norway produces the population projections, using two models: BEFINN and BEFREG. In BEFINN, the population is projected by age and sex at the national level up to and including the year 2100. Immigrants from three country groups, Norwegian-born children with immigrant parents and the rest of the population are projected as separate groups. In BEFREG, the population is projected by age and sex in 108 regions up to and including the year 2040. The population is thereafter summed up to counties and distributed to municipalities.

We use the cohort-component method, with two types of input:

- Updated figures for the population by sex and one-year age groups
- Assumptions about future development of the demographic components fertility, life expectancy, internal migration, immigration and emigration

The results of a population projection largely depend on the assumptions used about the components. We thus produce and publish different alternatives, for various future developments in fertility, life expectancy, internal migration and immigration:

- M: Medium or main alternative
- H: High alternative
- L: Low alternative
- K: Constant alternative
- 0: Zero alternative

Altogether, Statistics Norway projects the population in 15 combinations of these M, L, H, K and 0 alternatives. Each alternative is described using four letters in the following order: fertility, life expectancy, internal migration and immigration. The term 'main alternative' is used to refer to the MMMM alternative, which indicates that the medium level has been used for all components.

Sammendrag

Lavere befolkningsvekst, sterk aldring i distriktene og flere innvandrere. Det er noen av resultatene fra befolkningsframskrivingene 2018. I hovedalternativet øker folketallet i Norge gjennom hele dette århundret, og vi passerer 6 millioner før 2040. Befolkningsveksten kommer først og fremst i sentrale strøk, mens mange distriktskommuner får nedgang i folketallet. Det er særlig de eldre det blir flere av: Om femten år blir det for første gang flere eldre enn barn og unge i Norge dersom hovedalternativet slår til.

I våre hovedforutsetninger (lav- og høyalternativer i parentes) antar vi at fruktbarheten vil fortsette å synke noe de nærmeste årene og nå 1,6 i 2020, før den stiger igjen og stabiliserer seg på rundt 1,8 (1,6-1,9) i 2060. Levealderen forutsettes også å stige, fra dagens 81 år for menn og 84 år for kvinner, til henholdsvis 88 (86-90) og 90 (88-92) år i 2060. Økningen er primært forårsaket av økt levetid i de eldste aldersgruppene. Flyttinger innenlands forutsettes å fortsette etter det samme mønsteret som vi har sett det siste tiåret. Dermed framskriver vi en fortsatt sentralisering, særlig blant unge voksne. Innvandringen forutsettes å gå noe ned: I 2017 var det 56 400 innvandringer til Norge, mens vi forventer 49 000 (36 400-91 200) i 2060. Det framskrevne antallet utvandringer avhenger dels av antallet innvandringer, og den årlige nettoinnvandringen er forutsatt å synke svakt i hovedalternativet, fra dagens 21 000 til rundt 17 000 i 2060.

Rapporten dokumenterer også hvordan befolkningsframskrivingene utarbeides, ved hjelp av modellene BEFINN og BEFREG. I BEFINN framskrives folketallet etter alder og kjønn på nasjonalt nivå til og med år 2100. Innvandrere fra tre landgrupper, norskfødte med to innvandrerforeldre og den øvrige befolkningen framskrives som egne grupper. I BEFREG framskrives folketallet etter alder og kjønn i 108 regioner til og med år 2040. Folketallet summeres til fylker og fordeles deretter på kommuner.

Vi bruker kohort-komponentmetoden med to typer input:

- Oppdaterte tall for befolkningen etter kjønn og ettårig alder
- Forutsetninger om framtidig utvikling i de demografiske komponentene fruktbarhet, levealder, innenlandske flyttinger og inn- og utvandring.

Resultatene av en befolkningsframskriving avhenger i stor grad av hvilke forutsetninger som gjøres. Forutsetningene om framtidig fruktbarhet, levealder, innenlandske flyttinger og innvandring lages derfor i ulike alternativer:

- M: Mellom- eller hovedalternativ
- H: Høyalternativ
- L: Lavalternativ
- K: Konstantalternativ
- 0: Nullalternativ

Til sammen framskriver vanligvis Statistisk sentralbyrå befolkningen i 15 kombinasjoner av disse M-, L-, H-, K- og 0-alternativene. Et beregningsalternativ beskrives ved fire bokstaver i denne rekkefølgen: fruktbarhet, levealder, innenlandsk flytting og innvandring. Betegnelsen 'hovedalternativ' brukes om MMMM-alternativet, som angir at mellomnivået er brukt for alle komponentene.

Contents

1. Introduction

1.1. What are population projections?

Every two years, Statistics Norway projects the Norwegian population at national and regional levels. Two models are used for these projections:

- BEFINN – projects the population by age and sex at the national level up to and including the year 2100. Immigrants from three country groups, Norwegian-born children with immigrant parents and the rest of the population are projected as separate groups. Immigrants are also projected by length of stay based on when they first immigrated to Norway.

- BEFREG – projects the population by age and sex in 108 projection regions up to and including the year 2040. The population is then summed up to counties (N=18) and distributed across municipalities (N=422).

The two models give slightly different figures for the population at a national level, and the results from BEFREG are thus tallied to correspond with those resulting from BEFINN. Adjustments are made for each projected year to ensure that the sum of the total population over all regions is the same for BEFREG as for BEFINN, for all ages and both sexes, in all the different alternatives. However, as it is only the total population figures that are adjusted, minor differences exist in the results from the two models in for instance the number of births, deaths, immigrations and emigrations.

Text box 1.1. Population projection or population forecast?

A population projection is a calculation of the size and composition of a future population, usually by sex and age, but sometimes also by place of residence or other characteristics such as immigration category and country background. Projections are made by applying assumed probabilities or rates for future fertility, mortality, internal migration, immigration and emigration to the population by age and sex, along with other relevant characteristics used in the specific projection. How realistic an assumption is can vary. The term 'projection' is used for any estimate of the future population, including less likely ones.

A population forecast, or a prognosis, is a calculation of a future population based on the assumptions that are considered most likely. Statistics Norway publishes several projections, but the MMMM alternative which assumes the medium level for each component is our main alternative. The main alternative is the one we assume to be most plausible, and as such it may resemble a population forecast, although it is not a formal forecast. Other terms include 'plan', which denotes a desired development, and 'scenario', which is used to refer to a description of a possible future development or an action plan based on specific assumptions (de Beer 2011).

1.2. The process

To project the population, we must make assumptions about future fertility, mortality, internal migration, immigration and emigration. In addition, we need figures for the baseline population taken from Statistics Norway's population statistics. The projection work is thus organized around five areas:

- Fertility
- Mortality
- Internal migration
- Immigration and emigration
- Aggregation

Old time series need to be updated with new cohorts in each of these fields, assumptions need to be calculated in the form of age and sex-specific rates/probabilities, and input data for the models must be quality assured. The aggregation work also includes updating the baseline population and running the

BEFINN and BEFREG models to generate the actual projections. For a more technical description of the models and files, as well as the different steps in the work involved, see Leknes et al. (2016).

1.3. Data

The population projections use aggregated individual level data on population size, births, deaths and internal and international migration from Statistics Norway's population statistics (BESTAT), which is retrieved from the Directorate of Taxes for the Norwegian Population Register. No Norwegian population data is collected specifically for the purpose of developing the population projections.

However, additional data on, for instance, the development in fertility, life expectancy and migration in other countries, causes of death, economic development in various parts of the world, as well as international demographic projections are collected and used to help shape the assumptions. This is described in more detail in chapters 5–8.

The population statistics, which the projections are based on, only include persons who are registered as resident in the National Population Register. This includes persons who reside permanently in Norway as well as persons who plan to reside in Norway for six months or longer and hold a valid residence permit. Since 1956, Nordic citizens have gained residency automatically. The same now applies to all citizens from the EEA and/or EFTA countries.

However, many individuals work in Norway without being included in the statistics, particularly those on short term contracts. There are also those who reside in Norway without a permit. Furthermore, the population statistics include individuals who have moved abroad but have not registered this move. For more details on criteria for residency and emigration, please refer to the English publication by Zhang (2008) and the English abstract in the report on this topic by Pettersen (2013). Consequently, it is the 'de jure population' and not the 'de facto population' that is projected.

1.4. Publications

Statistics Norway's population projections are published every two years. The main results are presented in a press release at www.ssb.no/en/befolkning/statistikker/folkfram. In Statistics Norway's StatBank (www.ssb.no/en/statbank/list/Folkfram), large amounts of data are published about projected population figures and changes in the population at different geographical levels based on various demographic characteristics (see Table 1.1). Assumptions about fertility, mortality, internal migration, immigration and emigration, as well as the results of the projections, are also presented in reports and articles.

Table 1.1 Tables from the population projections available online in Statistics Norway's StatBank[1]

Table title	Content	Geographic level	Model
Population projections 1 January, by sex, age, immigration category and country background, in 15 alternatives	Total population	National	BEFINN
Population projections 1 January, by sex and age, in 9 variants	Total population	National, county, municipality and city district (Oslo)	BEFREG
Projected number of immigrants 1 January, by country background and duration of stay, in 5 alternatives	Total population	National	BEFINNN
Projected population changes, by immigration category and country background, in 9 alternatives	Births, deaths, immigration, emigration and net migration	National	BEFINN
Projected fertility rate, by country background, in 3 alternatives	Births, deaths, immigration, emigration and net migration	National	BEFINN
Projected life expectancy, for men, women and both sexes combined, in 3 alternatives	Life expectancy and remaining life expectancy	National	Lee-Carter/ ARIMA
Projected numbers of births and deaths, in 9 alternatives	Births and deaths	National and county	BEFREG
Projected probability of death (per 1 000), by sex and age, in 3 alternatives	Probability of death	National	Lee-Carter/ ARIMA

[1] The population counts are per 1 January, whereas the component information pertains to the entire year in question. The population on 1 January one year is identical to the population on 31 December the previous year, if we disregard changes in the classifications of the municipalities and/or counties, and account for the fact that all individuals have become one year older since age is defined at the end of the year.
Source: Statistics Norway

1.5. Users

The main users of Statistics Norway's population projections are public and private planning bodies at the municipal, county and central government levels, along with journalists, researchers, politicians and the general public. Every year, there are more than 30 000 downloads of the population projections from StatBank Norway at Statistics Norway's official website.

The projections are also used internally at Statistics Norway, for example as input in macroeconomic models such as KVARTS, MODAG, DEMEC and SNOW and in the micro-simulation model MOSART.

Statistics Norway regularly reports their assumptions and projection results to international agencies, such as Eurostat, the UN, the Nordic Council of Ministers and Nordstat, among others.

1.6. Regulations

The production process of the projections is founded on the Norwegian Statistics Act of 1989, and the population projections are published in accordance with international standards. The Norwegian figures are, however, more detailed (age, regional level, year, immigration category, country group and duration of stay) than what is commonly published by most other countries.

The population projections use aggregated individual level data on population size, births, deaths and migration from Statistics Norway's population statistics (BESTAT), which is retrieved from the Directorate of Taxes for the National Population Register. The results from the projections are stored as separate files in Statistics Norway's statistics bank, StatBank. Aggregated data may be downloaded electronically from Statistics Norway's website. No individual level data is produced.

1.7. History

Previous population projections

Statistics Norway has produced population projections regularly since the 1950s, and a number of models have been developed. The BEFREG model was developed during the 1970s and 1980s and is documented in Norwegian by Rideng and colleagues (1985). The BEFREG model (see chapter 4 for details) is currently in use, although it has undergone quite a few adjustments over the years. Among other changes, 'matrices of moves' have replaced 'pools of moves' in estimations of internal migration. BEFREG produces projections for counties and municipalities, and since 2012, the populations of the city districts of Oslo have also been projected as separate entities.

A separate projection model of immigrants and their Norwegian-born children by country group was used in 2005, 2008, 2009 and 2010. The model did not, however, include the general population. The regional projections from BEFREG, on the other hand, did not estimate separate numbers for immigrants. Consequently, the results from these projections were not comparable.

Since 2011, the entire population by immigration category, country group and duration of stay in Norway has been projected using the BEFINN model. This model is currently in use (see chapter 4 for details). The population figures resulting from the regional projections from BEFREG are adjusted to tally with the national projections from BEFINN in order to ensure consistency.

During the period 2008–2012, population projections were published annually, but they have been published every two years since then.

Projections with specific aims

- Some specific projections have been published over the years:
- Regional distribution of immigrants and their Norwegian-born children (REGINN). Used only once (2012)
- Projections by marital status. Used only once (1986)
- Household projections. Used only once (1995)

Documentation of previous projections

The projections were initially published in the Statistical Yearbook of Norway series and portrayed the size of the projected population at a national level. Since 1969, various regional and national projections have been produced and published, see www.ssb.no/en/befolkning/statistikker/folkfram/arkiv?fane=arkiv#content. In the period 1969–2002, thirteen sets of regional and national projections were published in the Official Statistics series.

Since 1996, the projection results have been published in StatBank Norway (www.ssb.no/en/statbank/list/folkfram), where they can be accessed and downloaded by all users. They have also been documented in various press releases and in Norwegian articles in Statistics Norway's internal journal *Economic Survey*. In 2016, an online article describing the main results was published in English for the first time, see www.ssb.no/en/folkfram (www.ssb.no/en/befolkning/artikler-og-publikasjoner/population-projections-2016-2100-main-results.) A documentation report in English was first published in 2014 (Aase et al. 2014).

Most of the previous documentation of population projections is only available in Norwegian, and interested readers are referred to, for instance, Rideng et al. (1985), Hetland (1998), and Texmon and Brunborg (2013). For a description of previous assumptions and results, see, for example, Tønnessen et al. (2016a), Tønnessen et al. (2014), Brunborg et al. (2012), Brunborg and Texmon (2011) and Brunborg and Texmon (2010).

Comparability over time

Generally speaking, the regular population projections may be compared over time from 1996 onwards, although changes to the models and the data have occurred.

For the most part, the projections are also comparable at the regional level, apart from a limited number of occurrences where municipalities have been merged or divided. For an overview of the current grouping of regions, see Appendix A.

As an example, the country groups are not entirely comparable over time, since the definition and the number of groups have varied (from two to five). Over the past decade, three country groups have been used. However, the countries comprising the groups have varied somewhat. Croatia was, for instance, moved from Country Group 3 to Country Group 2 when the country joined the EU in 2013. For an overview of the current grouping of countries, see Appendix B.

Comparability with the official population statistics

In comparing results from the population projections with the general population statistics at Statistics Norway, two main differences stand out:

- The projection models project the population from 1 January one year to 1 January the following year. This means that individuals who move several times during one year are only recorded with one move, or with zero moves, if the person resides in the same municipality at the beginning and the end of the year. This similarly applies to moves between Norway and other countries. If people move to and from Norway twice, they are not recorded in the modelled estimates of migration. Consequently, somewhat fewer migrations are tallied in the population projections compared to the numbers that are published in the general population statistics.
- The age definitions differ in the projections and the general population statistics. The projections are made for 120 age groups: 0, 1, 2, ..., 119 years. For age-specific rates for fertility, mortality and migration we define age in completed years at the end of the year. In the general population statistics, on the other hand, it is usually age at the time of the event that is used. This means that the age-specific rates and the probabilities that are used in the projections apply to a population that, on average, is half a year younger than those published in the population statistics. The same applies to life expectancy at birth and remaining life expectancy.

An overview of the report

First, we will present the main results from this year's population projection (chapter 2). Next, we provide details of the assumptions used to produce the projections (chapter 3). We will then move on to describe in detail how we project the population using the BEFINN and BEFREG models (chapter 4). Next, we explain how we arrive at the assumptions concerning fertility, mortality, internal migration and immigration and emigration (chapters 5–8). Finally, we will discuss the inherent uncertainty associated with population projections both in general and in Statistics Norway's projections in particular (chapter 9). This is followed by our conclusion (chapter 10).

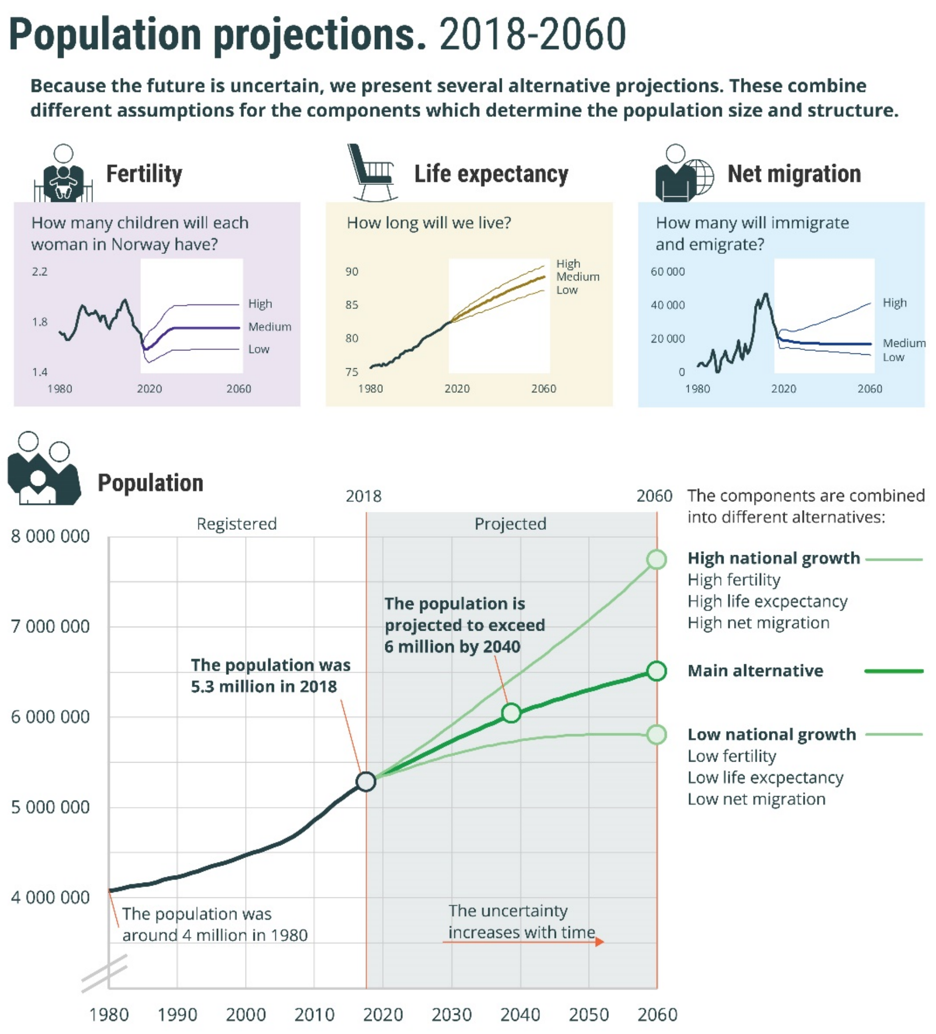
2. Main results from the 2018 population projections

Lower population growth, pronounced aging in rural areas and a growing number of (older) immigrants characterize some of the main results from the 2018 population projections.

According to the main alternative (MMMM), the population of Norway will increase throughout the remainder of this century and surpass 6 million inhabitants before the year 2040 (Figure 2.1). The population growth will be most pronounced in central areas, while many rural municipalities will experience a population decline. The growth in the number of elderly will be pronounced: in about 15 years there will be more elderly (65+ years) than children and adolescents (0-19 years) in Norway for the first time ever, according to the main alternative.

In this chapter we will present the main results from the 2018 population projections at a national and regional level. These results stem from the assumptions made regarding future fertility, mortality, internal migration, as well as immigration and emigration, presented in more detail in later chapters in this report. The assumptions are also summarized in Table 2.1 and in Figure 2.1.

Figure 2.1 An overview of the assumptions and the resulting population figures for Norway, registered and projected in three alternatives



Source: Statistics Norway

Text box 2.1 What do the H-M-L abbreviations mean?
The results of a population projection are largely dependent on the assumptions used for the different components. Since assumptions may be more or less realistic, a number of alternative projections are drawn up, with different combinations of assumptions. These are described using four letters in the following order:

Fertility
Life expectancy
Internal migration
Immigration

The main alternative, MMMM, uses the medium level for each of the components. These are the assumptions that we consider to be the most plausible.

The assumptions can be combined in a variety of ways. As an example, the LHML alternative describes a population trend with low fertility, high life expectancy, medium internal migration and low immigration, i.e. strong aging.

For fertility, life expectancy and immigration, we create high, medium and low alternatives, but for internal migration we only use the medium alternative. We draw up alternatives with constant (konstant in Norwegian) immigration (MMMK) and constant life expectancy (MKMM), and alternatives without domestic and international migration (MM00) and with zero net migration (MMM0). The latter two alternatives are primarily used for analytical purposes.

It is unlikely that fertility, life expectancy and immigration will all remain high (or low) throughout the relevant period. Nevertheless, the span between the HHMH and LLML alternatives illustrates a potential degree of uncertainty surrounding the projections and demonstrates the degree to which the results depend on the different assumptions used. The inherent uncertainty associated with population projections is discussed in greater detail in chapter 9.

Table 2.1 Population projections 2018. Key figures of the assumptions[1]

	2017 Registered	M Main alternative	H High alternative	L Low alternative
Total fertility rate, children per woman	1.62			
2020		1.60	1.73	1.48
2040		1.76	1.94	1.59
2060		1.76	1.94	1.59
Life expectancy at birth, men	80.9			
2020		81.6	82.2	81.0
2040		85.4	87.0	83.6
2060		88.4	90.4	86.0
Life expectancy at birth, women	84.3			
2020		84.7	85.2	84.2
2040		87.8	89.3	86.2
2060		90.3	92.1	88.1
Yearly immigrations	56 400			
2020		51 400	58 800	45 700
2040		48 900	70 800	40 800
2060		49 000	91 200	36 400
Yearly emigrations	35 058			
2020		32 200	33 100	31 300
2040		31 600	39 500	28 000
2060		32 000	49 800	25 800

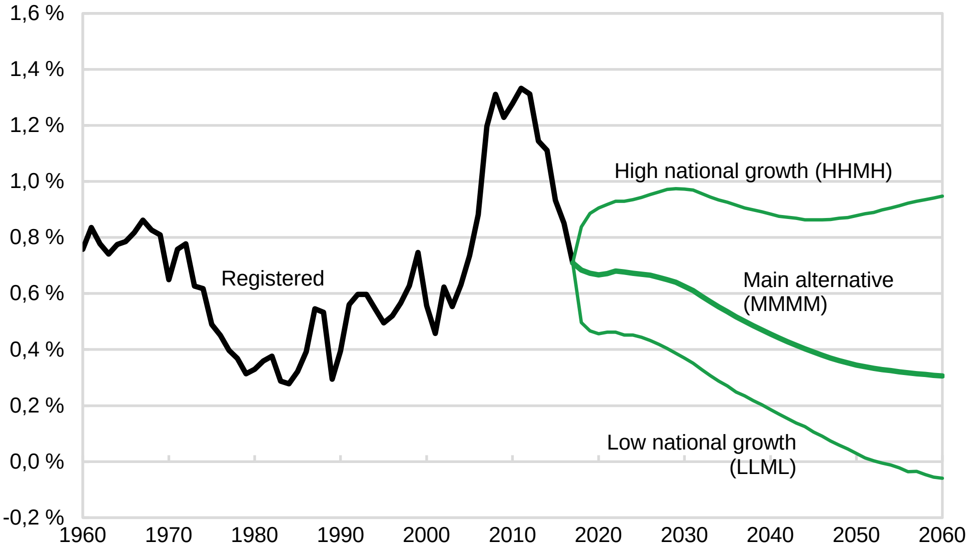
[1] The figures for registered life expectancy are not fully comparable with those presented in the population statistics. The figures on yearly immigrations and emigrations do not include persons who have moved to and from Norway (or vice versa) during the same calendar year. The H and L figures for emigrations are obtained from the MMMH and MMML alternatives.
Source: Statistics Norway

2.1. Lower population growth

The population growth has slowed markedly over the last few years (Figure 2.2). In the population projections' main alternative (MMMM), the growth continues to decelerate, but at a slower pace.

During the period 2006–2016, the population grew more than 0.8 per cent annually, and in the peak years 2011 and 2012 it was above 1.3 per cent. This is very high, both compared to earlier periods in Norway and compared to other countries.

Figure 2.2 Per cent growth in the population of Norway, registered 1960-2017 and projected 2018-2060 in three alternatives



Source: Statistics Norway

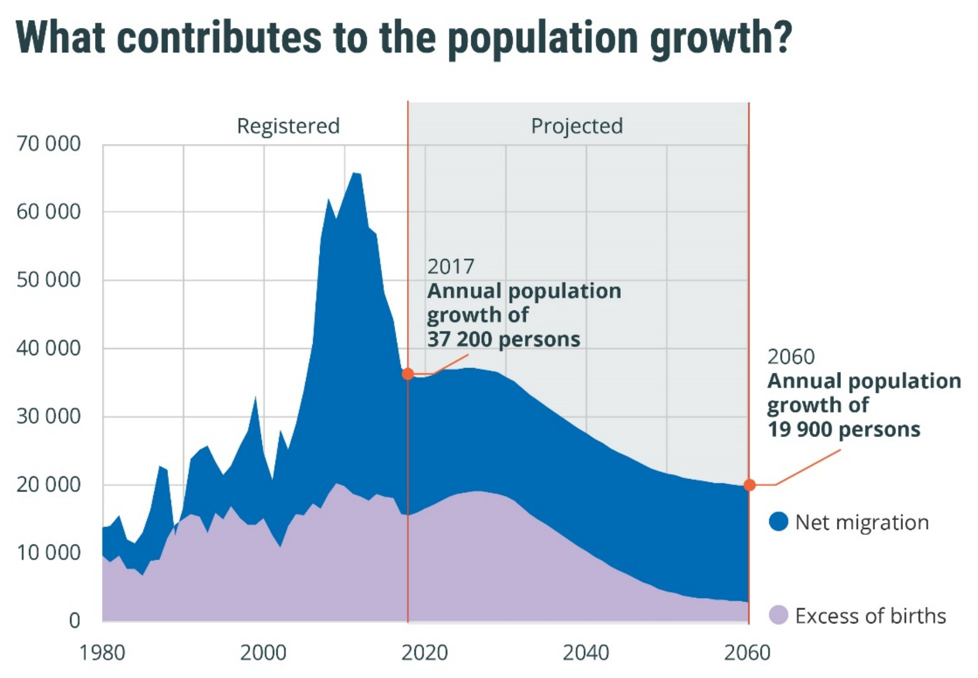
The pronounced growth during 2006-2016 had multiple causes. Immigration to Norway was unusually high following the eastward expansion of the EU in 2004, while emigration saw a more moderate increase. In the first half of the period, the fertility in Norway was relatively high, peaking in 2009 with a total fertility rate (TFR) of 1.98. Combined with a large share of the female population at an age when it is common to have children, this resulted in a high number of births. High immigration was also a contributory factor: many immigrant women have particularly high levels of fertility the first few years after they arrive.

In addition, the number of deaths was very low during the period. This is primarily a consequence of the aging of the small birth cohorts from the period between World War I and World War II, but also due to a general increase in life expectancy.

Overall, many factors contributed to the high population growth in 2006–2016. In the years to come, we expect somewhat lower immigration, especially from Eastern European EU countries. Consequently, the number of women of a child-bearing age will increase less. In addition, we expect fertility to remain low in the short term. Although we expect a continued fall in the mortality rate, the number of deaths is likely to increase as the large cohorts born after World War II grow older, thus reaching an age where it is more common to die. In combination, this leads us to expect a weaker population growth in the future compared to the period 2006–2016.

Population growth can result from an excess of births, i.e. where the number of births exceeds that of deaths, or from a positive net migration, where more people immigrate than emigrate, or from both. Figures 2.3 and 2.4 show the relative contribution of excess of births and net migration over time in Norway. Traditionally, the excess of births has been the largest contributor to the net growth, and if we go back one hundred years, net migration was negative. However, over the last decade, net migration has contributed most to the population growth in Norway. According to the main alternative (MMMM), net migration will continue to be a greater contributory factor than the excess of births, especially in the short term.

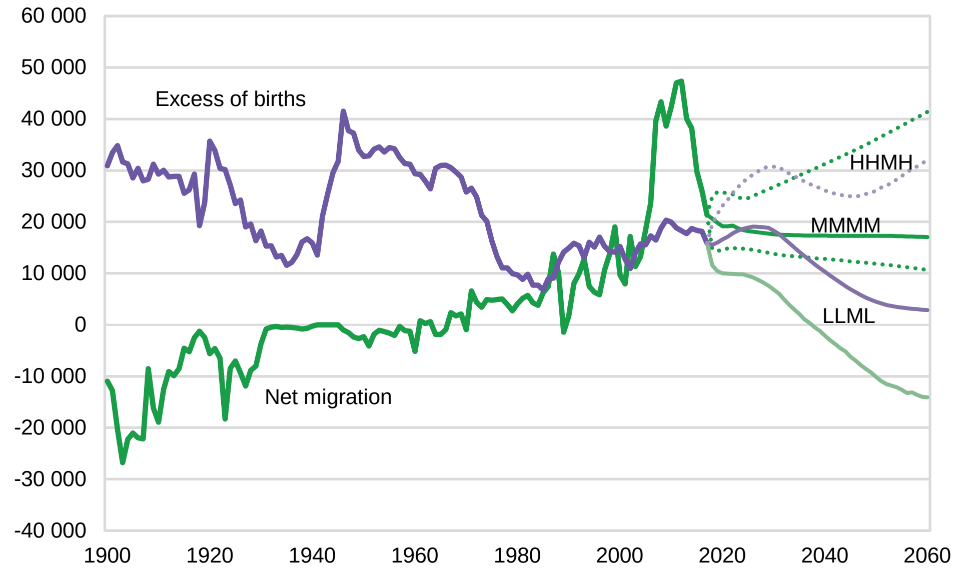
Figure 2.3 Population growth, net migration and excess of births, registered 1980-2017 and projected 2018-2060, main alternative (MMMM)[1]



[1] Excess of births is births minus deaths.
Source: Statistics Norway

While Figure 2.3 only shows the main alternative, Figure 2.4 also shows the variation in the low and high national growth alternatives. According to the alternatives shown, net migration is likely to contribute more to the growth than the excess of births, especially in the long term. However, in the near future, the situation is reversed in the high growth alternative.

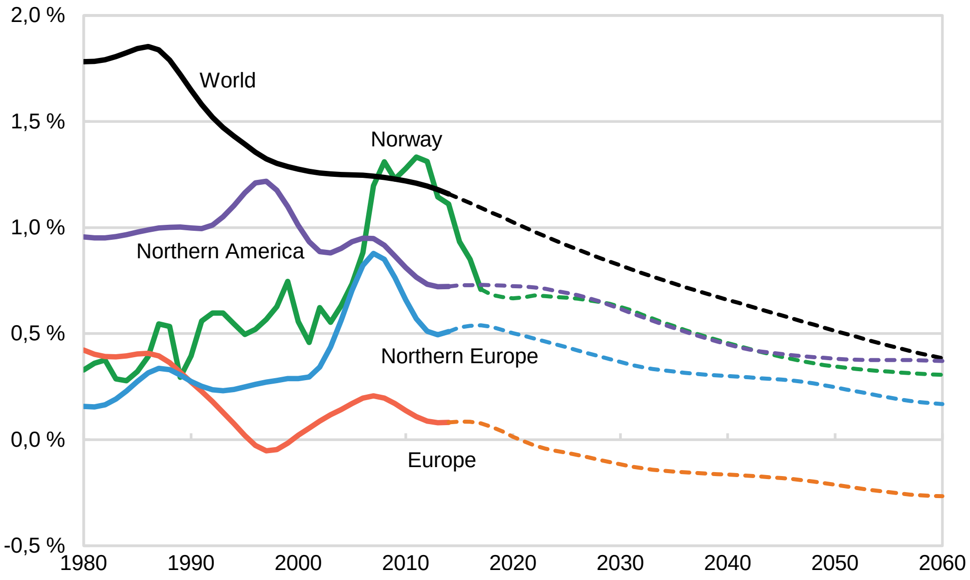
Figure 2.4 Excess of births and net migration, registered 1900-2017 and projected 2018-2060 in three alternatives[1]



[1] Excess of births is births minus deaths.
Source: Statistics Norway

Although future population growth will be somewhat lower than in the last 10-15 years, growth in Norway will nevertheless be high compared with many other countries, not least in Europe. Figure 2.5 shows the percentage growth in Norway compared to what has been registered and projected by the UN for other parts of the world. In Europe, several countries already have negative population growth. This is especially true in Eastern Europe, but in recent years there has also been a decline in the population in Southern Europe. For Europe as a whole, the UN expects a decline in the population within the next three years. This is largely driven by the countries in the eastern and southern parts, while in Northern Europe the UN expects continued population growth. Our projected population growth for Norway is higher than this, and about the same as for Northern America, but lower than the overall global growth.

Figure 2.5 Population growth in per cent, Norway and other parts of the world. Registered from 1980 and projected to 2060 in the UN's medium fertility alternative and Statistics Norway's main alternative (MMMM)[1]



[1] Northern Europe comprises the UK, Ireland, the Nordic and the Baltic countries.
Source: UN and Statistics Norway

2.2. Most pronounced growth in central areas

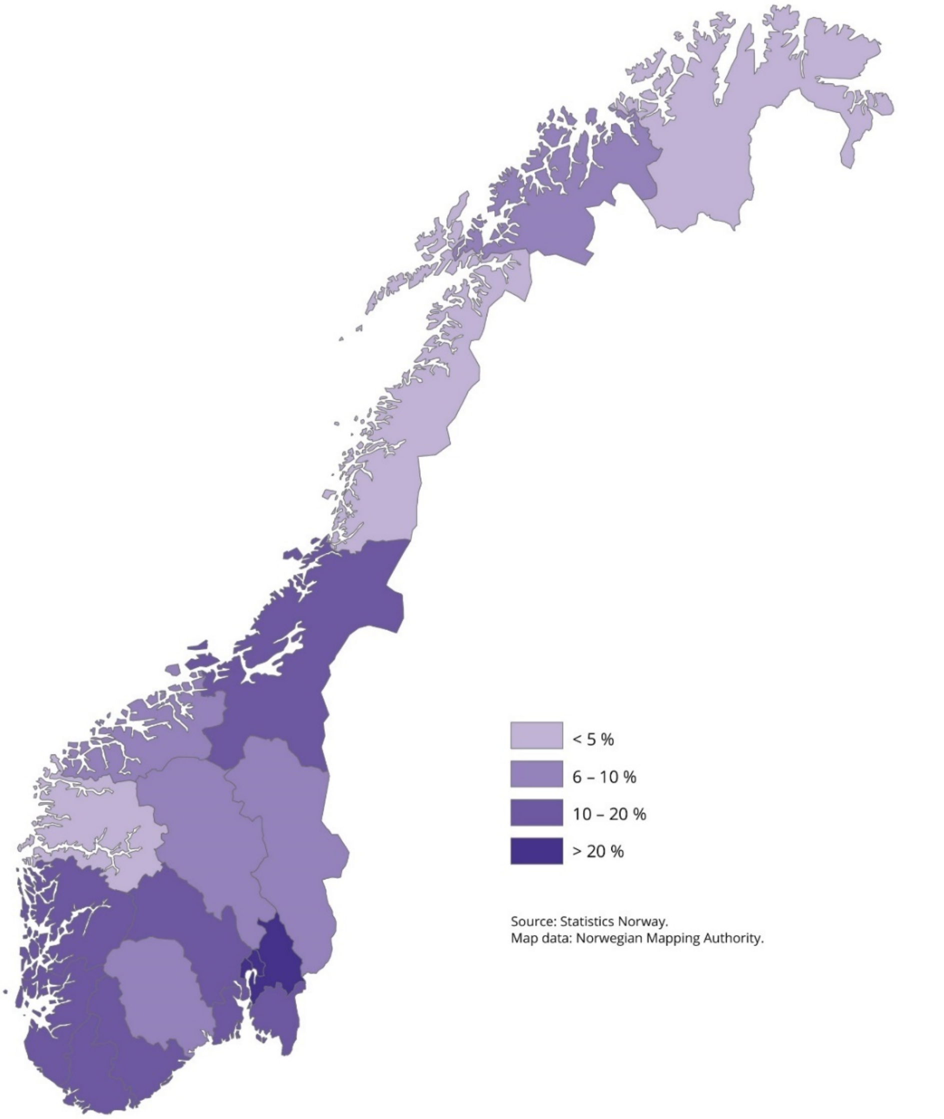
The population growth in Norway is most pronounced in central areas. Nationally, the main alternative (MMMM) shows a population growth rate of 14 per cent from 2018 to 2040, but this is unevenly distributed among the counties. The strongest growth is expected in Oslo and Akershus, with just over a 20 per cent increase in the population. Finnmark, Nordland and Sogn og Fjordane are at the other end of the scale with an expected growth of 2-4 per cent. In the main alternative, none of the counties will therefore have a population decline. In general, Northern Norway, the inland counties, North-Western Norway and Telemark show growth below average, while the counties in Eastern Norway, Southern Norway, South-Western Norway and Trøndelag have a stronger growth, as shown in Table 2.2 and Figure 2.6.

Table 2.2 Total population in the counties, registered 2018 and projected 2040 (main alternative, MMMM) and per cent growth in the period[1]

	Total population		Percentage growth 2018-2040		
	Registered 2018	Projected 2040, main alternative	Total growth	From excess of births	From net migration
Østfold	295 420	347 000	18	1	17
Akershus	614 026	749 000	22	7	15
Oslo	673 469	816 000	21	22	0
Hedmark	196 966	216 000	10	-4	14
Oppland	189 870	206 000	8	-3	11
Buskerud	281 769	328 000	16	3	14
Vestfold	249 058	288 000	16	0	15
Telemark	173 391	186 000	7	-2	9
Aust-Agder	117 222	136 000	16	3	13
Vest-Agder	186 532	219 000	17	9	8
Rogaland	473 526	537 000	13	12	1
Hordaland	522 539	599 000	15	10	5
Sogn og Fjordane	110 230	113 000	3	2	1
Møre og Romsdal	266 856	288 000	8	3	5
Trøndelag	458 744	520 000	13	7	6
Nordland	243 335	254 000	4	0	4
Troms - Romsa	166 499	177 000	6	4	2
Finnmark - Finnmárku	76 167	78 000	2	2	0
Norway, total	**5 295 619**	**6 056 000**	**14**	**7**	**7**

[1] The figures have been rounded off so that the projected population is shown in thousands and percentage growth without decimals. The latter sums do not always add up due to the rounding off.
Source: Statistics Norway

Figure 2.6 Growth in per cent in the counties from 2018 to 2040, main alternative (MMMM)



Source: Statistics Norway

The regional model generates the number of births and deaths in the counties in the period 2018–2040. This means we can break down growth into two sources: excess of births (births minus deaths) and net migration. This is done in Table 2.2. A problematic aspect of this is that migration also affects fertility in a region. Both internal migrants and immigrants are often young and of a childbearing age, which will also affect the number of children born through the effect on the age structure of the sender and recipient regions. A good example of this is Oslo, where the entire contribution to growth seemingly stems from the excess of births. On the other hand, if we look at the MM00 alternative, where we do not allow the population to migrate, the growth in Oslo is only half, at 11 per cent from 2018–2040. Other typical counties with high birth excesses are West Agder, Rogaland and Hordaland. Fertility is generally high in Western Norway and South West Norway. In Hedmark, Oppland and Telemark, there are more deaths than births during the period 2018–2040. These counties would therefore not have shown growth if there was no positive net in-migration. High-growth counties as a result of net in-migration are Østfold (17 per cent), Akershus and Vestfold (15 per cent), Hedmark, Buskerud and Aust-Agder (13–14 per cent).

Pronounced differences between the municipalities

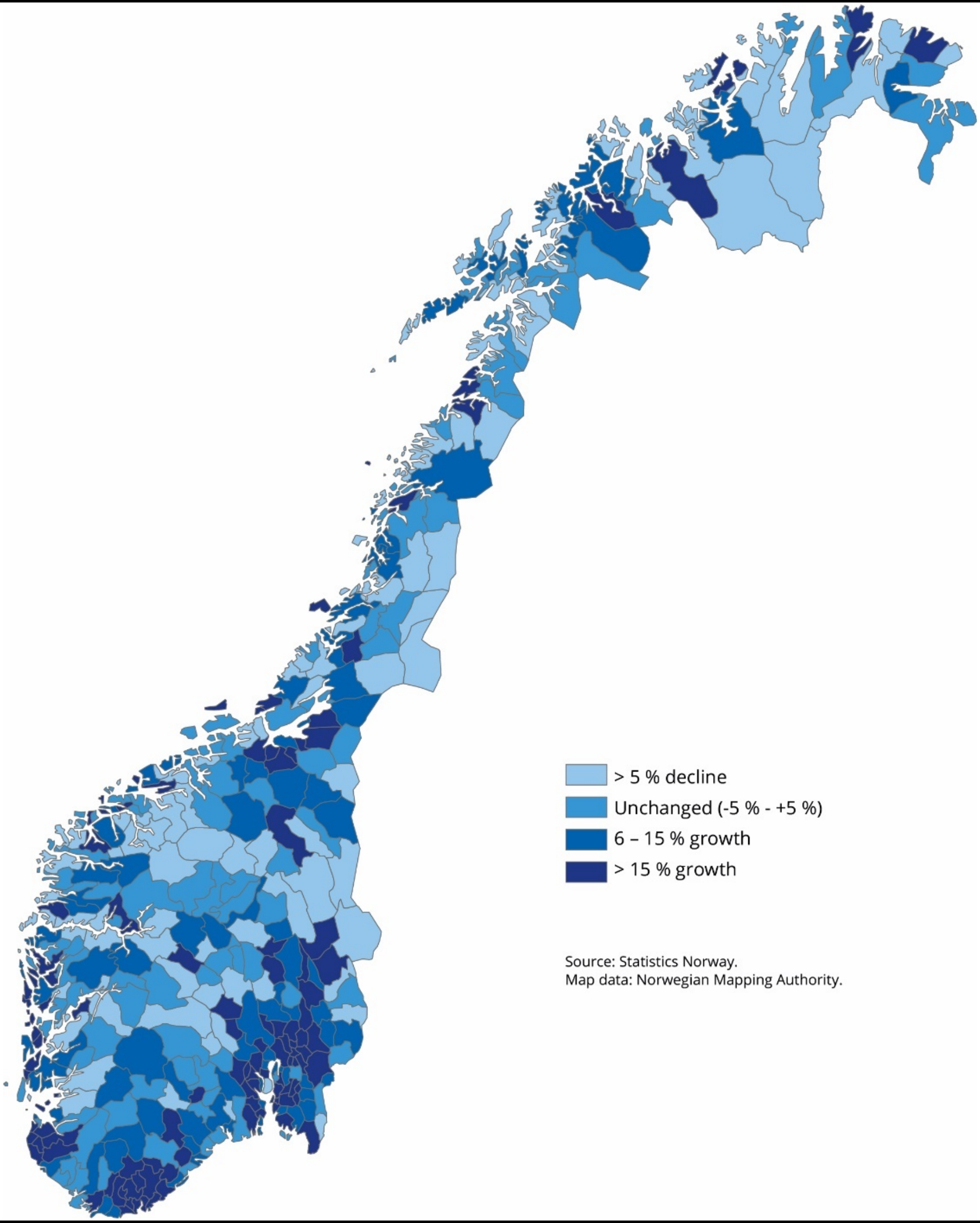
The municipalities of Norway are very different. If we look at the population as of January 2018, we have Oslo municipality and Bergen at the top, with approximately 670 000 and 280 000 inhabitants, while Utsira and Modalen do not have more than 208 and 380 inhabitants respectively. There is also a large spread in the projected population growth for Norwegian municipalities. The main picture is that most municipalities will grow. According to the main alternative, 223 of the country's 422 municipalities show growth between 2018 and 2040 of 5 per cent or more (Figure 2.7). Of these, over half (119) have a particularly high growth rate of 15 per cent or more. Almost as many (116) are expected to see a population decline of 5 per cent or more, while the figure will remain roughly unchanged in 83 of the municipalities.

Figure 2.7 shows that the municipalities with growth are largely centered around the cities of Oslo, Bergen, Trondheim, Stavanger, Kristiansand and Tromsø. There is, for the most part, strong growth in Eastern Norway right along the coast to just past Bergen. Inland municipalities, rural municipalities and municipalities in Northern Norway generally have lower growth, but municipalities with a high growth rate are found in all counties.

The projected growth or decline largely depend on the propensity to move: Both immigrants and internal migrants tend to move to central areas. In addition, those who move are relatively young. This results in a higher number of births in central regions, which also contributes to population growth.

Table 2.3 shows the municipalities with the highest and lowest growth in absolute numbers between 2018 and 2040. The municipalities with growth consist largely of the cities of Oslo, Bergen, Trondheim and Kristiansand. Sandnes is also on the list. There is a clear centralizing pattern to the growth.

Figure 2.7 Population change in per cent in the municipalities from 2018 to 2040, main alternative (MMMM)



Source: Statistics Norway

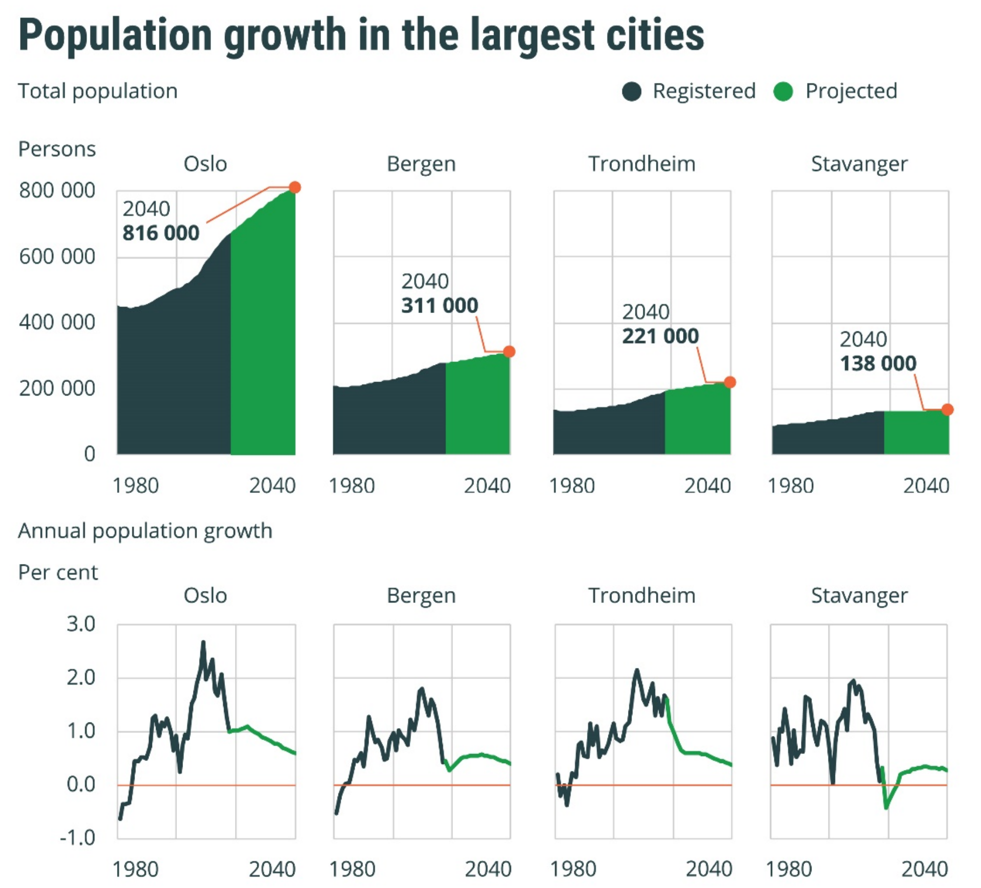
Table 2.3 Municipalities with the highest and lowest change in absolute numbers from 2018 to 2040, main alternative (MMMM)

	Population		Change	
	2018	2040	Count	Per cent
	7 municipalities with largest growth			
0301 Oslo municipality	673 469	815 500	142 000	21
1201 Bergen	279 792	310 600	30 900	11
5001 Trondheim	193 501	220 500	27 000	14
1102 Sandnes	76 328	96 400	20 100	26
1001 Kristiansand	91 440	109 800	18 400	20
0219 Bærum	125 454	143 700	18 200	15
0106 Fredrikstad	80 977	98 100	17 100	21
	7 municipalities with largest decline			
1224 Kvinnherad	13 180	12 100	-1 100	-8
1511 Vanylven	3 187	2 200	-1 000	-32
1424 Årdal	5 277	4 300	-1 000	-19
1837 Meløy	6 346	5 400	-1 000	-15
1528 Sykkylven	7 695	6 700	-1 000	-12
0814 Bamble	14 183	13 500	-700	-5
2020 Porsanger - Porsángu - Porsanki	3 964	3 300	-600	-16

Source: Statistics Norway

Among the largest municipalities (Figure 2.8), we expect particularly strong growth in Oslo, while Stavanger is experiencing weaker growth, which is due to the relatively low net migration to Stavanger in recent years. Oslo has a projected growth of around 140 000 and is expected to reach around 700 000 within 5 years and 800 000 in about 20 years. The model results indicate that Bergen will reach 300 000 within 15 years, Trondheim 200 000 within 5 years and Kristiansand 100 000 in about 10 years.

Figure 2.8 Total population and population growth in the largest municipalities, registered 2000-2018 (2017) and projected 2019 (2018)-2040, main alternative (MMMM)[1]



[1] These cities also constitute a municipality.
Source: Statistics Norway

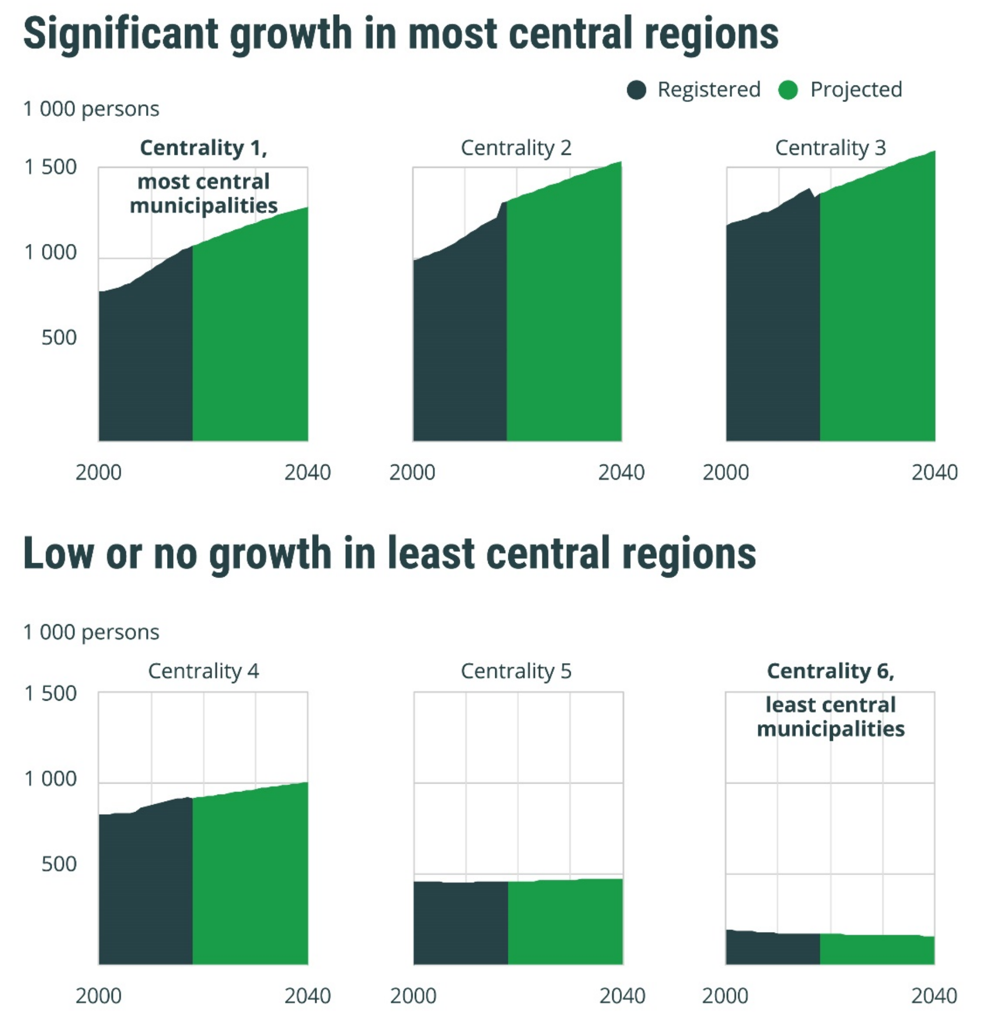
Many of the municipalities showing a population decline are small rural municipalities. Two such examples, shown in Table 2.3, are Vanylven and Sykkylven in Møre og Romsdal. Kvinnherad is the municipality with the largest decline, with about 1 100 fewer people in 2040, according to the main alternative. This corresponds to a decline in the population of about 8 per cent from 2018. The figures largely reflect developments over the past ten years. This means that special events, such as job losses, the housebuilding situation and infrastructure changes, characterize the numbers, especially for smaller municipalities. Use of the numbers in municipal planning requires knowledge of the historical development in the municipality and an evaluation of whether this is representative of the future.

Norway is becoming centralized

If we measure growth as a percentage, it is generally the outlying municipalities of the cities that have the greatest growth. There are probably several reasons for this. Those who live within commuting distance can still benefit from what the city has to offer and its labor market, whilst also enjoying lower housing costs. This migration behavior seems to be linked to life stage. Having children in particular increases the need for space, and many seek this solution during the childrearing stage of their lives.

Figure 2.9 shows the annual population growth for municipalities with varying degrees of centrality (see Appendix C for centrality categorizations). We use Statistics Norway's Centrality Index of 2018, which is based on labor market accessibility and proximity to services. Both historic and projected figures show that growth increases with the degree of centrality. The least central municipalities had a negative population development in 2007, 2016 and 2017. According to the main alternative, the population will continue to decline in these municipalities until 2022.

Figure 2.9 Total population in municipalities with varying degrees of centrality, registered 2000-2018 and projected 2019-2040, main alternative (MMMM)[1]

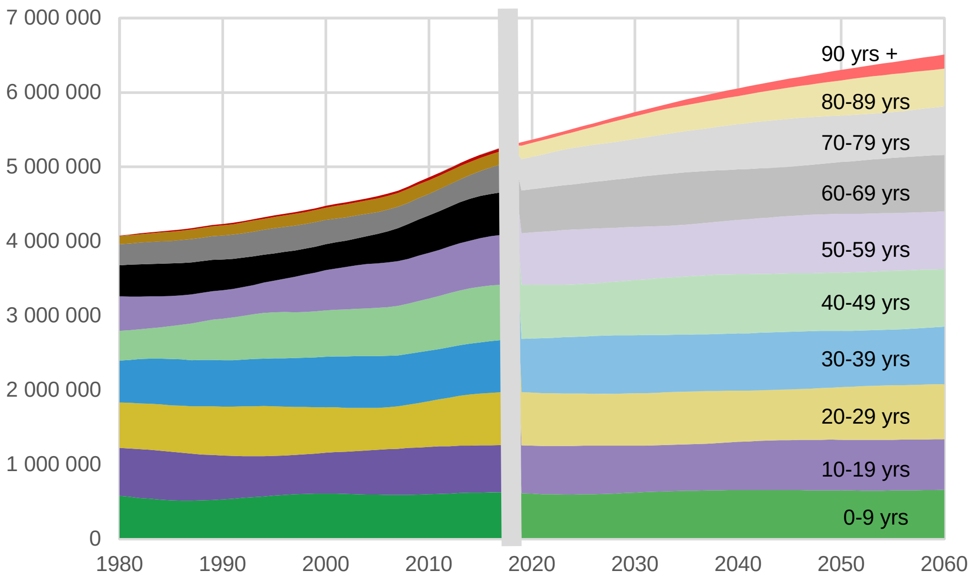


[1] Municipalities are categorized into centrality groups based on Statistics Norway's centrality standard from 2018. The most central municipalities are in category 1. Above average central municipalities are in categories 2 and 3. Medium central municipalities are in category 4. Those below medium are placed in categories 5 and 6.
Source: Statistics Norway

2.3. Twice as many people over 70

Norway is experiencing an aging population, and the phenomenon is projected to increase in the years to come. The number of persons aged 70 or over will more than double by 2060, from nearly 625 000 this year to over 1.3 million, according to the main alternative.

Figure 2.10 The population by age, registered 1970-2018 and projected 2019-2060, main alternative (MMMM)



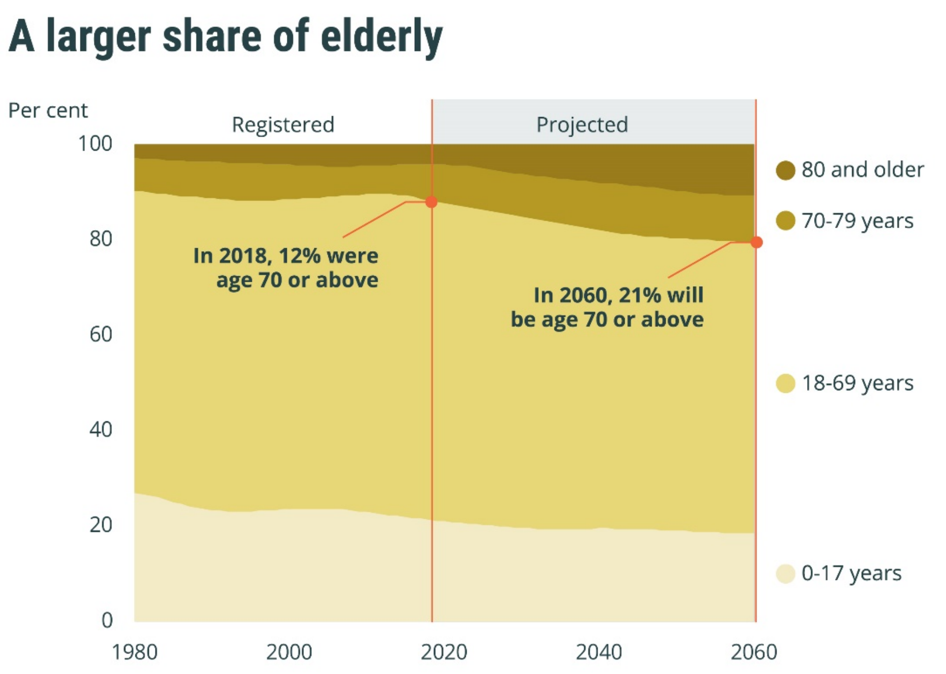
Source: Statistics Norway

Figure 2.10 shows the population divided into age groups, and it is the oldest age groups that are growing the most. While the number of people in all age groups under the age of 70 will remain fairly stable in the future, there is a sharp increase among the over 70s, and especially among the oldest of these. The group aged 80 and over will increase from 220 000 today to nearly 700 000 by 2060, which is a threefold increase.

Measured as a share of the population, the increase is also considerable, as shown in Figure 2.11. Today, every eighth person in Norway is aged 70 or over. By 2060, this number will be one in five, according to the main alternative.

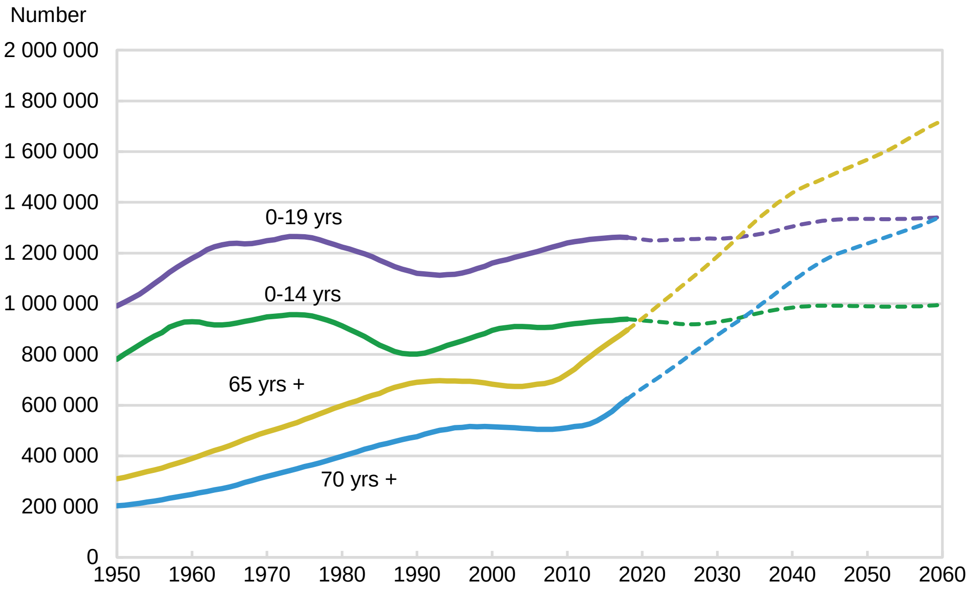
Throughout Norway's history, there have always been more children and adolescents than elderly in the population. Projections show that this will change. Even though the number of young people is increasing, the number of elderly is growing at a faster pace, as shown in Figure 2.12. According to the population projections' main alternative (MMMM), there will be more persons aged 65 and over than persons aged 0–19 in 2032. The following year, in 2033, there will be more aged 70 and over than aged 0–14.

Figure 2.11 The population as a percentage in four broad age groups, registered 1980-2018 and projected 2019-2060, main alternative (MMMM)



Source: Statistics Norway

Figure 2.12 The number of children and adolescents versus the number of elderly, registered 1950-2018 and projected 2019-2060, main alternative (MMMM)



Source: Statistics Norway

Dependency ratio

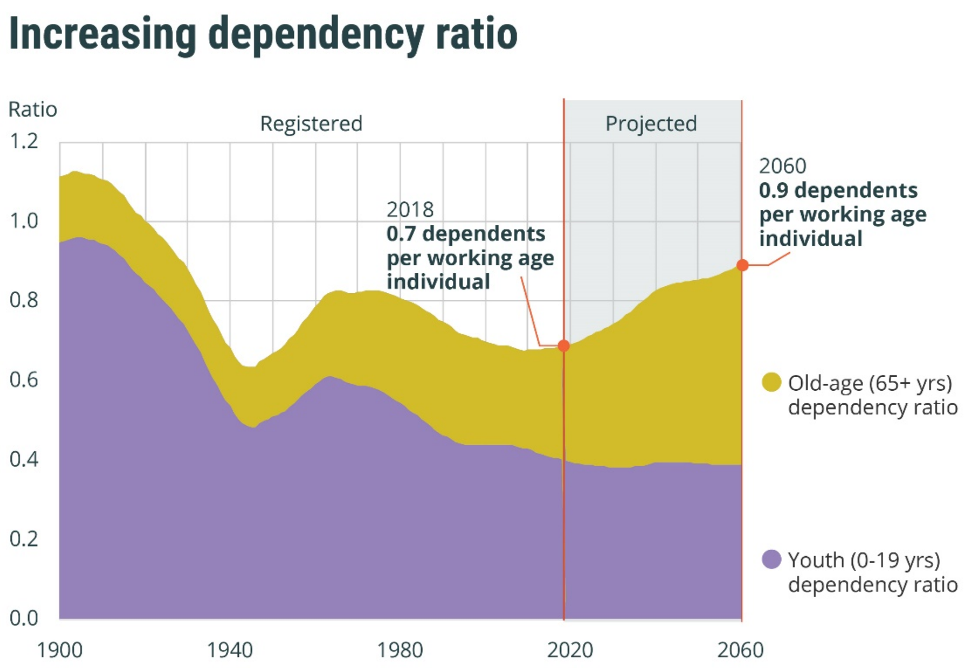
Aging strongly influences the demographic measure 'dependency ratio'. This measure shows how many people are at an age where it is common to work to help support children and/or elderly family members, in relation to the numbers of children and elderly.

The old-age dependency ratio (OADR) is a measure of the ratio between the number of people in older age groups, which typically do not work, and the number of people in age groups where it is typical to work. This measure thus indicates the relationship between different age groups in the population but does not take into account the actual employment rates of these groups, or whether the elderly are actually dependent or in need of care. Nevertheless, it is a simple and widely used measure that can illustrate aspects of the population structure that are of major importance for employment and government revenues on the one hand, and pension costs, nursing and care needs and the like on the other. In this report we have chosen to calculate the OADR as the ratio between the number of persons aged 65 and over and the number of persons aged 20–64. The age of 65 is chosen as a cut-off point because this is close to the average actual retirement age in Norway, which is around 64 years for women and 65 years for men (OECD 2015). It is also the definition most commonly applied internationally, although some also use age 70 and over, divided by the population aged 20–69.

The youth dependency ratio (YDR) is defined as the number in the age group 0–19 divided by the same denominator as that used for the OAD, i.e. the number in the age group 20–64.

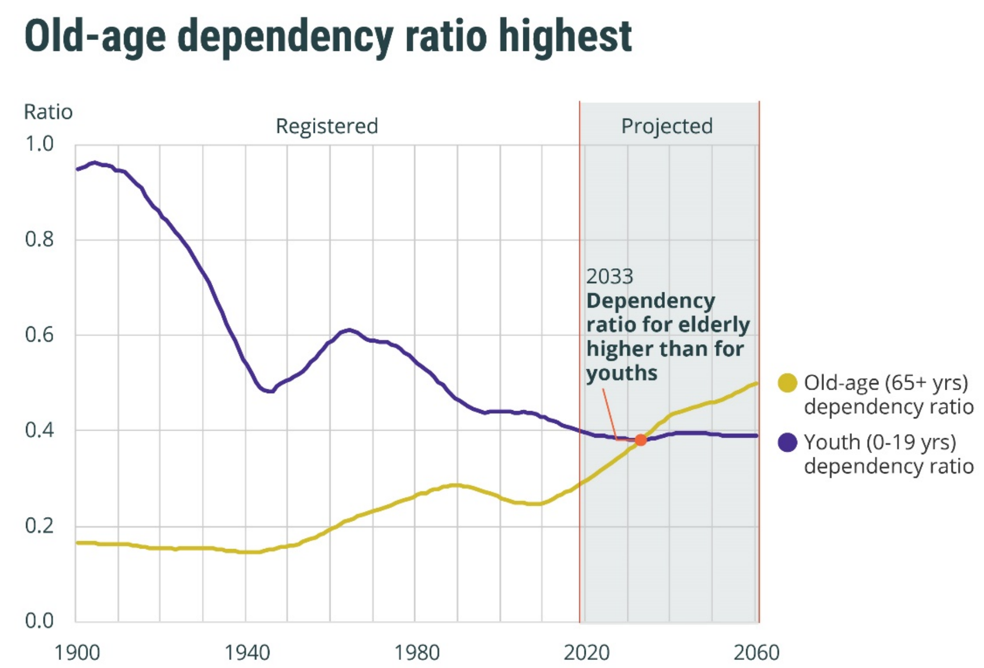
High dependency ratios imply a society with a large number of young people and/or elderly in relation to the number of people of working age. Figures 2.13 and 2.14 shows the development in these two dependency ratios. The youth dependency ratio is slightly higher than that for the elderly today: every person of working age must on average support 0.4 children and 0.3 elderly. However, from 2032 onwards, i.e. 15 years from now, the OADR will exceed that of the YDR in our main alternative (Figure 2.14). By 2060, every person of working age will have to support on average 0.4 children and 0.5 elderly. This means that there is almost a one-to-one relationship, which will have significant consequences for public finances and labor force accessibility.

Figure 2.13 Total, old-age and youth dependency ratios, registered 1900-2018 and projected 2019-2060, main alternative (MMMM)[1]



[1] The numerator is the dependents. For youth, persons aged 0-19, and for old-age, persons aged 65 and older. The denominator is the working age population, here defined as persons aged 20-64.
Source: Statistics Norway

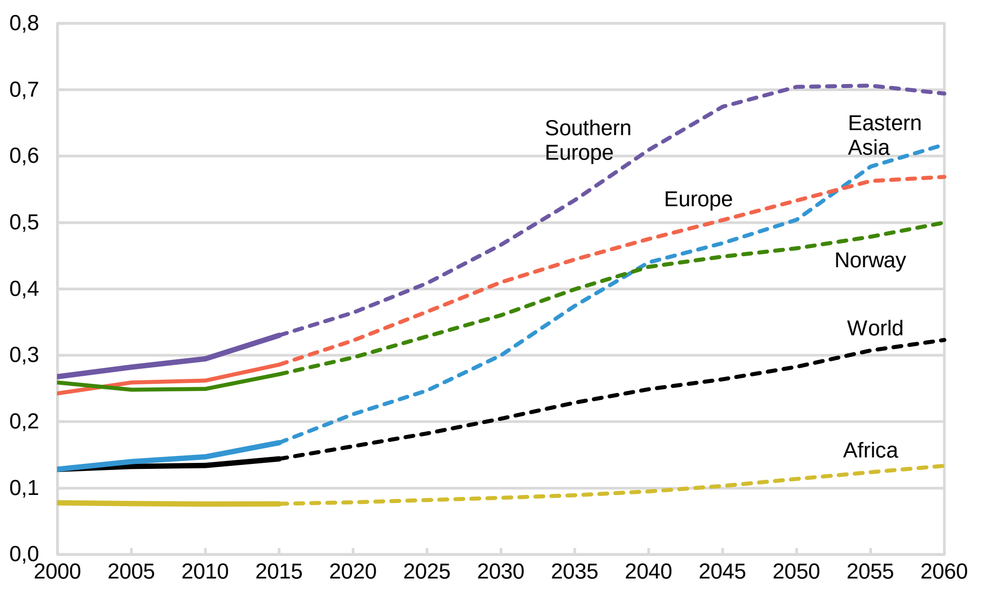
Figure 2.14 Youth and old-age dependency ratios relative to one another, registered 1900-2018 and projected 2019-2060, main alternative (MMMM)[1]



[1] The numerator is the dependents. For youth, age 0-19, and for old-age, age 65 and older. The denominator is the working age population, here defined as age 20-64.
Source: Statistics Norway

Even though the old-age dependency ratio is increasing markedly in Norway, the challenges associated with a relative decline in the working age population and a relative increase in the elderly population are much greater elsewhere in the world. Figure 2.15 shows that Norway has a lower OADR than the European average, particularly compared to Southern Europe. Eastern Asia has a low OADR today but expects a marked increase due to the pronounced aging that will result from the very low fertility a few decades back. In Africa, where fertility remains relatively high, a much weaker increase in the OADR is expected throughout this century.

Figure 2.15 Old-age dependency ratios, registered and projected for select geographic areas[1]



[1] Old-age dependency ratio is defined as the number of persons aged 65+ divided by the number of persons aged 20-64. All figures are from the UN's medium fertility alternative and from Statistics Norway's main alternative (MMMM).
Source: UN and Statistics Norway

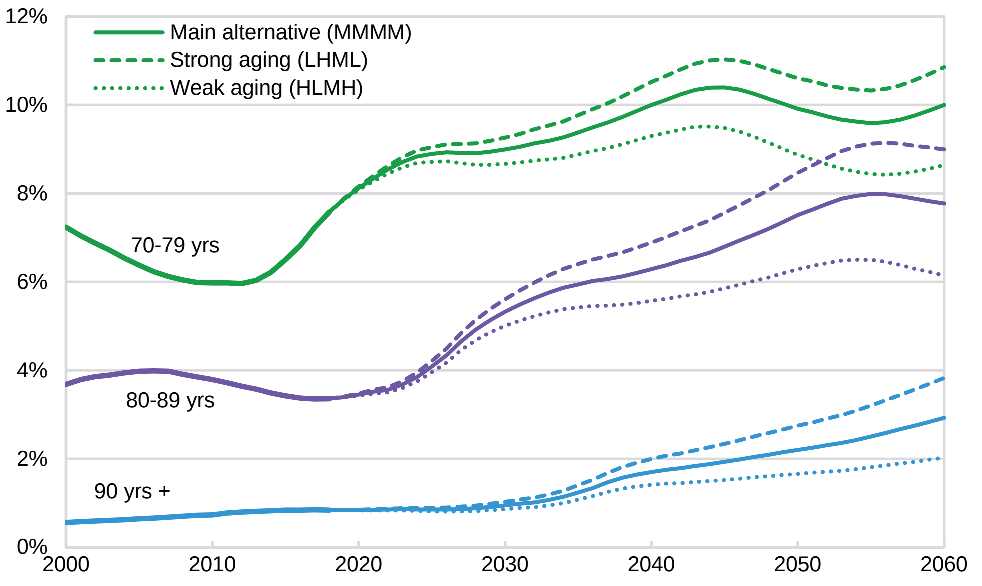
Population projections are made in several alternatives, with different assumptions about fertility, mortality, internal migration and immigration. These assumptions can be combined so that we get an alternative with strong aging – where fertility is low, life expectancy high and immigration low – and an alternative with weak aging – where fertility is high, life expectancy low and immigration high. These alternatives can help to illustrate how certain we are of the projected future aging.

Figure 2.16 shows the proportions of the oldest age groups recorded and projected in the main alternative (MMMM) as well as the alternatives for strong aging (LHML) and weak aging (HLMH). As the figure shows, there will be a clear increase in the proportion aged 80–89 or 90 and over, whatever the alternative.

It is therefore highly likely that we will get a marked increase in the proportion of individuals aged 80 or more. However, as the figure also shows, the increase in the 80–89-year-olds does not start until 2025. Then the large post-war cohorts begin to enter this age group. Likewise, the increase in the age group 90 and above will not be until the mid-2030s.

In the short term, there will also be an increase among the 70–79-year-olds, regardless of the alternative, but after 2040 this percentage will fall somewhat in all the alternatives. Compared to the situation today, however, there will nonetheless be population aging in all of these alternatives.

Figure 2.16 Share of the population in older age groups, registered 2000-2018 and projected 2019-2060 in three aging alternatives



Source: Statistics Norway

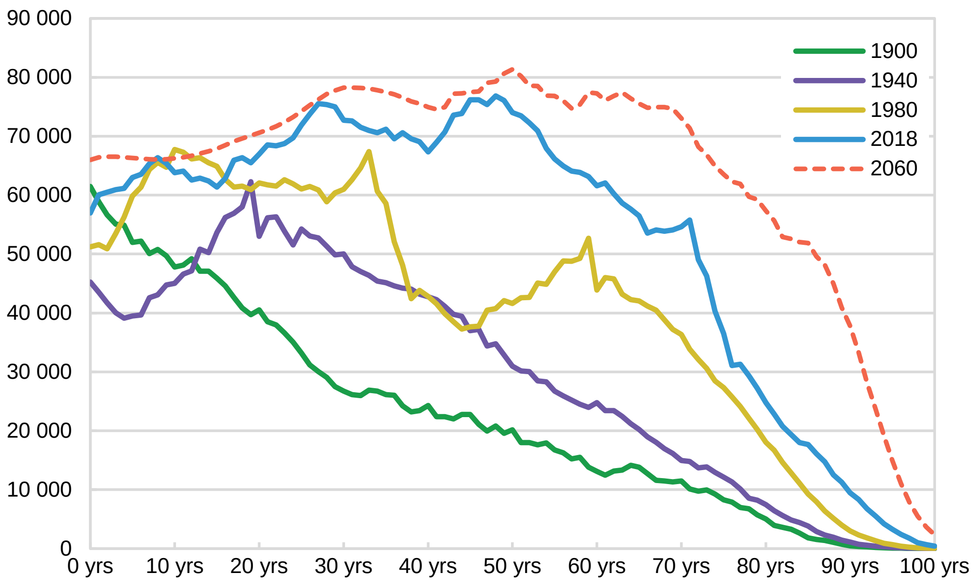
The aging in Norway today is weaker than in many comparable countries, and the projected grey tsunami in Norway will be far weaker than expected elsewhere (see for example Raftery et al. 2013). This is because Norway has had a smaller fall in fertility and a relatively high immigration of younger cohorts compared with other countries in, for example, Europe, while our life expectancy is not among the highest. In the 1960s, Norway had one of Europe's oldest populations measured by median age. Since then, the aging phenomenon has taken place at a quicker tempo in most European countries than in Norway (Eurostat 2018a). Today, Germany and Italy have some of Europe's oldest populations, with a median age of almost 47 years. Thus, half of all Germans and Italians are over the age of 47 and half the population is younger. These two countries also have low fertility rates. The aging of the population is also more prevalent in Sweden (41 years) and Finland (43 years) than in Norway (39 years).

The fact that the aging in Norway is weaker than in other comparable countries allows us to examine the challenges that these countries have met and what solutions they have chosen. Thus, we can benefit from the fact that our aging has been relatively moderate so far. At a national level, we have a few years to plan and implement possible solutions. It may be appropriate to start by examining our neighboring countries, as we have many similarities in terms of geography, health and welfare.

Modal age

Throughout the last hundred years, the number of Norway's youngest inhabitants has barely changed. Figure 2.17 shows the population's age distribution in select years from 1900 and projected in 2060. For the youngest children, the numbers have barely changed in a hundred years and we expect only a slight increase in this group by 2060. In the older age groups, on the other hand, we observe a pronounced growth. We thus observe a rectangularization of the curves, i.e. the curve takes the form of a rectangle as the population ages.

Figure 2.17 The age distribution of the population for select years, registered and projected, main alternative (MMMM)



Source: Statistics Norway

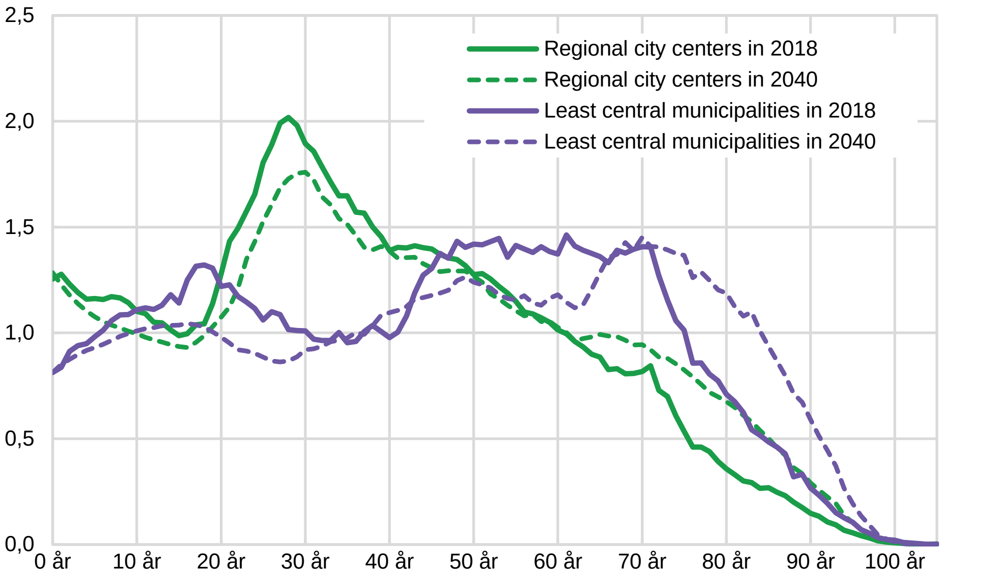
The figure also shows that some birth cohorts are larger than others. In the 2018-line (black) we see a local peak at age 71. This represents the 1946 cohort, which is the largest cohort ever born in Norway. This peak can also be seen in the line for 1980 (age 33). The 1946 cohort was the largest cohort in the Norwegian population from birth and through the 1950s and 1960s, but the birth cohorts in the late 1960s were also high, and since the beginning of the 1970s it is the 1969 cohort that has been the largest. This is still the case today, and immigration among this age group has contributed to its growth. However, the 1969 cohort has stopped growing because emigration and mortality now have a larger impact on this group than immigration. The 1969 cohort could lose its position as Norway's largest during the course of the next year. Then, according to the main alternative, they will be surpassed by the 1990 cohort. This cohort will remain Norway's largest up to 2043 if our projections reflect the actual development.

2.4. Strong aging in many rural municipalities

There are large regional differences in the aging of Norway. In the population projections, these differences will become even more pronounced in the future.

There are already marked differences in the elderly-young ratio between municipalities, which has implications for municipal finances and the supply of key workers, local health and care needs, and any other type of service that is vital to the health and welfare of the elderly.

Figure 2.18 Age structure in the regional city centers and in the least central areas in per cent of the total population, registered in 2018 and projected in 2040, main alternative (MMMM)[1]



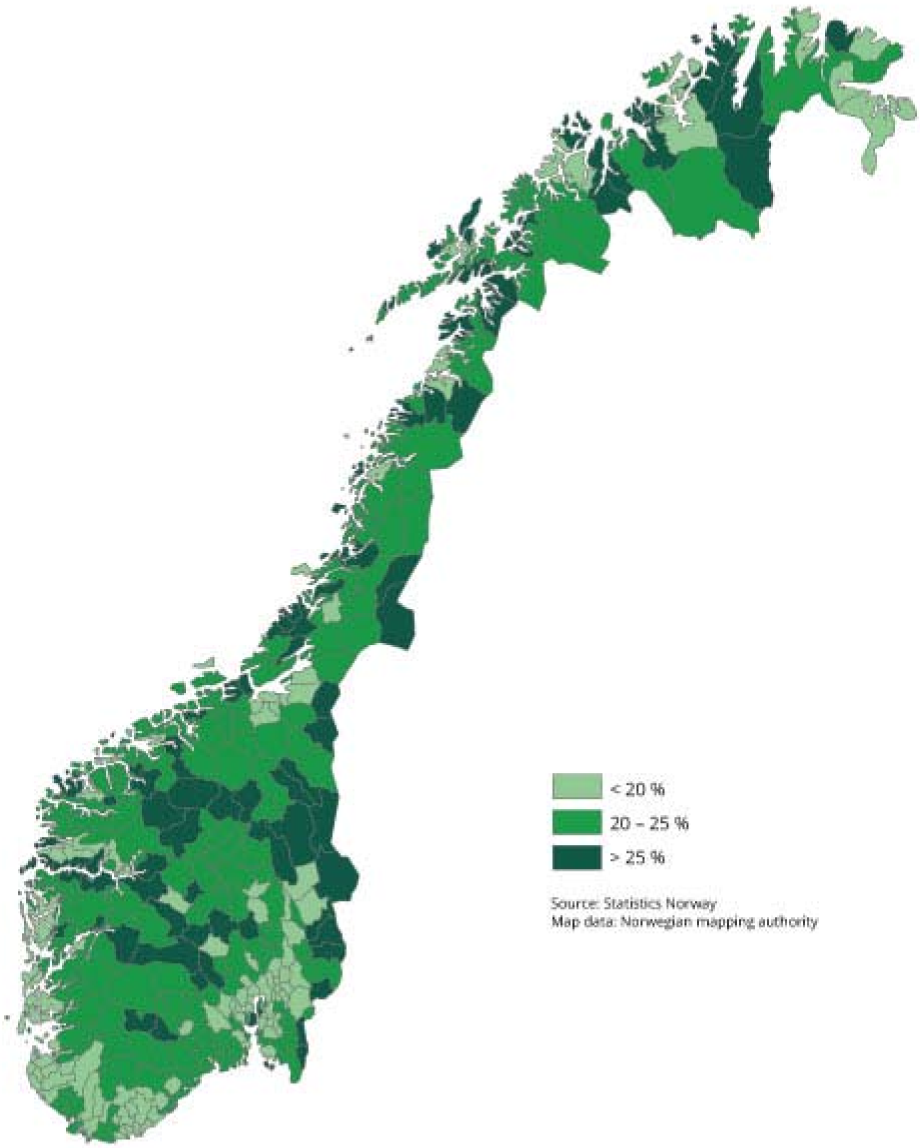
[1] The regional city centers are Oslo, Bergen, Trondheim, Stavanger, Kristiansand and Tromsø. The least central municipalities are those with the lowest score (<550) on Statistics Norway's centrality standard of 2018.
Source: Statistics Norway

Figure 2.18 shows the age structure of municipalities with varying degrees of centrality. The figure presents the proportion of the population in each age category. Even today, before the grey tsunami has fully made its mark, we see that the least central municipalities have a smaller proportion below age 10 and in the age range 20–47. On the other hand, they have a much higher proportion of people of retirement age. If we fast forward slightly more than 20 years to 2040, we see that this tendency is even clearer. Compared with the regional centers, the least central municipalities have a stronger increase in the number of elderly and a more pronounced reduction in the younger age groups' share of the population. In 2040, the modal age in the regional city centers is 30, whereas it is 70 in the least central municipalities.

Figure 2.19 shows the share of the population in each municipality that is aged 70 or over in 2040, in the main alternative. We recognize the urban-periphery pattern where there is lower aging in the more populated places. This is strongly influenced by internal migration and immigration. Young people move to the city from the rural areas, where the elderly remain. This also affects where children are born, which in turn reduces aging in the cities. In general, the small municipalities, either inland or in Trøndelag or Northern Norway, have a high number of older people.

According to the main alternative, 7 municipalities will have *more* older people than those of working age in 2040, and only 135 municipalities will have more than two persons of working age per elderly person. Municipalities with high levels of dependency for older people are Røst, Vanylven and Fedje. Oslo, on the other hand, only has a value of 0.28 (i.e. three to four people of working age per elderly person). Table 2.4. shows the municipalities which, according to the main alternative, will have the greatest and least old-age dependency ratio in 2040.

Figure 2.19 Share of the population 70 years and older in per cent in 2040, main alternative (MMMM)



Source: Statistics Norway

Table 2.4 The youngest and oldest municipalities, measured by the old-age dependency ratio in 2040, main alternative (MMMM)

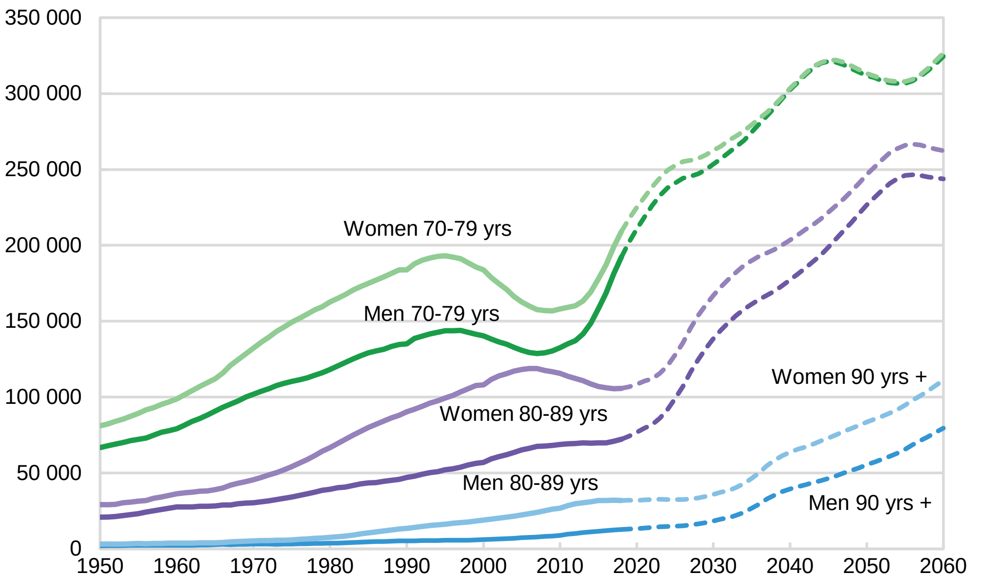
	2018		2040	
	Persons 65+	Old-age dependency ratio	Persons 65+	Old-age dependency ratio
The oldest municipalities in 2040				
1856 Røst	115	0.38	182	1.46
1511 Vanylven	871	0.53	976	1.19
1265 Fedje	140	0.50	185	1.11
0434 Engerdal	359	0.53	419	1.10
5048 Fosnes	188	0.59	196	1.09
2014 Loppa	275	0.52	268	1.06
5039 Verran	584	0.43	745	1.03
1839 Beiarn	309	0.57	326	0.97
0118 Aremark	313	0.40	489	0.97
2017 Kvalsund	294	0.54	304	0.97
The youngest municipalities in 2040				
0214 Ås	2778	0.22	5008	0.25
5029 Skaun	1163	0.25	2083	0.28
0301 Oslo	83554	0.19	144139	0.28
0821 Bø	1126	0.29	1649	0.32
0137 Våler	777	0.24	1640	0.32
0618 Hemsedal	377	0.26	711	0.32
0226 Sørum	2421	0.23	4826	0.33
1243 Os	3075	0.26	5585	0.33
1420 Sogndal	1294	0.27	2059	0.34
1256 Meland	1130	0.25	2224	0.34

[1] Old-age dependency ratio is defined as the number of persons 65+ divided by the number of persons aged 20-64. The municipalities are selected based on the projected magnitude of this measure in 2040.
Source: Statistics Norway

2.5. More men among the oldest

The oldest age groups in Norway are currently made up of a majority of women. Men today account for less than 40 per cent of the over 80s and under 30 per cent of the over 90s. In the future, this gender disparity may be significantly reduced (Figure 2.20). In the long term, there will be just as many men as women in the age group 70–79 years in our main alternative. There will also be a significantly higher proportion of men in the older age groups compared to today, although women will still be in the majority in the oldest groups in the years to come.

Figure 2.20 Women and men in the oldest age groups, registered 1950-2018, projected 2019-2060, main alternative (MMMM)



Source: Statistics Norway

There are two reasons for this development: there are more men than women in the Norwegian population in general, and life expectancy is expected to increase more for men than women. This may mean fewer elderly women living alone in the future (Rogne & Syse 2017). Additionally, elderly couples can be assumed to have less need for public nursing and care services compared to those living alone.

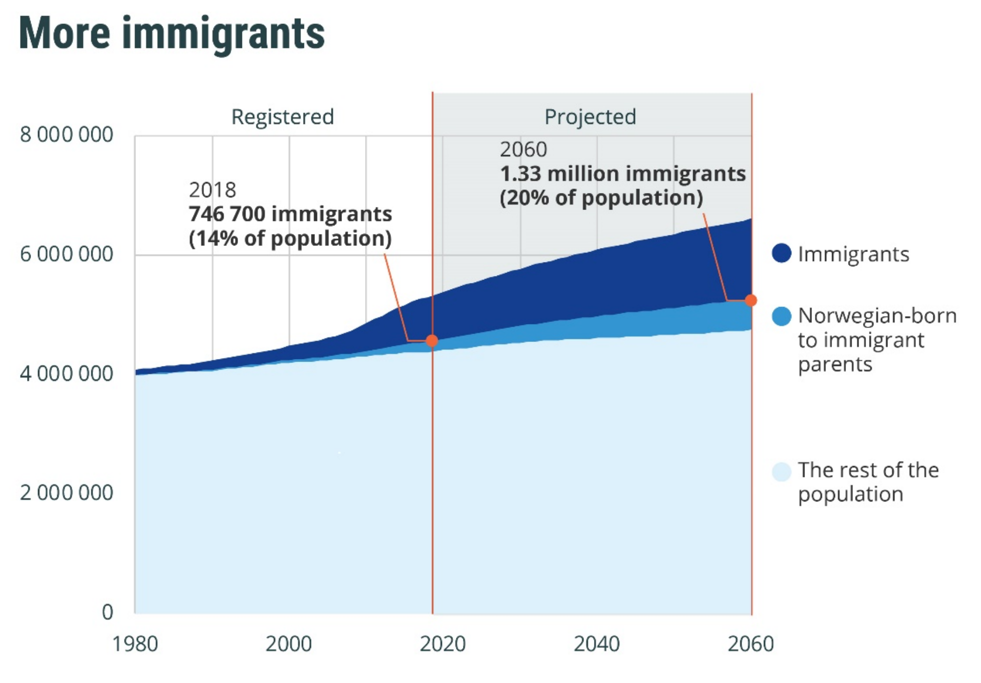
Before 2011, and as far back as 1846 when records on the population by gender began, there was always a majority of women in Norway. Even though more boys were born than girls, mortality was much higher among men than among women. Among the emigrants in the 1800s and early 1900s, there was also a majority of men. However, since 2011, there have been more men than women in the population. This is due to male-dominated immigration, which was particularly strong after the expansion of the EU in 2004, and because in recent decades men's life expectancy has been catching up with that of women.

We expect the gap in life expectancy to continue narrowing in the future. This is discussed in more detail in the chapter on mortality and life expectancy in this report. In addition, we expect immigration to remain relatively high, though not as high as in the last ten years. This is discussed in the chapter on immigration and emigration. These factors combined mean that the future population of Norway will have a larger proportion of men than today.

2.6. More immigrants in older age groups

In the main alternative of the population projections (MMMM), we have assumed substantially higher immigrations than emigrations throughout the projection period. This means that the number of immigrants in Norway will continue to increase. Figure 2.21 shows the population by immigrant background. Until 2060, the number of immigrants will increase from almost 750 000 to over 1.33 million. This is almost a twofold increase. The number of Norwegian-born to two immigrant parents will increase from 170 000 today to almost 530 000 by 2060. This is a threefold increase.

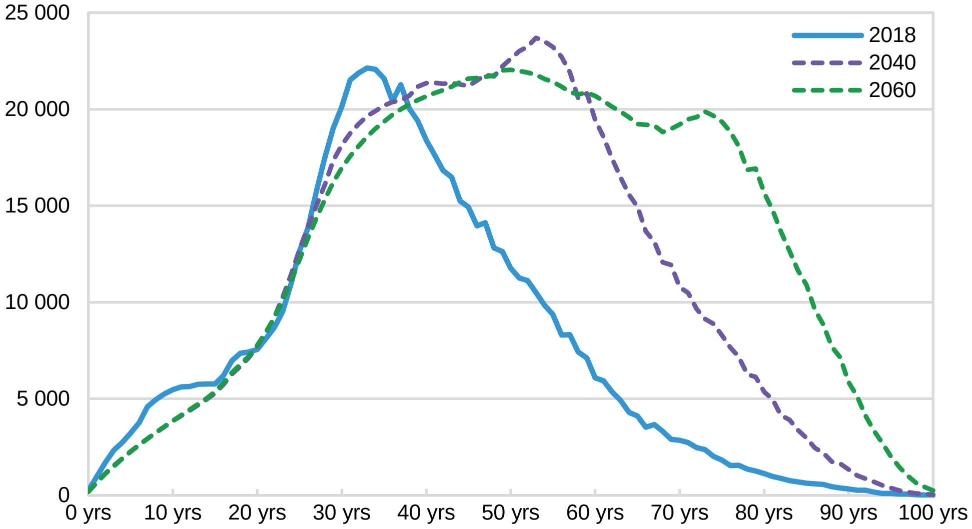
Figure 2.21 The population in three groups by immigrant background, registered 1980-2018 and projected 2019-2060, main alternative (MMMM)



Source: Statistics Norway

However, the number of immigrants does not increase in all age groups. In the main alternative (MMMM), the number of immigrants in younger age groups is projected to decline in the years to come. Population growth among immigrants in Norway is confined to age groups above 35 years, as shown in Figure 2.22. The increase in the number of immigrants in the oldest age groups is particularly evident.

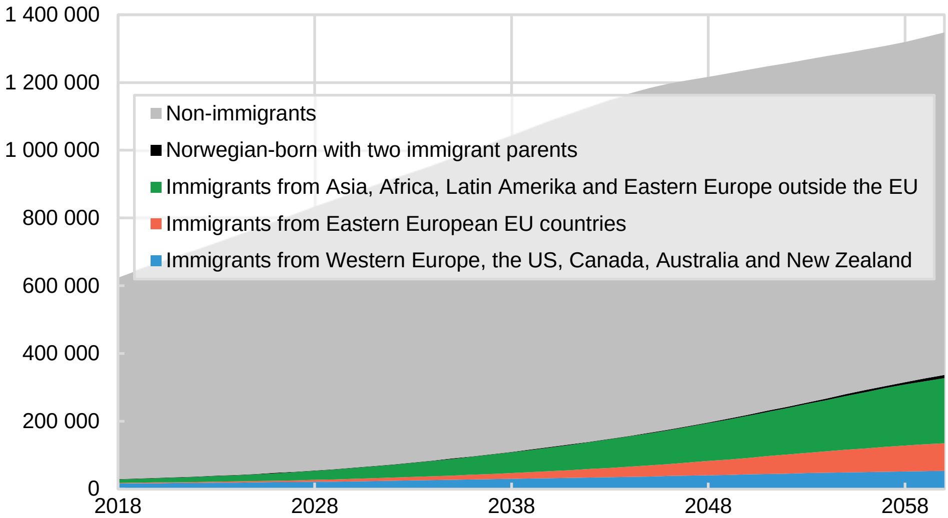
Figure 2.22 Immigrants in Norway by age, registered 2018 and projected in 2040 and 2060, main alternative (MMMM)



Source: Statistics Norway

Today, there are very few immigrants among the elderly in Norway. Less than 5 per cent of all persons aged 70 and over are immigrants. In the future, this share will increase. By 2060, immigrants will account for 24 per cent of the total population aged 70 and over, i.e. one in four elderly, according to the main alternative. Figure 2.23 illustrates this point and shows that most of the older immigrants in 2060 will have a background from Asia, Africa, Latin America or Eastern Europe outside the EU. By 2060, therefore, we can expect immigrants not only to be working in the health and care sector, but also to be users of these services. Norwegian-born to immigrant parents will comprise a minor share of the elderly in 2060.

Figure 2.23 The population aged 70 and over by immigrant background, registered in 2018 and projected 2019-2060, main alternative (MMMM)



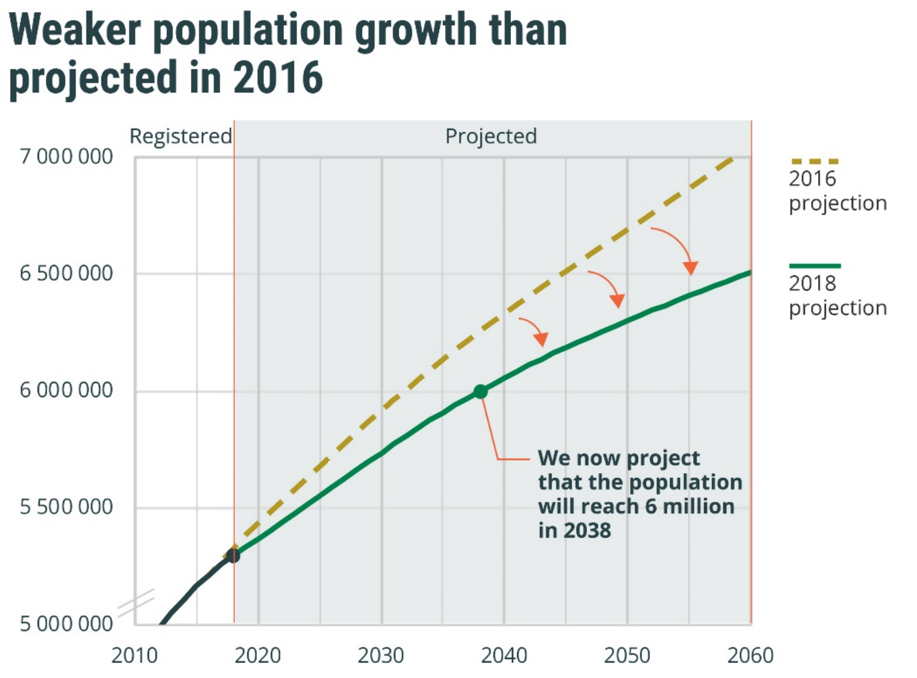
Source: Statistics Norway

Chapter 3.4 on immigration and emigration has more descriptions of immigrants who are projected to live in Norway in the future, for example, by duration of stay and country group.

2.7. Changes from previous projections

The projected population growth in Norway is not only lower than in the last ten-year period, it is also lower than what was reported in the previous population projection, published in June 2016. This is because the projected immigration is lower now and the fertility assumptions have been lowered, at least in the short and medium term. Figure 2.24 illustrates how the total population in this year's projection differs from that of the previous projection. The downward adjustment also affects the regional figures, and compared to the last projection, population growth up to 2040 is lower for all counties in the main alternative.

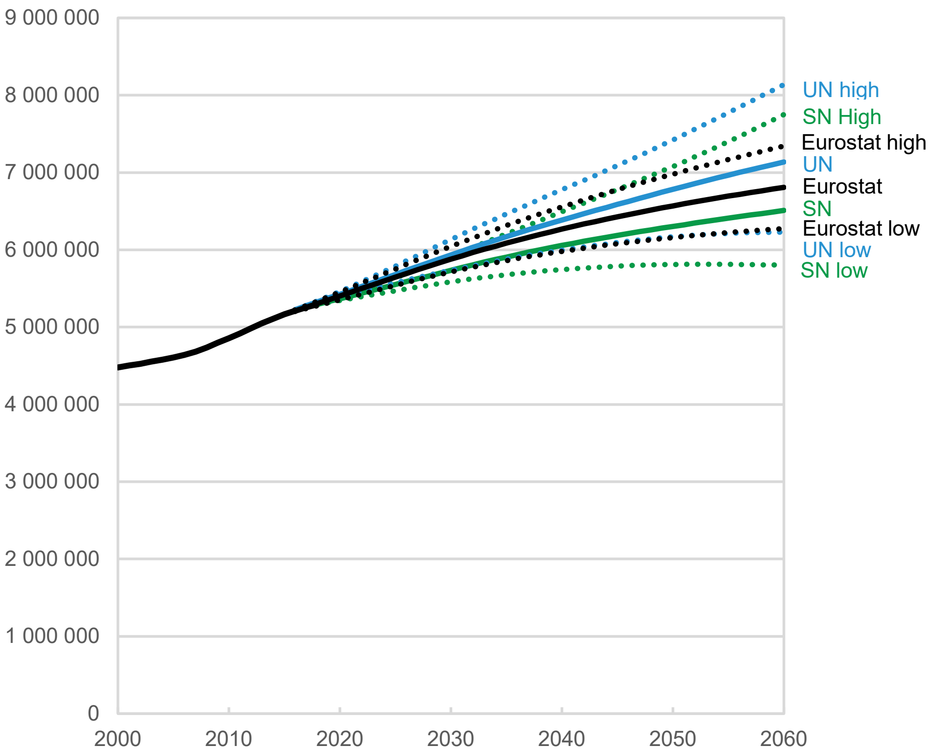
Figure 2.24 Projected population (MMMM) from the 2016 and 2018 population projections



Source: Statistics Norway

If we compare our projection to those the UN and Eurostat make for Norway, we find that the population in the main alternative of the 2018 projection is lower, as shown in Figure 2.25 (UN 2017, Eurostat 2018b). Both the UN and Eurostat projections are based on older time series and have not accounted for recent trends in fertility and immigration.

Figure 2.25 Population in Norway, registered 2000-2018 and projected by the UN, Eurostat and Statistics Norway until 2060[1]



[1] The UN's high and low alternatives correspond to 'high variant' and 'low variant'. For Eurostat, they show the high and low alternatives for immigration.
Source: UN, Eurostat and Statistics Norway (SN)

2.8. Uncertainty increases with time

All projections of the future population, its composition and geographical distribution are uncertain. The uncertainty increases the further into the future we look, and the figures are even more uncertain in projections for small groups, such as the population of municipalities by sex and age. Future immigration is particularly subject to a large degree of uncertainty, but fertility, mortality, immigration and internal migration can also end up rather different than expected. The assumptions used in projections determine the outcomes of the different alternatives, as evidenced by the variations between the different alternatives and the disparities between projections by other institutions. This is discussed in more detail in chapter 9.

Accuracy of 2016 projection

The previous population projection, which was released in June 2016, overestimated the short term population growth. Net migration turned out to be significantly lower than expected. In the 2016 projection, estimates for future immigration were boosted in the short term as a result of the high inflow of asylum seekers in the autumn of 2015. However, since then, the number of new asylum seekers has fallen sharply, and immigration from typical labor migrant countries has also fallen faster than projected. This contributed to marked deviations between projected and actual immigration in both 2016 and 2017, as shown in Table 2.5. Emigration was higher than projected, especially in 2016, which increased the deviations in net migration further. The number of births was also lower than projected, especially in 2017, while the number of deaths was about as expected.

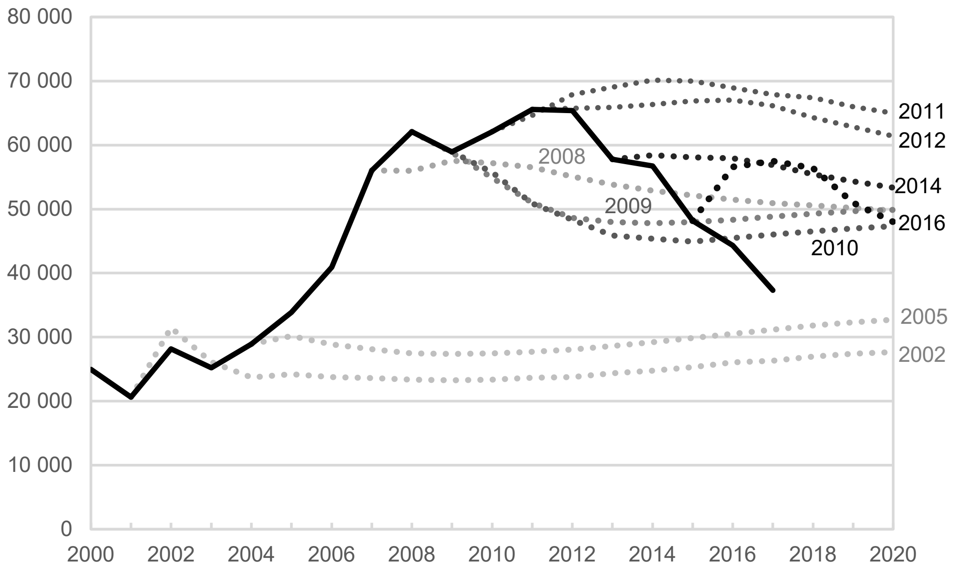
Table 2.5 short term comparisons, projected and registered figures[1]

	2016			2017		
	Projected	Registered	Discrepancy	Projected	Registered	Discrepancy
Births	59 780	58 890	890	61 016	56 633	4 383
Deaths	40 880	40 726	154	41 052	40 774	278
Immigrations	71 473	64 700	6 773	72 058	56 400	15 658
Emigrations	33 805	38 631	-4 826	34 482	35 058	-576
Population growth	56 565	44 332	12 233	57 544	37 302	20 242
Population at year-end	5 270 550	5 258 317	12 233	5 328 094	5 295 619	32 475

[1] Immigrations and emigrations exclude individuals who immigrate and emigrate during the same calendar year.
Source: Statistics Norway

Figure 2.26 shows the population growth in Norway, registered and predicted in main alternatives since 2000. While the population growth projected at the beginning of the 2000s was too low, the actual growth in 2017 was lower than in any of the projections since the 2008 projection.

Figure 2.26 Population growth in absolute numbers, registered and projected 2000-2020, main alternatives (MMMM)[1]



[1] The years denoted in the figure refer to the release of the respective projections.
Source: Statistics Norway

The discrepancy between registered and projected total population at 1 January 2018 was 32 500, or 0.6 per cent of the total population. In 190 of Norway's municipalities, the discrepancy was less than one per cent. The largest discrepancy in absolute figures was seen for Oslo, which had 673 500 inhabitants this January, 11 300 (1.6 per cent) fewer than projected.

3. Assumptions used in the 2018 projections

While chapters 5–8 describe the data and underlying methods used to produce the assumptions in the Norwegian population projections in general, this chapter provides details of the specific assumptions used in the current projection. An excerpt of the key assumptions is shown in Table 3.1.

Table 3.1 A brief summary of key assumptions[1]

	2017 Registered	M Main alternative	H High alternative	L Low alternative
Total fertility rate (TFR, i.e. no. of children per woman)	1.62			
2020		1.60	1.73	1.48
2040		1.76	1.94	1.59
2060		1.76	1.94	1.59
Life expectancy at birth, men	80.9			
2020		81.6	82.2	81.0
2040		85.4	87.0	83.6
2060		88.4	90.4	86.0
Life expectancy at birth, women	84.3			
2020		84.7	85.2	84.2
2040		87.8	89.3	86.2
2060		90.3	92.1	88.1
Yearly immigrations	56 400			
2020		51 400	58 800	45 700
2040		48 900	70 800	40 800
2060		49 000	91 200	36 400
Yearly emigrations	35 058			
2020		32 200	33 100	31 300
2040		31 600	39 500	28 000
2060		32 000	49 800	25 800

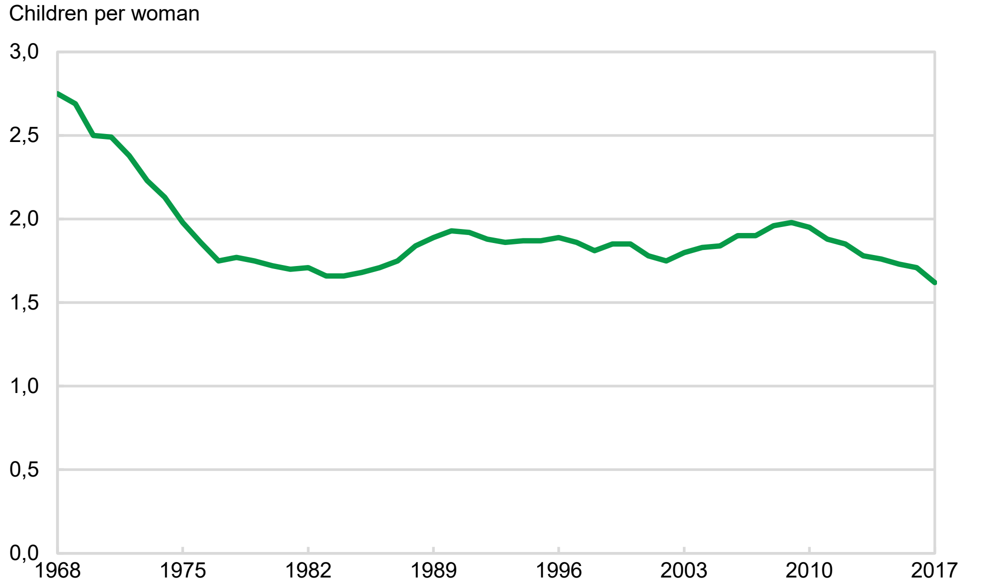
[1] Immigrations and emigrations exclude individuals who immigrate and emigrate during the same calendar year. The number of emigrations in the low and high alternative result from the low (LLML) and high (HHMH) national growth alternatives.
Source: Statistics Norway

3.1. Fertility

Assumptions at the national level

In the model that projects the population at a national level (BEFINN), we project the fertility for different groups of women, depending on immigrant characteristics. In addition to calculating fertility for Norwegian-born women (i.e. non-immigrants), we also factor in the fertility disparities between immigrant women in 15 combinations of country background and duration of stay in Norway. First, we ascertain the output levels for the different groups in the empirical, historical data. Next, we make assumptions on how we think fertility will develop over time. The historical development of the total fertility rate for all women is shown in Figure 3.1.

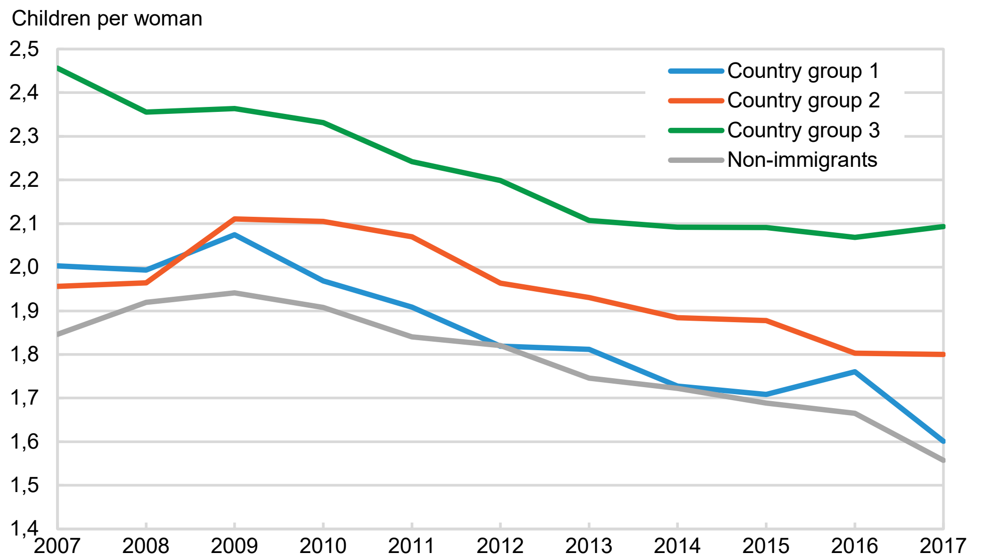
Figure 3.1 Total fertility rate in Norway, 1968-2017



Source: Statistics Norway

Fertility among immigrants
The recent development of the total fertility rate for immigrants from each country group is shown in Figure 3.2. Tønnessen (2014a) finds that immigrant fertility declines as the duration of stay in Norway increases. To estimate how many children will be born to immigrant women in the future, the immigrant women are first divided into three country groups (see Appendix B) and then into a further five groups according to their duration of stay (1 year or less, 2–3 years, 4–6 years, 7–11 years and 12 years or more). In total, this constitutes (3 x 5) 15 combinations of country group and duration of stay groups. In order to determine the fertility output level in the 15 different groups, age-specific fertility rates are calculated for each group as an average over the last ten years. This is a weighted average where the last year with available data counts the most.

Figure 3.2 Total fertility rate in Norway by country group, 2007-2017



Source: Statistics Norway

In order to calculate the number of Norwegian-born children to two immigrant parents we also make assumptions about the proportion of immigrant women who will have children with immigrant men (see Figure 3.34 later in this chapter).

Fertility among the rest of the population
Once we have calculated the fertility output level for immigrant women, we calculate the fertility of the remaining women (i.e. the majority). Norwegian-born daughters to one or two immigrant parents are also included in this group. To determine the fertility output level among these women, age-specific fertility rates are calculated for the last year.

Assumptions at the regional level

The projections of regional fertility are based on the fertility disparities in the past decade between 68 geographic regions – referred to as fertility regions. The future regional fertility development is determined by adjusting the output level in these regions proportionally with the future national fertility development. The regional fertility disparities are thereby accounted for since the output level of each fertility region is different, but we assume that the absolute differences between fertility regions remain constant throughout the entire projection period. The number of births and children below the age of 1 in the projection regions is then added up for the counties. Then the children below the age of 1 are broken down into municipalities using 55 fertility profiles. These profiles depend on the number of women in the municipality and their fertility level.

The 2018 assumptions for fertility

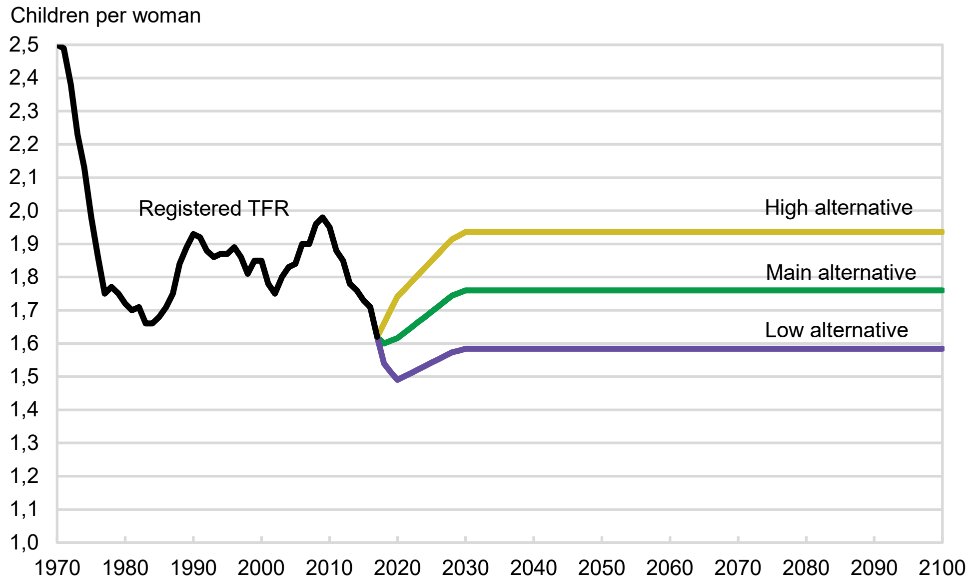
Once we have calculated the output level of fertility in the 16 groups (non-immigrant women and 15 groups of immigrant women), we need to make assumptions about how fertility will develop over time. For each year in the projection period, we use a factor that adjusts the age-specific fertility rates up or down. To illustrate the uncertainty attached to future fertility levels in Norway, we create three different alternatives for the fertility assumptions: low, medium (main alternative) and high. In combination, this constitutes three annual factors. The factors are determined by Statistics Norway after discussions with an advisory reference group consisting of fertility researchers.

Based on a summary of empirical knowledge of fertility trends and figures on births in the first quarter of 2018, we believe that the decline in fertility that we have seen since 2009 is about to come to an end. In the main alternative, we assume therefore that the drop in the fertility rate will level off in 2018 with a TFR of 1.60, before gradually increasing to a long term level of 1.76 in 2031.

In the low alternative, the TFR will reach a low point of 1.48 in 2020, which is close to the level we saw in Finland in 2017. Finland has the lowest fertility among Norway's neighboring countries and has also had a lower TFR than Norway almost every year since 1960. In the long run, the low alternative is assumed to gradually approach a TFR of 1.59. This long term low alternative level is 10 per cent below the long term level of the main alternative and is shown in Figure 3.3.

The high alternative for the TFR is expected to reach a level of 1.72 in the short term, which is close to the level we had in Norway in 2015. In the longer term, the high alternative is assumed to gradually approach a TFR of 1.94. This long term high level is 10 per cent above the long term level of the main alternative and is shown in Figure 3.3.

Figure 3.3 Registered total fertility rate and three alternative fertility assumptions, 1968-2100



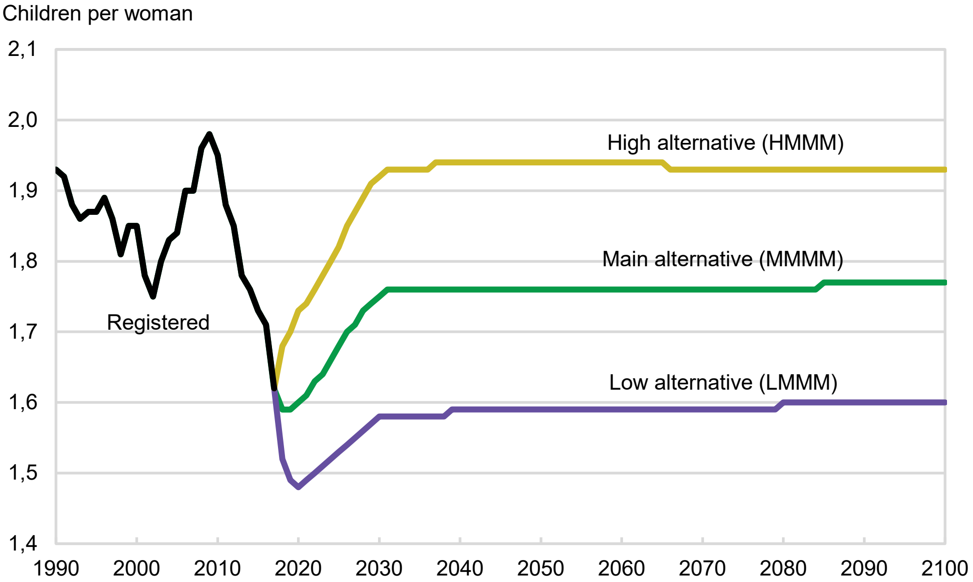
Source: Statistics Norway

The three alternatives in Figure 3.3 are the baseline fertility rate assumptions. These assumptions form the basis for calculating the factor we use to scale the fertility rates for all 16 groups of non-immigrants and immigrants. For example, the baseline level of fertility in the main alternative is 1.76 in 2030 (and onwards), which is 8.6 per cent higher than the TFR of 1.62 in 2017. This means that the fertility rates in the main alternative will be 8.6 per cent higher in 2030 (onwards) than the current level for all 16 groups. For the high- and low alternative the factor in 2030 (onwards) will be 19.8 per cent higher and 2.5 per cent lower than the current levels, respectively. This means that the long term level of TFR for the non-immigrant women, which was 1.56 in 2017, will end up at 1.70 from 2030 and onwards. The high alternative TFR for these non-immigrant women will end up at 1.87, while the low alternative will end up at 1.53.

Implications for projected fertility

Figure 3.4 shows the registered TFR for all women in the period 1990–2017 and the assumptions for 2018–2100 in the main alternative (MMMM), as well as the alternatives with low and high fertility (LMMM and HMMM respectively). As mentioned earlier, we apply the same assumptions of percentage change to fertility for all 16 groups of women. The reason why the projected total TFR changes somewhat over time is that the composition of women, with different immigrant backgrounds and durations of stay, will change somewhat throughout the projection period. It is also dependent on the assumptions about future immigration, as discussed later in this chapter.

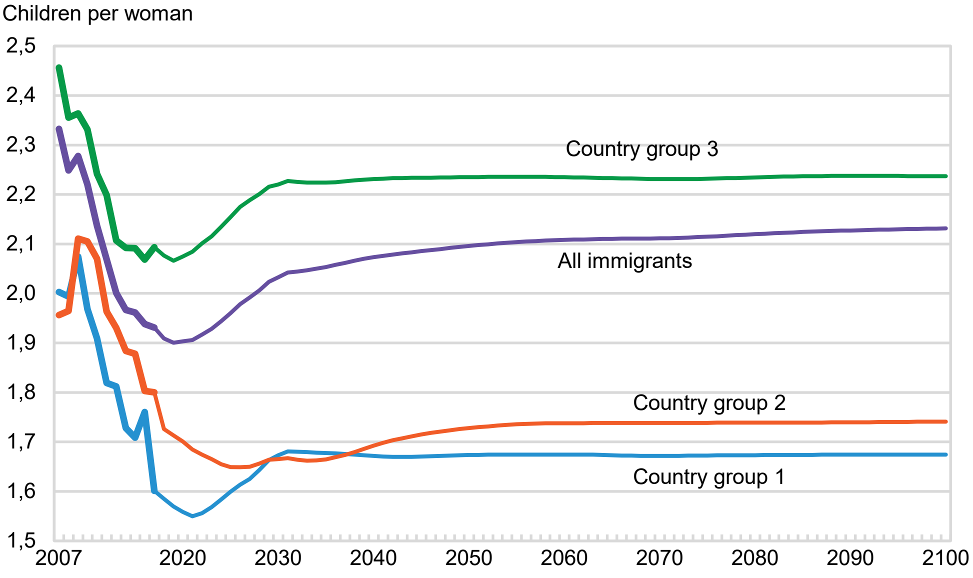
Figure 3.4 Registered and projected total fertility rate in Norway 1990-2100 in three alternatives



Source: Statistics Norway

Figure 3.5 shows registered TFR for immigrant women from each of the three country groups from 2007–2017, and the main alternative projections until 2100. In the short term, the fertility level will slightly increase for women from country groups 1 and 3, before stabilizing from 2031 onwards. This is in accordance with the assumptions for gradual phasing-in of long term levels of TFR discussed earlier. For country group 2, however, there is a relatively large decrease in fertility in the short term, stabilizing in the long term at a level that is well below today's level. One explanation for this pattern is that we expect lower immigration from this group throughout the projection period, and that more women will thus end up in groups with a long duration of stay, which gives a lower fertility level. Overall, long term fertility for women with immigrant backgrounds will stabilize at a level of just over 2.1 children per woman.

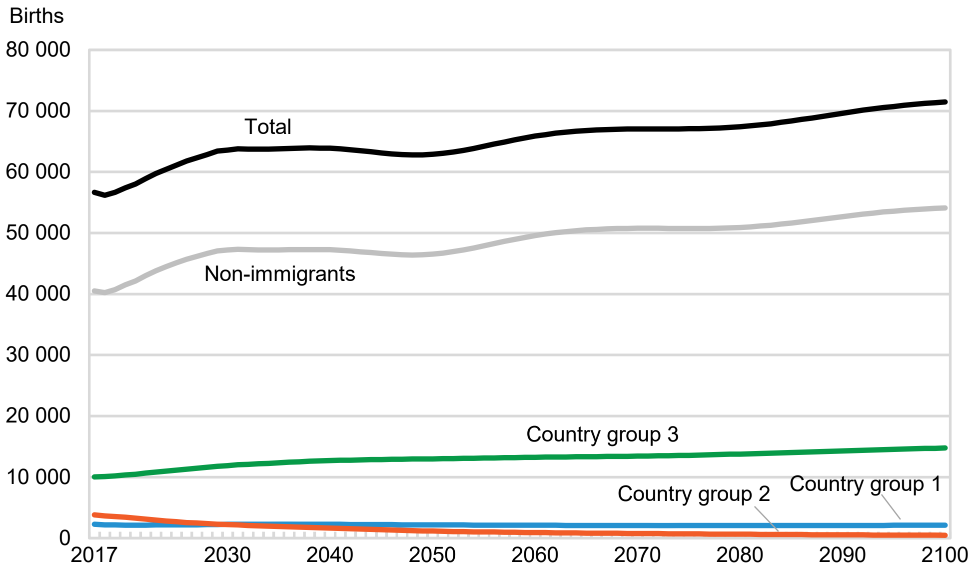
Figure 3.5 Total fertility rate in Norway by country group, registered 2007-2017 and projected 2018-2100, main alternative (MMMM)



Source: Statistics Norway

Figure 3.6 shows the development in the number of births throughout the period for the main alternative (MMMM). The number of future births is determined both by the set fertility levels and the number and age composition of the women of childbearing age. According to our main alternative, the number of births will increase from 56 633 today, to around 63 900 and 65 900 in 2040 and 2060, respectively.

Figure 3.6 Projected births in total and by immigration background, 2017-2100, main alternative (MMMM)



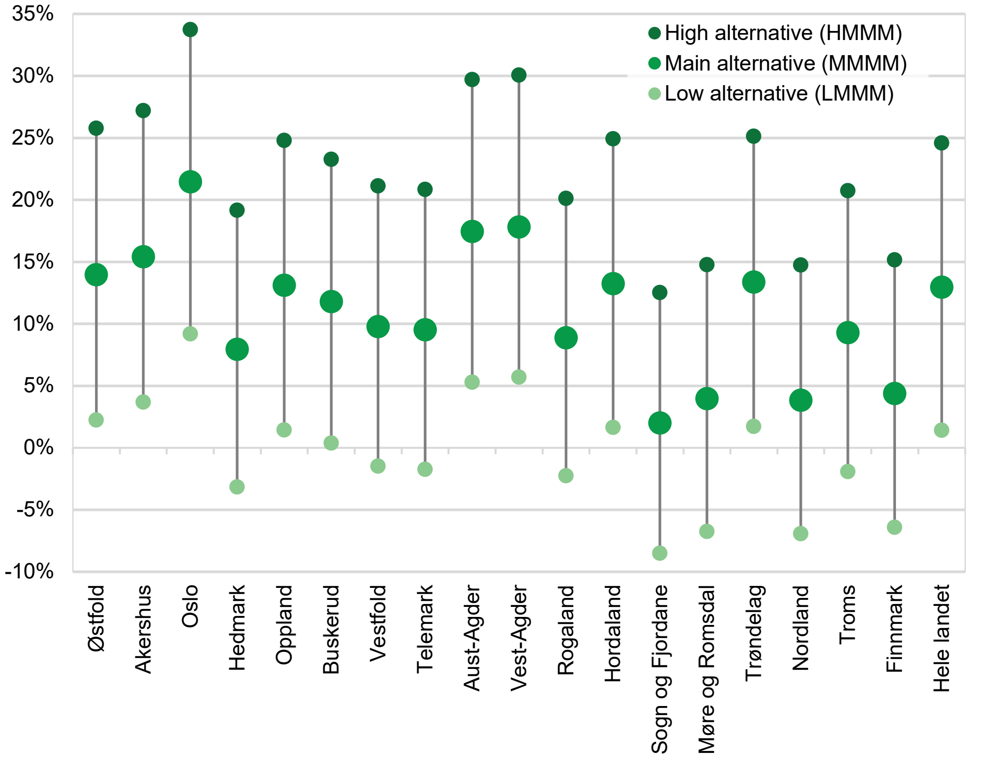
Source: Statistics Norway

In the low fertility alternative (LMMM), the number of births will be slightly higher in 2040 with around 57 400 births, then sink slightly towards 2060 to about 55 500. In the high fertility alternative (HMMM), the number of births rises quite sharply up to 2040 to around 70 400, and further to around 77 100 in 2060.

In 2017, around 28 per cent of all children were born to an immigrant woman, and in the main alternative this percentage is expected to fall somewhat during the projection period. The proportion born to a woman from country group 3 increases throughout the period, from 18 per cent in 2017 to about 20 per cent in 2060, while the proportion born to a woman from country group 2 drops considerably from seven per cent in 2017 to about one per cent in 2060. It may be interesting to note that the number of children born to a woman in country group 1 surpasses the number of children born to a woman in country group 2 in 2030.

As mentioned, the existing regional differences in fertility are maintained throughout the projection period. Thus, fertility is low in Oslo, Troms and Telemark, and remains high in Western Norway. Looking closer at the projection regions, the Hedmark municipalities in Kongsvinger and the surrounding areas will have the lowest fertility in 2040, with just over 1.6 children in the main alternative. The highest fertility is found in the municipalities Lyngdal, Farsund and Hægebostad in Vest-Agder,

Figure 3.7 Projected percentage growth in number of births from 2017 to 2040 by county in three alternatives



Source: Statistics Norway

3.2. Life expectancy

Assumptions for future life expectancy at birth and remaining life expectancy are calculated from projected probabilities of death. A detailed explanation of the models used to obtain the probabilities of death and the discretionary assessments made is given in chapter 6. In short, we employ a modified Lee-Carter model (Lee & Carter, 1992, Li & Lee 2005, Lee 2000). The method estimates parameters of change in mortality levels over time by sex and age, and we use a product-ratio version to reduce the correlation between the mortality rates for men and women (Hyndman et al. 2013). Next, to make assumptions about how mortality will develop in the future, we use what is known as an ARIMA model (Wei 2006), which stands for Auto-Regressive Integrated Moving Average. In this model, we include a 'random walk with drift', which means that we factor in a mortality trend that we expect to continue in the future.

Statistics Norway's population projections primarily use three alternative paths for the future development of life expectancy: medium (M – the main alternative), low (L – low life expectancy/high mortality) and high (H – high life expectancy/low mortality). The estimated projected alternative is called the main alternative, for which we give an 80 per cent prediction interval (Savelli & Joslyn 2013). The upper limit in the prediction interval for mortality rates gives us the low alternative, while the lower limit gives the high alternative. At the national level, we also provide a constant alternative (K), where the probabilities of death in the main alternative for the first projection year are kept constant throughout the entire projection period.

Assumptions at the national level

At the national level, probabilities of death are applied by sex, age in years and calendar year. The same mortality is assumed for immigrants as for others, since the disparities on average are below 10 per cent and decline further for immigrants with a long duration of stay in Norway (Syse et al. 2016, Syse et al. 2018).

The probabilities of death are fed into the BEFINN model, to calculate the number of deaths. The number of deaths is necessary to calculate the overall population figures.

Life expectancy at birth and remaining life expectancy are calculated directly from the probabilities of death.

Assumptions at the regional level

At a regional level, we account for existing regional differences in mortality. We let the mortality level vary between the counties (N=18) and between Oslo's largest districts (N=15). In total, we thus have 32 regions, where the death rate is allowed to vary by region, age in years and sex. To determine the mortality output level in the 32 mortality regions, age-specific mortality probabilities are calculated as an average of the last ten years in each mortality region. This is a weighted average where the last year with available data counts the most. Once we have ascertained the output level in each region, we add assumptions about future mortality at a national level. The national assumptions are the same in BEFINN and BEFREG.

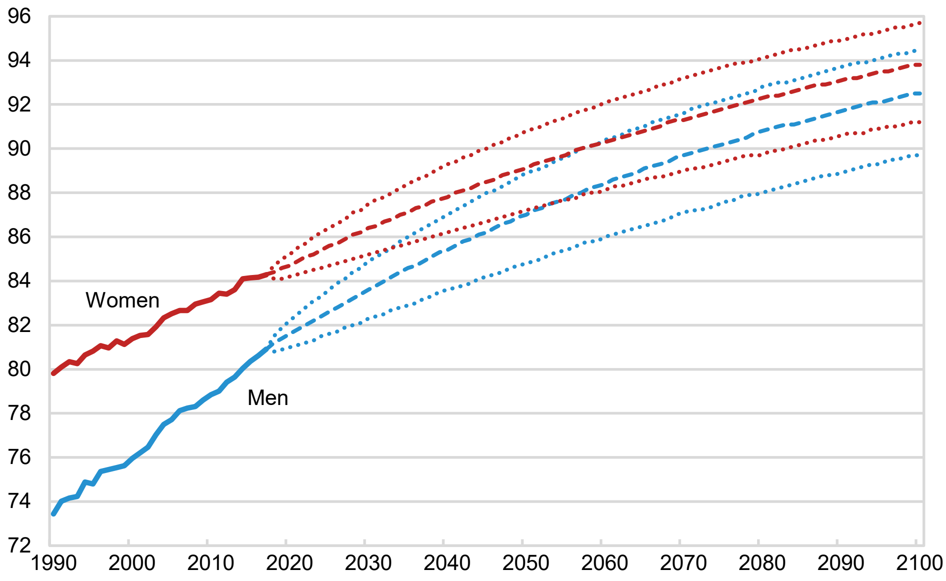
The future regional mortality trend is determined by adjusting the output level in the 32 mortality regions proportionally to the future national development in mortality. The regional mortality disparities are thus factored in since the output level by age in years and sex is different in each mortality region. Thus, we assume that the disparities between the mortality regions remain constant throughout the entire projection period.

In the population projections, we calculate the future population by sex and age in years in 108 projection regions. Projection regions that belong to the same mortality region will therefore have the same age-specific probabilities of death. We only calculate the number of deaths at county level and for projection regions, not at the municipality level.

2018 assumptions for life expectancy

This year's projections are based on developments in mortality during the period 1990–2017. We assume that mortality will continue to decline. In our main alternative, life expectancy at birth for men will rise from around 81 years in 2017 to above 88 years in 2060, i.e. an increase of about 7.5 years. This is shown in Figure 3.8. For women, we have assumed a slightly less pronounced increase from a little over 84 years in 2017 to just over 90 years in 2060, i.e. an increase of about 6 years. In the low alternative, the increase will be weaker – around 5 years for men and 4 years for women respectively – over the same time period. In stark contrast, life expectancy in the high alternative will increase sharply, with almost 10 years for men and close to 8 years for women.

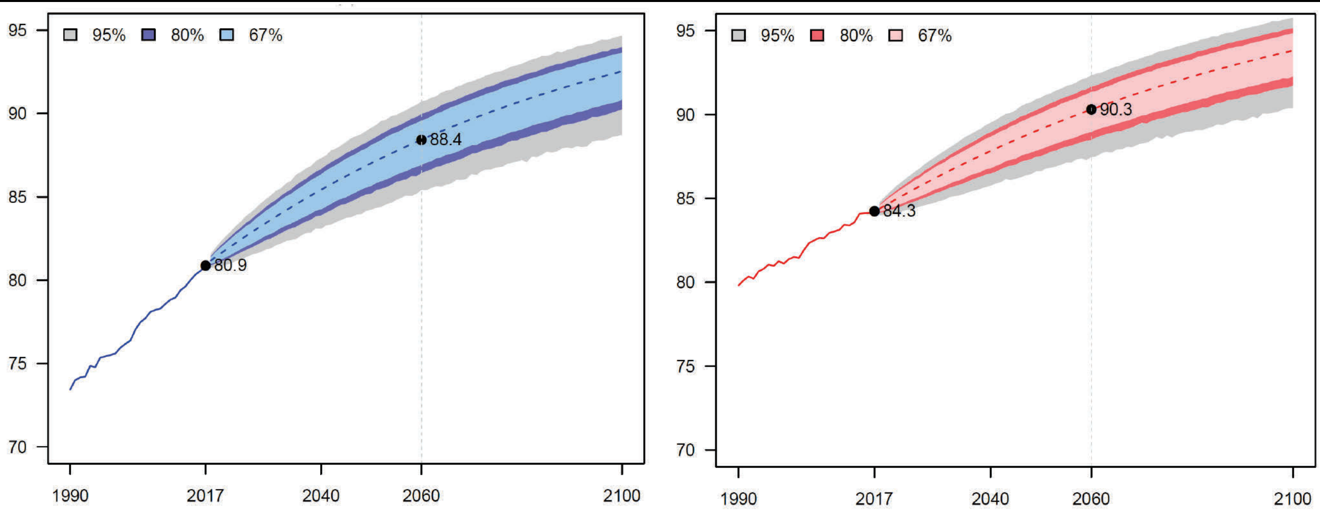
Figure 3.8 Life expectancy at birth for men (blue) and women (red), registered 1990-2017 and projected 2018-2100 in three alternatives



Source: Statistics Norway

The high and low alternatives for a specific year coincide with the limits of an 80 per cent prediction interval. However, we also opt to show the 67 and 95 per cent prediction intervals in order to highlight the large uncertainty associated with projections of mortality (Figure 3.9).

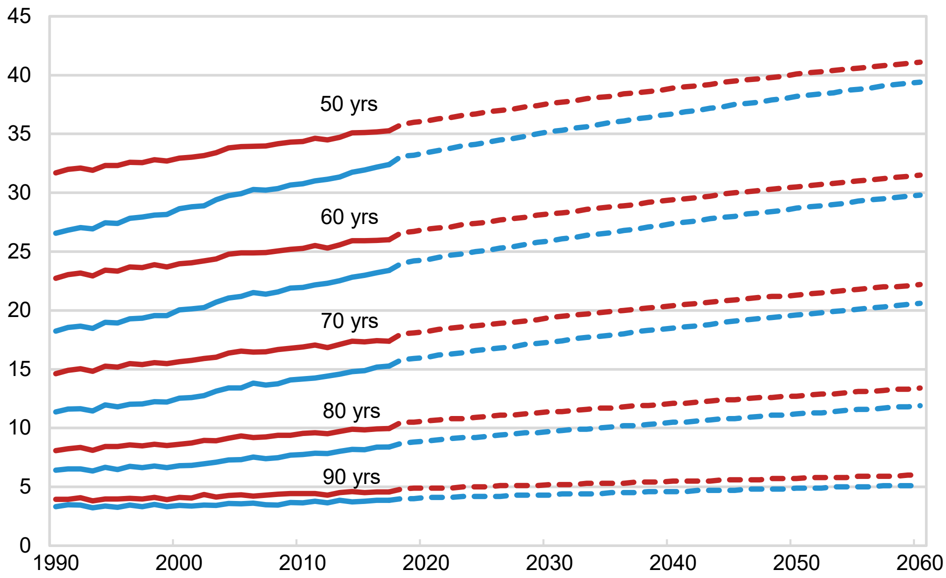
Figure 3.9 Main alternative (dashed line) and prediction intervals for life expectancy at birth for men (blue) and women (red)



Source: Statistics Norway

One of the main reasons for the projected increase in life expectancy at birth is the expected increase in remaining life expectancy in older age groups, as shown in Figure 3.10. According to the main alternative, the remaining life expectancy for 70-year-olds will be around 4-5 years higher in 2060 compared to today. The increase is also pronounced for the 80-year-olds, who can expect to live 3 years longer in 2060. This is also reflected in the mean age of death, which for men is expected to increase from 77 years today to almost 88 years in 2060, in the main alternative. The increase for women is less steep, from today's 82 to almost 90 years in 2060.

Figure 3.10 Registered and projected remaining life expectancy at age 50, 60, 70, 80 and 90 for men (blue) and women (red), main alternative (M)



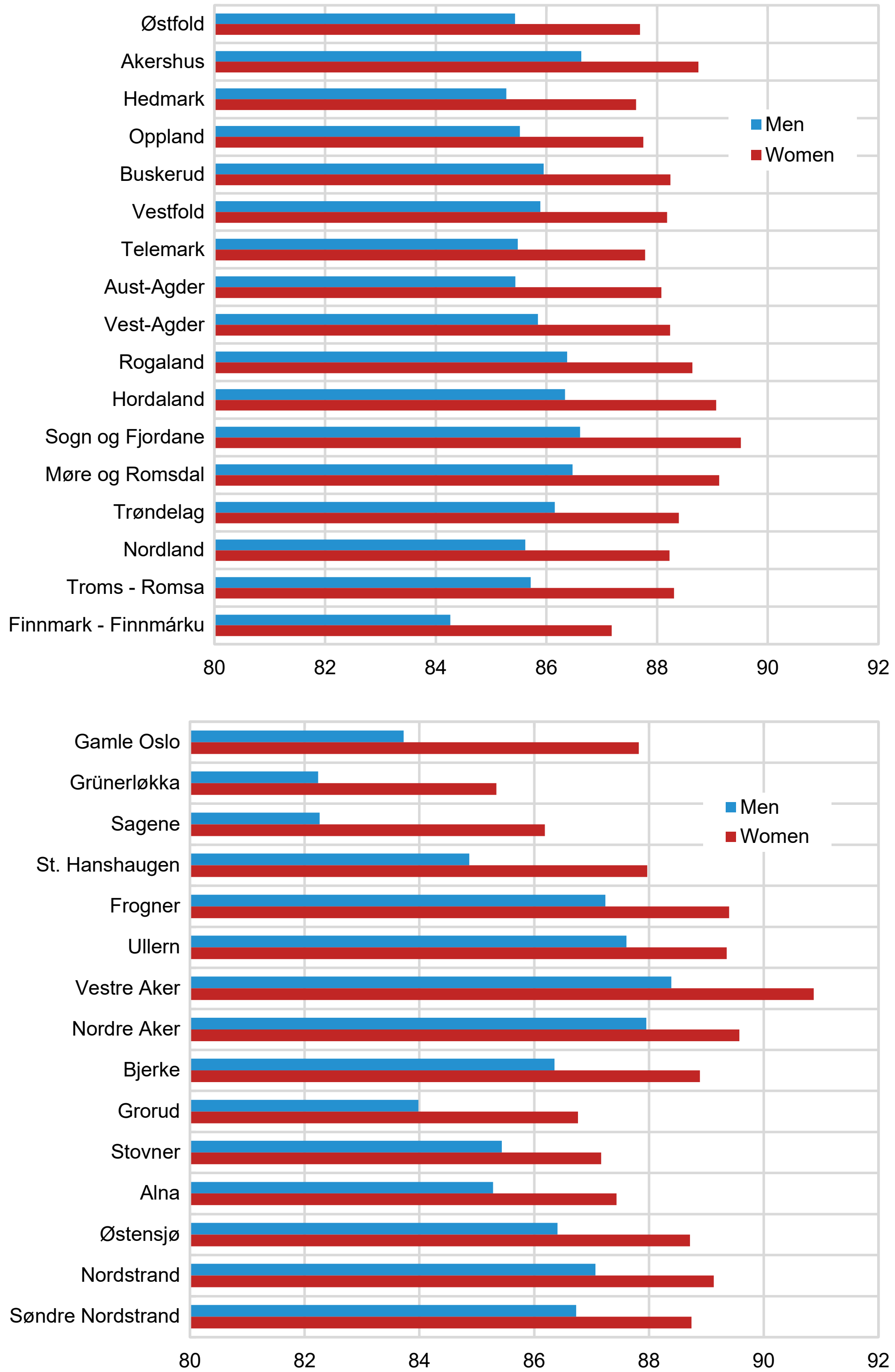
Source: Statistics Norway

In the long term, it is assumed that life expectancy for men will increase faster than for women. Thus, it is assumed that the disparity in men and women's life expectancy will decline further in almost all age groups. If our assumptions reflect the actual development, the sex disparity in pensioners' remaining life expectancy will steadily narrow in the years to come.

As the regional differences in the age and sex-specific probabilities of death between counties and Oslo's major districts are projected to remain proportionally similar to those observed over the last decade in our projections, they primarily reflect already existing differences.

The gap between life expectancy at birth along with the remaining life expectancy at specific ages will nevertheless decrease slightly until 2040, as the regional disparities have declined slightly over the past decade. According to the main alternative, the difference in life expectancy between the counties with the highest and lowest life expectancy at birth will be around 2.4 years for men and 2.3 years for women in 2040 (Figure 3.11). For Oslo's major districts, the corresponding differences will be 6.2 and 5.5 years. The differences between the counties are most pronounced for the youngest ages. This applies to both empirically calculated estimates as well as projected figures. As such, it is essentially inequalities in relatively early deaths that are responsible for the observed differences, especially for the counties.

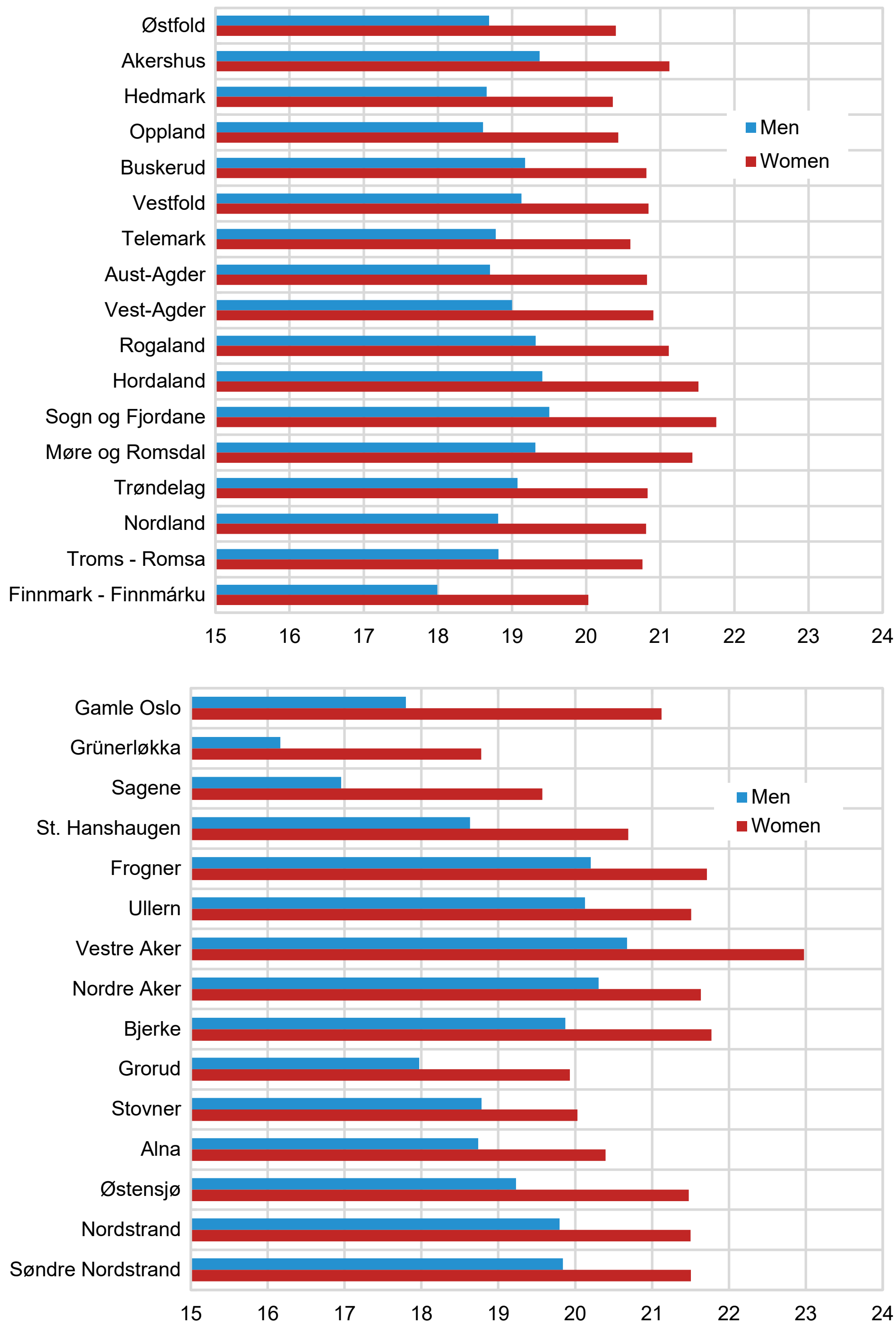
Figure 3.11 Projected regional differences in life expectancy at birth for men (blue) and women (red) in 2040. Counties and Oslo's districts, main alternative (M)



Source: Statistics Norway

As shown in Figure 3.12, the absolute differences between counties are significantly lower at age 70 in 2040; 1.5 years for men and 1.7 years for women. For Oslo's districts, inequalities also persist in older ages, and the differences between Oslo's districts at age 70 in 2040 are 4.5 and 4.2 years for men and women respectively.

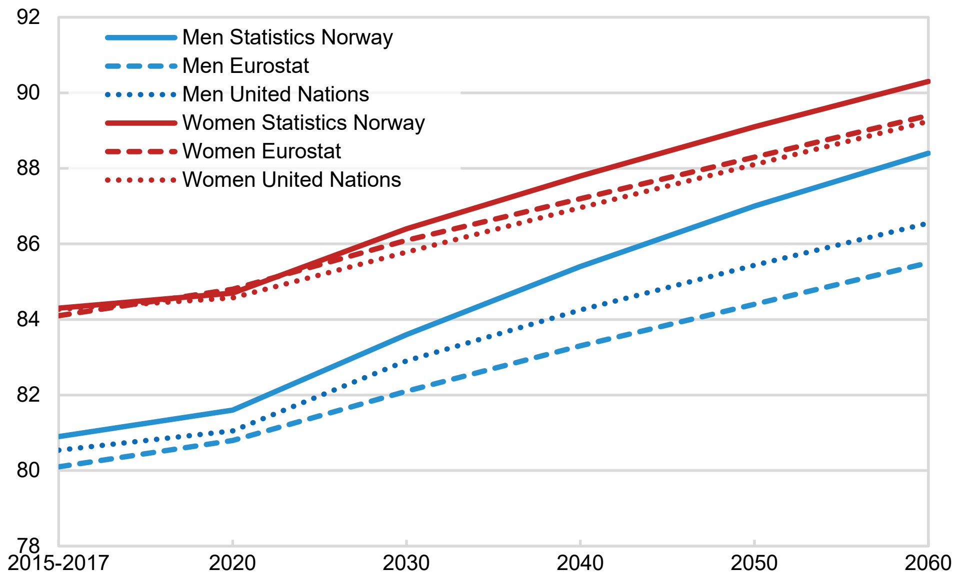
Figure 3.12 Projected regional differences in life expectancy at age 70 for men (blue) and women (red) in 2040. Counties and Oslo's districts, main alternative (M)



Source: Statistics Norway

When we compare the current assumptions for life expectancy with those used by the UN and Eurostat, it is evident that Statistics Norway's assumptions show a more marked increase in life expectancy at birth for both men and women, although the difference is most pronounced for men (Figure 3.13).

Figure 3.13 Projected life expectancy at birth for men (blue) and women (red) for Norway, by Statistics Norway, the UN and Eurostat, medium alternatives[1]



[1] For the UN, the medium fertility alternative was used.
Source: Statistics Norway, UN and Eurostat

To summarize, we assume a pronounced increase in life expectancy at birth and remaining life expectancy in this year's projections. Consequently, older people will constitute an increasing share of the population in the years to come. At the same time, the mean age of older people will continue to rise.

The mortality gap between men and women is expected to narrow, and there will only be around a two-year difference in men's and women's life expectancy at birth in 2060, according to our main alternative.

3.3. Internal migration

The national population model (BEFINN) does not model internal migration. However, in the regional population model (BEFREG), internal migration is an essential element in estimating how the population in Norway will be geographically distributed in the future. Unlike the assumption for immigration, mortality and fertility, the assumptions for internal migration are not based on separate models or baseline scenarios set after discussions with experts. The modelling of internal migration uses the last 10 years of observed migration to determine the future population's movements. The method is based on demographic migration probabilities and is rather mechanical.

Internal migration is estimated in two steps. First, we calculate the probability of moving out of a region. Second, we determine the destination of the migrants based on historical migration patterns. There are two rounds of relocation. First between regions, then between municipalities within regions. The last type of relocation is described in more detail in Chapter 7.[1]

[1] The regional population model projects the population in large municipalities directly, while for the smaller municipalities, aggregate regions are used. Read more about the model in Chapter 7. A tabulation of the regional classification can be found in Appendix A.

As mentioned, to model internal migration, the model calculates migration probabilities. These probabilities are computed for each sex from age 1 to 69. In the model, the opportunity to relocate is therefore limited by age. The frequency of migration drops quite markedly after age 70, thus making it difficult to estimate appropriate migration probabilities for this group. Since migration encompasses both internal and international migration, two separate sets of probabilities are calculated.

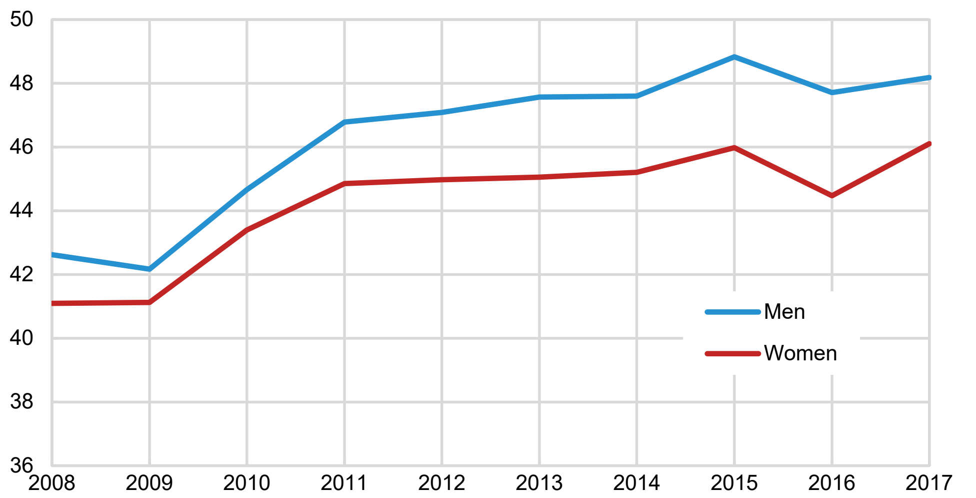
The destinations of internal and international migrants are determined by a migration matrix. The matrix is based on observed migration flows in the last 10 years and, in principle, uses proportions to distribute migrants. For instance, if on average 5 per cent of all 22–24-year-old men from Trondheim have moved to Bergen in the last ten years, that will also be the case in the projection.

2018 assumptions for internal migration

The regional population model mainly assumes that the flow rates we have seen over the past ten years will continue throughout all projection years, 2018–2040. An examination of the migration pattern across municipalities in the period 2008–2017 shows that the model generally gives men higher mobility than women. Nonetheless, young women move more than young men. Looking at migration behavior in general, it is mainly children below school age and young adults that move. They move towards central areas, which leads to a shift in age structures and a more aging population in rural areas.

From Figure 3.14, we see that the propensity to move between municipalities has increased throughout the period. This applies to both sexes. Women generally move somewhat less than men. In 2008, about 41 women and 43 men per thousand moved within Norway. In 2017, the corresponding figures were 46 and 48. Immigrants have a higher propensity to move compared to the rest of the population. The population consisted of a higher share of immigrant men than immigrant women during this period, which can explain part of the discrepancy. The likelyhood to move around is somewhat lower in the years around the financial crisis, especially in 2008 and 2009. There is also somewhat lower mobility in 2016, which may be influenced by the dramatic shift in oil prices (Statistics Norway 2018). Lower geographical mobility in economic slumps has also been found for other countries and is often explained by fewer labor market opportunities (Saks & Wozniak 2011).

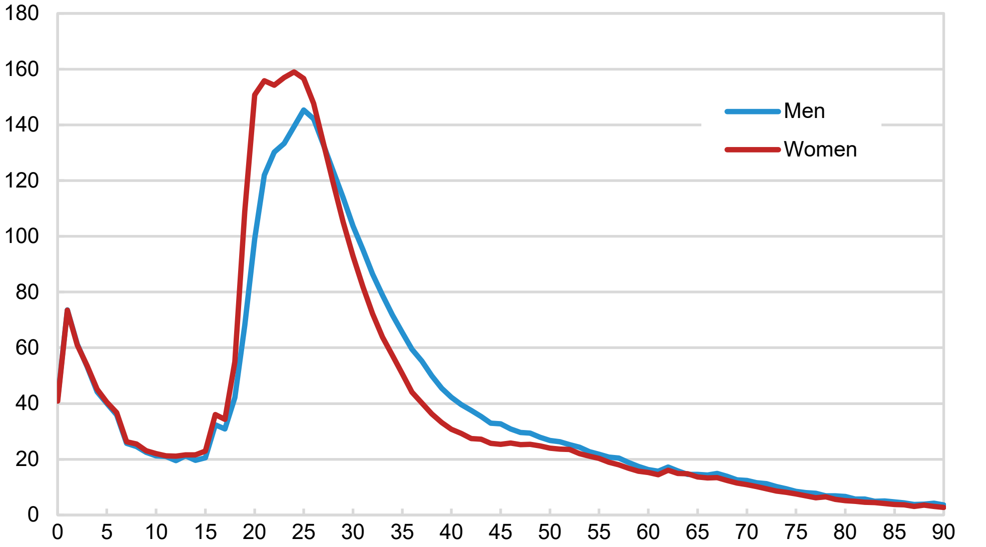
Figure 3.14 Internal migration probabilities across municipalities per 1000 capita, by sex[1]



[1] Internal migration probability is defined as the number of relocations across municipalities relative to beginning of year population, for each sex.
Source: Statistics Norway

The propensity to move is higher at certain ages and in certain life phases. From Figure 3.15, we can see that young adults move the most. In particular, mobility is very high for the age group 19–25, behavior that is most likely linked to studies and early career choices. Men display a peak at age 25 with about 145 moves per thousand, while women move most at age 24 with 159 moves per thousand. The migration propensity of women and men is similar up to the end of the teen years. After that, women have a higher mobility than men until age 28. Men subsequently have higher mobility until age 63. Children move (with their parents) relatively often until school age. Thereafter, mobility is rather flat until the age when higher education normally begins (Tønnessen et al. 2016b). In general, mobility is low for people over 50 years.

Figure 3.15 Internal migration probabilities across municipalities per 1000 capita, by age and sex[1]



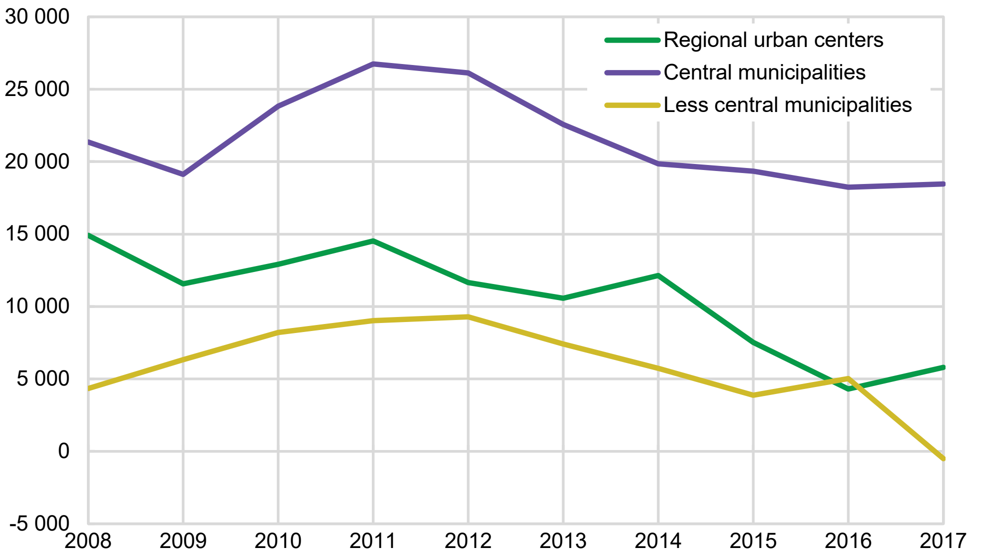
[1] Internal migration probability is defined as the number of relocations across municipalities relative to beginning of year population, for each sex. It is denoted as the average over the years 2008–2017 for each one-year age group.
Source: Statistics Norway

Historically, there has been a strong centralization trend in Norway, as an increasing proportion of the population has settled in central areas. The rate of centralization was particularly strong – and the highest in Europe – in the 19th century (Helle et al. 2006). Compared with Sweden, Denmark and Iceland, Norway experienced less urbanization in the 1900s, especially in the years between the world wars. Consequently, relative to our neighbors, the Norwegian urbanization process has been slower. Sweden and Denmark already had a population density in urban areas of 80 per cent in the 1960s, which is the urban density in Norway today (Ministry of Local Government and Modernisation 2018). Although the place-based policies in favor of rural areas are different in these countries, the long term trend indicates that it is reasonable to expect continued centralization in Norway.

Relying on urban economic theories and empirical findings, we would expect increased urbanization in Norway in the future. There are several reasons for this. First, workers in cities generally have higher wages and more jobs to choose from (Carlsen et al. 2017, Leknes 2017). Second, cities are perceived as desirable places to live and tend to become more attractive as they grow (Albouy 2012, Glaeser et al. 2001, Leknes 2015). Third, as the population becomes more centralized, there will be more people with family and social networks in cities, which might make these places even more attractive.

In Figure 3.16, all of the Norwegian municipalities are categorized into three groups based on Statistics Norway's centrality index. The index is constructed on the basis of travel time to workplaces and service functions (Høydahl 2017). The three groups are labelled regional urban centers, central municipalities and less central municipalities. The regional urban centers consist of Oslo, Bergen, Trondheim, Stavanger, Kristiansand and Tromsø. From Figure 3.16, we see that centralization is, at least partly, driven by the migration behavior. Central municipalities, excluding regional urban centers, are growing the most. The central municipalities generally have a higher net migration than the less central municipalities. The exception is the year 2016, when the groups all have growth of about 5 000 from net migration. The less central municipalities also generally have positive growth from net migration, except in 2017. This year the net out-migration is about 500. It is important to remember that migration is not the only demographic source of centralization in Norway, fertility and mortality patterns can also be of importance.

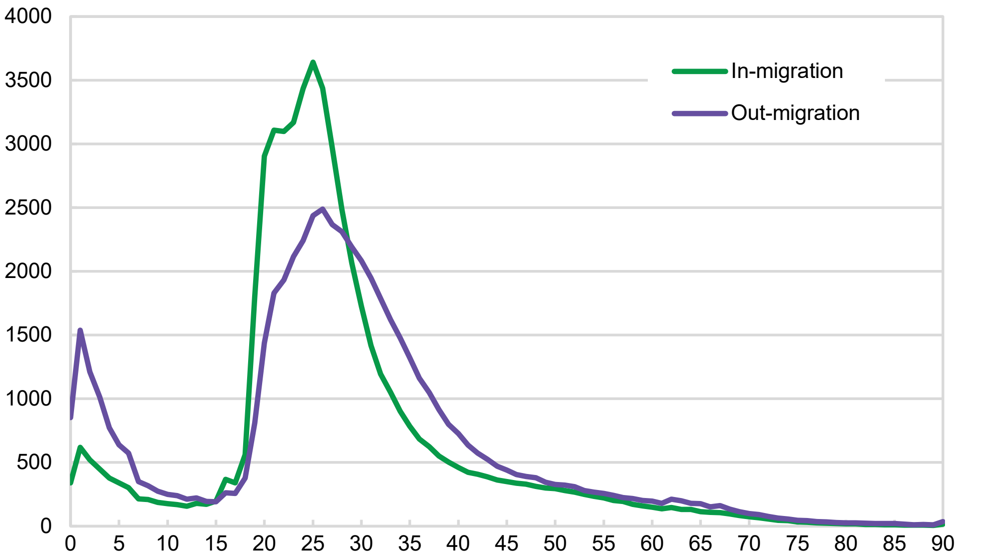
Figure 3.16 Net migration to municipality groups, by centrality[1]



[1] Net migration is defined as the sum of net internal migration and net international migration. Central municipalities are in centrality categories 1–3, excluding the regional urban centers – Oslo, Bergen, Trondheim, Stavanger, Kristiansand and Tromsø. Less central municipalities are in centrality categories 4–6. See Appendix C for details.
Source: Statistics Norway

The centralization trend affects the age structure in both the destination and departure municipalities. In the following, the age of internal migrants in municipalities with different centralities is examined more closely. Municipalities at opposite ends of the centrality spectrum are examined. The focus is on internal migration since immigrants tend to be relatively young and therefore pull down the average age in the municipality. From Figure 3.17, we see that internal migration in and out of regional urban centers depends a lot on age. There are more in-migrants than out-migrants in the ages 15–28. Specifically, net internal migration is high at age 20, with a difference of just under 1 500. There are large waves of out-migration from regional urban centers of children below school age and adults who have passed their 20s. In the higher age groups, there is a higher rate of out-migration from the regional urban centers than in-migration, but the difference is miniscule.

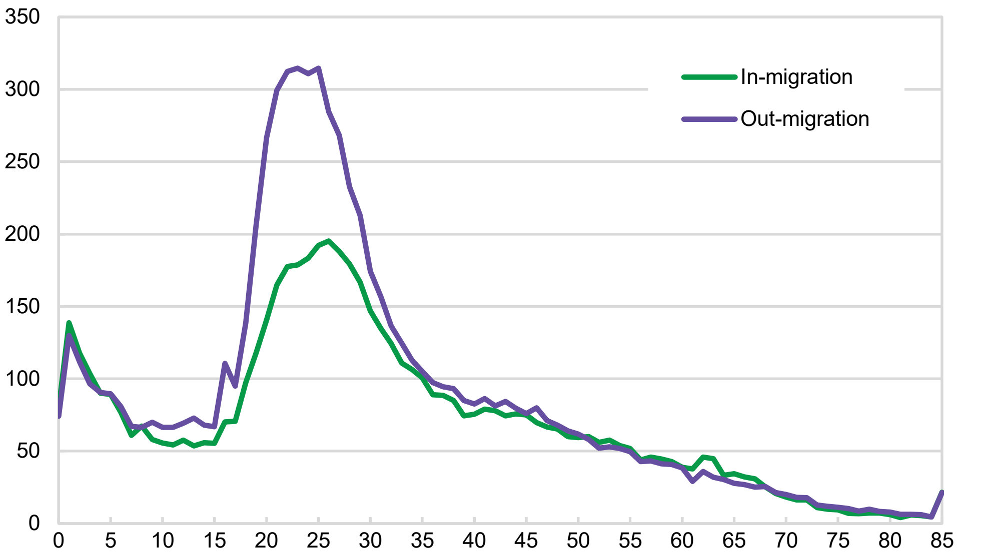
Figure 3.17 Average internal in-migration and out-migration in regional urban centers, by age[1]



[1] Mean for the years 2008–2017 for each age. The regional urban centers are Oslo, Bergen, Trondheim, Stavanger, Kristiansand and Tromsø.
Source: Statistics Norway

For the least central municipalities, the picture is almost the opposite (see Figure 3.18). The least central municipalities count 101 in number, which constitutes about a quarter of all municipalities. Around 3 per cent of the population live in these municipalities. In general, the least central municipalities experience net out-migration. Net out-migration is particularly strong in the age span 6–29. Children of school age and young adults have a tendency to leave the least central municipalities, while for the rest of the age groups net migration is close to zero. This migration pattern contributes to an aging population in the rural municipalities in the long term – the young leave and the old stay behind.

Figure 3.18 Average internal in-migration and out-migration in the least central municipalities, by age[1]



[1] Means over the years 2008-2017 for each age. The least central municipalities are in centrality-categories 4-6.
Source: Statistics Norway

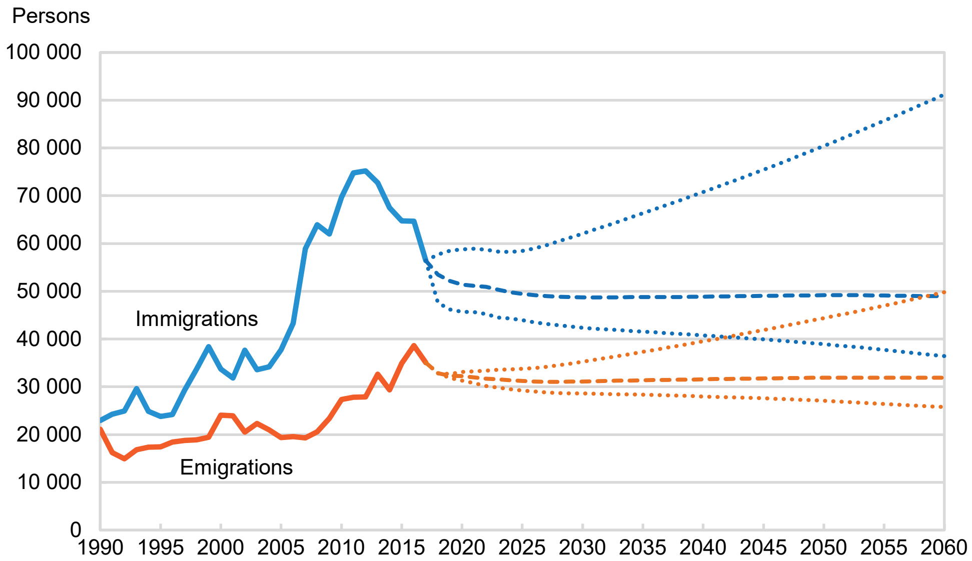
3.4. Immigration and emigration

We predict, in our main alternative, that immigration will fall as we approach 2030, primarily due to fewer immigrants from the new EU countries in Eastern Europe.

This is based on expectations of improved economic conditions in this area relative to Norway, and an expected population decline in Eastern European countries.

After 2030, we predict a slight increase in immigration to Norway. This is linked to an expected global population growth, particularly in Africa and Asia, which will increase the number of potential immigrants to Norway. Conversely, Norway's leading economic position in relation to the rest of the world is expected to lose ground as Norwegian oil and gas revenues decline and capital income from the Government Pension Fund Global falls as a percentage of national income. This will curb the growth in immigration.

Figure 3.19 Immigrations and emigrations. Registered 1990–2017 and projected 2018–2060 in three alternatives[1]



[1] Excludes persons who have both immigrated and emigrated during the same year. The three alternatives are MMMM (main alternative), HHMH (high alternative) and LLML (low alternative).
Source: Statistics Norway

Future emigration from Norway depends on the number of people living in Norway, who can potentially emigrate. Immigrants are more likely to emigrate than others, and we expect the total emigration to increase in line with the number of immigrants living in Norway. In the main alternative, emigration drops leading up to 2030, then increases slightly throughout the remainder of the projection period. Figure 3.19 shows the number of immigrations and emigrations in recent decades, as well as three alternative paths for future immigration and emigration.

Net migration is the number of immigrations minus the number of emigrations. In the main alternative (MMMM), net migration falls from just over 21 000 in 2017 to a projected long term level of between 17 000 and 19 000 annually.

According to these assumptions, the number of immigrants in Norway will increase from 750 000 this year to 1.1 million in 2040 and 1.3 million in 2060, and the number of people born in Norway to two immigrant parents will increase from 170 000 this year to 370 000 in 2040 and 530 000 in 2060.

All estimates for future immigration and emigration are uncertain because migration flows are affected by conditions that are difficult and sometimes impossible to predict with current knowledge. The uncertainty increases the farther ahead we look. This is illustrated in our high and low alternatives, where we have used alternative assumptions about future population trends in the countries where immigrants stem from and future income disparities between Norway and the rest of the world.

In the population projections, immigration to Norway is predicted using a separate model. In this model, immigration is largely determined by the following factors:

- income per capita in Norway compared with other parts of the world, measured in purchasing power-adjusted gross domestic product (GDP) in nominal value
- unemployment rate in Norway and other parts of the world
- number of immigrants already in Norway
- population trends in other parts of the world

The model is used to calculate immigration from three country groups:

1) Western Europe, USA, Canada, Australia and New Zealand
2) Eastern European EU countries
3) Rest of the world

Chapter 8 provides more details of the model and the country groups, as well as the data that is used in the model and the methods we use to estimate future immigration and emigration.

Here we present the assumptions about immigration and emigration used in this year's population projections. We also show the future development of the numbers of immigrants and Norwegian-born to two immigrant parents according to our new projections.

Model results

Our modelled estimations of the impact of the various factors on immigration to Norway are shown in Table 3.2. This time, unemployment was found to have no significant effects in country group 2, so this variable was omitted from the model.[2] Because 2016 and 2017 were special years in terms of immigration from country group 3, with particularly high levels of immigration from Syria, we have used parameter values from the previous projection for country group 3 in relation to the effect of income disparities, networks and the emigration rate from the country group the year before.

Table 3.2 Variable list and estimates of the unknown parameters in the model for each of the three country groups

Variable	Explanation
INNVjt	Immigration to Norway from country group j in year t, j=1,2,3
BEFjt	Mid-year population in country group j in year t, j=1,2,3
BNPRATEjt	GDP per capita in Norway relative to GDP per capita in country group j in nominal terms and after purchase power adjustment, j=1,2,3
ARBNORt	Unemployment rate in Norway (per cent) in year t
ARB1t	Unemployment rate in country group 1 (per cent) in year t
BEH3t	Number of immigrants from country group 3 already living in Norway in year t
DUM1999t	Dummy variable with value 1 in 1999 and value 0 all other years (related to large immigration from Kosovo and Croatia)
DUMM2004t	Dummy variable with value 2/3 in 2004 and 1from 2005 onwards (related to the expansion of EU May 1 2004)
DUMM2007t	Dummy variable with value 1 in 2007 onwards and value 0 all previous years (related to Romania and Bulgaria entering EU)
DUM2016t	Dummy variable with value 1 in 2016 and value 0 all other years (related to large immigration from Syria)

[2] When the econometric immigration models are re-estimated biennially for a new projection, the sample will include two additional years. Also, the income data for previous years are updated. Consequently, all the estimates for all the variables in the model, as well as their statistical significance, can vary quite a bit from projection to projection.

Explanatory variable	Estimate	T value
Country group 1[a]		
Constant	-2.252	-5.41
$\log(INN1_{t-1}/BEF1_{t-1})$	0.514	5.93
$\log(BNPRATE1_{t-1})$	0.576	4.70
$\log(ARBNOR_t/ARB1_t)$	-0.316	-5.81
$\log(ARBNOR_{t-3}/ARB1_{t-3})$	0.198	4.15
$\Delta\log(ARBNOR_t)$	-0.205	-2.40
Country group 2[b]		
Constant	-2.478	-4.81
$\log(INNV2_{t-1}/BEF2_{t-1})$	0.590	9.36
$\log(BNPRATE2_t)$	0.557	2.27
$\log(BNPRATE2_{t-2})$	1.704	5.63
$\log(BNPRATE2_{t-3})$	-0.923	-3.08
$\log(ARBNOR_t)$	-0.826	-6.45
$\log(ARBNOR_{t-1})$	0.820	4.67
$\log(ARBNOR_{t-3})$	-0.656	-7.40
$DUM2004_t$	1.017	10.6
$DUM2007_t$	0.226	1.91
$DUM1999_t$	0.564	6.41
Country group 3[c]		
Constant	5.746	-2.63
$\log(INNV3_{t-1}/BEF3_{t-1})$	0.474[d]	
$\log(BNPRATE3_{t-2})$	0.317[d]	
$\log(BEH3_t)$	0.198[d]	
$ARBNOR_{t-1}$	-0.119	-5.67
$DUM1999_t$	0.331	3.28
$DUM2016_t$	0.380	3.80

[a] Endogenous variable $\log(INN1_t/BEF1_t)$. Estimation period 1973-2017
[b] Endogenous variable $\log(INN2_t/BEF2_t)$. Estimation period 1991-2017
[c] Endogenous variable $\log(INN3_t/BEF3_t)$. Estimation period 1994-2017
[d] The parameter value is not estimated, but set to the same value as used in the 2016 projections
Source: Statistics Norway

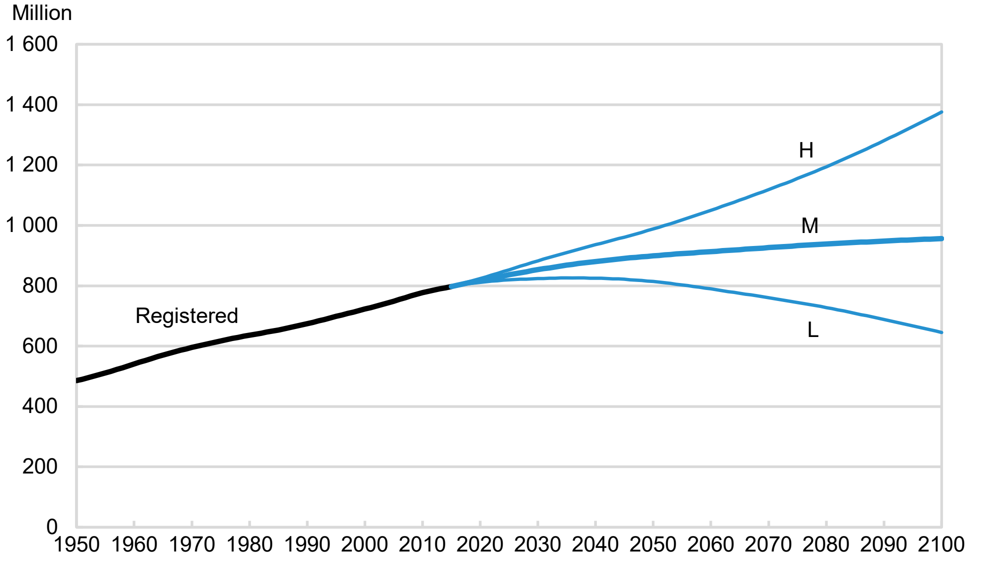
Future values of the variables

When the parameters are estimated, they are used to calculate how future immigration will develop, based on assumptions about developments in the economic and demographic variables. These are obtained from international (mainly the OECD) and national sources, and are also based on separate assessments, particularly for the long term projections.

Figures for the future development of the global population in the three country groups are retrieved from the UN's population projections. We use the UN's alternative for medium fertility to calculate our medium alternatives, and the UN's high fertility and low fertility variants to calculate our high and low alternatives respectively for immigration from the three country groups. Figures 3.20-3.22 show the future development of the population in the three country groups, according to the UN's latest projections from 2017.

For country group 1 (Figure 3.20), the UN's medium fertility variant shows a slight increase in the future population. This is primarily due to population growth in the USA. The UN only predicts a marginal increase in Western Europe until the 2040s, followed by a decline.

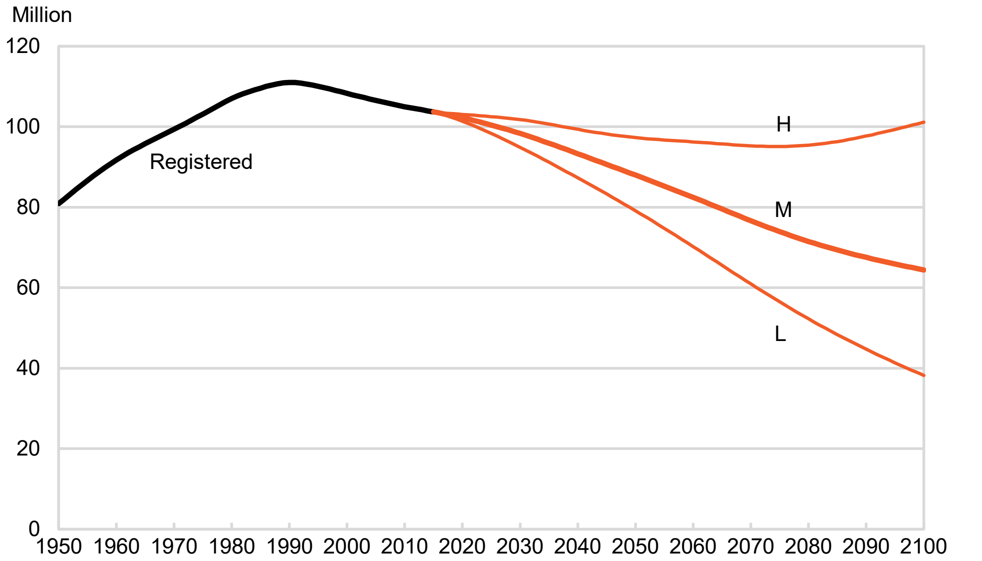
Figure 3.20 Population in country group 1, registered 1950–2015 and projected 2016-2100 by the UN in three alternatives



Source: UN

The population in country group 2 (Figure 3.21) has been falling since 1990, and the UN expects this fall to continue. In the medium fertility alternative, the population in country group 2 falls from the current 103 million to 65 million at the end of the century – a decline of almost 40 per cent.

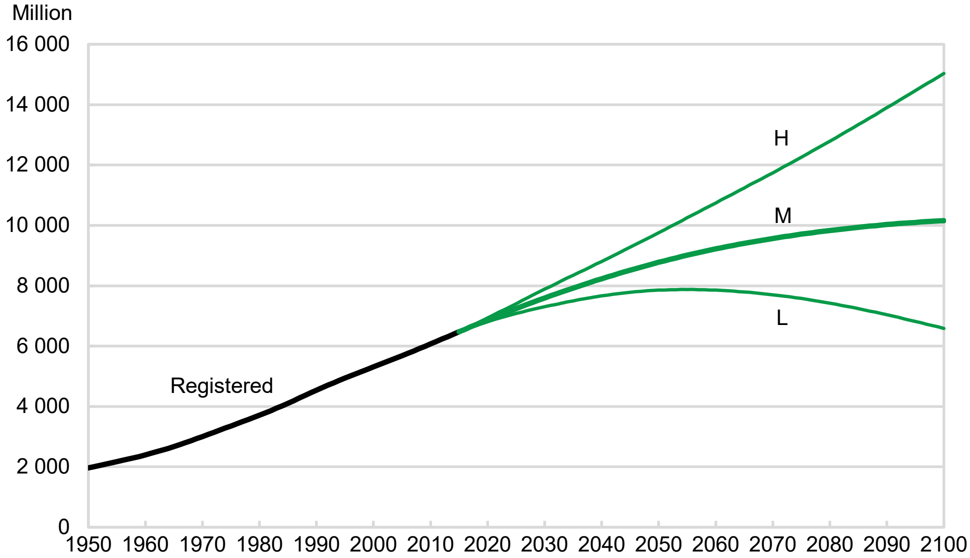
Figure 3.21 Population in country group 2, registered 1950–2015 and projected 2016-2100 by the UN in three alternatives



Source: UN

Country group 3 (Figure 3.22) already includes the majority of the global population, with about 6.5 billion of the world's 7.5 billion inhabitants. This is also where the UN expects the clearest population growth – an increase to just over 10 billion by the end of this century, according to the medium fertility variant. High fertility rates in Africa mean particularly high population growth in this part of the world. In Asia and Latin America, the UN projects growth until 2055–2060, followed by a decline.

Figure 3.22 Population in country group 3, registered 1950–2015 and projected 2016-2100 by the UN in three alternatives



Source: UN

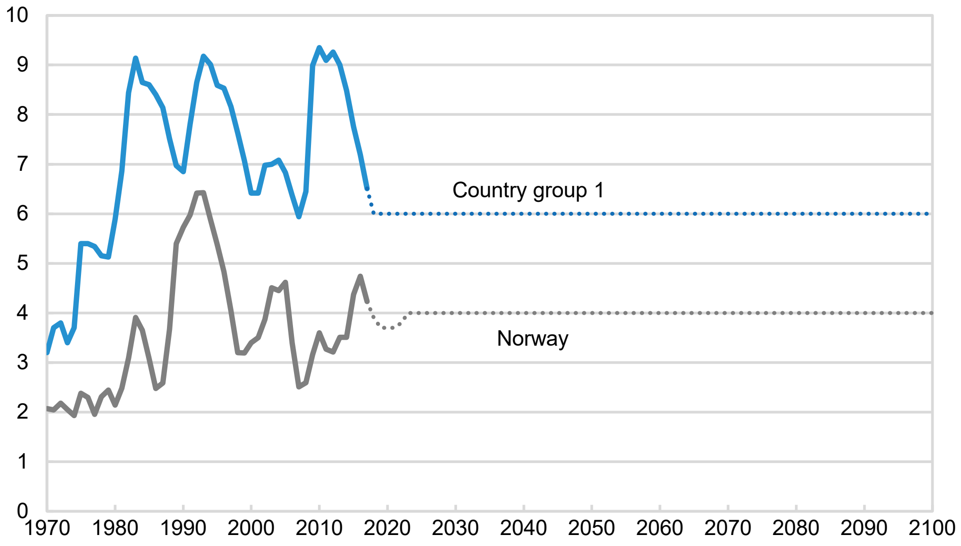
The estimates of the future number of immigrants residing in Norway (which are used to calculate the network effect) are based on figures from the previous population projection. Once the number of immigrations has been calculated, the whole cohort component model (BEFINN) is run using the updated immigration figures. The model produces new estimates of the number of resident immigrants from each country group in Norway. These figures are then used to estimate immigration again. Such rounds of iteration are repeated several times until the difference between the last and the second last time series for the number of immigrations is small.

Rule changes, political decisions, wars and conflicts have also impacted on the historical immigration to Norway. For estimates in the model, we have therefore included some 'dummies' in order to weed out special years with major deviations in immigration due to such conditions (particularly for country group 3). In terms of the future, we have not factored in any new policy changes that could impact on immigration in the years ahead, as this is very difficult to predict. The same applies to natural disasters and armed conflicts, which can lead to new flows of refugees. However, since all years with major deviations that are weeded out for country group 3 have particularly high immigration, this can systematically yield assumptions about future immigration that are too low. In order to offset this, we have calculated what the effect of these years would have been when distributed evenly throughout the estimation period. We have then factored this into the long term paths for immigration from country group 3. The correction means that the paths for future immigration are adjusted upward by 3 per cent.

Forecasts of unemployment rates in Norway are retrieved from Statistics Norway's macroeconomic projections.[3] The figures on short term future unemployment rates in country group 1 are based on OECD forecasts. In the long term, these levels are also expected to level out at historical 'normal' levels, as shown in Figure 3.23. The unemployment variable in the countries where immigrants stem from is not used for country group 3, and for this year's estimation of the model, it did not have any significant effect for country group 2.

[3] http://www.ssb.no/nasjonalregnskap-og-konjunkturer

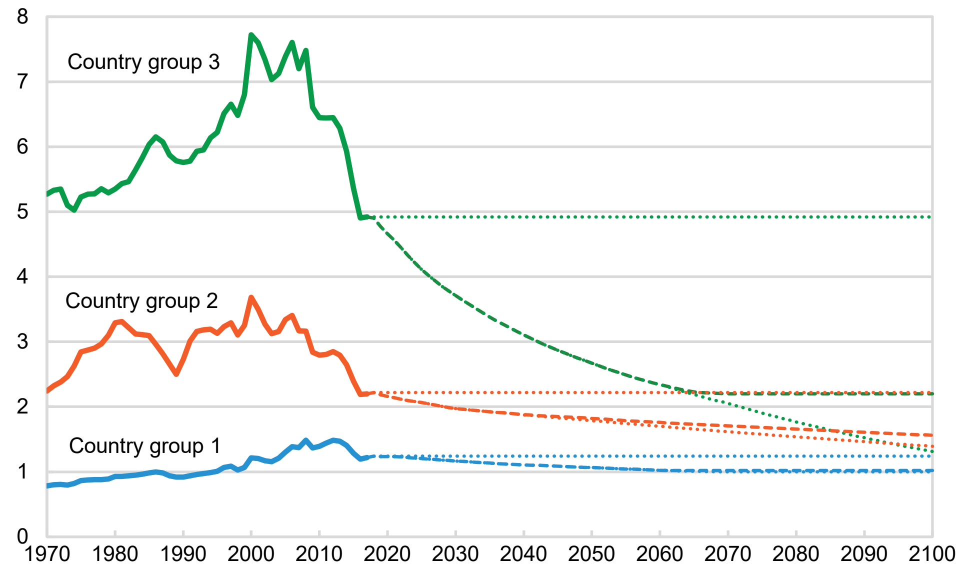
Figure 3.23 Unemployment rates in Norway and country group 1, registered time series 1970–2017 and assumed future values 2018–2100. Per cent



Source: OECD and Statistics Norway

For future income development, three alternative paths have been created (low, medium and high), as shown in Figure 3.24. These paths reflect three different alternatives for future economic developments – where the low alternative assumes the smallest income disparities between Norway and the rest of the world in the years ahead. In the high alternative, today's relative income disparities between Norway and the three country groups continue throughout the projection period. The medium alternative (indicated by dotted lines) is our main alternative and is discussed in more detail in the sections below.

Figure 3.24 Annual relative income per capita in Norway compared to country groups 1, 2 and 3. Historical series 1970–2017 and assumed alternative paths 2018–2100



Source: OECD and Statistics Norway

In addition to the different assumptions about future income disparities and population trends in the country groups yielding different paths for future immigration, the estimated standard deviation in the econometric model is used to take into account model uncertainty in the calculations. This is done by adding one standard deviation in the high alternative and correspondingly subtracting one standard deviation in the low alternative. This method is used for each of the three country groups. Some unevenness generated by the econometric model at the start of the paths has been discretionarily levelled out.

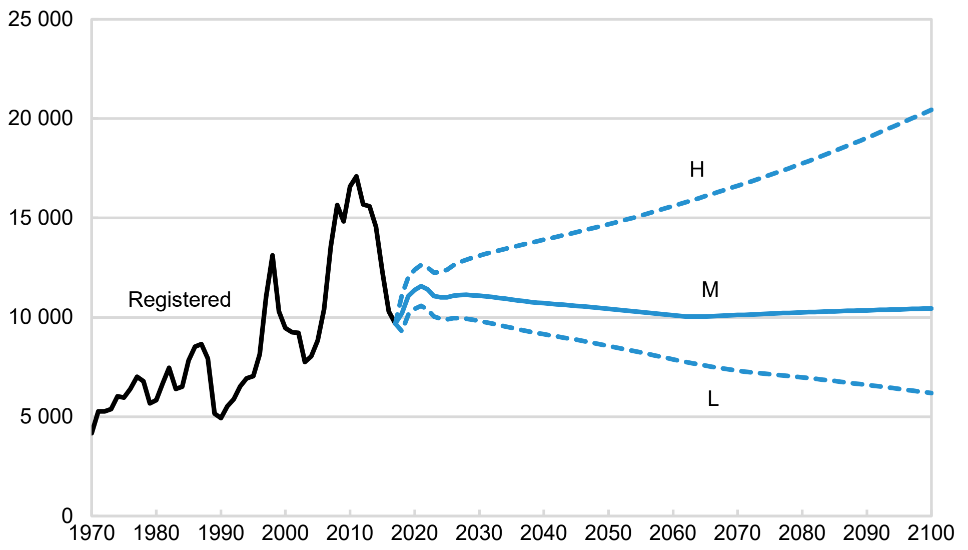
Future immigration to Norway

Our assumptions about future immigration to Norway combine the three alternative paths for future income development with the UN's various projections of population trends, whereby the UN's high fertility variant and our high alternative for income development are used to create the high alternative for immigration, and likewise for the low alternative. The main immigration alternative uses the main alternative for future income development and the UN's medium fertility variant for population trends.

Country group 1

Figure 3.25 shows registered immigration from country group 1, and three alternative paths for future development. In the next few years, we expect this immigration to increase slightly after falling for several years. This is due to the economic shift in the Norwegian economy, which occurred about a year ago, causing renewed growth in the country, a slight fall in unemployment, and higher oil prices. However, after a few years, we expect reduced petroleum activity in Norway and lower investment activity to lead to somewhat more moderate economic growth in Norway than the average for countries in group 1. We also do not expect the real price of oil to increase after 2020. Since we have assumed a roughly stagnant unemployment figure both in Norway and in country group 1, it is the relative changes in income that will drive the immigration from this country group, together with population developments in this region. As shown in Figure 3.20, the population will increase slightly. From 2060, when there will be no significant change in relative income (see Figure 3.24), population growth in country group 1 will lead to a slight increase in immigration up to 2100. The low and high alternatives are driven by a combination of other assumptions about relative income and population as shown in Figures 3.20 and 3.24.

Figure 3.25 Annual immigration, country group 1, registered 1970–2017 and projected 2018–2100 in three alternatives

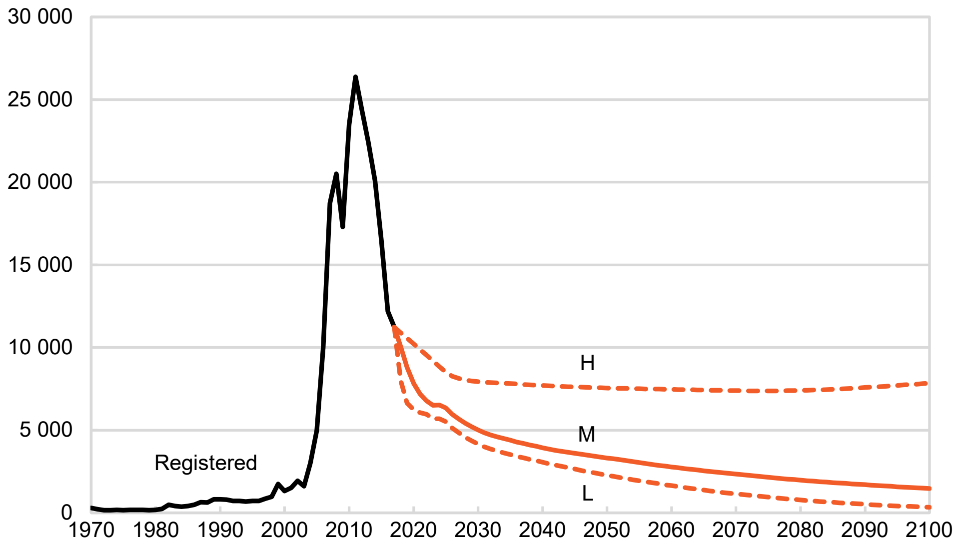


Source: Statistics Norway

Country group 2

For country group 2, the results of the model show a continued decline in immigration (Figure 3.26). The main reason for this in the short term is that the economic development in most of the countries in group 2 is characterized by higher growth than in Norway. One of the reasons we underestimated the decline in immigration from this country group in our previous projection was that we underestimated the economic growth in these countries, coupled with the fact that the OECD figures for purchasing power-adjusted GDP for Norway were overestimated. Forecasts from both the EU and the OECD show continued high income growth in country group 2, which in turn contributes to lower immigration. After about 2030, the decline in population in group 2 will be stronger than before and will be a key factor in the long term development in immigration. In addition, we assume that the potential for economic growth in these countries is high, as shown in Figure 3.24. This is based on the slightly higher growth rates that the OECD (and the EU) assumes up to 2060 continuing until 2100. The reason why immigration from country group 2 does not increase in the high alternative is that the population falls slightly in the country group even in the UN's high alternative. In the low alternative, higher income growth and lower population growth are combined, whereby immigration from country group 2 will reach almost zero by 2100.

Figure 3.26 Annual immigration, country group 2, registered 1970–2017 and projected 2018–2100 in three alternatives



Source: Statistics Norway

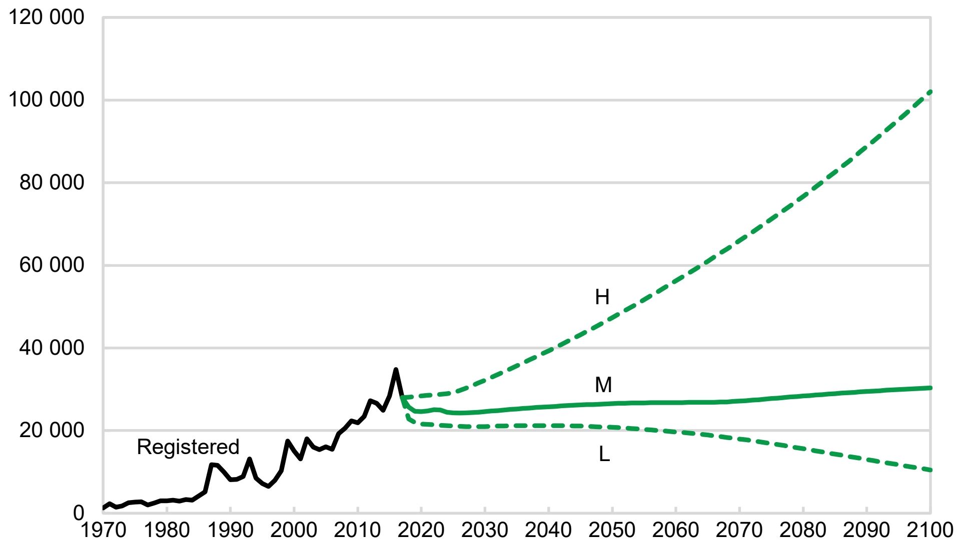
Country group 3

Immigration from country group 3 drops slightly in the first few years of our main alternative (M), then rises slightly towards the end of the century (Figure 3.27). For this group, three factors in particular impact on the results. Expected population growth in this country group (Figure 3.22) and the network effect, i.e. the number of immigrants from this country group already living in Norway, will both push up immigration. Conversely, we expect the income gap between this country group and Norway to narrow (Figure 3.24), and this will pull in the opposite direction.

Our estimates for country group 3 are particularly uncertain, and the distance between the high and low alternatives widens considerably in the long run. In the high alternative, immigration from country group 3 will rise sharply, and by 2060 will be over 55 000 per year. By comparison, immigration in 2016 – in the wake of the influx of asylum seekers to Norway in 2015 – was almost 35 000 from country group 3. Our projections do not include any upper limits for the number of immigrants that can come to Norway before restrictions are put in place.

In the low alternative, immigration from country group 3 will remain relatively stable at just over 20 000 annually up to 2060, and will then decrease. In this alternative, we have used the UN's low alternative, in which the population in country group 3 will decline in the long term.

Figure 3.27 Annual immigration, country group 3, registered 1970–2017 and projected 2018–2100 in three alternatives



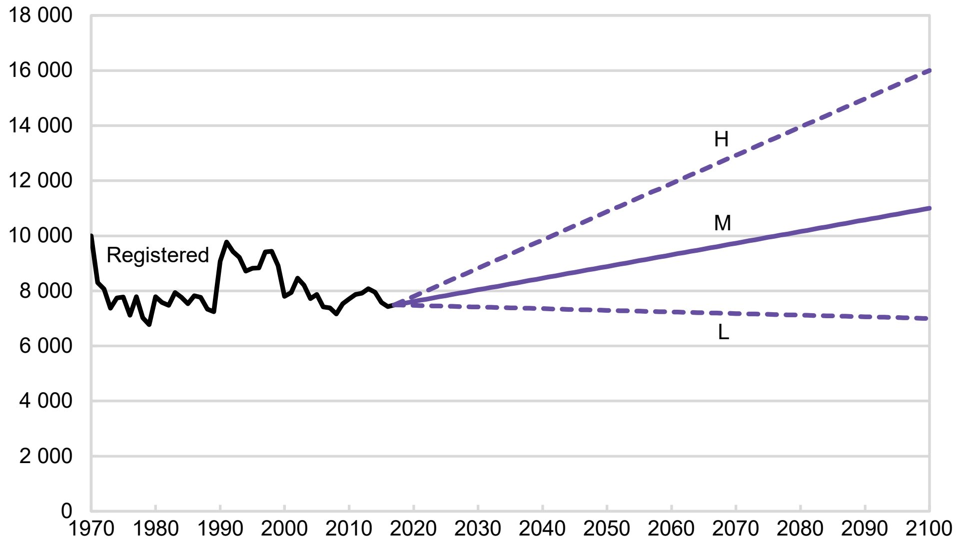
Source: Statistics Norway

Immigration of non-immigrants

Every year, a number of people with a Norwegian background who have been living abroad immigrate back to Norway, including persons born in Norway to two foreign-born parents. We have created assumptions about future immigration of this group based on registered immigration for the last year (2017) and have factored in a growing trend towards 2100. The trend is growing because we also expect an increase in emigrations among people in this group, something that indicates greater numbers who can potentially move back to Norway. Immigration is given at a slightly lower level than emigration, since some of those who move abroad never move back.

In the main alternative, we assume that immigration of non-immigrants increases from 7 490 in 2017 to 11 000 in 2100. In the high alternative, the increase is stronger – to 16 000 in 2100, and in the low alternative there is a decline to 7 000 immigrants in 2100 (Figure 3.28).

Figure 3.28 Annual immigration, non-immigrants, registered 1970–2017 and projected 2018–2100 in three alternatives

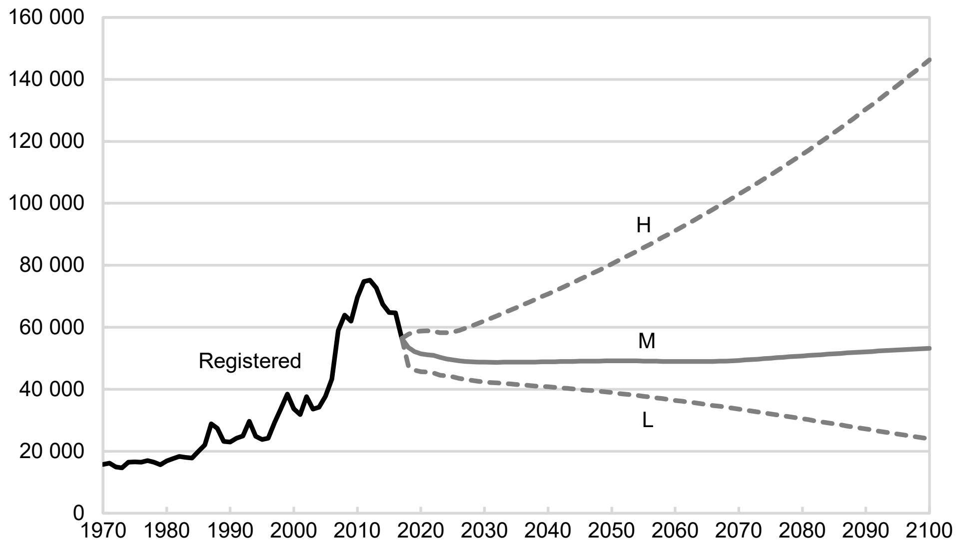


Source: Statistics Norway

Considerable uncertainty

When we add the figures for all four groups together (immigrants from the three country groups plus non-immigrants), this gives us the total immigration to Norway, as shown in Figure 3.29. Expected lower immigration from country group 2 pulls the figure down, while the expected long term increase from country group 3 and among non-immigrants has the opposite effect. Overall, immigration to Norway is fairly stable at around 50 000 annually in the main alternative.

Figure 3.29 Total gross immigration to Norway, registered 1970–2017 and assumptions 2018–2100 in three alternatives



Source: Statistics Norway

However, the uncertainty in these figures should not be overlooked. There are uncertainties about the assumed paths for the explanatory variables in the model, such as income disparities, network effect and unemployment. Furthermore, despite the model taking into account many factors that impact on immigration, there are many other factors that have a large bearing on immigration but which are difficult or impossible to predict. This applies not least to future political changes, such as EU expansion or reduction, and changes in European and Norwegian asylum and immigration policies. Wars, conflicts and natural disasters are other examples of factors that can have a large impact on immigration. In addition to the difficulties in predicting when and where wars will break out or end, quantifying how this will impact on the influx of immigrants to Norway is also a challenge.

Immigration to Norway can therefore be both higher and lower than our assumptions in the main alternative. It may be higher if new wars break out or more serious crises and conflicts arise, particularly if this happens within and close to Europe, such as in Ukraine and Turkey. As long as the war in Syria continues, there is always a large potential for new Syrian refugees arriving in Europe and Norway. This immigration, as well as the high immigration from Africa, largely depends on what asylum routes to Europe are possible. Although Europe's leaders have learned lessons from the refugee crisis in 2015, new crises can take a different form (Collett 2018).

Another component that points to potentially higher immigration is climate change, which results in those affected moving to different countries. However, the links between climate change and international migration to Norway are steeped in uncertainty, see Tønnessen (2014b).

Although it may seem unlikely in the short term, expanding the EU to include new member countries may also lead to an increase in immigration to Norway. Figure 3.26 shows the large increase in immigration from country group 2 following the eastward expansion of the EU in 2004 and 2007.

As Figure 3.26 also shows, we assume a decline in immigration from country group 2 in the future. A drop in the number of new migrant workers from Eastern European countries in the EU may increase the demand for migrant workers from other parts of the world, such as country group 3. In Asia, Africa and Latin America, the level of education is increasing (UNESCO 2018), which can make it easier for people from these countries to get jobs in Norway. This can push up immigration from country group 3.

The aging of the Norwegian population, as assumed in the population projections, is also likely to lead to a greater demand for health and care workers. If these are mainly recruited from abroad, it may mean higher immigration.

For poor countries in country group 3, there may also be mechanisms that drive emigration up – as opposed to down – in line with economic development (Clemens & Postel 2017). In our model, we have not found such effects for country group 3, which may be linked to the vast size of this country group and the fact that it includes many countries that are already above the income level at which economic development often leads to an increase in emigration.

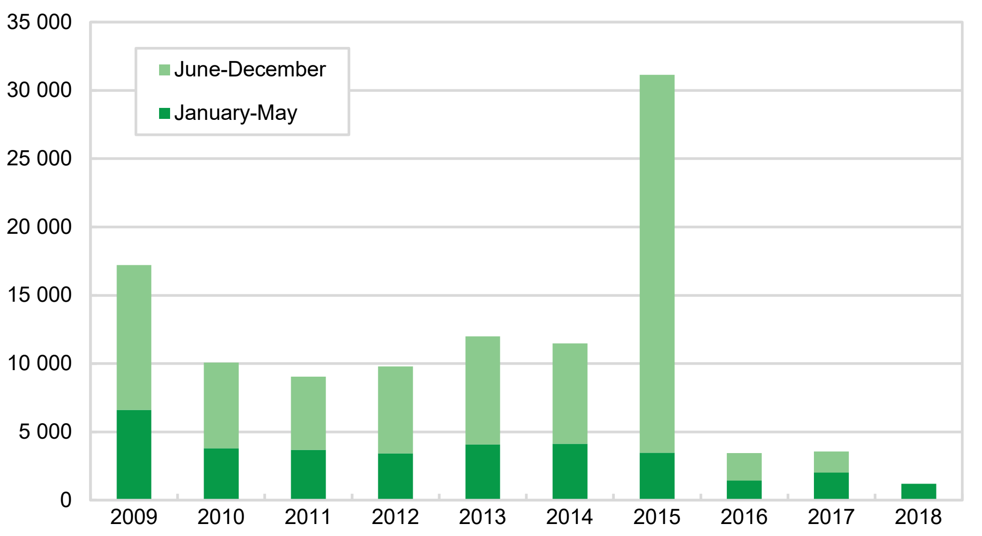
Whilst it will thus be less attractive to emigrate from these relatively rich countries, it will also be more appealing for those from poorer parts of the world to move to such countries. Our model does not give much consideration to how other potential destination countries than Norway may be more or less attractive.

In the same way, the situation in other Western European countries can not only affect the migration from these countries to Norway, but also the migration of people from other countries where Norway is considered one of several potential destination countries.

This latter point is particularly relevant now that the UK has decided to leave the EU in March 2019. It is still unclear what Brexit will mean for future immigration to Norway. The migration of British citizens to Norway has remained at around 1 000 per year over the last 10–15 years. This figure may fall if it becomes more difficult for people from the UK to get permission to move here. Conversely, the UK has long been a key destination for migrant workers from the new EU countries in Eastern Europe, such as Poland and Lithuania. Negotiations on a leaving agreement and transitional arrangements are still ongoing, but it seems clear that EU citizens already living in the UK will be allowed to stay (Hunt & Wheeler 2018), and it is unlikely that this group will leave the country in any great number (Makosa 2018). The question is how easy or difficult it will be for citizens of EU/EFTA countries to move there in the future, and whether those who are not allowed to travel there will choose to go to Norway instead. In our model, we have not made any changes to the future immigration paths as a result of Brexit. However, if this impacts on immigration to Norway, it is not inconceivable that it may result in a slight fall in immigration from country group 1, but an increase from country group 2.

As mentioned, our model does not predict political changes, nor the migration situation that Europe and the world at large will be faced with in the long term. To the extent that the policy regime in the years ahead will lead to fewer immigrations than that which resulted from the policy in the period we use to estimate our model, this is not taken into account in our figures. In Europe, there is currently a climate for tightening immigration and a wish to establish a more coordinated immigration policy. Control of the borders and restrictions on the number of migrants coming across the Mediterranean are high on the agenda. In Norway, there has also been a clear political desire to limit immigration from non-EU countries. This could mean that immigration from country group 3 could be lower than we have assumed in the main alternative. More European emergency measures for new refugee flows can also mean fewer unexpected peaks in immigration, as was seen in connection with the huge influx of asylum seekers in the autumn of 2015 – the peak for 2016 in Figure 3.27 reflects the fact that many of these were included in the population statistics in 2016.

Figure 3.30 Asylum applications, 2009–2018[1]



[1] The figures for 2018 only cover the period from January to May.
Source: Norwegian Directorate of Immigration

Given the time it takes from when an asylum application is submitted until the applicant is granted residence and registered as an immigrant, we can use the Norwegian Directorate of Immigration's figures for new asylum applications[4] as an early indicator. Figure 3.30 shows the number of asylum applications per year dating back to 2009. There is a clear peak in autumn 2015, but since then the

[4] See www.udi.no/statistikk-og-analyse/statistikk/

number of asylum applications has been very low in Norway. For 2018, we only have figures up to the end of May, but these already indicate few new asylum applications this year.

There are also other factors that could lead to lower immigration than in our main alternative. There is no guarantee that the EU will continue throughout this century in its present form and with the current member countries. Which countries join and leave the EU can have a large impact on immigration from country groups 1 and 2 to Norway.

For country group 3, there are several factors that indicate that the network effect may be weaker than we have assumed. First, the rules on family reunification have been tightened. Those reuniting with someone with a refugee status must now apply within one year of the reference person being granted permission to stay, in order to be exempt from the requirement concerning the reference person's income. Family immigrants make up a large proportion of immigration to Norway. Since 2005, more than 10 000 family immigrants have arrived annually, and over half have been from country group 3. Family immigration is discussed in detail in Dzamarija and Sandnes (2016).

In our model, the network effect depends on the number of immigrants from country group 3 already living in Norway. As we will show in Figure 3.38, growing numbers of these are likely to have a long duration of stay in Norway. It is not certain whether the network effect remains strong after immigrants have lived here for a long time and established themselves in the Norwegian society. If the network effect diminishes with duration of stay, our estimates for the future effect will be too high.

One element that can also push immigration below that anticipated is the development of wars and conflicts in the world. In a study by the Peace Research Institute in Oslo (PRIO), Hægre et al. (2013) analyze various driving forces that affect the likelihood of armed conflict. They find that demographic variables, education level and degree of poverty all have a significance, and they predict that the number of armed conflicts will significantly decrease as we head towards 2050, primarily due to an expected reduction in poverty in many countries.

One final factor that we do not take into account in our model is the expected age development in the three country groups. In all three country groups, the UN expects a clear aging of the population, as well as a decrease in the proportion that are of an age when it is common to migrate (20–39 years). This may in turn boost demand or create more opportunities for these people in the domestic labor market. Aging in the country groups can thus lead to less outward migration from these countries, also to Norway.

How we project the emigration from Norway

Emigration in population projections is calculated using emigration probabilities. These are described in more detail in Chapter 8.2. Non-immigrants have the lowest rate of emigration. For the three country groups, the likelihood of emigrating is greatest among persons with a background from country group 1 and smallest for those from group 3. Emigration is highest in the first few years following immigration to Norway and decreases with duration of stay (Pettersen 2013).

The emigration probabilities can be adjusted, and in the previous projection they were adjusted upward in the short term for country groups 1 and 2 and for persons with a Norwegian background in order to account for an expected downturn in the economy. This time we have not made any such discretionary adjustments to the emigration probabilities.

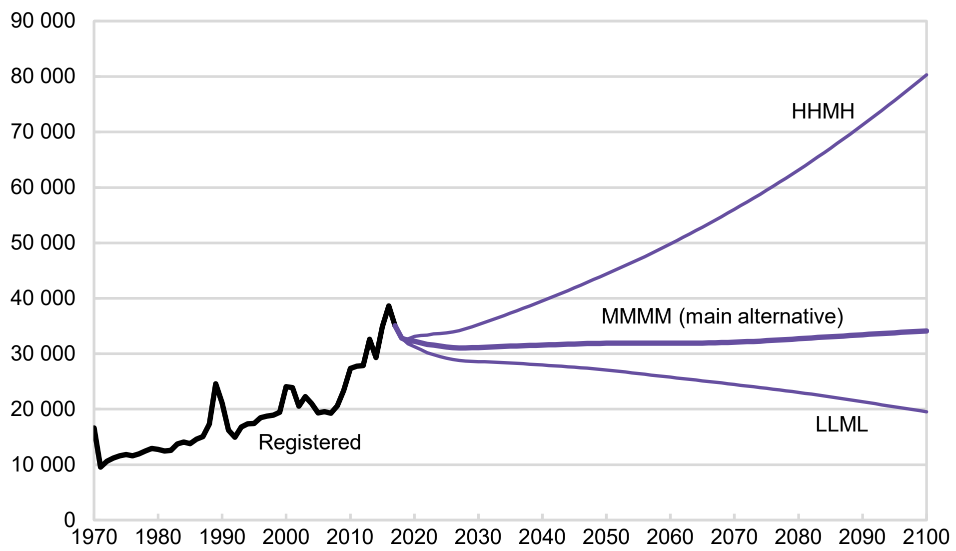
Since high immigration one year will lead to higher emigration in the years that follow, the estimates of the number of emigrations largely depend on the immigration figures. There are no separate high, low and medium alternatives for emigration probabilities. The difference between emigration figures in different alternatives for emigration is solely related to the fact that we use different figures for the population in Norway.

Future emigration and net migration

Figure 3.31 shows projected emigration from Norway, in three different alternatives for population trends. Most people who emigrate from Norway are immigrants (Pettersen 2013, Skjerpen et al. 2015), and Figure 3.32 shows registered and projected emigration according to which country group the emigrants originated from. We expect a clear decline in the emigration of immigrants from country group 2 due to the expected low immigration in this group in the future. Emigration by immigrants from country group 1 is expected to remain relatively stable in the future, while we expect an increase among immigrants from group 3 (where immigration is also expected to increase, see Figure 3.27) and among non-immigrants, which also includes persons born in Norway to two immigrant parents.

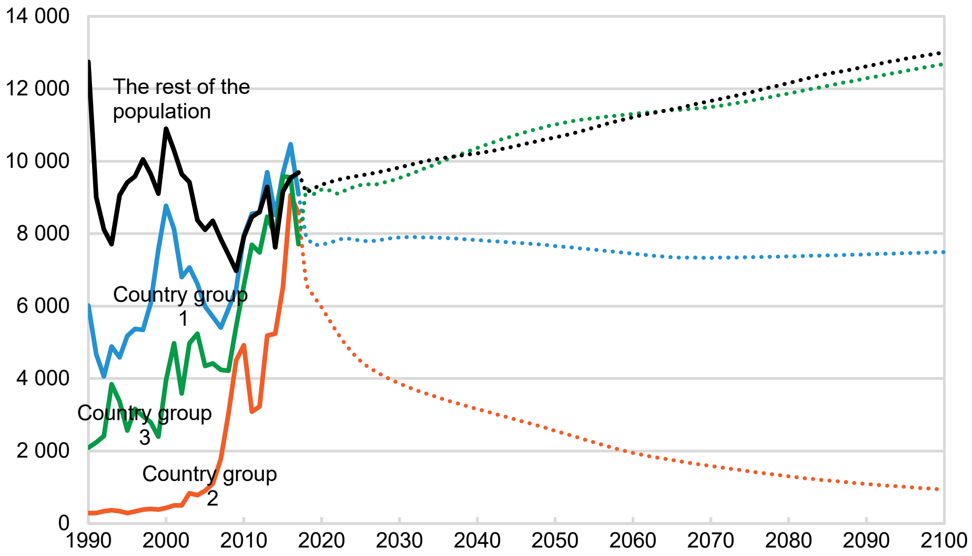
Emigration numbers are also uncertain. Changes in Norwegian immigration regulations, with more temporary residence permits and more withdrawals of permits, may contribute to an increase in emigration. This can also be the case if conflicts and wars end, making it more attractive for refugees and their families to return to their origin country. The aging of the population in their countries of origin can also cause migrant workers to move back because of the greater demand for them and to assist older family members. Developments in the EU – and any changes in which countries practice the free flow of people – could also have a major impact on emigration.

Figure 3.31 Emigration from Norway, registered 1970–2017 and projected 2018–2100 in three alternatives



Source: Statistics Norway

Figure 3.32 Emigration from Norway for immigrants from three country groups and the rest of the population, registered 1990–2017 and projected 2018–2100, main alternative (MMMM)

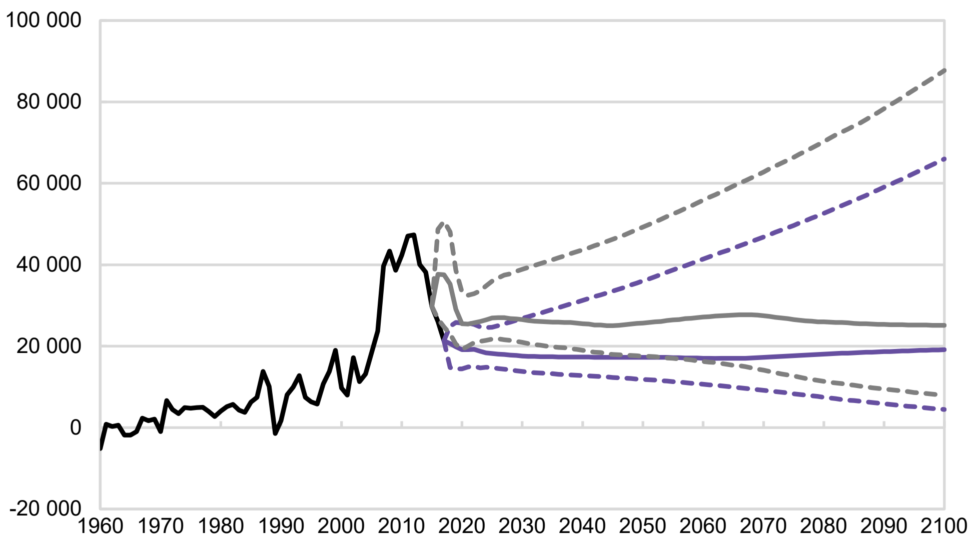


Source: Statistics Norway

Net migration of almost 20 000 every year

Net migration is calculated by deducting the emigrations from the immigrations for the year. Until 2010, specific assumptions about future net migration were made, but now net migration is simply a calculation based on the assumed gross immigration and emigration. The projected net migration for the year is shown in Figure 3.33, where the net migration we projected the last time (in 2016) is also shown. The projection for the year is generally lower than in the previous projection, for all alternatives. This is primarily due to lower immigration, which in turn is linked to the OECD's overly optimistic estimated figures for the Norwegian economy in 2015, but also to the economic development in country groups 1 and 2 being more favorable than we assumed two years ago. Moreover, the flow of asylum seekers was less than expected in 2016. The overestimation of immigrant numbers in Norway also means a somewhat weaker network effect. In the projection for the year, net migration in the main alternative is almost 20 000 per year for most of this century, compared with 25 000–28 000 in the previous projection.

Figure 3.33 Total net migration, registered and projected in 2016 (grey) and in 2018 (purple)

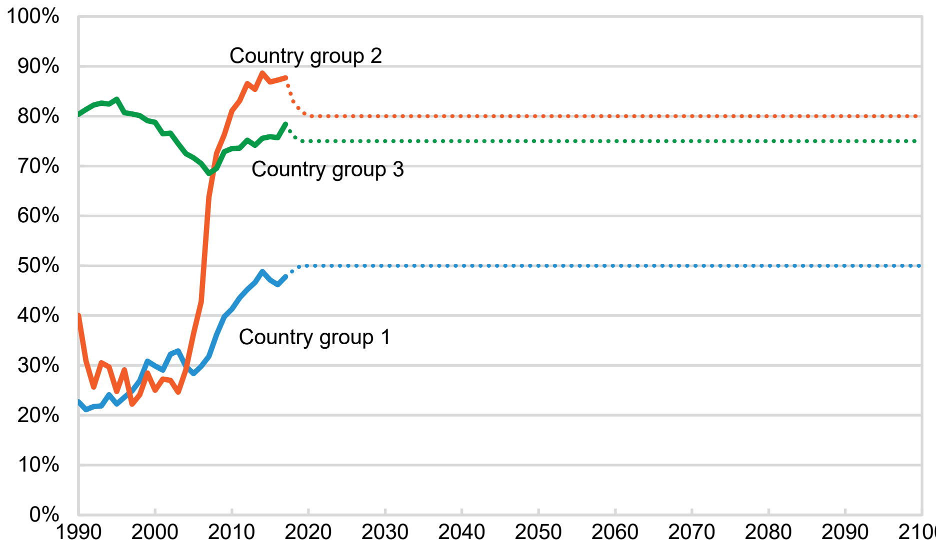


Source: Statistics Norway

Number of immigrants in Norway in the years ahead

Once we have made assumptions about immigration, emigration and mortality, BEFINN can calculate how many immigrants will to live in Norway in the future. In BEFINN, we also calculate how many future residents will be Norwegian-born children of two immigrant parents. In addition to assumptions about future fertility rates for immigrant women, this also requires assumptions about what proportion of immigrant women's children will have a father who is also an immigrant. These assumptions are shown in Figure 3.34, and only one alternative is made. In recent years, the proportion has been highest for women from country group 2. There was a strong growth in this proportion after the eastward expansion of the EU in 2004, but the growth has stopped in recent years. Among women from country group 1, the proportion who have children with other immigrants has also increased. On the one hand, there is reason to believe that more immigrants overall in Norway will mean a continued high proportion who have children with another immigrant. We have therefore increased the proportion for country group 1 – which today is much lower than the other country groups – to 50 per cent. Conversely, country group 2 in particular is now at a very high level, which we do not believe will continue throughout the remainder of the century, as future immigrants will have had more experience of living in Norway and will have become more closely integrated in Norwegian society. We therefore assume that the proportion will fall slightly for country group 2 (to 80 per cent), whilst remaining at approximately today's level for country group 3 (75 per cent).

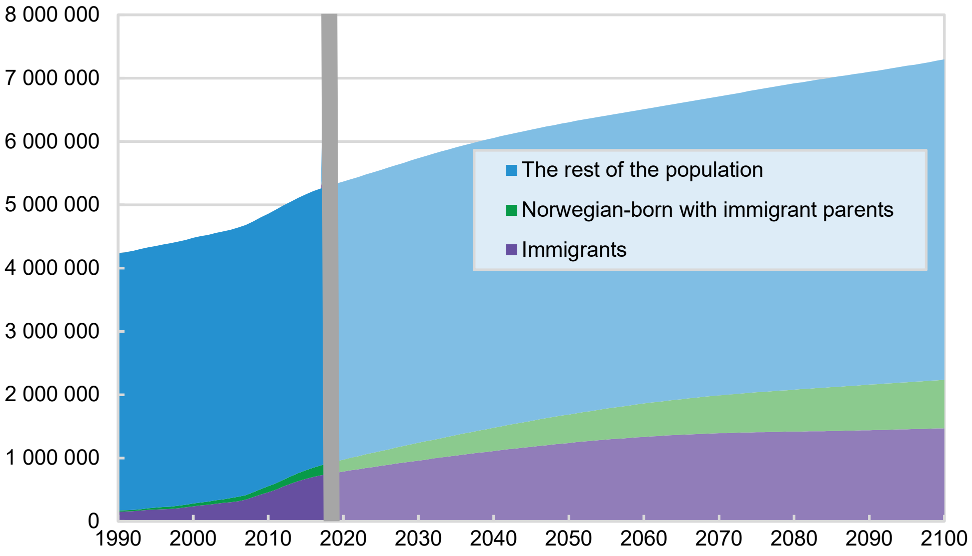
Figure 3.34 Proportion of children born to an immigrant woman, with a father who is also an immigrant, for three country groups, registered 1990–2017 and projected 2018-2100



Source: Statistics Norway

The number of immigrants in Norway is set to increase by 2060, regardless of which of the three mentioned alternatives for future immigration are applied. The number of Norwegian-born to two immigrant parents will also increase in all alternatives. Figure 3.35 shows the figures from the main alternative (MMMM) for the future population in Norway in three groups: immigrants, Norwegian-born to two immigrant parents and the rest of the population. The number of immigrants will increase from almost 750 000 today to 1.33 million by 2060. Growth will gradually decrease because a certain percentage of immigrants will emigrate or die. The number of Norwegian-born to immigrant parents will increase from 170 000 today to approaching 530 000 by 2060.

Figure 3.35 Immigrants, persons born in Norway to two immigrant parents and the rest of the population, registered 1990–2018 and projected 2019-2100, main alternative (MMMM)

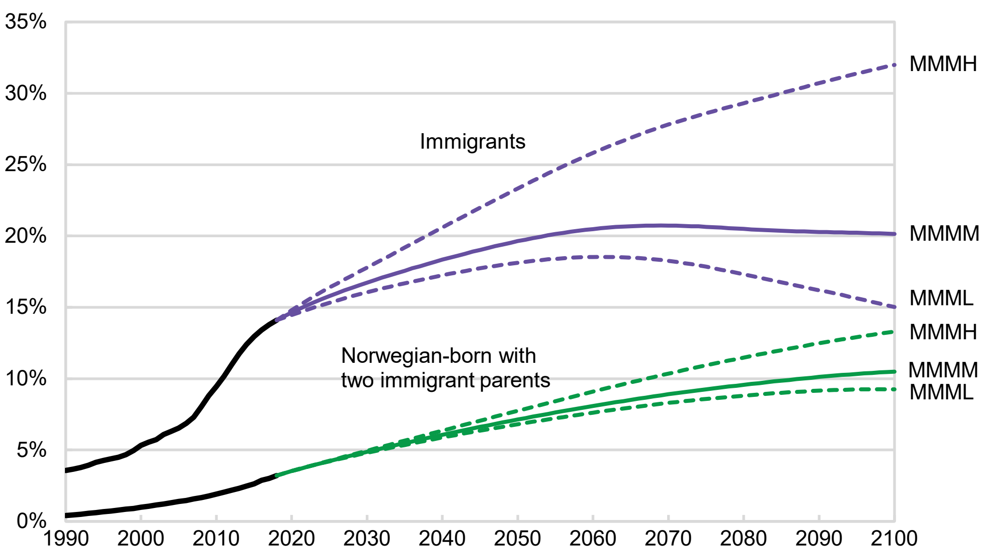


Source: Statistics Norway

Today, immigrants make up 14 per cent of the population in Norway, while Norwegian-born to two immigrant parents constitute 3 per cent. How high these proportions will be in the future largely depends on future immigration and emigration. Figure 3.36 shows the development of the proportions in the main alternative as well as in the alternatives for high and low immigration. In the main alternative, the proportion of immigrants increases from the current 14 per cent to 20 per cent by 2060, and the corresponding increase for Norwegian-born to two immigrant parents is 3 to 8 per cent.

In the high alternative for immigration, the proportions will be much higher: 26 per cent of the population will be immigrants by 2060, and 9 per cent will be Norwegian-born to two immigrant parents. In the low alternative for immigration, the proportions will be 19 and 7.6 per cent by 2060 respectively.

Figure 3.36 Proportion of immigrants and Norwegian-born to two immigrant parents, registered 1990–2018 and projected 2019–2100 in the MMMM, MMML and MMMH alternatives

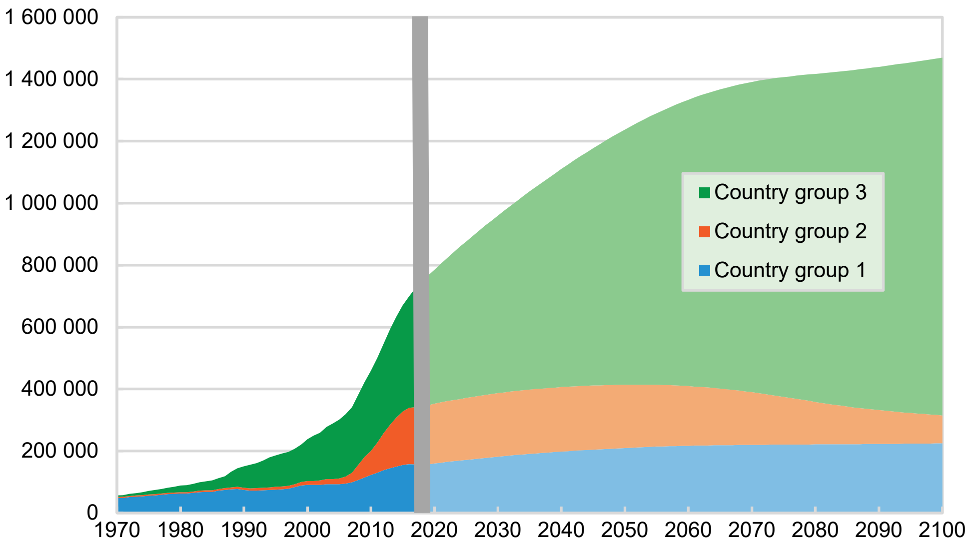


Source: Statistics Norway

Country groups, duration of stay and age

As shown in Figures 3.25–3.27, we predict a decline in immigration from country group 2, and fairly stable or slightly increasing immigration from country groups 1 and 3. This also impacts on which countries future immigrants to Norway will stem from. In the main alternative, as shown in Figure 3.37, the number of immigrants from country group 2 will decrease after 2040, while the number from the other two country groups will increase throughout the period. The increase is particularly high among immigrants from country group 3. This is already the largest group by a large margin. One of the main reasons why this country group shows stronger growth than country group 1 is that immigrants from country group 3 are generally less likely to emigrate.

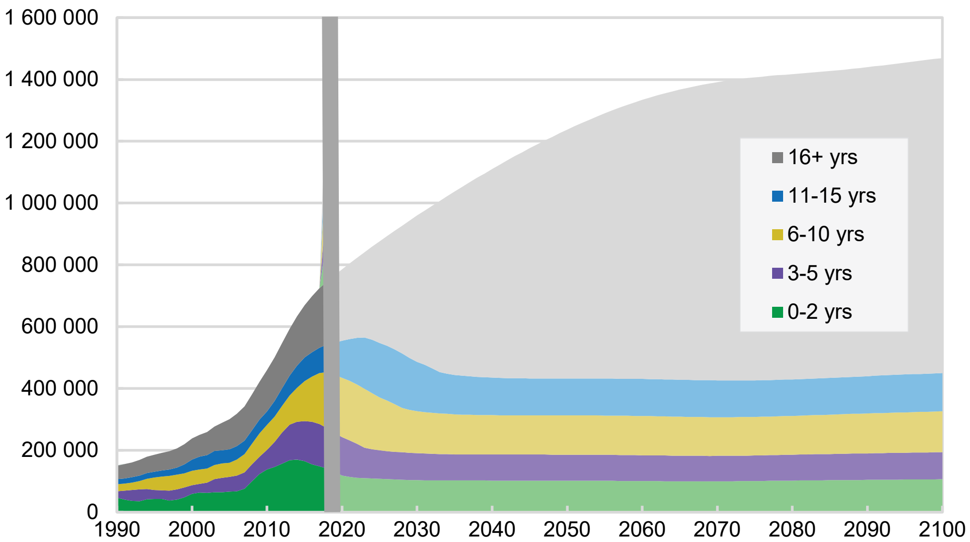
Figure 3.37 Immigrants resident in Norway, by country background, registered 1970–2018 and projected 2019–2100, main alternative (MMMM)



Source: Statistics Norway

The probability of emigration usually decreases with duration of stay. Generally speaking, the longer a person has been in Norway, the less likely they are to emigrate. Consequently, immigrants who have lived in Norway for a long time are the group that grows most, as shown in Figure 3.38.

Figure 3.38 Immigrants in Norway by duration of stay, registered 1970–2018 and projected 2019–2100, main alternative (MMMM)

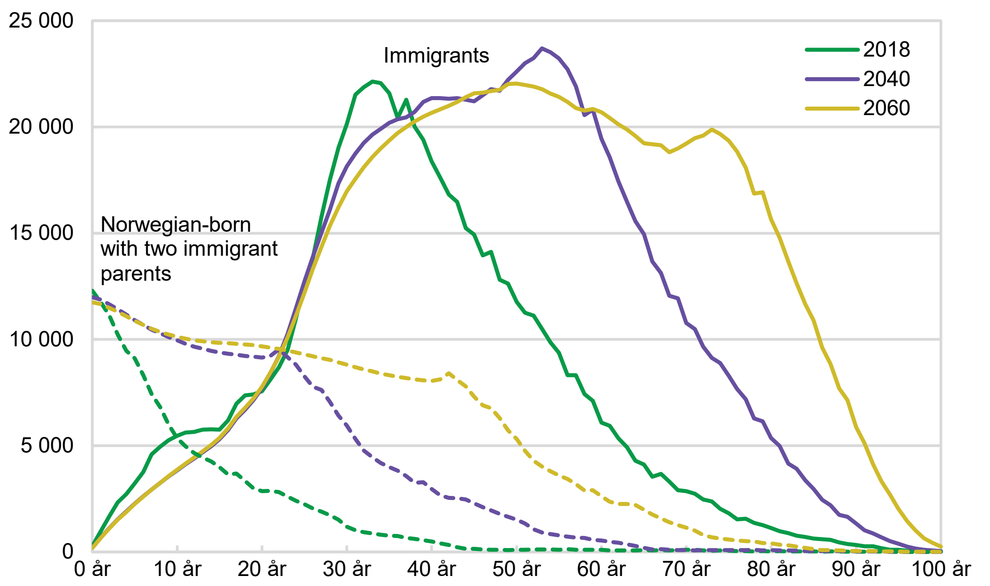


Source: Statistics Norway

We also predict a clear aging of immigrants in Norway. Today's immigrants are relatively young, with most in the 30–35 age group. Thus, almost the entire growth in the number of immigrants is in the older age groups in the population projections, as shown in Figure 3.39. By 2040, the most common age will be 53 years, according to the main alternative. We do not expect any growth among the young immigrants.

Today, most Norwegian-born to two immigrant parents are young, as indicated by the dotted blue line in Figure 3.39. There will continue to be a large number of young children in this group, but future growth will primarily be in the older age groups.

Figure 3.39 Immigrants in Norway and Norwegian-born to two immigrant parents by age, registered 2018 and projected in 2040 and 2060, main alternative (MMMM)



Source: Statistics Norway

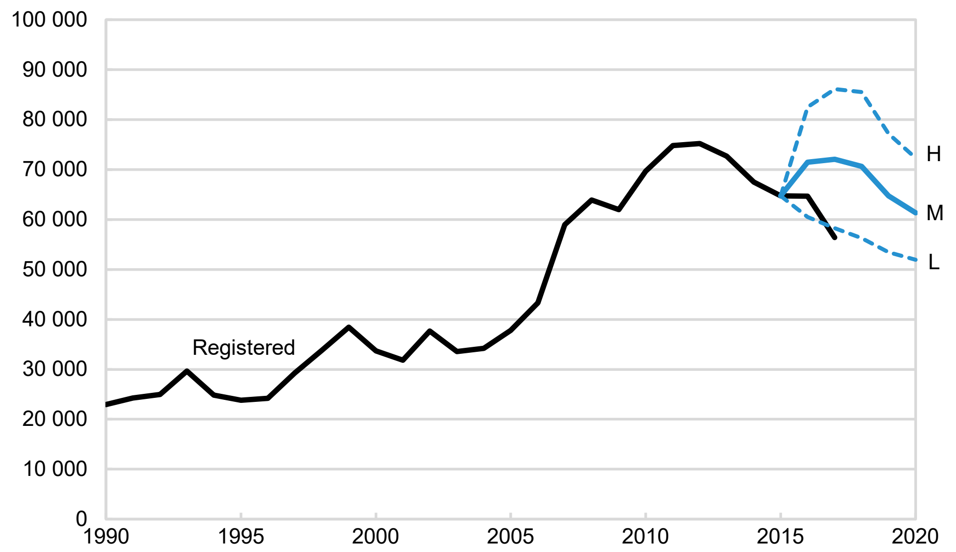
All of the figures and estimates shown in this chapter are associated with a degree of uncertainty. Estimates of future immigration are often regarded as the most uncertain element of a population projection. In our work, every aspect entails uncertainty to some extent: in the building and estimation of the econometric model, and in estimates of future economic growth, unemployment and population trends. All of the other assumptions we have made – such as emigration probabilities and the distribution of immigrants by age and sex – are also associated with uncertainty. This further propagates to our projections of how many immigrants and Norwegian-born to immigrant parents who will live in Norway in the future.

By studying the accuracy of the previous projection, we can form an impression of the short term uncertainty that characterizes the immigration projections. This is done in the next section. A thorough review of the accuracy of previous population projections is given in Rogne (2016).

Accuracy of the last projection

The last population projection was published in June 2016. It assumed a short term increase in immigration in connection with the large influx of asylum seekers in the preceding autumn, and a slight increase in emigration. Registered figures show that immigration to Norway in 2016 and 2017 was lower than in the main alternative, and for 2017 it was also lower than in the low alternative (Figure 3.40). Immigration was lower than projected for all country groups. For country group 2, immigration was lower than in our low alternative in both 2016 and 2017. The discrepancy in absolute numbers was greatest for country group 3 in 2017, with in excess of 10 000 fewer immigrations than assumed in the main alternative.

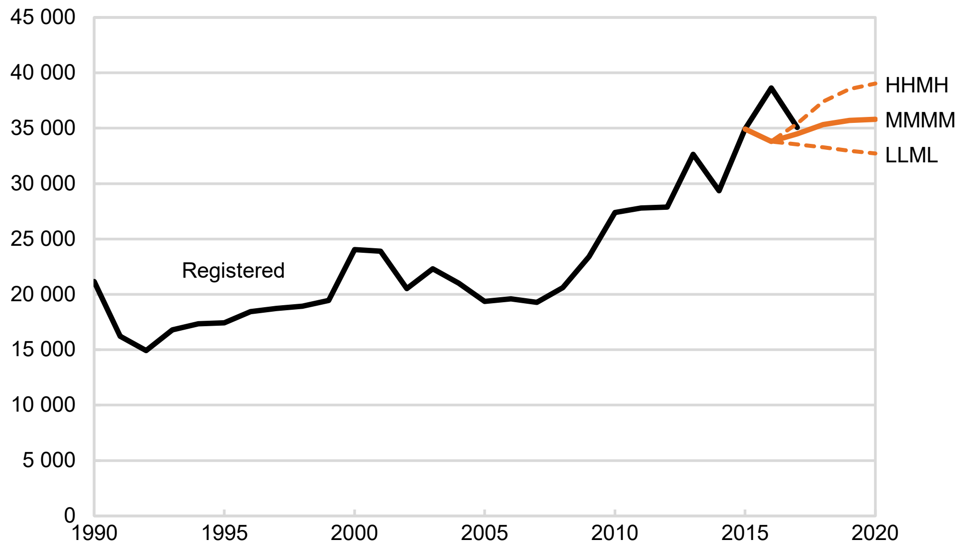
Figure 3.40 Immigration to Norway, registered 1990–2017 and projected in the 2016 projection



Source: Statistics Norway

Emigration was higher than projected, as shown in Figure 3.41. This applies to all country groups, except for country group 3 in 2017, when there were fewer emigrations than we had expected.

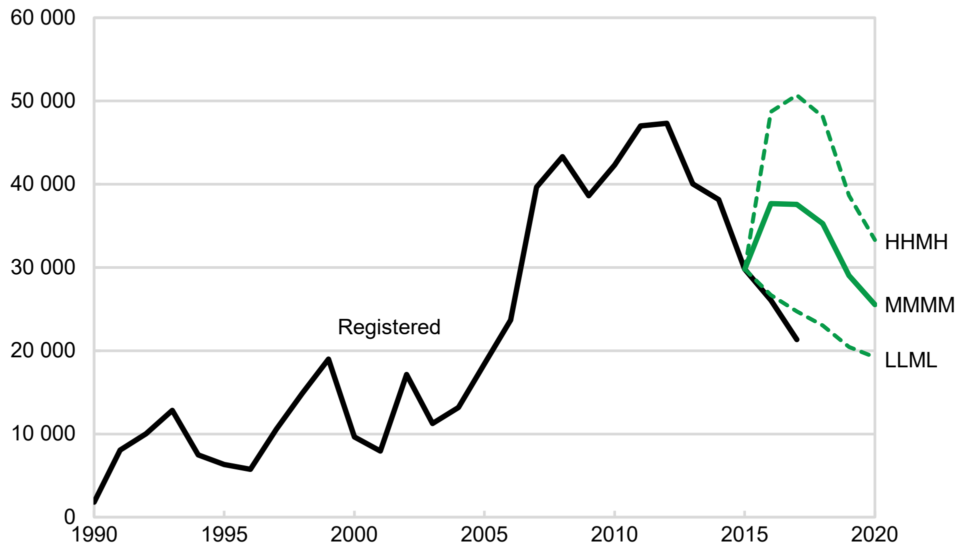
Figure 3.41 Emigration from Norway, registered 1990–2017 and projected in the 2016 projection



Source: Statistics Norway

The discrepancies in the immigration and emigration figures pulled in the same direction, which meant that the deviation in net migration was fairly large (Figure 3.42). Net migration to Norway was lower than projected in our low national growth alternative (LLML) in both 2016 and 2017.

Figure 3.42 Net migration, registered 1990–2017 and projected in the 2016 projection



Source: Statistics Norway

4. The projection models BEFINN and BEFREG

The cohort-component method is used for the projection of the population. It calculates next year's population by starting with the population in the current year and adding births, deducting deaths and emigrations/internal out-migrations, and adding immigrations/internal in-migrations. This is done for both sexes by one-year age groups. When next year's population has been calculated, it is used as the basis for calculating the population the year after.

The cohort-component method is used in both BEFINN and BEFREG. The population in BEFINN and the total national population in BEFREG are tallied by adjusting the results from BEFREG so that they are consistent with the results from BEFINN for the overall population figures by age and sex.

The population is projected in several different alternatives. Each alternative is described using four letters in the following order: fertility, life expectancy, internal migration and immigration. The alternative MMMM indicates that the medium or main level is used for all the four components. It is denoted our main alternative. The components can also have the levels L = low, H = high, K = constant or 0 = zero.

4.1. The cohort-component method

The cohort-component method is a method for projecting populations that is used by most agencies that project populations at a national or international level.

Data and methods

We use two types of input when projecting the population using the cohort-component method:

I. Updated figures for the population by sex and one-year age groups for the baseline year
II. Assumptions about the future development of the demographic components:
   - fertility
   - life expectancy
   - internal migration
   - immigration
   - emigration

The population projections utilize aggregated individual level data on population size, births, deaths and migration from Statistics Norway's population statistics (BESTAT), collected from the Directorate of Taxes for the National Registry. We employ data categorized by age, sex, immigrant background and country group for 1 January each year, in addition to the aforementioned figures on births, deaths, internal migration between municipalities and Oslo's city districts, immigration and emigration by age, sex and municipality/city district. No samples are used. The projections utilize the whole population in estimations.

Table 4.1 shows an example of how we do this. When we have an overview of the number of men and women in each age group in the baseline year, and assumptions about the demographic components for each of these groups, we can work out how many persons there will be in each age group the year after. If, for example, we start with 14-year-old females in a given year and deduct those who are assumed to emigrate/move away or die during the course of a year, and then add the number of 14-year-old females who are assumed to immigrate, we arrive at the number of 15-year-old females the year after. This figure is then used as the basis for calculating the number of 16-year-old females the year after that, and so on. These women are indicated in blue in the table. A cohort can thereby be followed through the projection period.[5]

Table 4.1 An illustration of the cohort-component method

	Number of women			
	Registered year	Projected years		
	t	t+1	t+2	t+3
Age 0	27 628	27 461	27 696	28 060
Age 1	29 038	27 955	27 792	28 026
Age 2	29 367	29 237	28 154	27 998
Age 3	29 650	29 510	29 370	28 290
Age 4	29 979	29 749	29 601	29 455
Age 5	30 677	30 065	29 827	29 674
Age 6	30 893	30 775	30 152	29 911
Age 7	31 870	30 967	30 849	30 222
Age 8	32 289	31 962	31 052	30 937
Age 9	31 747	32 390	32 056	31 144
Age 10	31 099	31 852	32 489	32 153
Age 11	31 252	31 214	31 954	32 588
Age 12	30 618	31 370	31 323	32 055
Age 13	30 677	30 732	31 475	31 426
Age 14	30 441	30 794	30 838	31 576
Age 15	30 028	30 558	30 902	30 940
Age 16	30 523	30 191	30 714	31 053
Age 17	31 772	30 660	30 324	30 844
Age 18	31 840	31 895	30 790	30 455
Age 19	31 621	32 026	32 097	31 000
Age 20	32 253	31 905	32 297	32 367

This method cannot be used directly for one age group, namely those below the age of 1. To project the number of 0-year-olds, we start with the number of women in each age group between 15-49 years and combine this with the assumptions about fertility for each age group. We then arrive at a figure for newborn boys and girls. To calculate the number of newborn boys, this figure is multiplied by 0.51369, since the birth of boys is usually more frequent than that of girls. The women this pertains to is indicated in green in the table.

The assumptions

Most of the assumptions that are used in the cohort-component method are stated as rates, probabilities or proportions by sex and one-year age groups. These are assumptions about future fertility, mortality, internal migration and emigration. For immigration, the total assumed number is distributed by age and sex based on the age and sex distribution observed in previous immigrations.

The future fertility is projected based on observed trends in fertility and differ by immigration background. The fertility of women with a Norwegian background is projected separately, whereas the fertility of women with immigration background is projected in 15 alternatives by combinations of country group and time of residency in Norway (see chapter 5). Probabilities of death and life expectancy are projected employing Lee-Carter and ARIMA models (see chapter 6). An econometric model has been used from 2008 onwards to project future immigration (see chapter 8). In this model, immigration is projected based on factors like income levels, unemployment, population size and prior immigration to Norway from the country groups, see Cappelen et al. (2015).

Multiple events during the course of one year

In principle, our version of the cohort-component method only calculates changes from the turn of one year to the turn of the next. This implies that there is limited

[5] A cohort is a group of people who have experienced something during the same period, such as being born, getting married or being a student. The term is most frequently used about birth cohorts, i.e. men and/or women born in the same year.

possibility for the same person to experience more than one demographic event during the course of one year. A person cannot, for example, immigrate and then emigrate (or die or have a child) in one and the same year. One result of this is that projected figures for immigration and emigration do not include persons who have both immigrated and emigrated during the same year. This means that the immigration and emigration figures from the population projections are somewhat lower than the corresponding figures from Statistics Norway's population statistics. The figures will, however, be comparable for net migration.

An exception from the rule of only one demographic event during each year concerns newborns: It is possible to be born and die in the same year, or to be born and emigrate/move away in the same year. This is because of the order in which the components are entered in the model: First, all the births are entered, and the age of all the age groups is increased by one year. This newly projected population (including the births) is then used to calculate the number of deaths and the number of emigrations in each age group. Finally, both the number of deaths and the number of emigrations are deducted, and the number of immigrations added.

Age at the end of the year

In the population projections, age at the end of the year is used in the definition and calculation of the demographic events (births, deaths and migrations). In the general population statistics, on the other hand, it is usually age at the time of the event that is used. This means that the age-specific rates and the probabilities that are used in the projections apply to a population that, on average, is half a year younger than those published in the population statistics. The same applies to life expectancy at birth and remaining life expectancy.

4.2. The BEFINN model

The BEFINN model projects the population at the national level, and immigrants, Norwegian-born persons with immigrant parents and the remaining general population are projected as separate groups. Since immigrants and Norwegian-born children with immigrant parents are separate groups, separate assumptions can also be used about the demographic components for these groups. For fertility, separate birth rates are assumed for immigrant women from three country groups and five duration of stay groups, while the same rates as for other women are assumed for Norwegian-born daughters of immigrant parents. For mortality, the same age and sex-specific probabilities apply to all groups. For emigration, separate probabilities are used for immigrants, for Norwegian-born persons with immigrant parents and for the remaining general population. These probabilities differ, in turn, depending on which of the three country groups the immigrants and their Norwegian-born children come from. For immigrants, the probability of emigration also varies with duration of stay.

To be able to calculate the number of Norwegian-born persons with immigrant parents, assumptions must be entered about how large a proportion of the children who are born to immigrant women also have an immigrant father. These proportions vary between the three country groups. This is shown in more detail in chapter 3.

Results

BEFINN calculates the future population as of 1 January in Norway for each projection year up to and including 2100 based on the following characteristics:

- one-year age group (0,1, 2, …, 119 years)
- sex
- immigration category

  - o immigrant
  - o Norwegian-born children with immigrant parents
  - o the remaining general population
- country group, i.e. country group of birth for immigrants and mothers' country of birth for Norwegian-born children of two immigrant parents
- Duration since first immigration to Norway (only for immigrants)

The country groups currently in use, is described in detail in Appendix B. In short, *Country Group 1* comprises all the Western European countries, i.e. countries that were part of the 'old' EU (pre-2004) and/or the EEA and EFTA, as well as the US, Canada, Australia and New Zealand. On average, nationals from these countries display relatively similar demographic behavior for fertility and emigration. Moreover, few or no restrictions apply for their living and working in Norway. *Country Group 2* comprises the eleven new EU countries in Eastern Europe (became EU members in 2004 or later): Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Slovenia, Croatia, Bulgaria and Romania. We have merged them to form one group since it is from these countries that immigration to Norway has increased most in recent years. Moreover, of all the EU countries, it is these eleven countries where the income differences are greatest relative to Norway. The potential for migration to Norway is thereby great. At the same time, restrictions on immigration have been largely abolished. *Country Group 3* comprises the rest of the world, e.g. the rest of Eastern Europe, Africa, Asia (including Turkey), Latin America and Oceania (excluding Australia and New Zealand). Nationals from these countries must apply for a permit to live and work in Norway. This group is very heterogeneous, and we have primarily merged these countries into one group for the sake of simplicity.

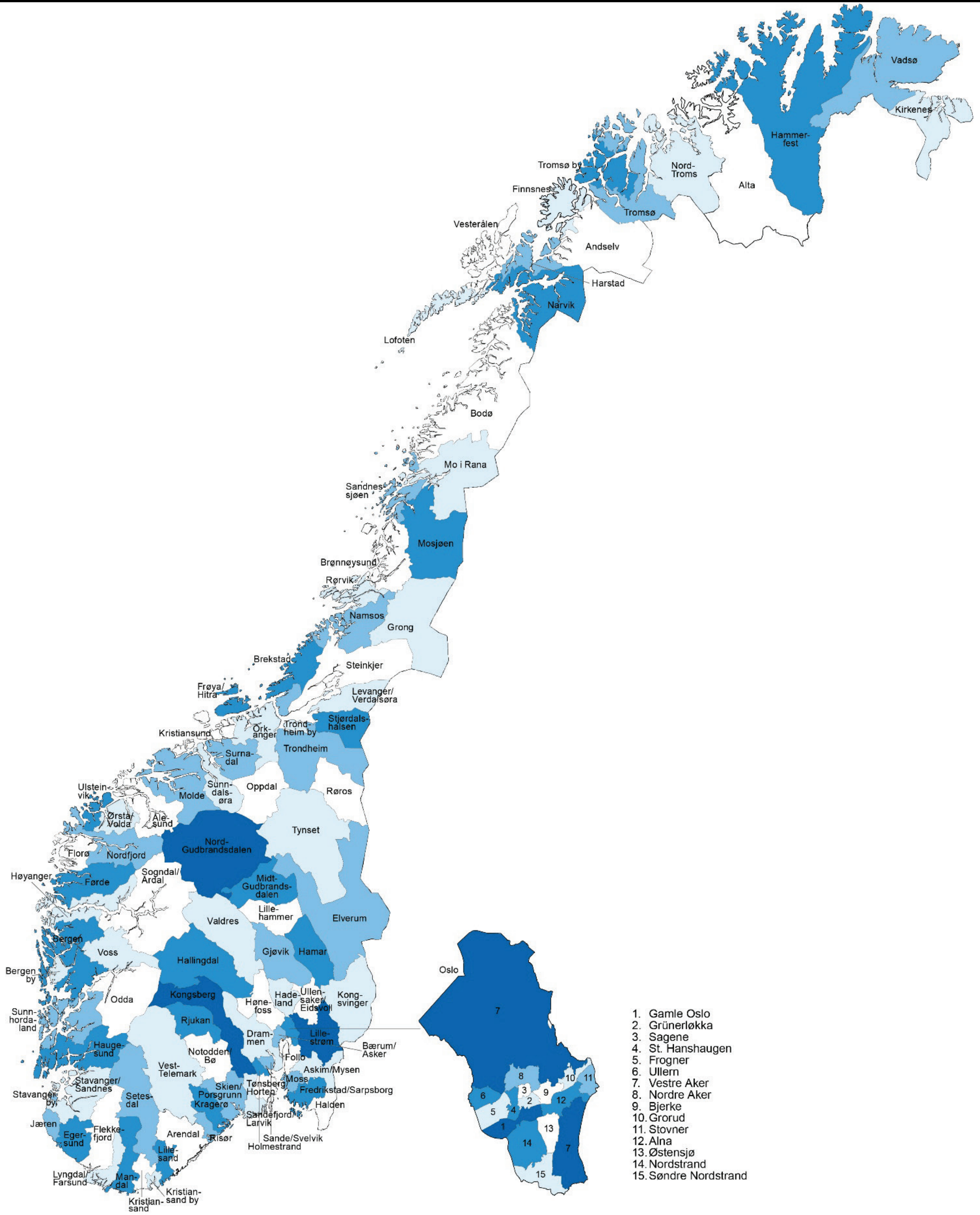
In short, the number of people at the beginning of a year (t+1) is derived from the status of the previous year (t) and the changes in year t in births, deaths, emigrations and immigrations. The components are primarily estimated based on age- and sex-specific rates and probabilities.

For each projection year, BEFINN also calculates the number of births, deaths, emigrations and immigrations based on the same characteristics as above.

4.3. The BEFREG model

In the BEFREG model, the population is projected at the regional level through the year 2040. In this model, immigrants and Norwegian-born children of immigrant parents are not treated as separate entities, and they are thereby included in the general population. The projection regions play a central role in BEFREG, because the cohort-component method projects the population by sex and one-year age groups in each of the 108 projection regions (see Text box 4.1). Figure 4.1 shows the 108 projection regions in Norway. The figures for the projection regions are next summed up to generate population figures for counties. The projected figures for each projection region are thereafter disaggregated to the respective municipalities in the region in accordance with the growth during the last ten years for broad age groups. For an overview of which municipalities belong to the different projection regions, see Appendix A.

Figure 4.1 Projection regions in the Norwegian population projections



Source: Statistics Norway

Text box 4.1 The projection regions
The projection regions comprise a regional level between the counties (N=18) and municipalities (N=422). The criteria used to define these regions are particularly related to economic conditions, labor (commuting distances) and retail trade. In the version used here, Norway is divided into 89 economic regions, each comprising between 1 and 18 municipalities (Statistics Norway 2000). The division is analogous to the EU standard regional division, NUTS 4 (Nomenclature des Units Territoriales Statistiques).

However, the following exceptions exist:
– The cities of Kristiansand, Stavanger, Bergen, Trondheim and Tromsø have been extracted from the economic regions with the same names and are treated as separate projection regions
– Oslo has been sub-divided into 15 projection regions (the 15 largest city districts). The small city districts Marka and Sentrum have been merged with Vestre Aker and St. Hanshaugen, respectively, whereas those without a registered residential address have been included in St. Hanshaugen.

The number of projection regions in BEFREG is therefore 89 + 5 + 15 – 1 = 108.

To project the population at the regional level, we need to make assumptions about future fertility, mortality and internal migration in each of the projection regions. They are stated as sex and age-specific rates or probabilities. They are a combination of the national assumptions that were used in BEFINN and registered regional fertility, mortality and migration in the last ten observation years prior to the projection. BEFREG projects both the population and the demographic components in each projection region during the entire projection period.

The projections are made by utilizing regional probabilities, rates or proportions for births, deaths, internal migration, immigration and emigration for the population by sex and one-year age groups (0, 1, 2, …, 119 years), and the baseline is the regional differences over the last ten years, Thereafter the differences are projected to remain proportionally constant during the projection period.

Even though BEFREG projects the population in each projection region, estimates based on various regional levels are used when we project the individual components. As an example, county-specific death probabilities are used in estimates of life expectancy.

Municipality figures

To project the population by age and sex in each county, the populations from the projection regions in the county in question are added together. To project the population of each municipality, the population by age and sex in the projection region in question is distributed between the municipalities in the projection region. This distribution is based on the following main principles:

- For those who are 50 years old or older, the proportion of the population in the projection region who belong to each municipality (by sex and one-year age groups) is equal to the proportion of persons who were one year younger and belonged to the same municipality one year earlier. For example, the proportion of 61-year-old women in a given municipality will be the same as the proportion of 60-year-old women in the same municipality the year before.
- For the age groups 1–49 years, we also take internal migration into account. This is done using growth rates, which show the growth in the municipalities in the ten years preceding the projection. More information on how internal migration has been taken into account in breaking down the figures to the municipal level is provided in chapter 7.
- Girls and boys who are not yet one year old are distributed using different fertility profiles for the municipalities in the same projection region. See chapter 5 for more information on this.

It is thus the population and not the components that is distributed from the projection regions to the municipalities. That is why we do not calculate figures for deaths, births and migrants at the municipal level.

4.4. Calibration

When we have projected the population using BEFINN and BEFREG, the results do not usually tally exact at the national level. In such case, the population figures in BEFREG are adjusted. This is done by calculating a factor for each age group and for each sex by which the national totals from BEFREG are multiplied in order to arrive at identical results as in BEFINN. The population in all the projection regions by sex and one-year age groups is then adjusted by the relevant factor. This is done for each projection year. If, for example, the total number of 90-year-old women in BEFINN in 2020 is 10 010 and the corresponding national total in BEFREG is 10 000, the adjustment factor will be 1.001 for this group for the year in question, and all the figures in BEFREG for 90-year-old women will be multiplied by 1.001. Corresponding adjustments are not made for the components (for example births and deaths), so that, for these, there may be some differences between the published results from BEFREG and BEFINN.

Rounding off

BEFINN and BEFREG use decimals throughout the projection. Before the results are published, the decimals are converted into whole numbers. In many cases, this involves a simple rounding off, but in cases where, for example, there are very many numbers that are closer to 0 than to 1, a simple rounding off will mean that the totals are incorrect. In some cases, therefore, and particularly when breaking down the figures to the municipal level, a method is used that is described in more detail (in Norwegian) in Rideng et al. (1985). The method is based on the principle that the percentage distribution of the population for municipalities in the same projection region should add up to 100. We first calculate and round off the smallest number. We then calculate the second smallest number as a percentage of the remaining total and round it off, and so on for increasingly large numbers. Even though we use this form of rounding off, there can nonetheless be some differences between the totals from the different models and the different geographical levels in the population projections.

4.5. Alternative projections

The results of a population projection depend on the assumptions which are used for the components. Different alternatives are therefore produced for fertility, life expectancy and immigration:

- M – medium alternative
- H – high alternative
- L – low alternative
- K – constant alternative
- 0 – zero alternative

Statistics Norway projects the population using a total of 15 combinations of these alternatives (Table 4.2). Each calculation alternative is described using four letters in the following order: fertility, life expectancy, internal migration and immigration. The term 'main alternative' is used to designate the MMMM alternative, which indicates that the medium level has been used for all components.

Table 4.2 Statistics Norway's projection alternatives[1,2]

Alternative	Description
MMMM1	Medium national growth
LLML	Low national growth
HHMH	High national growth
HMMM	High fertility
LMMM	Low fertility
MHMM	High life expectancy
MLMM	Low life expectancy
MKMM	Constant life expectancy
MMHM	High immigration
MMML	Low immigration
MMMK	Constant immigration
LHML	Strong aging
HLMH	Weak aging
MMM0	No net migration
MM00	No migration (internal or international)

[1] The MMMM-alternative is Statistics Norway's main alternative, and the one we recommend using unless we explicitly state otherwise, or the users have a particular aim in mind for their analyses.
[2] The constant alternatives are only modelled in BEFINN.
Source: Statistics Norway

In the MMM0 alternative (no net migration), immigration and emigration take place, but the difference between them is 0. In other words, there are as many emigrations as immigrations. Internal migration is the same as in the other alternatives. In the MM00 alternative, on the other hand, there is no net migration at all, neither internationally nor domestically.

One reason why we project the population in so many alternatives is to illustrate the uncertainty associated with the projections. This is discussed in more detail in chapter 9. For example, the alternatives with constant life expectancy or immigration and the alternatives with zero migration and/or net migration are relatively unrealistic, but they can nonetheless yield interesting analytical results. The same applies to the alternatives high national growth (HHMH) and low national growth (LLML). It is not very probable that we will see a combination of high fertility, high life expectancy and high immigration, or of low fertility, low life expectancy and low immigration throughout the projection period.

5. Fertility assumptions

In BEFINN, which projects the population at the national level, we project fertility for different groups of women. These groups are women with Norwegian backgrounds, as well as immigrant women in 15 combinations of country background and duration of stay in Norway.

Based on observed fertility trends, Statistics Norway makes assumptions about how fertility will develop in the future in these 16 groups. In the regional population model, BEFREG, we take differences in fertility between 68 geographical regions in Norway – referred to as fertility regions –as our point of departure. The assumptions about overall future fertility are taken from BEFINN. The paths are then moved either up or down so that they mirror regional differences in fertility. The regions' birth rates are therefore constant in relation to the national rates throughout the projection period. Based on the regional fertility differences, we project the number of 0-year-olds (births) in 108 projection regions. They are summed up to counties and later distributed between Norway's counties.

Text box 5.1. Age-specific fertility rates (ASFR)

ASFRs are calculated by dividing the number of births to women of a given age by the mean population of women of the same age. The mean population is the average number of women of the age in question who are resident in the country in a calendar year. Women are divided into one-year age groups from 15 to 49 years. Moreover, immigrant women are divided by country background and duration of stay in Norway, and all women are divided into groups by where in Norway they live.

The formula for age-specific fertility rates can be written as follows:

$$ASFR(x, t) = f(x, t)/k(x, t)$$

where $f(x, t)$ is the number of live births to women of age x in year t, and $k(x, t)$ is the mean population of women of age x in year t.

Total fertility rate (TFR) is the sum of the age-specific fertility rates for women aged 15–49 years in a given period, normally a calendar year. TFR can be interpreted as the average number of children each woman will give birth to, provided that the period-specific fertility pattern in the period will persist and that no deaths occur before age 50.

Data

We use observed data to calculate the baseline level for fertility in the different subgroups, such as the different regions in Norway. We take the number of women aged 15–49 years from Statistics Norway’s population statistics. The data source, which is Statistics Norway’s version of the National Population Register, also contains information about the women's backgrounds, i.e. where they live, whether they are immigrants or not, and how long they have lived in Norway. Data about births are also obtained from Statistics Norway's population statistics, which contain information about live-born children of women resident in Norway in a given calendar year.

5.1. Fertility for the country as a whole

BEFINN projects the population at the national level. To do this, we need estimates of future birth rates. This is done separately for immigrant women and for the remaining population. We first find the baseline level for the different groups and then make assumptions about how we believe fertility will develop for these groups in the future.

Fertility among immigrants
To calculate how many children will be born to immigrant women in future, we create groups based on country group and duration of stay.

We use three country groups (see Appendix B for detailed list):
- Country group 1: Western Europe, the US, Canada, Australia and New Zealand
- Country group 2: Eastern EU member countries (Bulgaria, Estonia, Croatia, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia, Czech Republic and Hungary)
- Country group 3: The rest of the world, e.g. the rest of Eastern Europe, Africa, Asia (including Turkey), Latin America and Oceania (excluding Australia and New Zealand)

Duration of stay is calculated as the number of whole years since first-time immigration to Norway. We divide duration of stay into five groups:
- 1 year or less
- 2–3 years
- 4–6 years
- 7–11 years
- 12 years or more

Together, this amounts to 3 x 5=15 combinations of country group and duration of stay. To find the baseline level for fertility in the 15 different groups of immigrant women, age-specific fertility rates are calculated for each group as an average of the last ten years. This is a weighted average where the last year with available data counts most.

Fertility among the remaining population
Once we have calculated the baseline level for fertility among immigrant women, we are left with the rest. Norwegian-born women with immigrant parents are also part of this group. To calculate the baseline level for fertility among the remaining women, age-specific fertility rates are calculated for the last year.

Fertility assumptions
Once we have calculated the baseline level for fertility for the 16 groups (15 groups of immigrant women and the remaining women), we have to set assumptions about how fertility will develop in future. For each year in the projection period, we use a factor that adjusts the age-specific fertility rates up or down based on how we believe fertility will develop in future. The yearly factor is created in three alternatives: low, medium and high. The factor is set by Statistics Norway after discussions with an advisory reference group consisting of fertility researchers.

When we set the factor, we take fertility of the entire population of women as our point of departure. For example, we can envisage the overall fertility rate being 1.78 children per woman in 2020 – i.e. ten per cent higher than in 2017, when women gave birth to 1.62 children on average. The factor will then upwardly adjust the age-specific fertility rates for all groups of women, so that they are ten per cent higher in the year 2020 than in 2017. This means if women from country group 3 with 4-6 years of residence had a TFR of 1.95 in 2017, the projected TFR of that group will be 2.15 in 2020.

Since the same factor is used for everyone, it is conceivable that the differences in fertility between the immigrant women from each of the three country groups and the remaining women could be constant throughout the projection period. They are not, however. This is because immigrant women's fertility varies with their duration of stay, and because the number of immigrant women varies over time. During the projection period, most immigrant women will switch duration of stay groups several times, so that the composition of the 15 groups of immigrant women changes. This has consequences for how many women can potentially give birth in each duration of stay group – and thereby for how fertility will develop among immigrant women overall. This means that the projected total fertility rate will not be constant as the composition of the 16 groups will change over time.

5.2. Fertility at the regional level

Regional differences in fertility

In BEFREG, we need to make assumptions about fertility in different parts of Norway. This is done separately for women in 68 geographical areas, called fertility regions. This division into fertility regions involves merging some projection regions in the same area to form larger regions in order to arrive at more stable fertility figures (see text box 5.2). For an overview of which municipalities belong to the different fertility regions, see Appendix A. To find the baseline level for fertility in the 68 fertility regions, age-specific fertility rates are calculated as an average of the last ten years in each region. This is a weighted average where the last year with available data counts most. The rates are smoothed using the Hadwiger function (Berge & Hoem 1974).

Regional fertility assumptions

Once we have calculated the baseline level in each region, we enter assumptions about future fertility. The assumptions are based on what we believe the national fertility trends will be in future. The assumptions about the development of regional fertility are therefore taken from the model results from the national BEFINN model. The reason for this is that the sum of the number of births in the different parts of Norway should correspond to the number of births in the country as a whole.

The future development of regional fertility is set by adjusting the baseline level in the 68 fertility regions in proportion to the future development of national fertility. The regional fertility differences are thereby taken into account since the baseline level in each fertility region is different, but we assume that the absolute differences between the fertility regions will remain constant throughout the projection period.

In the actual population projection, we calculate the future population by sex and one-year age groups in 108 projection regions. The projection regions that belong to the same fertility region will therefore have the same age-specific fertility rates.

Breakdown to municipalities

Once we have projected the population in each projection region, we distribute the population between the municipalities in Norway. How large a proportion of 0-year-olds in each projection region will be allocated to each individual municipality in the region depends on both the number of women in the municipality and their fertility level. The local fertility level is calculated by classifying the municipalities according to 55 fertility profiles (see text box 5.2). The reason why we do not want to use the geographical fertility regions mentioned above is that municipalities within a fertility region can differ in terms of fertility. We know, for example, that fertility is often lower in cities than in the surrounding municipalities. For all municipalities with the same fertility profile, we calculate age-specific fertility rates as an average of the last ten years. For an overview of which municipalities have which fertility profiles, see Appendix A.

For each projection region, we also calculate how large a proportion of women in each age group (15–49 years) belong to each municipality in the region. If a municipality is a separate projection region, the proportion in each age group will be 1.

Text box 5.2. Regional fertility classifications

When calculating regional differences in fertility, we use the classifications fertility region and fertility profile.

Fertility region refers to a classification where, in order to ensure more stable fertility figures, some of the 108 projection regions are merged to form larger geographical areas. The five projection regions in Telemark county, for example, have been merged to form two fertility regions. We have 68 fertility regions in the country as a whole. We use this classification when we calculate the baseline level for the regional fertility differences in BEFREG.

Fertility profile refers to a classification of the municipalities by fertility level (TFR) and average age on giving birth. The fertility profiles are a classification that is independent of geography, so that two municipalities in completely different parts of the country can have the same fertility profile. The municipalities are classified according to 55 fertility profiles, and we use this classification when we distribute the number of 0-year-olds to the municipalities.

Figures 1 and 2 illustrate the difference between fertility region and fertility profile. Figure 1 shows the five fertility regions in Oppland county: Lillehammer, Gjøvik, Nord-Gudbrandsdalen, Hadeland and Valdres. Figure 2 shows municipalities with the same fertility profile as Lillehammer municipality. Hvaler, Hamar, Våler, Kongsberg, Hol, Bø, Seljord, Tydal and Skånland have roughly the same TFR and age of giving birth as Lillehammer.

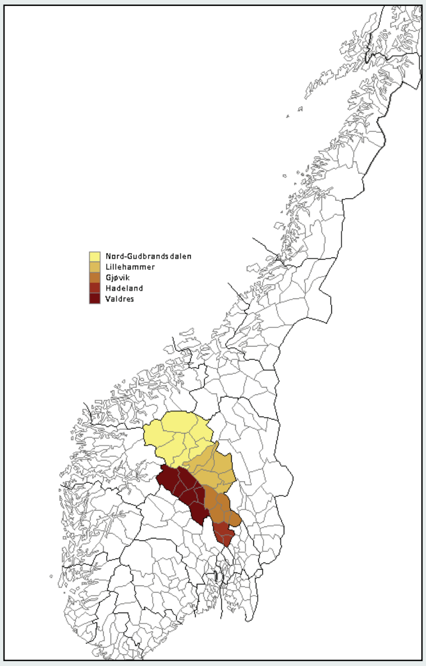


Figure 1. Fertility regions in Oppland county

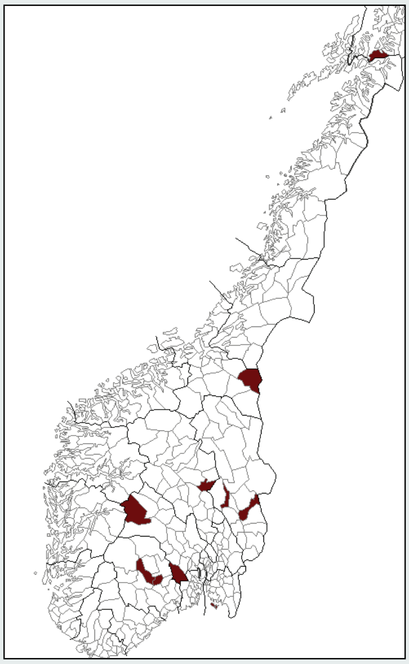


Figure 2. Municipalities with the same fertility profile as Lillehammer

In each municipality, the proportion of women in each age group of childbearing age is multiplied by the age-specific fertility rates for the fertility profile to which the municipality belongs (average of the last ten years). By adding them together over all age groups, we can find out how large a percentage contribution the women in each municipality make to the TFR in the projection region. If a projection region consists of two municipalities, one of the municipalities could, for example, contribute 0.05 children to the TFR in the region, while the other municipality contributes 1.8 children. Taken together, the TFR in the projection region will then be 1.85 children per woman. By dividing the TFR in the municipality by the TFR in the projection region, we find out how large a proportion of 0-year-olds should be assigned to each municipality in the projection region. This proportion is recalculated for every year in the projection period.

When breaking down the population, we thereby calculate the number of 0-year-olds in each municipality for each year in the projection period. The number of 0-year-olds differs somewhat from the number of births since some of them may die or move to or from the municipality during the first year of their lives. At the county level, however, we calculate both the number of births and the number of 0-year-olds for each year in the projection period.

5.3. Fertility assumptions in BEFINN and BEFREG

The projected probabilities of birth are used as assumptions about fertility in BEFINN and BEFREG. In BEFINN, probabilities of birth by country group, duration of stay, one-year age group and calendar year in three alternatives: high (H), medium (M) and low (L) fertility.

In BEFREG, we take account of existing regional differences in fertility. We allow the fertility level to vary between the fertility regions. See Appendix A for an overview of the fertility regions. In order to find the baseline level for fertility in the 68 fertility regions, age-specific probabilities of birth are calculated as an average of the last ten years in each region. This is a weighted average where the last year of available data counts most. The probabilities are smoothed.

Once we have calculated the fertility in each region, we use the assumptions about future fertility at the national level. The national assumptions are the same in BEFINN and BEFREG. The national number of births are distributed to the fertility regions based on the smoothed age-specific fertility rates. This means that the number of births in the regional model corresponds to the number of births in the national model. Births within each fertility region are then distributed among the municipalities based on the fertility level and population of women in 55 regions with similar fertility profiles (see text box 5.2).

6. Life expectancy assumptions

We make assumptions about future mortality by sex and age using different models. We use the 'product-ratio' variant of a Lee-Carter model in which the trend over time in the observed development in mortality, represented by two estimated time series, is continued using an ARIMA model (RWD). The Lee-Carter modeling is primarily based on the development in observed mortality from 1990 onwards. The resulting trends have, however, been adjusted slightly. This is described in more detail below.

This method yields mortality rates by age and sex until and including the year 2100. The assumptions about future mortality are used to calculate the number of deaths in the whole country and in each county during the projection period, and to estimate the future population of the country as a whole and at county, municipal and city district level. The future mortality rates are also used when we calculate life expectancy at birth and remaining life expectancy for each age group up to and including 105 years. This is done separately for men and women, and for both sexes combined.

In the national projection model, BEFINN, mortality rates are similar for everyone of the same age and sex in a calendar year. In other words, we do not take account of characteristics such as immigration status, country background or duration of stay.

In the regional model, BEFREG, regional differences in mortality are taken into account. Here, we use mortality differences during the last decade in each county, and in each of Oslo's city districts, as our point of departure.

6.1. Projection of future life expectancy

Statistics Norway uses recognized models to project mortality in Norway. In these models, future mortality is largely determined by the historical empirical development in the mortality rate.

We use the product-ratio variant of a Lee-Carter model, where the trend in mortality for a selected time period, represented by two estimated time series, is extended using an ARIMA model. The period used as input is determined prior to each projection.

This method gives us mortality rates by age in years and sex up to and including the year 2100, which are subsequently used in the models BEFINN and BEFREG. The projected mortality rates are also used to calculate life expectancy at birth and the remaining life expectancy at every age up to and including 105 years. Calculations are made for men and women separately and together.

Data

The figures for the number of deaths and the size of the population are taken from Statistics Norway's population statistics. In the current projection, we use an input-period from 1990-2017 in the modeling work. We calculate age-specific death rates for men and women, and the total for both sexes by age in years for each calendar for the ages 0-110, and allow for the fact that deaths do not occur linearly throughout the year. Age is defined as the age in whole years at the end of the year. When the mortality rates are calculated, an adjustment is made for extreme values. Once we have calculated the mortality rates in the period we have chosen to base our model on and made adjustments for extreme values, the actual modelling of projected rates can begin.

Text box 6.1. Mortality rates

We calculate age-specific mortality rates for men, women and combined for both sexes by one-year age groups from 0 to 110 years for each calendar year in the period from 1990 up to and including the last year for which data are available. Age at death is defined as age in whole years at the end of the year. Once the mortality rates have been calculated, they are corrected for extreme values. Mortality rates with the value 0 are set to the average of the rates for the age groups before and after for ages up to and including 100 years. This happens relatively rarely, but it is because deaths have not occurred in a certain year, sex and age group. For example, deaths are rare among females aged between 10 and 15 years, and in individual years and in one-year age groups, deaths have therefore not occurred.

For the age group 101–107 years, extreme values are corrected using an extrapolated average, and the rates are smoothed. From age 108, the death probabilities are set to 0.5 for both men and women. Once we have calculated the mortality rates in the period 1990 until and including the last year for which data are available, and corrections have been made, the actual modeling can begin.

The models

Initially, we use the 'product-ratio method' (Hyndman et al. 2013). The purpose of this method is to reduce the correlation between the mortality rates for men (M) and women (K). The method can be formally described as follows:

$$p(x,t) = \sqrt{(m_M(x,t) * m_K(x,t))}$$
$$r(x,t) = \sqrt{(m_M(x,t)/m_K(x,t))}$$

where $p(x,t)$ is defined as the square root of the product of the mortality rate ($m(x,t)$) of men and women, respectively, at age x in year t, and $r(x,t)$ corresponds to the square root of men's mortality rate divided by women's mortality rate. Even if $p(x,t)$ and $r(x,t)$ are not completely uncorrelated, the correlation is significantly reduced.

A model based on the Lee-Carter model (Lee & Carter 1992, Li & Lee 2005, Lee 2000) is then applied to the observed mortality data in our sample. This model was originally developed by Lee and Carter in 1992, but has subsequently been further developed. The method estimates parameters for changes in the mortality level over time and by sex and age. It can be expressed as follows:

$$\log m(x,t) = a(x) + \sum b_i(x)k_i(t) + u(x,t)$$

where $\log m(x,t)$ is the logarithm of the mortality rate in year t for age x, $a(x)$ is the general age pattern, $b_i(x)$ is the age-dependent correction in the time index, $k_i(t)$ is the time index and $u(x,t)$ is a stochastic error term that is assumed to be normally distributed.

Given that we have already reworked the mortality rates $m(x,t)$ for men and women using the product-ratio method, we use a Lee-Carter model in which the mortality rates $m(x,t)$ for men and women are replaced by $p(x,t)$ and $r(x,t)$, respectively. We thereby model mortality for men and women in the same process. The sum of the age-dependent correction in the time index $b_i(x)$ multiplied by the time index $k_i(t)$ can consist of one or more components. Our data prove to be well adapted using the following Lee-Carter model with two components (Keilman & Pham 2005).

$$\log p(x,t) = a_p(x) + b_{p1}(x)k_{p1}(t) + b_{p2}(x)k_{p2}(t) + u_p(x,t)$$
$$\log r(x,t) = a_r(x) + b_{r1}(x)k_{r1}(t) + b_{r2}(x)k_{r2}(t) + u_r(x,t)$$

So far, we have only modeled the observed mortality rates, i.e. mortality from and including 1990 until the last year for which data are available. In order to make assumptions about how mortality will develop in future, we use what is referred to as an ARIMA model (Wei, 2006).

ARIMA is an acronym for Auto-Regressive Integrated Moving Average. In this model, we include what is called a 'random walk with drift' (RWD), which means that we take account of a trend in mortality that we expect to continue into the future. The formula we use is as follows:

$$k_i(t) = \theta_i + k_i(t-1) + v_i(t),\ i=1,2$$

where θ_i is the trend (drift), $k_i(t)$ is the time index and $v_i(t)$ is a stochastic error term that is assumed to be normally distributed.

When we enter the predicted values for $k_1(t)$ and $k_2(t)$ in the Lee-Carter model, together with the estimated values for the age profiles $a_i(x)$ and $b_i(x)$ (i=1,2), we obtain predicted values for $p(x,t)$ and $r(x,t)$. These are transformed back into the projected mortality rates $m(x,t)$ for men and women.

Once we have calculated the age-specific mortality rates for the whole projection period using the models presented above, uncertainty from the RWD model is estimated by simulating 5 000 alternatives by means of bootstrapping. This yields different paths for a possible development in future life expectancy.

Statistics Norway's population projections mainly use three alternative paths for the future development of life expectancy: medium (M), low (low life expectancy/high mortality) (L) and high (high life expectancy/low mortality) (H). The estimated projected alternative is called the medium or main alternative. We assign it an 80 per cent confidence interval, in line with standard practice (Savelli & Joslyn 2013). We name the upper limit of the confidence interval for mortality rates the low alternative, while the lower limit is called the high alternative. In addition, we have a constant alternative (K), where the mortality rates in the medium alternative from the first projection year are held constant and throughout the projection period.

Before the age and sex-specific mortality rates in the four alternatives can be used in BEFINN and BEFREG, the mortality rates are converted into probabilities using the following formula:

$$q(x,t)=1-(\exp(-m(x,t)))$$

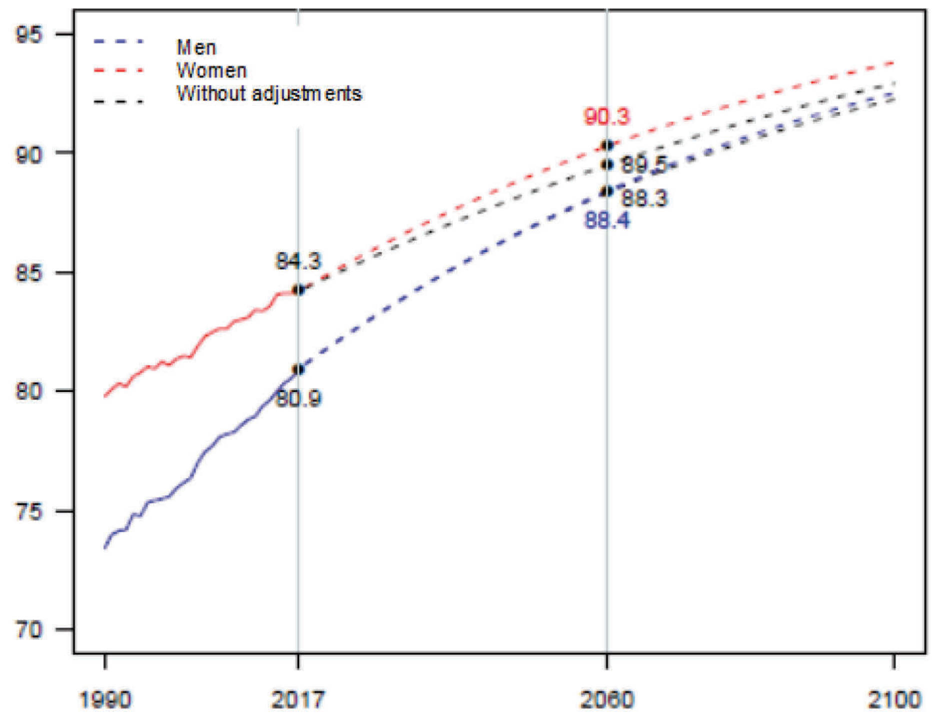
where $q(x,t)$ corresponds to the probability of death at age x in year t and $m(x,t)$ corresponds to the mortality rate at age x in year t. Because of the low population and very few deaths among persons over the age of 108, the probability of death is set to a constant 0.50 for men and women aged 108–119 throughout the projection period.

Discretionary assessments

The period used as input is determined prior to each projection. After assessing the plausibility of the projected mortality rates resulting from the model, we also make other discretionary assessments. If adjustments seem appropriate, we make these in consultation with an advisory reference group consisting of mortality researchers from other research institutions in Norway and abroad.

While there are certain well-known issues with the estimated mortality rates, such as a slightly poor fit of infant mortality and a too large reduction in young age mortality, we argue that these discrepancies are tolerable in a population projection perspective. However, since men's mortality has declined very rapidly the last few years, an extrapolation leads to higher life expectancies for men than women in a number of ages in the range 50-80 years in the near future if we do not modify the model. We have therefore chosen to add some parameters that, throughout the projection period, reduce the mortality rates and increase life expectancy somewhat more than the model estimates indicate for women. The effect of this adjustment is shown in Figure 6.1.

Figure 6.1 Predicted trends in life expectancy at birth for men and women, with and without adjustment of the trajectories by model parameters



Source: Statistics Norway

6.2. Life expectancy at birth and remaining life expectancy

Once we have estimated age-specific probabilities of death in the projection period, we calculate life expectancy at birth and remaining life expectancy for each age group in each projection year (see text box 6.2). We calculate this for the country as a whole in three alternatives. We do this for men and women separately and for men and women combined. The latter is based on probabilities of death for both sexes together.

Text box 6.2. Life expectancy at birth and remaining life expectancy

Life expectancy is the expected number of years a person can expect to live according to the age-specific death rates in a given period, usually a calendar year. It is usually estimated at birth but can also be estimated for other ages.

Life expectancy at birth refers to the number of years a newborn baby will live if the relevant age-specific mortality probabilities for a period (normally a calendar year) persist. Remaining life expectancy is defined as the remaining number of years a person at a given age will live if the age-specific mortality probabilities for the remaining ages in the period persist. Statistics Norway calculates the remaining life expectancy for each age level up to and including 105 years.

6.3. Mortality assumptions in BEFINN and BEFREG

It is the projected probabilities of death that are used as assumptions about mortality in BEFINN and BEFREG. In BEFINN, probabilities of death are used by sex, one-year age group and calendar year in four alternatives: high (H), medium (M), low (L) and constant (K) life expectancy. The same mortality level is assumed for immigrants and others.

In BEFREG, we take account of existing regional differences in mortality. We allow the mortality level to vary between the counties, and between the 15 biggest city districts in Oslo. This yields a total of 32 mortality regions. See Appendix A for an overview of the mortality regions. In order to find the baseline level for mortality in the 32 mortality regions, age-specific probabilities of death are calculated as an average of the last ten years in each mortality region. This is a weighted average where the last year with available data counts most. The probabilities are smoothed.

Once we have calculated the baseline level in each region, we enter assumptions about future mortality at the national level. The national assumptions are the same in BEFINN and BEFREG. The future regional development in mortality is set by adjusting the baseline level in the 32 mortality regions in proportion to the future development of mortality at the national level. The regional differences in mortality are thereby taken into account since the baseline level by one-year age groups and sex is different in each mortality region. We thus assume that the absolute differences between the mortality regions will remain constant throughout the projection period.

In the actual population projection, we calculate the future population by sex and one-year age groups in 108 projection regions. The projection regions that belong to the same mortality region will therefore have the same age-specific probabilities of death. We do not calculate the number of deaths at the municipal level, only for counties.

7. Internal migration

Internal migration is not relevant in the national population projections, but has a crucial role in determining the future population pattern, i.e. where in Norway will people live?

Internal migration is modeled in three rounds. First, out-migration from each projection region is calculated. Second, the emigrants are distributed between projection regions using an internal migration matrix. Finally, the model takes into account local migration in distributing the population to municipalities within the projection regions. In the following we will provide a detailed description of each step in the modeling process.

7.1. Migration in the regional population projections

In the regional projection model, BEFREG, we take account of internal migration. Assumptions about internal migration are produced for persons aged 0–69 years. It is this age group that moves most. Migration within the same municipality is not calculated, except for Oslo, where we take moves between city districts into account. In the projections, we only take account of place of residence at the beginning and end of a calendar year. In other words, we ignore so-called multiple migrants in the same way as for immigration and emigration (see Text box 7.1).

Text box 7.1. Multiple migrants

In BEFREG, we project the size and composition of the population from the turn of one year to the turn of the next. This means that people who migrate several times during one year only contribute one migration, or no migrations, if the person in question lives in the same municipality at the beginning and end of the year. Migration between more than two municipalities in the same year is therefore treated as if only one migration took place between the first and the last municipality. For that reason, migration back and forth between two different municipalities, or city districts in Oslo, is not captured by the model either. This also applies to migration between Norway and other countries. This means that people who migrate both to and from Norway during one calendar year do not contribute to the immigration and emigration figures used in the model. Thus, there are slightly fewer internal migrations, immigrations and emigrations in this model than are usually published in the population statistics.

The migration assumptions are largely based on the continuation of the observed migration patterns for the past ten years, but some adjustments are made so that the number of emigrations from each region to abroad tallies with the national emigration figures.

There are few observed migrations to and from the least populated regions, particularly when broken down to one-year age groups. Certain steps are taken to avoid the migration probabilities being overly influenced by random variations, such as smoothing the probabilities and merging geographical areas and age groups that have similar migration patterns.

Only one medium alternative is calculated for domestic migration flows, and not high and low alternatives as in the case of fertility, life expectancy and immigration. In order to isolate the effects of fertility and mortality at the regional level, an alternative with zero migration is produced (no migration within the country nor across national borders) – the MM00 alternative. This alternative is not very realistic, of course, but it can be useful for analytical purposes.

7.2. Calculating emigration

When we produce assumptions about future migration, emigration is first calculated for each projection region using emigration probabilities. These probabilities are calculated for each sex by one-year age groups (0–69 years), and they are based on observed migration from each projection region in the last ten years. Since it is possible to migrate both abroad and to other parts of Norway, separate probabilities are calculated for these events for each projection region. These probabilities are calculated using slightly different approaches.

International emigration probabilities

The probabilities of moving abroad are first smoothed based on a relatively simple procedure in which the observed probabilities of the age group in question and the neighboring age groups are averaged together using a weighted average. This is done separately for women and men. For the probabilities of emigration to produce results that correspond with the national emigration figures from BEFINN, the emigration probabilities for each projection region are adjusted by an index.

National emigration varies over the projection period. The emigration probabilities in the migration calculations therefore also vary over the projection period. Since the emigration figures in BEFINN are dependent on the figures for immigration (high immigration leads to higher emigration in the ensuing years), different emigration probabilities are produced depending on which immigration alternative is to be used in the projection alternative in question. The probabilities of moving abroad are thus higher in the alternatives with high immigration to Norway than in the other alternatives.

Internal migration probabilities

The probabilities of migrating to other parts of the country are smoothed in a more extensive process. It is based on spline functions and is documented in Sørensen (1980). To achieve a smooth transition from the internal migration probabilities in the last observed year to the internal migration probabilities that will apply in the long term (and which are based on observed figures for the last ten years), the long term probabilities are gradually phased in during the first four projection years.

Migration to and from abroad

As mentioned above, international migration from the projection regions is calculated using emigration probabilities that are based on observed emigration, but adjusted to match the projected national emigration figures.

The probabilities of moving to a projection region from abroad are taken from the national figures for immigrations to Norway. Immigrants to Norway are distributed between the projection regions based on the proportion of the immigration to the respective region over the last ten years. This is done in the internal migration matrix, described later in this section.

We calculate how the immigrants break down by age and sex by taking the national figures for immigration to Norway as our point of departure, and then calculating how large a proportion belong to each sex and one-year age group. These proportions are also used when the immigrants are distributed between the projection regions. Different national assumptions about immigration result in a somewhat different national distribution of immigrants by age and sex. We therefore also produce different distributions depending on which immigration alternative is used in the projection alternative in question.

Distribution of internal out-migrants – the internal migration matrix and the emigration areas

Once we have projected the number of persons who move from the projection regions and from abroad to Norway, they have to be distributed as migrants to the projection regions. For that purpose we use an internal migration matrix. In the internal migration matrix, there are separate proportions for migrations from the different parts of the country and to each projection region. Since the number of possible migration flows between all the 108 projection regions is very high (108 x 108 = 11 664) and many of the flows are minor, rare occurrences in these flows can have a pronounced effect on the estimated rates. We have therefore merged the projection regions into larger out-migration areas. For an overview of which municipalities and projection regions belong to each out-migration area, see Appendix A.

The out-migration areas are based on the five regions (Eastern Norway, Agder and Rogaland, Western Norway north of Rogaland, Trøndelag and Northern Norway) and on how central the projection regions are. For example, the projection regions in Western Norway are merged to form four areas: Bergen, the area around Bergen, central areas of Møre and Romsdal county, and the rest of Western Norway. A similar subdivision has been made for the other regions, whereby 18 out-migration areas have been established in total. Abroad and Oslo's 15 largest city districts come in addition. This results in a total of 34 out-migration areas in the matrix.

In the internal migration matrix, proportions have been calculated for how large a part of the migration from each of the internal out-migration areas (and abroad) will be to each projection region. They are based on observed migration during the last ten years, for 20 groups of migrants. The migrants are divided by age and sex as follows:

- For the two youngest age groups, 0–5 years and 6–16 years, boys and girls are merged.
- For the older age groups (17–21 years, 22–24 years, 25–26 years, 27–28 years, 29–31 years, 32–35 years, 36–42 years, 42–51 years and 52–69 years), women and men are in separate groups.

Since the tendency to move is high when people are in their 20s, the age intervals are relatively narrow compared to the groups among the oldest, who move relatively rarely.

Since we use emigration areas and relatively large age groups in the matrix, there is less need to smooth the migration proportions that are used in the matrix calculations. In the same way as for the emigration probabilities, however, we take the migration proportions for the last observed year as our point of departure and gradually phase in the long term migration proportions (which are based on observed migration in the last ten years). The phasing-in takes place during the first five projection years.

We show an example of an internal migration matrix in Table 7.1. The proportions are based on observed migration figures among women aged 17–21 years. In this example, we have selected emigration areas and immigration areas (i.e. projection regions) in Western Norway (north of Rogaland). The emigration areas are in the left-hand column, which show the four emigration areas in Western Norway. The horizontal rows show the proportion of migrants from each of the emigration areas that will be included in the different projection regions. The projection regions are somewhat aggregated in this illustration. In this example, the projection regions in Western Norway are highlighted.

Table 7.1 Excerpt from the internal migration matrix for women aged 17–21 years in Western Norway

	To projection regions in Eastern Norway	To projection regions in Agder and Rogaland	City of Bergen	Municipalities surrounding Bergen	Odda	Voss	Sunnhordland	Florø	Høyanger	Sogndal/Årdal	Førde	Nordfjord	Molde	Kristiansund	Ålesund	Ulsteinvik	Ørsta/Volda	Sunndalsøra	Surnadal	To projection regions in Trøndelag	To projection regions in Northern Norway
City of Bergen	0.31	0.13	0	0.33	0.01	0.01	0.03	0	0	0.01	0.02	0	0.01	0	0.01	0	0	0	0	0.06	0.03
Municipalities surrounding Bergen	0.11	0.08	0.68	0	0.01	0.02	0.03	0	0.01	0.01	0	0	0	0	0.01	0	0	0	0	0.02	0.02
Remaining Western Norway	0.20	0.16	0.24	0.06	0.01	0.01	0.01	0.02	0.01	0.02	0.04	0.02	0.02	0.02	0.07	0.01	0.01	0	0	0.06	0.02
Central Møre and Romsdal	0.32	0.05	0.11	0.01	0	0	0	0	0	0	0	0.01	0.06	0.04	0.07	0.02	0.04	0.01	0.01	0.21	0.04

Source: Statistic Norway

Breakdown from projection region to municipality

Once BEFREG has projected the population in each projection region, the population is distributed by sex and one-year age groups between the municipalities within the region. In this breakdown, account has been taken of migration between municipalities within the same projection region among persons aged 1–49 years. In order to find out how large a proportion of the persons in each age group are to be distributed to each municipality, we first deduct the calculated number of emigrations and deaths by one-year age group. That leaves only the sedentary population. The calculated number of immigrations is then added to the sedentary population, which makes up the new population of the municipality. The new population of the municipality is then divided by the projected population of the projection region, thereby giving us the proportion in each age group (1–49 years) that is to be distributed to the municipality in question.

The probabilities that are used to calculate the number of emigrations and deaths are constant over time and vary by sex and one-year age group. They are identical for all the municipalities in a projection region and are based on registered migration to other Norwegian municipalities and deaths in the last ten years prior to the projection.

The number of internal migrations to each of the municipalities is calculated using growth rates for the municipalities. To calculate the municipalities' growth rates, the population is divided into four groups:

- boys and girls 1–15 years
- women 16–28 years
- men 16–28 years
- men and women 29–49 years

Separate growth rates are calculated for each of these groups. The growth rates tell us how large a proportion of those who belong to the group in question in a given year live in the municipality in question, compared with the corresponding proportion who lived in the municipality one year earlier (and who were one year younger). These growth rates are based on registered figures for the municipalities' growth in these groups in the last ten years prior to the projection, and they therefore vary between municipalities in the same projection region.

To ensure that the growth rates result in a population of the municipalities that adds up to the projected population of the projection region, the growth rates are adjusted by a correction factor before being used further.

Using the growth rates, which take account of internal out-migrations and deaths, the (gross) migration to the municipalities can be calculated. This is done for each of the five groups defined above. We start with the adjusted growth rates for the group in question, deduct 1 and multiply by the number of persons in this group in the municipality – which isolates the net growth – and add emigrations and deaths. This leaves us with the estimated figure for the gross number of immigrants to each municipality in each group (because net growth = immigration minus deaths minus emigration). This figure is divided by the corresponding figure for the sum of immigrations in each group in the projection region. This is done in order to determine the proportion of immigrations in each group that is to be distributed from the projection region to each municipality within the region. The breakdown is also documented by Rideng et al. (1985).

8. Immigration and emigration assumptions

In the population projections, international immigration and emigration are calculated separately. A separate model is used to make assumptions about future immigration to Norway. In this model, immigration to Norway is affected by three factors in particular: differences in income level and in unemployment between Norway and other countries, and how many people from the immigrants' country group already live in Norway.

Emigration is determined by probabilities of emigration. These probabilities are based on observed figures for emigration and they vary by age and sex. They also vary depending on whether people are immigrants, Norwegian-born to immigrant parents or belong to the remaining general population. For immigrants and their children, we have different probabilities of emigration depending on country background and (for immigrants) duration of stay.

For both immigration and emigration, the world outside Norway is divided into three country groups of origin (see also Text box 8.1 and Appendix B):

1. Western Europe, the US, Canada, Australia and New Zealand
2. Eastern EU member countries
3. The rest of the world

Immigrants and their Norwegian-born children are grouped according to their own (immigrants) or their mothers' (Norwegian-born children of immigrants) country of origin.

.

Net migration is calculated by deducting annual emigration from annual immigration.

The projections of immigration and emigration are also used to estimate the future number of immigrants and Norwegian-born children with immigrant parents who will live in Norway.

Immigrants, immigration and Norwegian-born children of immigrant parents

Immigrants are persons who are born abroad and have two foreign-born parents and four foreign-born grandparents, and who are registered as residents in Norway.

Immigration is defined as the number of migrations to Norway during a period, irrespective of the immigrants' country of birth and nationality. For example, immigration to Norway during a calendar year includes 8 000 to 10 000 Norwegian citizens, most of whom were born in Norway and do not have an immigrant background.

Since our version of the cohort-component method only calculates changes from the turn of one year to the turn of the next year, projected figures for immigration and emigration do not include persons who have both immigrated and emigrated during the same year. This means that the immigration and emigration figures from the population projections are somewhat lower than the corresponding figures from Statistics Norway's population statistics, see chapter 4.1.

Norwegian-born children of immigrant parents are defined as persons born in Norway to two parents born abroad, and who also have four grandparents who were born abroad.

8.1. Immigration

Statistics Norway uses a separate model to calculate future immigration to Norway (Cappelen et al. 2015). In this model, immigration is largely determined by the following factors:

- income in Norway compared with in each of the country groups (purchasing power-adjusted gross domestic product (GDP) in nominal value per capita)
- unemployment in Norway and in the country groups
- the network effect, i.e. the number of immigrants (from the same country group) who are already in Norway
- the population size in the three country groups

We model the immigration rate, i.e. gross immigration to Norway from each of the three country groups divided by the total population of the country group in question.

The model

Slightly simplified, the model can be written as follows (the time lag can vary between country groups):

$$ln(I_t) = c_o + c_1\, ln(I_{t-1}) + c_2\, ln(Y_{t-1}) + c_3\, U_{t-1} + c_4\, O_{t-1} + c_5\, ln(B_{t-1}) + c_6\, D_t + e_t$$

where
I_t is the emigration rate from a country group of origin to Norway in year t (the percentage of the population from the region in question that migrates to Norway)
I_{t-1} is the emigration rate to Norway from the area in question the year before (t-1)
Y_{t-1} is GDP per capita in Norway in year t-1 divided by the corresponding figure for the country group of origin in year t-1 in purchasing power-adjusted prices
U_{t-1} is the unemployment rate (percentage) in Norway in year t-1
O_{t-1} is the unemployment rate (percentage) in the area one migrates away from in year t-1
B_{t-1} is the number of immigrants from the area in question who already live in Norway in year t-1 (included to capture the network effect)
D_t is a vector with dummy variables that captures special events (wars, crises or major rule changes) in year t
e_t is a stochastic error term that is assumed to be normally distributed
c_i are unknown parameter vectors that must be estimated

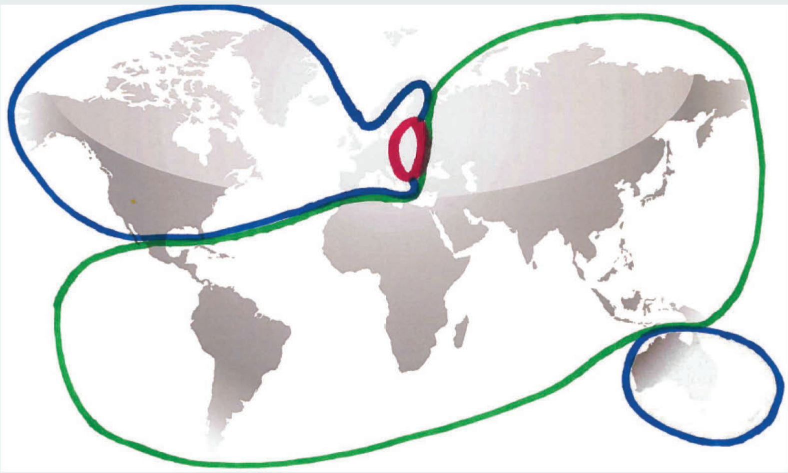
In the projections, we estimate a separate variant of the model for each of the three country groups (see Text box 8.1). This means that we have taken ordinary significance criteria and other econometric considerations into account when we have specified the model for each country group. All the parameters are therefore country group-specific, for example can income differences have different effects on immigration depending on which country group we examine. Some variables may also prove to be important in relation to immigration from one country group of origin, but not another. This applies, for example, to the network effect, which only has been significant for country group 3.

Text box 8.1. The country groups
We have divided the countries of the world into three groups. Even though there are pronounced differences within each country group of origin, there are also certain similarities.

Country Group 1 comprises all the Western European countries, i.e. countries that were part of the 'old' EU (pre-2004) and/or the EEA and EFTA, as well as the US, Canada, Australia and New Zealand. On average, nationals from these countries display relatively similar demographic behavior as regards fertility and emigration. Moreover, few or no restrictions apply as regards their living and working in Norway.

Country Group 2 comprises the eleven new EU countries in Eastern Europe (EU members in 2004 or later): Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Slovenia, Croatia, Bulgaria and Romania. We have grouped them together since it is from these countries that immigration to Norway has increased most in recent years. Moreover, of all the EU countries, it is these 11 countries where the income differences are greatest relative to Norway. The potential for migration to Norway is thereby great, as also the restrictions on immigration have largely been abolished.

Country Group 3 comprises the rest of the world, e.g. the rest of Eastern Europe, Africa, Asia (including Turkey), Latin America and Oceania (excluding Australia and New Zealand). Nationals from these countries must apply for a permit to live and work in Norway. This group is very heterogeneous, and we have primarily grouped these countries for the sake of simplicity.



It is a person's country of origin that decides which group he or she belongs to. For persons born abroad, this is (with a few exceptions) their country of birth. For persons born in Norway, it is their mother's country of birth.

Data
Data on immigration to Norway are taken from Statistics Norway's population statistics. If someone moves both to and from Norway (or vice versa) during the same calendar year, this is neither registered as an immigration nor an emigration in this context, since the population projections are based on a change taking place from the turn of one year to the turn of the next. This does not affect the figures for net migration, but both the immigration and emigration figures will be a little lower than those that are published from Statistics Norway. This applies in particular to country group 1, i.e. primarily persons from Western Europe.

The population of the three country groups, which is used as the denominator in the variable I_t, is obtained from the latest version of the UN's population statistics.[6]

The purchasing power-adjusted GDP per capita in Norway and in the three country groups are obtained from the World Bank and the OECD.

[6] The UN's global demographic estimates and projections are updated every other year, see http://esa.un.org/unpd/wpp/index.htm

The unemployment rate for Norway is based on Statistics Norway's labor market surveys, which are available in the OECD's database dating back to 1970. For the unemployment rate in country group 1, we use unemployment figures from the OECD. For the unemployment rate in country group 2 (the new Eastern European EU countries), we have used figures from both the OECD and Eurostat. They contain unemployment rates in each of the countries from the end of the 1990s. We have calculated a weighted average of the figures from both sources, and further weighted them by the countries' respective populations. For the earlier period, 1988 until the end of the 1990s, the unemployment rate has been calculated retrospectively using the change in the unemployment rate for the OECD. For country group 3 (the rest of the world), there are no figures for the unemployment rate that give a satisfactory picture of the labor market situation. When the model is estimated for this group, this variable is therefore not included.

We have calculated a measure of the network effect using the number of immigrants from each country group who are resident in Norway. These figures are taken from Statistics Norway's population statistics.

Forecasts for the variables

Once the parameters have been estimated, they are used to calculate how immigration will develop in future, based on forecasts of how the economic and demographic variables will develop. These forecasts are taken partly from international and partly from Norwegian sources and own estimates.

The figures for the future development of the world's population in the three country groups are taken from the UN's most recent population projections. In our main alternative, we use UN's medium fertility variant. In our high and low alternatives, we use UN's high and low fertility variants respectively.

The estimates of the future number of immigrants residing in Norway (which are used to calculate the network effect) are based on figures from the previous population projection. Once the number of immigrations has been calculated, the whole projection model is run using the updated figures. The model produces new estimates of the number of resident immigrants from each country group. These figures are then used to estimate immigration again. Such iteration rounds are repeated several times.

Rule changes and political decisions have also influenced immigration to Norway. When estimating the model, we have therefore included indicators for years when important political changes have taken place. We are not able to predict when possible new political changes might occur and how these would influence immigration. The same applies to natural disasters or armed conflicts that can lead to new flows of refugees. We do however take out the effects of these changes in the past in the estimation.

Forecasts of the unemployment rate in Norway are taken from Statistics Norway's macroeconomic projections.[7] In the long term, the unemployment rate has been leveled off to a 'normal' level around the average of the last decades.

In the short term, the figures for future unemployment rates in country groups 1 and 2 (this variable is not used for country group 3) are based on OECD forecasts. In the long term, these levels are also expected to level off at historically 'normal' levels.

[7] http://www.ssb.no/nasjonalregnskap-og-konjunkturer

Three alternative paths have been made for future income development (low, medium and high alternatives). They reflect three different alternatives as regards to future economic development, where the high alternative assumes the greatest income differences between Norway and the rest of the world in the years ahead.

Projected immigration

Based on these different demographic and economic estimates, the immigration model yields three different paths (low, medium and high alternatives) for immigration from each of the three country groups. Some unevenness generated by the econometric model at the start of the paths is smoothed based on a discretionary assessment. In addition, the estimated standard error in the econometric model is used to allow for model uncertainty in the calculations. This is done by adding the standard deviation of the prediction error to the forecast for immigration in the high alternative and correspondingly deducting the standard deviation from the low alternative. This is done for each of the three country groups.

Every year, there are also some persons with a Norwegian background who immigrate back to Norway. We have projected this immigration by taking registered immigration for the last year as our point of departure and adding a linear trend in in the period up until 2100. The trend is usually increasing, reflecting an increasing emigration from Norway in this group. Separate low and high linear alternatives are also made.

Immigration from the three country groups (projected in three alternatives), as well as immigration by persons with a Norwegian background, is entered into the national projection model BEFINN.

Distribution by age, sex etc.

In BEFINN, the assumed number of immigrations from each of the three country groups is distributed by sex, one-year age groups (0–69 years) and one-year residence period (0–30 years). This distribution is based on the breakdown of immigration the last ten years: How many have been women and men, and what age and what duration of stay they have had. Some may have lived in Norway before, and this is also taken into account. People with a Norwegian background who move back to Norway are distributed by sex, one-year age groups (0–69 years) and whether they are Norwegian-born to immigrant parents (who have lived abroad for a period) or belong to the remaining general population. If they are Norwegian-born to immigrant parents, they are also distributed by country group.

8.2. Emigration

Emigration is calculated using emigration probabilities. These probabilities are based on observed emigration during the last ten years.

The probability of emigrating is significantly higher for immigrants than for their children born in Norway. Persons who belong to the remaining general population have the lowest tendency to emigrate. For the three country groups, the probability of emigrating is greatest for persons with a background from Country Group 1 and lowest for Country Group 3. Emigration is greatest in the first years after immigration to Norway, and it decreases as the duration of stay increases.

In the population projections, separate emigration probabilities are used for immigrants, Norwegian-born children of immigrant parents and the remaining general population. The probabilities are calculated by sex, one-year age groups (0–69 years), country group and duration of stay (for immigrants), with a few exceptions:

- For persons under the age of 15, the same probability of emigration is used for boys and girls

- For persons aged 55–69, the probabilities are calculated for five-year age groups for each sex

Five duration of stay groups are used:
- 0 years
- 1 year
- 2–4 years
- 5–9 years
- 10 years' residence or more

One group – immigrants from Country Group 2 with the longest duration of stay – consists of too few persons for the observed figures to be used to produce good emigration probabilities. An average of the emigration probabilities for persons with the longest duration of stay in Country Groups 1 and 3 is used instead. For persons who are 70 years old or more, the population projections do not assume any immigration or emigration.

Since high immigration one year will entail higher emigration in the ensuing years, the estimates of the number of emigrations are largely dependent on the figures for immigration. Separate high, low and medium alternatives of emigration *probabilities* are not produced.

8.3. Net migration

Net migration is calculated by deducting annual emigration from annual immigration.[8] Previously, assumptions were made about future net migration, but this is now just the result of the assumptions about gross immigration and emigration.

8.4. The number of persons with immigrant backgrounds

Once we have made assumptions about immigration, emigration and mortality, BEFINN can calculate how many immigrants will live in Norway in future. In BEFINN, we also calculate how many of the future inhabitants will be Norwegian-born children of two immigrant parents. For this, in addition to assumptions about future fertility among immigrant women, we need assumptions about how large a proportion of immigrant women's children will have a father who is also an immigrant. These latter assumptions are based on projections of observed trends for each of the country groups.

In BEFREG, we do not distinguish between individuals with or without an immigrant background.

[8] Net migration corresponds to the difference between the number of immigrations to and emigrants from the country during a period. It is net migration that constitutes the contribution of immigration and emigration to population growth in Norway.

9. Uncertainty, sources of error and quality

In general terms, a *projection* refers to the calculation of some estimates at a future date. A population projection is defined as 'calculations which show the future development of a population when certain assumptions are made about the future course of population change, usually with respect to fertility, mortality and migration' (UN 2018). Population projections show how populations would develop provided that the assumptions on fertility, mortality and migration remained true over the projection period. In other words, population projections answer the question: what would the size and structure of the population look like if assumptions hold?

The usual time horizon of population projections is of a few decades ahead, up to a century. The Norwegian projections have two time perspectives: we project the population at national level until 2100, and at regional level until 2040.

Various alternatives are normally created in population projections, showing different trajectories for possible future developments. The different alternatives are based on assumptions about future developments, usually formulated for three demographic components: fertility, mortality and migration. As such, population projections are a type of 'what-if' analysis: how would a population change if particular assumptions remained true over the relevant projection period? Based on various assumptions, usually about fertility, mortality and migration, projections show different and sometimes divergent trajectories for future development (Eurostat 2018c, UN 2018).

Population projections are not the same as population forecasts. A population forecast aims to provide users with what is believed to be the most plausible development of a future population size and composition, while population projections can seemingly contain fairly implausible and purely theoretical 'what if' alternatives, such as *zero immigration* or *constant life expectancy*. Other relevant concepts include plans, which are used for a desired development, and scenarios, which are used as a description of a possible development or an action plan with certain assumptions (de Beer 2011).

The main purpose of population projections is to help society understand population dynamics and contribute to the debate on future social change. However, they can also be used as a starting point for policy changes if the developments that emerge are not deemed desirable. The future is not only something to be discovered, it can also be viewed as something to be created (Romaniuk 2010). As such, population projections can be useful planning tools. They can be used as a means of influencing the future, and thus trigger outcomes that will prove them wrong.

The future is difficult to predict and project. As such, estimates of future populations are inherently uncertain. This applies to the size of a future population as well as its composition and geographical location. The uncertainty increases with time. Nevertheless, population structures are normally associated with a large degree of persistence. After all, most of us will be one year older and live in the same place next year. This means that projecting a population is a more fruitful task than predicting or forecasting, for instance, economic structures or events. Although population projections usually perform well within limited time horizons due to demographic momentum, their accuracy is adversely affected by unpredictable events such as wars, economic crises and natural disasters. For example, the sudden surge in the number of births (the baby boom) and its abrupt end two decades later (the baby bust) were largely unforeseen (UN 2018).

There will always be discrepancies between the projected and the registered total population and between population segments. The main reason for this is that we cannot accurately predict the future development of the fertility, mortality, internal migration and/or international migration components (see section 9.1 below). Future immigration is particularly subject to a large degree of uncertainty. For the country as a whole, and for many municipalities, immigration is currently the largest source of uncertainty. However, fertility, mortality and internal migration can also end up rather different from that projected, as illustrated in chapter 3. In recent years, mortality has declined steadily and thus the impact on errors in the projections has usually been minor. For the respective cohorts, the uncertainty is greatest for the cohorts that are not yet born at the time the projection is made, as we need to make assumptions about future fertility. Lastly, we know that the uncertainty of estimates of the future population and its composition and geographical distribution increases the longer into the future we project.

Discrepancies in percentages are typically greatest for small municipalities, and for age group breakdowns. The calculated population figures for smaller municipalities should therefore be interpreted more as trends rather than as a reflection of precise numbers. Another important reason for this is that the regional model is calibrated to the national model in all alternatives. We therefore have a 'top-down' modelling process. Thus, the uncertainty at the national level – for a large group – is distributed to smaller regional units. In theory (and in practice) uncertainty is greater for smaller, disaggregated entities, but this is not taken into account in our models.

Consequently, we generally recommend that when making planning decisions, local authorities consider adjusting the results of the projections to account for local conditions that are not reflected in the model. There may be indicators that signify the housebuilding situation, job losses and transportation projects or other conditions that are likely to influence their populations in the future. Our results will not reflect such events unless they are already reflected in the demographic rates and thereby the assumptions about fertility, mortality, internal migration and /or international migration.

In this chapter we will review three main sources of uncertainty: demographic assumptions, model specifications and official statistics. Then we will briefly describe our ongoing quality assurance work, and conclude with a description of the factors we consider relevant for producing and publishing high-quality population projections.

9.1. Assumptions about the demographic components

There is a marked uncertainty about whether the assumptions used in making the population projections will accurately reflect future demographic trends. This uncertainty is referred to as 'uncertainty of the future'. This type of uncertainty increases with time. It includes uncertainty about whether events will occur, such as the implementation of policies affecting demographic levels and trends.

The projection results are very sensitive to the assumptions that are used for each of the demographic components. This is demonstrated by the marked discrepancies in the results from the different alternatives in Statistics Norway's projections, as well as in the differences between these projections and those for Norway from other institutions such as Eurostat (2018b) and the UN (2017).

Before a new set of projections is made, analyses are conducted of historical trends and possible future developments in each of the components fertility, mortality, internal migration, immigration and emigration. These analyses are component-specific, and are discussed by researchers in the respective fields, both within Statistics Norway and externally. An advisory board group is consulted for most components. The process of determining the assumptions is discussed in more detail in chapters 5-8.

Over the past decade, future immigration has proven to be the most difficult component to project. This is also likely to be the case in the years ahead. Fertility, mortality and internal migration can also be very different from what was projected. For this reason, we make alternative assumptions for the components fertility, life expectancy and immigration. This is described in more detail in chapters 3, 5, 6 and 8.

In order to illustrate the uncertainty inherent in population projections, alternative assumptions are made for the four main components: fertility, life expectancy, internal migration and immigration. Each projection alternative is described by four letters in this order, and the alternatives are M for medium, L for low, H for high, K for constant and 0 for zero. K is only used for life expectancy and immigration, whereas 0 is only used for internal migration and (net) migration. Our main alternative is denoted MMMM, reflecting the fact that the medium alternative is used for all components. LLML and HHMH denote low and high national population growth respectively. These latter alternatives are, however, considered less realistic, as all components are projected to take on relatively extreme values throughout the entire course of the projection period. In order to demonstrate how the age structure may be affected by different developments in the various components, we also provide alternatives for strong (LHML) and weak (HLMH) aging.

The plurality of alternatives highlights the uncertain nature of population projections by making it clear that there is not just one possible outcome for the future, but, rather, multiple possibilities. We thus provide our users with alternative, internally consistent futures that can be compared, thus furthering the understanding of the sensitivity of the projected results to variations in the assumptions, where some assumptions are more plausible than others, but where those that are less plausible are nevertheless useful as a hypothetical case for use in policy-driven discussions. Such comparisons provide a form of sensitivity analysis and may be helpful in guiding potential interventions or policy development.

As stated, the different assumptions may be combined in different ways to produce different alternatives, which may be realistic to varying degrees. What characterizes all the alternatives are that a smooth development is often assumed in the components. For example, we do not assume extreme highs and lows in immigration from one year to the next, although this does often happen. Since we have little information about these short term fluctuations, we choose to project a smooth trajectory that cuts through irregularities. Such assumptions will in themselves be unrealistic, but the idea is that the negative and positive fluctuations will balance each other out in the longer term.

9.2. Model specifications

Structural uncertainty refers to uncertainty related to limitations in our understanding of population dynamics and in our capacity to model them (UN 2018). Typically, parts of the population projection methodology are immune to structural uncertainty. One example here is the cohort-component model, which is employed in the Norwegian projections. In this type of model, the demographic equation consists of exact relationships between population growth and the components of growth (excess of births and net migration). However, structural uncertainty comes into play when modelling these components and projecting them into the future.

Models are simplifications of reality, and as such may only capture a few key mechanisms. This means that there are a multitude of other conditions that will affect population development which are not considered. Our two projection models have different strengths: the national model BEFINN differentiates the population based on immigration characteristics and duration of stay, while the regional model BEFREG captures regional variations in the demographic components and provides regional estimates, which are useful for local and county authorities. Other characteristics that may also affect demographic behavior, but which are not included, include education, health and residence history.

The total population figures by age and sex in the regional model BEFREG are tallied to correspond with those resulting from the BEFINN model, for all the different alternatives we make. As a consequence, the uncertainty at national level is, in principle, distributed proportionally to the various regions. This is incorrect in a statistical probability perspective, as the uncertainty increases as the samples are reduced in size. Furthermore, since we only tally the population figures, there are minor but detectable differences in the number of births and deaths that result from the two models.

The marked uncertainty associated with internal migration is not explicitly expressed nor accounted for in our models. One reason for this is that developments in one region are affected by what happens in surrounding regions. This makes it difficult to create different alternatives for internal migration for the respective regions. Instead, the assumptions are varied at the national level. A potentially different way of doing this, such as also implementing a high and low alternative for internal migration, would have limited impact on the population counts for most of the regions and/or municipalities.

The Norwegian population projections are deterministic. One consequence of this is that the models do not generate formal uncertainty estimates and prediction intervals. As such, we cannot quantify the statistical uncertainty associated with the different alternatives resulting from the projections. The assumptions for the various components used in deterministic projections determine the outcomes of the different alternatives, as evidenced by the variations between the different alternatives and the disparities between projections by other institutions. Stochastic projections for Norway are not currently produced on a regular basis, but interested readers are referred to Keilman et al. (2002) and Foss (2012).[9] The deterministic approach has often been viewed as an unsatisfactory way of assessing and communicating the uncertainty of population projections (e.g. Keilman et al. 2002, Romaniuk (2010), de Beer 2011). The main limitations voiced include:

- The deterministic approach does not adequately reflect the uncertain nature of population projections
- Because no probabilities are associated with the different parameters of the inputs, it is not possible to provide a probabilistic interpretation of the results of deterministic alternatives. It is also not possible, without revising the specification of the alternatives, to modify the width of the high–low interval

[9] Lee and Edwards (2002) observed that users tend to perceive probabilistic projections merely as improved high and low prediction intervals, despite their potential for more detailed and sophisticated analysis. Consequently, it is doubtful that providing probabilistic projections will lead to markedly better decision making if there is no accompanying increase in knowledge about how to use such projections. Furthermore, publishing measures of probability may convey a misleading sense of precision and may not be justifiable in view of the past performance of projections (Lutz et al. 2004).

for some specific purposes. These characteristics may limit the usefulness of deterministic variants for planning purposes.

On the other hand, the publication of multiple deterministic alternatives underlines the fact that the future does not have just one possible path. It also provides a simple way to communicate the plausible range of future demographic trends given what is currently known (Romaniuk 2010).

9.3. Errors in official statistics

The third source of uncertainty relates to the inaccuracy of the data used to construct the projection, such as the baseline population and the observed rates used to choose the assumptions.

The population statistics on which the population projections are based comprise persons registered as resident in the National Population Register, i.e. persons who live in Norway permanently or who intend to have their fixed place of residence in Norway for at least six months and who are legally residing in Norway. Nordic nationals have been granted residence permits automatically since 1956. The same now applies to nationals of EFTA/EEA countries. There are some people staying in Norway who are not included in the statistics, however, for example people working on short term contracts or people staying in Norway without a permit. Consequently, it is the 'de jure population' and not the 'de facto population' that is projected.

Norway has administrative registers covering the entire population. The registers are up to date and generally considered to be of high quality. Consequently, errors from official statistics constitute a minor source of error in the projections compared to that of many other countries. Such errors nevertheless exist. One example is the delay in the registering of emigrations in the Population Register, as there is not much incentive for individuals to notify the authorities of their departure (Pettersen 2013). The implication is that some people who no longer live in the country remain in the register. Also, according to the current registration rules, some cases of internal migration are exempt from reporting or reporting is optional, for instance for students. This may cause discrepancies between the registered and the actual population of a region. Such issues create a discrepancy between the actual and the registered population at both the national and regional level, but also impact on the age structure and death rates.

9.4. Quality assurance

We employ several methods to quality assure the Norwegian population projections. In short, we review past trends in the demographic components fertility, life expectancy, internal migration, immigration and emigration. We also evaluate previous short and long term projections, and compare the projections produced by Statistics Norway with those produced for Norway by the UN and Eurostat. To ensure transparency, we document the data and methods we employ. We publish the results from 15 alternative projections and highlight the uncertainty associated with population projections in general. Lastly we examine the degree to which the various results we publish are used by users and attempt to clarify issues that arise from interaction with users.

Review of past trends

Before a new set of projections is made, we analyze the historical trends in each of the components fertility, mortality, internal migration, immigration and emigration, as shown in section 9.1 above. An overview of historical developments and trends is therefore presented along with the publication of each new set of projections. In this report, a summary of the historical trends is given in chapter 3. A more thorough discussion of the historical trends is available in the report by Leknes et al. (2018). Although the report itself is in Norwegian, the figures are fairly self-explanatory and may therefore also be useful to an international audience.

Historical evaluations

Repeated comparisons of projected values with historical estimates reveal the limitations of population projections and inform users about what can reasonably be expected from them. Engaging in this exercise also enables Statistics Norway to reflect on the source of past inaccuracies, serving as a basis for improving future projection assumptions and methodologies.

The quality of the projection figures is evaluated by comparing the projected results with registered population figures for succeeding years as these become available. We also compare our projections with earlier projections. We do this for both the individual components and the different entities that result from using the models. As an example, we investigate how the projected fertility (measured by the total fertility rate) compares to what was empirically shown to actually happen, but we also examine the number of projected and actual newborns and deviations in these figures – both nationally and regionally. The results are published in connection with the release of new population projections, as well as in summary reports on population development, most recently for example in Economic Survey 2017 (Statistics Norway 2018). An evaluation of previous regional projections may be found in Rogne and Tønnessen (2014), while a longer-term evaluation of national projections from 1996 is available in Rogne (2016).

Errors in percentages are typically greatest for small municipalities. For the respective cohorts, the uncertainty is greatest for cohorts that are not yet born at the time the projection is made, as we need to make assumptions about future fertility. The mortality decline has been consistent in recent years, so the impact on errors in the projections is minor. An exception is among the most elderly population, where the mortality is pronounced, and the future course is more difficult to predict. For the country as a whole and for many municipalities, immigration is currently the largest source of uncertainty, but emigration also represents a challenge to the accuracy of our projections.

International comparisons

Furthermore, we compare Norwegian projections with those made for Norway by, for example, Eurostat and the UN. We do this both for the assumptions we employ, as well as for the final results. Examples of such comparisons may be found in chapters 2 and 3 in this report.

Documentation of data, methods, assumptions and models

Transparency is a vital part of assuring quality in the population projections. Our goal is to make it easy for users to find information and documentation about population projections. Our website includes links to data in the statistics bank (StatBank), both for current and previous projections. Here we have also published a StatBank guide for our users, but this is currently only available in Norwegian. We also create publications, such as this report, which show the assumptions underlying the projections we make, as well as the models used to project the future. These are published both in Norwegian and English. Although our primary users are Norwegian speakers, it is important that we also publish our methods, assumptions and results in English so that other countries and international users and/or researchers have the opportunity to give constructive criticism on our work (UN 2018, Eurostat 2018c). This must also be considered as part of our quality assurance work.

Communication of uncertainty

At Statistics Norway, we primarily use words to convey the general idea of uncertainty. In general, verbal expressions are more easily remembered than numerical expressions and are better adapted to lay audiences (Kloprogge et al. 2007). We attempt to use conditional phrasing when we present our results. Furthermore, we ensure that we incorporate additional information regarding the uncertainty of the results, both in the oral and written communication with users. We publish results from 15 alternative projections, thus underlining the inherent uncertainty associated with population projections in general. In addition, we attempt to distinguish empirical and projected numbers clearly in our communication, for instance by using different colors in graphs, and by consistently rounding off projected numbers.

User orientation

We attempt to foster a relationship with our users. The users should perceive our numbers as relevant, and we strive to provide numbers that coincide with the needs of users. Users can download all the figures we produce in StatBank: https://www.ssb.no/en/folkfram. Also, users can easily get in touch with us by email: folkfram@ssb.no. Lastly, we examine the degree to which the various results we publish are used by users and attempt to clarify issues that arise from interaction with users in subsequent releases.

9.5. Quality in the population projections

The quality of population projections is dependent on a multitude of factors. At Statistics Norway, our work to ensure the production and publication of high-quality population projections is guided by the following:

- **Independence, integrity and transparency:** Our population projections should be based on research, i.e. empirical analyses of the forces underlying demographic change. This is partly safeguarded through our contributions to the international projection environment. We endeavour to be an independent contributor to setting framework conditions for society, and we aim to produce transparent and well-documented projections in both Norwegian and English. This also includes communicating the uncertainty about projected numbers.

- **User orientation, accessibility and relevance:** We aim for our figures, and the dissemination and interpretation of them, to help set the agenda for discussions about future population changes. Users should perceive our numbers as relevant, and we strive to provide numbers that match user needs. We refer to the alternative that comprises the medium level of all components as the 'main alternative'. We nevertheless guide users who have specific hypotheses in mind to also consider other alternatives. As we publish multiple deterministic projection alternatives, we encourage users to consider a range of projection results rather than a single result, by comparing multiple alternatives. We always provide at least three alternatives to our assumptions (i.e. the L, M and H alternatives) when we provide figures directly for users.

- **Accuracy:** We strive to employ realistic assumptions in our main alternative, both in the short and long term, based on the knowledge available at the time of projection. The accuracy of previous projections is evaluated regularly in order to highlight areas where improvements may be useful and/or warranted. Lastly, we monitor the actual population change continuously, and should the future development differ to our assumptions in our main alternative, we guide users as to which of our alternatives diverge the least from actual population figures, and explain why our main alternative may not be the best option, depending on the intended use.

9.6. Summary

Population projections are intended to serve as a basis for better decision making in democracies. Independence and impartiality in population projections are vital to fulfilling this demanding role (UN 2018). Users of population projections expect results that are independent and impartial, and these are principles that are followed by Statistics Norway. A transparent approach can help preserve and even promote these principles.

The accuracy of a projection depends on many factors that are difficult or impossible to anticipate. In this chapter, we have described three types of uncertainty: i) 'Uncertainty of the future'; ii) Structural uncertainty; and iii) Uncertainty related to the data. In the Norwegian setting, the 'uncertainty of the future' is considered to have the greatest influence. As such, we choose to end this chapter by reminding ourselves and our users that Statistics Norway's projections do not describe an inevitable outcome – they merely show how the Norwegian population would develop if the assumptions on fertility, mortality, internal migration and immigration remained true over the projection period.

10. Conclusions

This report describes the main results from the 2018 population projections. In short, we expect a continued population growth, a pronounced aging in rural areas and a growing number of (older) immigrants. The report also details the assumptions used to produce the projections. In summary, the total fertility rate will continue to decline for a few more years and reach 1.6 in 2020, before it stabilizes at a level of around 1.8 (low: 1.6, high: 1.9). Life expectancy will continue to increase from today's 81 years for men and 84 years for women and reach about 88 (86-90) and 90 (88-92) years respectively, in 2060. The increase is largely a result of an increase in remaining life expectancy in older age groups. Internal migration is projected to continue, resulting in a continued urbanization of younger individuals, thus resulting in a pronounced aging in the rural areas. International migration will continue, albeit at a slower pace: In 2017, the number of immigrations to Norway was 56 400. It is assumed to be 49 000 (36 400-91 200) in 2060. Net migration is projected to decline slightly in the main alternative, from today's 21 000 to around 17 000 in 2060.

Lastly, the report documents how Statistics Norway projects the population using the BEFINN and BEFREG models. We have described how assumptions about future fertility, life expectancy, internal migration and immigration are ascertained, and how we project the population using the cohort-component method.

In BEFINN, the population is projected by age and sex at the national level up to and including the year 2100. Immigrants from three country groups, Norwegian-born children with two immigrant parents and the remaining general population are projected as separate groups. In BEFREG, the population is projected by age and sex in 108 projection regions up to and including the year 2040. The population is thereafter summed up to counties and distributed to municipalities.

All projections of a future population, its composition and geographic distribution are uncertain. The uncertainty increases the further into the future we look, and the figures are even more uncertain in projections for small groups, such as the population of municipalities by sex and age in single years. Future immigration is particularly subject to a large degree of uncertainty. However, also fertility, mortality, emigration and internal migration can end up rather different than projected.

For more information about the projected population and populations changes, see www.ssb.no/en/folkfram.

In Statistics Norway's StatBank www.ssb.no/en/statistikkbanken, detailed figures are available for the projected population and population changes.

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Appendix A. Regional classifications used in BEFREG

Tabell A1.1 Regional classifications used in BEFREG

Municipality code	Projection region	Municipality name	Fertility profile	Fertility region	Mortality region	Internal out-migration area
0101	0191	Halden	35	01	01	12
0118	0191	Aremark	57	01	01	12
0104	0192	Moss	35	03	01	13
0135	0192	Råde	36	03	01	13
0136	0192	Rygge	46	03	01	13
0137	0192	Våler	37	03	01	13
0105	0193	Sarpsborg	35	02	01	12
0106	0193	Fredrikstad	36	02	01	12
0111	0193	Hvaler	27	02	01	12
0128	0193	Rakkestad	46	04	01	12
0119	0194	Marker	45	04	01	13
0121	0194	Rømskog	55	04	01	13
0122	0194	Trøgstad	35	04	01	13
0123	0194	Spydeberg	46	04	01	13
0124	0194	Askim	35	04	01	13
0125	0194	Eidsberg	45	04	01	13
0127	0194	Skiptvet	65	04	01	13
0138	0194	Hobøl	37	04	01	13
0211	0291	Vestby	38	47	02	13
0213	0291	Ski	48	47	02	13
0214	0291	Ås	58	47	02	13
0215	0291	Frogn	58	47	02	13
0216	0291	Nesodden	58	47	02	13
0217	0291	Oppegård	48	47	02	13
0219	0292	Bærum	58	48	02	13
0220	0292	Asker	58	48	02	13
0221	0293	Aurskog-Høland	45	49	02	13
0226	0293	Sørum	37	49	02	13
0227	0293	Fet	38	49	02	13
0228	0293	Rælingen	46	49	02	13
0229	0293	Enebakk	36	49	02	13
0230	0293	Lørenskog	38	49	02	13
0231	0293	Skedsmo	47	49	02	13
0233	0293	Nittedal	48	49	02	13
0234	0293	Gjerdrum	36	49	02	13
0236	0293	Nes	36	49	02	13
0235	0294	Ullensaker	36	49	02	13
0237	0294	Eidsvoll	36	49	02	13
0238	0294	Nannestad	35	49	02	13
0239	0294	Hurdal	46	49	02	13
0301	0301	Gamle Oslo	10	05	03	14
0302	0302	Grünerløkka	11	50	13	15
0303	0303	Sagene	12	51	21	16
0304	0304	St. Hanshaugen	13	52	22	17
0316	0304	Sentrum	13	52	22	17
0318	0304	Uoppgitt	13	52	22	17
0305	0305	Frogner	14	53	23	18
0306	0306	Ullern	15	54	24	19
0307	0307	Vestre Aker	16	55	25	25
0317	0307	Marka	16	55	25	25
0308	0308	Nordre Aker	17	56	26	26
0309	0309	Bjerke	18	57	27	27
0310	0310	Grorud	19	58	28	28
0311	0311	Stovner	20	59	29	29
0312	0312	Alna	21	60	30	35
0313	0313	Østensjø	22	61	31	36
0314	0314	Nordstrand	23	62	32	37
0315	0315	Søndre Nordstrand	28	63	33	38
0402	0491	Kongsvinger	26	07	04	11
0418	0491	Nord-Odal	36	07	04	11
0419	0491	Sør-Odal	36	07	04	11
0420	0491	Eidskog	55	07	04	11
0423	0491	Grue	26	07	04	11
0425	0491	Åsnes	26	07	04	11
0403	0492	Hamar	27	06	04	12
0412	0492	Ringsaker	55	06	04	12

Municipality code	Projection region	Municipality name	Fertility profile	Fertility region	Mortality region	Internal out-migration area
0415	0492	Løten	37	06	04	12
0417	0492	Stange	36	06	04	12
0426	0493	Våler	27	08	04	11
0427	0493	Elverum	36	08	04	11
0428	0493	Trysil	35	08	04	11
0429	0493	Åmot	26	08	04	11
0430	0493	Stor-Elvdal	26	08	04	11
0434	0493	Engerdal	66	08	04	11
0432	0494	Rendalen	48	08	04	11
0436	0494	Tolga	98	08	04	11
0437	0494	Tynset	68	08	04	11
0438	0494	Alvdal	48	08	04	11
0439	0494	Folldal	68	08	04	11
0441	0494	Os	77	08	04	11
0501	0591	Lillehammer	27	09	05	12
0521	0591	Øyer	47	09	05	12
0522	0591	Gausdal	36	09	05	12
0502	0592	Gjøvik	36	10	05	12
0528	0592	Østre Toten	36	10	05	12
0529	0592	Vestre Toten	35	10	05	12
0536	0592	Søndre Land	36	10	05	12
0538	0592	Nordre Land	24	10	05	12
0516	0593	Nord-Fron	35	09	05	11
0519	0593	Sør-Fron	45	09	05	11
0520	0593	Ringebu	36	09	05	11
0511	0594	Dovre	45	08	05	11
0512	0594	Lesja	67	08	05	11
0513	0594	Skjåk	36	08	05	11
0514	0594	Lom	47	08	05	11
0515	0594	Vågå	46	08	05	11
0517	0594	Sel	54	08	05	11
0532	0595	Jevnaker	45	11	05	13
0533	0595	Lunner	36	11	05	13
0534	0595	Gran	36	11	05	13
0540	0596	Sør-Aurdal	86	12	05	11
0541	0596	Etnedal	45	12	05	11
0542	0596	Nord-Aurdal	26	12	05	11
0543	0596	Vestre Slidre	46	12	05	11
0544	0596	Øystre Slidre	47	12	05	11
0545	0596	Vang	67	12	05	11
0602	0691	Drammen	36	13	06	13
0621	0691	Sigdal	36	13	06	13
0623	0691	Modum	25	13	06	13
0624	0691	Øvre Eiker	36	13	06	13
0625	0691	Nedre Eiker	45	13	06	13
0626	0691	Lier	48	13	06	13
0627	0691	Røyken	58	13	06	13
0628	0691	Hurum	46	13	06	13
0604	0692	Kongsberg	27	12	06	13
0631	0692	Flesberg	66	12	06	13
0632	0692	Rollag	48	12	06	13
0633	0692	Nore og Uvdal	45	12	06	13
0605	0693	Ringerike	36	11	06	13
0612	0693	Hole	48	11	06	13
0622	0693	Krødsherad	25	11	06	13
0615	0694	Flå	36	12	06	11
0616	0694	Nes	56	12	06	11
0617	0694	Gol	36	12	06	11
0618	0694	Hemsedal	57	12	06	11
0619	0694	Ål	68	12	06	11
0620	0694	Hol	27	12	06	11
0701	0791	Horten	46	15	07	12
0704	0791	Tønsberg	37	15	07	12
0716	0791	Re	56	15	07	12
0729	0791	Færder	37	15	07	12
0715	0792	Holmestrand	35	14	07	13
0710	0793	Sandefjord	46	16	07	12
0712	0793	Larvik	46	16	07	12
0711	0794	Svelvik	46	14	07	13
0713	0794	Sande	56	14	07	13
0805	0891	Porsgrunn	45	17	08	12
0806	0891	Skien	35	17	08	12
0811	0891	Siljan	37	17	08	12
0814	0891	Bamble	45	17	08	12
0819	0891	Nome	35	17	08	12
0807	0892	Notodden	36	18	08	11
0821	0892	Bø	27	18	08	11

Municipality code	Projection region	Municipality name	Fertility profile	Fertility region	Mortality region	Internal out-migration area
0822	0892	Sauherad	37	18	08	11
0827	0892	Hjartdal	55	18	08	11
0815	0893	Kragerø	44	18	08	12
0817	0893	Drangedal	44	18	08	12
0826	0894	Tinn	25	18	08	11
0828	0895	Seljord	27	18	08	11
0829	0895	Kviteseid	26	18	08	11
0830	0895	Nissedal	56	18	08	11
0831	0895	Fyresdal	76	18	08	11
0833	0895	Tokke	58	18	08	11
0834	0895	Vinje	55	18	08	11
0901	0991	Risør	45	19	09	22
0911	0991	Gjerstad	44	19	09	22
0904	0992	Grimstad	65	20	09	22
0906	0992	Arendal	46	20	09	22
0912	0992	Vegårshei	66	20	09	22
0914	0992	Tvedestrand	55	20	09	22
0919	0992	Froland	55	20	09	22
0929	0992	Åmli	74	20	09	22
0926	0993	Lillesand	56	19	09	23
0928	0993	Birkenes	86	19	09	23
0935	0994	Iveland	74	19	09	22
0937	0994	Evje og Hornnes	85	19	09	22
0938	0994	Bygland	78	19	09	22
0940	0994	Valle	57	19	09	22
0941	0994	Bykle	67	19	09	22
1001	1001	Kristiansand	56	21	10	24
1014	1091	Vennesla	84	21	10	23
1017	1091	Songdalen	75	21	10	23
1018	1091	Søgne	66	21	10	23
1002	1092	Mandal	66	19	10	23
1021	1092	Marnardal	86	19	10	23
1026	1092	Åseral	97	19	10	23
1027	1092	Audnedal	96	19	10	23
1029	1092	Lindesnes	75	19	10	23
1003	1093	Farsund	74	22	10	21
1032	1093	Lyngdal	74	22	10	21
1034	1093	Hægebostad	84	22	10	21
1004	1094	Flekkefjord	55	22	10	21
1037	1094	Kvinesdal	63	22	10	21
1046	1094	Sirdal	76	22	10	21
1103	1103	Stavanger	57	23	11	24
1101	1191	Eigersund	85	22	11	21
1111	1191	Sokndal	94	22	11	21
1112	1191	Lund	95	22	11	21
1114	1191	Bjerkreim	96	22	11	21
1102	1192	Sandnes	76	23	11	23
1122	1192	Gjesdal	95	23	11	23
1124	1192	Sola	77	23	11	23
1127	1192	Randaberg	76	23	11	23
1129	1192	Forsand	85	23	11	23
1130	1192	Strand	83	23	11	23
1133	1192	Hjelmeland	86	23	11	23
1141	1192	Finnøy	97	23	11	23
1142	1192	Rennesøy	86	23	11	23
1144	1192	Kvitsøy	96	23	11	23
1106	1193	Haugesund	75	25	11	22
1134	1193	Suldal	75	25	11	22
1135	1193	Sauda	75	25	11	22
1145	1193	Bokn	63	25	11	22
1146	1193	Tysvær	95	25	11	22
1149	1193	Karmøy	74	25	11	22
1151	1193	Utsira	94	25	11	22
1160	1193	Vindafjord	95	25	11	22
1119	1194	Hå	94	23	11	23
1120	1194	Klepp	95	23	11	23
1121	1194	Time	85	23	11	23
1201	1201	Bergen	57	27	12	34
1238	1291	Kvam	66	27	12	33
1241	1291	Fusa	86	27	12	33
1242	1291	Samnanger	67	27	12	33
1243	1291	Os	65	27	12	33
1244	1291	Austevoll	94	27	12	33
1245	1291	Sund	45	27	12	33
1246	1291	Fjell	85	27	12	33
1247	1291	Askøy	75	27	12	33
1251	1291	Vaksdal	75	27	12	33

Municipality code	Projection region	Municipality name	Fertility profile	Fertility region	Mortality region	Internal out-migration area
1252	1291	Modalen	65	27	12	33
1253	1291	Osterøy	94	27	12	33
1256	1291	Meland	75	27	12	33
1259	1291	Øygarden	84	27	12	33
1260	1291	Radøy	54	27	12	33
1263	1291	Lindås	74	27	12	33
1264	1291	Austrheim	75	27	12	33
1265	1291	Fedje	25	27	12	33
1266	1291	Masfjorden	96	27	12	33
1227	1294	Jondal	97	24	12	31
1228	1294	Odda	65	24	12	31
1231	1294	Ullensvang	57	24	12	31
1232	1294	Eidfjord	66	24	12	31
1233	1295	Ulvik	67	24	12	31
1234	1295	Granvin	47	24	12	31
1235	1295	Voss	67	24	12	31
1211	1296	Etne	65	26	12	31
1216	1296	Sveio	85	26	12	31
1219	1296	Bømlo	93	26	12	31
1221	1296	Stord	84	26	12	31
1222	1296	Fitjar	93	26	12	31
1223	1296	Tysnes	86	26	12	31
1224	1296	Kvinnherad	64	26	12	31
1401	1491	Flora	86	29	14	31
1438	1491	Bremanger	76	29	14	31
1411	1492	Gulen	86	28	14	31
1412	1492	Solund	76	28	14	31
1416	1492	Høyanger	66	28	14	31
1418	1492	Balestrand	76	28	14	31
1417	1493	Vik	78	28	14	31
1419	1493	Leikanger	48	28	14	31
1420	1493	Sogndal	67	28	14	31
1421	1493	Aurland	38	28	14	31
1422	1493	Lærdal	77	28	14	31
1424	1493	Årdal	56	28	14	31
1426	1493	Luster	98	28	14	31
1413	1494	Hyllestad	95	29	14	31
1428	1494	Askvoll	77	29	14	31
1429	1494	Fjaler	66	29	14	31
1430	1494	Gaular	98	29	14	31
1431	1494	Jølster	86	29	14	31
1432	1494	Førde	78	29	14	31
1433	1494	Naustdal	77	29	14	31
1439	1495	Vågsøy	76	29	14	31
1441	1495	Selje	95	29	14	31
1443	1495	Eid	97	29	14	31
1444	1495	Hornindal	98	29	14	31
1445	1495	Gloppen	78	29	14	31
1449	1495	Stryn	78	29	14	31
1502	1591	Molde	57	32	15	32
1535	1591	Vestnes	75	32	15	32
1539	1591	Rauma	55	32	15	32
1543	1591	Nesset	76	32	15	32
1545	1591	Midsund	74	32	15	32
1547	1591	Aukra	65	32	15	32
1548	1591	Fræna	65	32	15	32
1551	1591	Eide	84	32	15	32
1557	1591	Gjemnes	36	32	15	32
1505	1592	Kristiansund	35	33	15	32
1554	1592	Averøy	55	33	15	32
1573	1592	Smøla	54	33	15	32
1576	1592	Aure	66	33	15	32
1504	1593	Ålesund	67	31	15	32
1523	1593	Ørskog	68	31	15	32
1524	1593	Norddal	76	31	15	32
1525	1593	Stranda	76	31	15	32
1526	1593	Stordal	67	31	15	32
1528	1593	Sykkylven	66	31	15	32
1529	1593	Skodje	86	31	15	32
1531	1593	Sula	86	31	15	32
1532	1593	Giske	86	31	15	32
1534	1593	Haram	66	31	15	32
1546	1593	Sandøy	64	32	15	32
1511	1594	Vanylven	84	30	15	31
1514	1594	Sande	66	30	15	31
1515	1594	Herøy	65	30	15	31
1516	1594	Ulstein	86	30	15	31

Municipality code	Projection region	Municipality name	Fertility profile	Fertility region	Mortality region	Internal out-migration area
1517	1594	Hareid	75	30	15	31
1519	1595	Volda	67	30	15	31
1520	1595	Ørsta	65	30	15	31
1560	1596	Tingvoll	56	33	15	31
1563	1596	Sunndal	45	33	15	31
1566	1597	Surnadal	75	33	15	31
1567	1597	Rindal	75	33	15	31
1571	1597	Halsa	46	33	15	31
5001	1601	Trondheim	46	36	50	44
5027	1691	Midtre Gauldal	64	36	50	43
5028	1691	Melhus	55	36	50	43
5029	1691	Skaun	65	36	50	43
5030	1691	Klæbu	56	36	50	43
5031	1691	Malvik	56	36	50	43
5032	1691	Selbu	46	36	50	43
5033	1691	Tydal	27	36	50	43
5054	1691	Indre Fosen	84	36	50	43
5013	1692	Hitra	63	35	50	41
5014	1692	Frøya	83	35	50	41
5015	1693	Ørland	75	35	50	41
5017	1693	Bjugn	55	35	50	41
5018	1693	Åfjord	74	35	50	41
5019	1693	Roan	54	35	50	41
5020	1693	Osen	85	35	50	41
5021	1694	Oppdal	65	34	50	41
5022	1694	Rennebu	64	34	50	41
5011	1695	Hemne	83	34	50	42
5012	1695	Snillfjord	96	34	50	42
5016	1695	Agdenes	55	34	50	42
5023	1695	Meldal	44	34	50	42
5024	1695	Orkdal	45	34	50	42
5025	1696	Røros	77	34	50	41
5026	1696	Holtålen	57	34	50	41
5004	1791	Steinkjer	55	38	50	41
5039	1791	Verran	64	38	50	41
5040	1791	Namdalseid	75	38	50	41
5041	1791	Snåsa	76	38	50	41
5053	1791	Inderøy	66	38	50	41
5005	1792	Namsos	54	35	50	41
5046	1792	Høylandet	65	35	50	41
5047	1792	Overhalla	64	35	50	41
5048	1792	Fosnes	56	35	50	41
5049	1792	Flatanger	97	35	50	41
5034	1793	Meråker	54	37	50	43
5035	1793	Stjørdal	65	37	50	43
5036	1794	Frosta	75	37	50	42
5037	1794	Levanger	75	37	50	42
5038	1794	Verdal	74	37	50	42
5042	1795	Lierne	84	38	50	41
5043	1795	Røyrvik	76	38	50	41
5044	1795	Namsskogan	85	38	50	41
5045	1795	Grong	75	38	50	41
5050	1796	Vikna	83	35	50	41
5051	1796	Nærøy	94	35	50	41
5052	1796	Leka	54	35	50	41
1804	1891	Bodø	56	41	18	51
1836	1891	Rødøy	94	41	18	51
1837	1891	Meløy	73	41	18	51
1838	1891	Gildeskål	65	41	18	51
1839	1891	Beiarn	63	41	18	51
1840	1891	Saltdal	26	41	18	51
1841	1891	Fauske	54	41	18	51
1845	1891	Sørfold	54	41	18	51
1848	1891	Steigen	76	41	18	51
1849	1891	Hamarøy	67	41	18	51
1805	1892	Narvik	55	42	18	51
1850	1892	Tysfjord	64	42	18	51
1851	1892	Lødingen	65	42	18	51
1852	1892	Tjeldsund	45	42	18	51
1853	1892	Evenes	84	42	18	51
1854	1892	Ballangen	65	42	18	51
1811	1893	Bindal	97	39	18	51
1812	1893	Sømna	65	39	18	51
1813	1893	Brønnøy	55	39	18	51
1815	1893	Vega	76	39	18	51
1816	1893	Vevelstad	54	39	18	51
1818	1894	Herøy	55	39	18	51

Municipality code	Projection region	Municipality name	Fertility profile	Fertility region	Mortality region	Internal out-migration area
1820	1894	Alstahaug	55	39	18	51
1822	1894	Leirfjord	64	39	18	51
1827	1894	Dønna	65	39	18	51
1834	1894	Lurøy	83	39	18	51
1835	1894	Træna	94	39	18	51
1824	1895	Vefsn	55	39	18	51
1825	1895	Grane	65	39	18	51
1826	1895	Hattfjelldal	66	39	18	51
1828	1896	Nesna	75	40	18	52
1832	1896	Hemnes	74	40	18	52
1833	1896	Rana	55	40	18	52
1856	1897	Røst	94	43	18	51
1857	1897	Værøy	94	43	18	51
1859	1897	Flakstad	96	43	18	51
1860	1897	Vestvågøy	76	43	18	51
1865	1897	Vågan	55	43	18	51
1874	1897	Moskenes	93	43	18	51
1866	1898	Hadsel	55	43	18	51
1867	1898	Bø	54	43	18	51
1868	1898	Øksnes	84	43	18	51
1870	1898	Sortland	76	43	18	51
1871	1898	Andøy	65	43	18	51
1902	1902	Tromsø	57	45	19	54
1903	1991	Harstad	55	42	19	52
1911	1991	Kvæfjord	76	42	19	52
1913	1991	Skånland	27	42	19	52
1917	1991	Ibestad	56	42	19	52
1933	1992	Balsfjord	75	45	19	51
1936	1992	Karlsøy	54	45	19	51
1938	1992	Lyngen	84	45	19	51
1939	1992	Storfjord	66	45	19	51
1919	1993	Gratangen	66	44	19	51
1920	1993	Lavangen	54	44	19	51
1922	1993	Bardu	66	44	19	51
1923	1993	Salangen	56	44	19	51
1924	1993	Målselv	76	44	19	51
1925	1994	Sørreisa	76	44	19	51
1926	1994	Dyrøy	24	44	19	51
1927	1994	Tranøy	84	44	19	51
1928	1994	Torsken	83	44	19	51
1929	1994	Berg	73	44	19	51
1931	1994	Lenvik	64	44	19	51
1940	1995	Gaivuotna Kåfjord	65	44	19	51
1941	1995	Skjervøy	74	44	19	51
1942	1995	Nordreisa	75	44	19	51
1943	1995	Kvænangen	75	44	19	51
2002	2091	Vardø	75	46	20	51
2003	2091	Vadsø	66	46	20	51
2024	2091	Berlevåg	73	46	20	51
2025	2091	Deatnu Tana	55	46	20	51
2027	2091	Unjarga Nesseby	68	46	20	51
2028	2091	Båtsfjord	63	46	20	51
2004	2092	Hammerfest	45	46	20	51
2017	2092	Kvalsund	63	46	20	51
2018	2092	Måsøy	64	46	20	51
2019	2092	Nordkapp	84	46	20	51
2020	2092	Porsanger	55	46	20	51
2021	2092	Karasjohka Karasjok	86	46	20	51
2022	2092	Lebesby	65	46	20	51
2023	2092	Gamvik	63	46	20	51
2011	2093	Guovdageaidnu Kautokeino	76	46	20	51
2012	2093	Alta	85	46	20	51
2014	2093	Loppa	84	46	20	51
2015	2093	Hasvik	64	46	20	51
2030	2094	Sør-Varanger	65	46	20	51

Source: Statistics Norway

Appendix B: Definition of country groups

Countries included in the three country groups:

Country group 1
Sweden, Denmark, Finland, Iceland, Faeroe Islands, Greenland, United Kingdom, Ireland, Isle of Man, Channel Islands, Netherlands, Belgium, Luxembourg, Germany, France, Monaco, Andorra, Spain, Portugal, Gibraltar, Malta, Italy, Holy See, San Marino, Switzerland, Liechtenstein, Austria, Greece, Cyprus, Canada, United States, Bermuda, Australia and New Zealand.

Country group 2
Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Slovenia and Croatia.

Country group 3
All remaining countries, e.g. those in Africa, Latin America and the Caribbean, Asia (excluding Cyprus), Oceania (excluding Australia and New Zealand), and all non-EU member states in Eastern Europe.

Appendix C: Centrality categorizations

N	Centrality 1	Centrality 2	Centrality 3	Centrality 4	Centrality 5	Centrality 6
1	0104 Moss	0105 Sarpsborg	0101 Halden	0111 Hvaler	0428 Trysil	0432 Rendalen
2	0219 Bærum	0106 Fredrikstad	0122 Trøgstad	0118 Aremark	0429 Åmot	0434 Engerdal
3	0220 Asker	0124 Askim	0123 Spydeberg	0119 Marker	0430 Stor-Elvdal	0439 Folldal
4	0228 Rælingen	0136 Rygge	0125 Eidsberg	0121 Rømskog	0436 Tolga	0512 Lesja
5	0230 Lørenskog	0211 Vestby	0127 Skiptvet	0239 Hurdal	0438 Alvdal	0545 Vang
6	0231 Skedsmo	0213 Ski	0128 Rakkestad	0418 Nord-Odal	0441 Os	0633 Nore og Uvdal
0	0301 Oslo	0214 Ås	0135 Råde	0420 Eidskog	0511 Dovre	0830 Nissedal
8	0602 Drammen	0215 Frogn	0137 Våler	0423 Grue	0513 Skjåk	0831 Fyresdal
9		0217 Oppegård	0138 Hobøl	0425 Åsnes	0514 Lom	0833 Tokke
10		0227 Fet	0216 Nesodden	0426 Våler	0515 Vågå	0940 Valle
11		0233 Nittedal	0221 Aurskog-Høland	0427 Elverum	0517 Sel	0941 Bykle
12		0234 Gjerdrum	0226 Sørum	0437 Tynset	0519 Sør-Fron	1026 Åseral
13		0235 Ullensaker	0229 Enebakk	0516 Nord-Fron	0540 Sør-Aurdal	1133 Hjelmeland
14		0403 Hamar	0236 Nes	0520 Ringebu	0541 Etnedal	1134 Suldal
15		0625 Nedre Eiker	0237 Eidsvoll	0521 Øyer	0543 Vestre Slidre	1144 Kvitsøy
16		0626 Lier	0238 Nannestad	0522 Gausdal	0544 Øystre Slidre	1151 Utsira
17		0627 Røyken	0402 Kongsvinger	0528 Østre Toten	0615 Flå	1227 Jondal
18		0701 Horten	0412 Ringsaker	0529 Vestre Toten	0618 Hemsedal	1231 Ullensvang
19		0704 Tønsberg	0415 Løten	0536 Søndre Land	0620 Hol	1232 Eidfjord
20		0710 Sandefjord	0417 Stange	0538 Nordre Land	0622 Krødsherad	1252 Modalen
21		1102 Sandnes	0419 Sør-Odal	0542 Nord-Aurdal	0632 Rollag	1265 Fedje
22		1103 Stavanger	0501 Lillehammer	0616 Nes	0817 Drangedal	1266 Masfjorden
23		1124 Sola	0502 Gjøvik	0617 Gol	0826 Tinn	1411 Gulen
24		1127 Randaberg	0532 Jevnaker	0619 Ål	0827 Hjartdal	1412 Solund
25		1201 Bergen	0533 Lunner	0621 Sigdal	0828 Seljord	1413 Hyllestad
26		5001 Trondheim	0534 Gran	0631 Flesberg	0829 Kviteseid	1417 Vik
27			0604 Kongsberg	0711 Svelvik	0834 Vinje	1418 Balestrand
28			0605 Ringerike	0807 Notodden	0912 Vegårshei	1421 Aurland
29			0612 Hole	0811 Siljan	0929 Åmli	1428 Askvoll
30			0623 Modum	0815 Kragerø	0935 Iveland	1438 Bremanger
31			0624 Øvre Eiker	0819 Nome	0938 Bygland	1441 Selje
32			0628 Hurum	0821 Bø+I74	1021 Marnardal	1524 Norddal
33			0712 Larvik	0822 Sauherad	1027 Audnedal	1546 Sandøy
34			0713 Sande+G76	0901 Risør	1034 Hægebostad	1571 Halsa
35			0715 Holmestrand	0911 Gjerstad	1046 Sirdal	1573 Smøla
36			0716 Re	0914 Tvedestrand	1112 Lund	1576 Aure
37			0729 Færder	0919 Froland	1135 Sauda	1811 Bindal
38			0805 Porsgrunn	0928 Birkenes	1141 Finnøy	1812 Sømna
39			0806 Skien	0937 Evje og Hornnes	1145 Bokn	1815 Vega
40			0814 Bamble	1003 Farsund	1211 Etne	1816 Vevelstad
41			0904 Grimstad	1004 Flekkefjord	1219 Bømlo	1818 Herøy+L42
42			0906 Arendal	1014 Vennesla	1222 Fitjar	1825 Grane
43			0926 Lillesand	1017 Songdalen	1223 Tysnes	1826 Hattfjelldal
44			1001 Kristiansand	1029 Lindesnes	1224 Kvinnherad	1827 Dønna
45			1002 Mandal	1032 Lyngdal	1233 Ulvik	1828 Nesna
46			1018 Søgne	1037 Kvinesdal	1234 Granvin	1834 Lurøy
47			1106 Haugesund	1101 Eigersund	1241 Fusa	1835 Træna
48			1119 Hå	1111 Sokndal	1244 Austevoll	1836 Rødøy
49			1120 Klepp	1114 Bjerkreim	1416 Høyanger	1837 Meløy
50			1121 Time	1129 Forsand	1419 Leikanger	1838 Gildeskål
51			1122 Gjesdal	1130 Strand	1422 Lærdal	1839 Beiarn
52			1243 Os	1142 Rennesøy	1424 Årdal	1848 Steigen
53			1246 Fjell	1146 Tysvær	1426 Luster	1849 Hamarøy
54			1247 Askøy	1149 Karmøy	1429 Fjaler	1850 Divtasvuodna
55			1502 Molde	1160 Vindafjord	1430 Gaular	1852 Tjeldsund
56			1504 Ålesund	1216 Sveio	1431 Jølster	1853 Evenes
57			1804 Bodø	1221 Stord	1433 Naustdal	1854 Ballangen
58			1902 Tromsø	1228 Odda	1439 Vågsøy	1856 Røst
59			5024 Orkdal	1235 Voss	1443 Eid	1857 Værøy
60			5028 Melhus	1238 Kvam	1444 Hornindal	1859 Flakstad
61			5030 Klæbu	1242 Samnanger	1445 Gloppen	1867 Bø (Nordland)
62			5031 Malvik	1245 Sund	1449 Stryn	1871 Andøy
63			5035 Stjørdal	1251 Vaksdal	1511 Vanylven	1874 Moskenes
64				1253 Osterøy	1514 Sande	1917 Ibestad
65				1256 Meland	1525 Stranda	1919 Gratangen
66				1259 Øygarden	1526 Stordal	1920 Loabák
67				1260 Radøy	1539 Rauma	1926 Dyrøy
68				1263 Lindås	1543 Nesset	1927 Tranøy
69				1264 Austrheim	1545 Midsund	1928 Torsken
70				1401 Flora	1547 Aukra	1929 Berg
71				1420 Sogndal	1551 Eide	1936 Karlsøy
72				1432 Førde	1554 Averøy	1938 Lyngen
73				1505 Kristiansund	1557 Gjemnes	1939 Storfjord
74				1515 Herøy+I116	1560 Tingvoll	1940 Gáivuotna

N	Centrality 1	Centrality 2	Centrality 3	Centrality 4	Centrality 5	Centrality 6
75				1516 Ulstein	1563 Sunndal	1943 Kvænangen
76				1517 Hareid	1566 Surnadal	2002 Vardø
77				1519 Volda	1567 Rindal	2011 Guovdageaidnu
78				1520 Ørsta	1813 Brønnøy	2014 Loppa
79				1523 Ørskog	1822 Leirfjord	2015 Hasvik
80				1528 Sykkylven	1832 Hemnes	2017 Kvalsund
81				1529 Skodje	1840 Saltdal	2018 Måsøy
82				1531 Sula	1845 Sørfold	2019 Nordkapp
83				1532 Giske	1851 Lødingen	2022 Lebesby
84				1534 Haram	1860 Vestvågøy	2023 Gamvik
85				1535 Vestnes	1865 Vågan	2024 Berlevåg
86				1548 Fræna	1866 Hadsel	2025 Deatnu
87				1805 Narvik	1868 Øksnes	2027 Unjárga
88				1820 Alstahaug	1911 Kvæfjord	5018 Åfjord
89				1824 Vefsn	1913 Skånland	5019 Roan
90				1833 Rana	1922 Bardu	5020 Osen
91				1841 Fauske	1923 Salangen	5026 Holtålen
92				1870 Sortland	1924 Målselv	5033 Tydal
93				1903 Harstad	1925 Sørreisa	5041 Snåase
94				2004 Hammerfest	1931 Lenvik	5042 Lierne
95				2012 Alta	1933 Balsfjord	5043 Raarvihke
96				5004 Steinkjer	1941 Skjervøy	5044 Namsskogan
97				5005 Namsos	1942 Nordreisa	5046 Høylandet
98				5021 Oppdal	2003 Vadsø	5048 Fosnes
99				5025 Røros	2020 Porsanger	5049 Flatanger
100				5027 Midtre Gauldal	2021 Kárásjohka	5051 Nærøy
101				5029 Skaun	2028 Båtsfjord	5052 Leka
102				5032 Selbu	2030 Sør-Varanger	
103				5037 Levanger	5011 Hemne	
104				5038 Verdal	5012 Snillfjord	
105				5053 Inderøy	5013 Hitra	
106					5014 Frøya	
107					5015 Ørland	
108					5016 Agdenes	
109					5017 Bjugn	
110					5022 Rennebu	
111					5023 Meldal	
112					5034 Meråker	
113					5036 Frosta	
114					5039 Verran	
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