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Assumptions on fertility

Ways to project fertility – how do European countries project fertility and what are their perceptions of current practices?

Note by Statistics Norway*

Summary

Norway is currently considering changing the way we project fertility. This paper aims to describe the different ways various European countries project fertility in their national population projections, to establish a solid basis for deciding the way forward. We are currently in a preliminary phase, and a finalized paper will be prepared early 2020.

Data will be collected in two steps: First, the Offices of National Statistics (ONSs) in Europe are asked to respond to a questionnaire regarding their current practices. These results will be summarized qualitatively. For a quantitative overview, the different methods used by the participating countries will be categorized into four broad groups: 1) Model-based, deterministic projections 2) Model-based stochastic projections (frequentist and/or Bayesian approaches); 3) Expert-based projections; 4) Other methods. A descriptive analysis of similarities and differences will be performed to assess which methods were most common, how satisfied the ONSs were with their method, the public availability of documentation, and the extent to which the accuracy of the projections was assessed short- and long-term. Second, select countries will be selected for a more in-depth analysis. The countries represent a variety of ways of projecting fertility, to illustrate the range of options available and in use across Europe. We will examine readily available information and documentation online, as well as reports and journal articles. For comparison purposes, this study also includes the fertility projection methods utilized by Eurostat and the UN.

In the final paper, strengths and weaknesses associated with the different methods will be presented, discussing both the comments and feedback from the ONSs, as well as those emerging in a broader perspective based on the comparisons made in this study.

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I. Introduction

1. Population projections are widely used by governments, policy makers, planners, and organizations around the world because they provide a "…picture of what the future size and structure of the population by sex and age might look like" (Insee, 2019). Population projections are made by national governments in many countries around the world, as well as by international organizations like the United Nations (UN) and Eurostat who both project population at global and national levels.
2. Three components are important when projecting population of a geographic area; fertility, mortality, and migration, and the interaction between these three components results in population growth or decline. Thus, assumptions about fertility, mortality, and migration, in combination with past trends, comprise a basis for projecting population trends for years to come (Insee, 2019). Over the past years, (international) migration has become perhaps the most challenging component when creating population projections as it is more difficult to project compared to fertility and mortality (PRB, 2019). Migration changes are often a result of "short-term changes in economic, social or political factors that are hard to predict or quantify" (PRB, 2019).
3. However, fertility continues to be a much-debated topic as "close to half of all people globally live in a country or area where fertility is below 2.1 births per woman over a lifetime" (UN WPP, 2019, p. 2). Total Fertility Rate (FTR) can be defined as "the average number of children a woman would bear if she survived through the end of the reproductive age span, experiencing at each age the age-specific fertility rates of that period" (Alkema et al., 2011, p. 816). The impact of fertility projections is substantial, as the cumulative effect over generations can have pronounced consequences for a country as "…slightly higher fertility will play out over several decades" (UN DESA, 2013, p. 2) and vice versa when projected fertility levels are set slightly lower. Thus, it is of great importance to utilize well-tested and well-assessed methods for projecting future fertility.
4. In general, population projections tend to become less accurate the further away they are from the date of the projection. Thus, when projecting fertility for the next 50 years, the likelihood is that the projected numbers for 2050 will be less accurate than the projected numbers for 2025. However, because of the great variation in methods that exists for population projections, the accuracy and margin of errors varies. Regardless of method there will always be potential errors when projecting fertility for future years, but an important reasoning behind a chosen method should be to increase the likelihood of projecting numbers that are as accurate as possible, especially short-term. When explaining and comparing fertility, one can look at either period-fertility or cohort-fertility (Rowland, 2003). However, past research highlights challenges when trying to choose a method for projecting fertility as little information exists on *how* to choose among the methods available (Bohk-Ewall, Li, & Myrskylä, 2018). As period-fertility is utilized in most national projections, this study is limited to the assumptions made to project period-fertility.
5. Statistics Norway is currently considering changing the way in which we project fertility. The aim of this study is to explore the different methods employed to make assumptions about future fertility and ways to project it by countries across Europe, to assess their strengths, and weaknesses. The present study is a mixed-methods study, consisting of two-parts. The first is a document review based on the available information on current practices across Offices of National Statistics (ONSs) in

Europe, as well as the UN and Eurostat. The second part of the study comprises a survey regarding current practices, benefits, and potential suggestions for changes in how fertility ought to be projected. The survey has been piloted in the Nordic countries and was distributed to the rest of the Eurostat countries on November 5th, 2019 (44 countries total, across pilot and survey). At the time of submission of this working paper to Eurostat, fifteen countries had responded (this also includes the pilot study). An underlying goal of the study is to enable both Norway and other countries to use this explorative study to help evaluate whether their current methods for fertility projection are adequate or if other approaches might be worth considering.

II. Literature Review

1. Norway

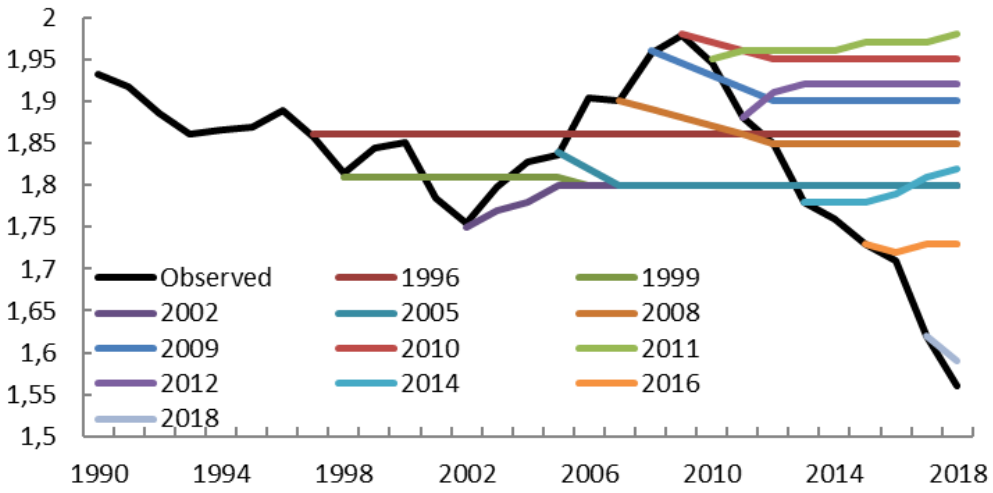
(a) Current Method

6. Future population development in Norway is projected by Statistics Norway using the cohort-component method. The projections are deterministic and a total of 15 alternatives is produced, differing in their combinations of assumptions for the components of life expectancy, fertility, internal migration and international migration. The main alternative (MMMM) uses a medium level for all components. For the national projections, fertility is projected for 16 different groups of women, depending on country group of origin (4 groups) and for immigrants, length of stay in Norway (5 groups) in Norway (Statistics Norway, 2018). Three different scenarios are calculated for the fertility assumptions: low, medium, and high. In practice, three annual factors are determined, one for each alternative. This factor raises or lowers the fertility of native women to a level determined after analyses of historical developments and expert consultations with a multidisciplinary advisory group consisting of fertility researchers (Statistics Norway, 2018, p. 41). The respective annual factor is applied to produce assumptions of future fertility for native women by multiplying it with the current age-specific fertility rates. The same factor is used also for the 15 other groups of immigrant women, but because their age-specific fertility rates vary, the total TFR differs between all groups. Since the distribution of native and immigrant women varies across the projection period, the total TFR for the country as a whole is a result, rather than an assumption, in our set-up. The fertility assumptions and projections are published biennially, up to the year 2100.

(b) How does past projections compare to observed?

7. When examining past fertility projections in Norway, there has been great variation in the preciseness of the projected fertility. Certain years, especially following the second world war, the projected TFR was too low, while the projected fertility for the 1970s and 1980s was too high (Rogne, 2016). Research indicates that population projections in developed countries often have had too generous fertility projections in the past (Keilman, 1991; Texmon, 1993; Texmon & Keilman, 1991). In a study examining projected and observed population changes in Norway in the years between 1996 and 2005, Rogne (2016) found that the deviations between the medium projected alternative and observed TFR did not follow a clear pattern (p. 67).

Figure 1. Observed and projected (medium alt.) TFR



8. There seems to have been a tendency of projecting fertility at a similar level as that observed the year prior to the production of the population projections, i.e. the baseline year (see figure 1.). Thus, the medium fertility has been projected too high during years with periods of high or increasing fertility, while it has been projected too low during years with low or declining fertility.

2. Present Study

9. Because of the great variation in methods used across countries that project fertility as part of their population projections, this study aims to examine the different methods utilized among European countries, as well as the methods used by Eurostat and the UN. The goal is an overall comparison of these methods, focusing on their strengths and weaknesses, as well as short-term accuracy. We also want to understand how ONSs regard their methods, including their usefulness, their ease of use, their accuracy and how they are communicated to the public.

10. This summary will enable Statistics Norway to compare their current practices with other methods that might be a better option for projecting fertility. In addition, there are other countries that have indicated a need to improve their fertility projections, such as Luxembourg (Peltier, 2018). Thus, our hope is that this examination will be useful not only for Norway, but also for other countries that are considering changing their methods or who are interested in a broader comparison of the different methods already in use for making fertility assumptions and projecting fertility.

III. Data and Methods

11. This is a mixed-method study, utilizing both qualitative and quantitative data and analytic techniques. First, the ONSs in Europe were asked to respond to a survey regarding their current practices. Some examples of questions asked were “Do you currently use a formal statistical model to project fertility?”; “In the data you use, what type of information is available?”, and; “If you could choose freely, do you have any suggestions of changes to the way your country projects fertility?” The survey was piloted in the Nordic countries and relevant adjustments were made

based on their feedback. The survey will be distributed to the ONSs in Europe in November 2019. When their responses have been received, approximately eight countries will be selected for a more in-depth analysis in the second part of this study. The survey responses will be compared and complemented with an examination of readily available information and documentation online, as well as published reports and journal articles. For comparison purposes, this study also includes the projection methods utilized by Eurostat and the UN.

12. For the pilot study, a total of 6 questionnaires were sent out to the Nordic countries (Sweden, Denmark, Finland, Faroe Islands, Greenland, and Iceland). A total of 4 questionnaires were completed and submitted. Based on the responses and feedback from the pilot-countries, the survey was adjusted and distributed to the Eurostat countries on Nov. 5th. A total of 44 countries have received the study, as well as the UN and Eurostat. Below are the preliminary results based on the pilot study and the completed responses to the survey as of Nov. 11th.

IV. Results

1. Document Review

(a) United Nations

13. The UN Department for Economic and Social Affairs have produced 26 rounds of the World Population Prospects (WPP), projecting future population trends related to fertility, mortality, and international migration. Currently, data from more than 230 countries or areas are included. This review is based on the most recent WPP, published in 2019. It includes estimates of TFR going back to 1950, as well as fertility projections until 2100 (UN DESA, 2019a). The most recent revision of the WPP includes ten different projection variants that combined illustrates "…the sensitive of the medium-variant projection to changes in the underlying assumptions" (UN DESA, 2019b). Five of the ten variants differ with respect to the level of fertility. These are low, medium, high, constant-fertility, and instant-replacement-fertility and the comparison between. According to the UN, these five variants allow an assessment of the effects that different fertility assumptions have on other demographic parameters (UN DESA, 2019b). The alternative most commonly used by the UN is the medium variant, in which the fertility assumption is a medium fertility level based on probabilistic methods which provide 80 and 95% prediction intervals (UN DESA, 2019b). The UN generates assumptions about future age-specific fertility rates for most countries by projecting forward the overall TFR and then converting the overall levels to age-specific rates taking into account changing age patterns for fertility (Raftery, Alkema, & Gerland, 2014, p. 60). More details on the methodology used for the WPP 2019 will be included as soon as it is released, but personal communication indicated that the methods used for WPP 2019 are similar to those used for WPP 2017 (UN DESA, 2017), with some exceptions.

14. The fertility projection model in the most recent WPP had three major updates, first to "…include the experience of a larger number of countries currently with low levels of fertility (UN DESA, 2019a, p.1). Second, the model utilized to "…project the age patterns of fertility was also updated to include new empirical evidence. The projection model combines past national trends of the age pattern of fertility with a

trend leading towards a global model age pattern of fertility" (UN DESA, 2019a, p. 1). Lastly, the level of fertility projected for countries with fertility below 2.1 live births per woman was adjusted "…to smooth the transition between a recent downward trend in fertility and an expected future increase" (UN DESA, 2019a, p. 1). To illustrate the uncertainty of the fertility projections, UN utilizes probabilistic methods (Bayesian) that take into account the past experience of each country, while also reflecting uncertainty about future changes based on the past experience of other countries under similar conditions (UN DESA, 2019c).

(b) Eurostat

15. Eurostat, the statistical office of the European Union, produces population projections every three years using data on births, deaths, and migration reported by countries in the EU, the European Economic Area (EEA), current EU candidates, as well as countries that are part of the European Neighborhood Policy (ENP-countries). Data on population demography such as fertility is reported by the individual countries to Eurostat every year. The most recent population projections published, EUROPOP2018, was published June 2019 and provides national estimates for 31 countries (Eurostat, 2019c).

16. To project TFR, Eurostat utilizes a statistical model that combines "…a country-specific trend extrapolation and the convergence assumption" (Eurostat, 2019b, p. 3). The convergence assumption has been assessed on past trends of fertility (Lanzieri, 2009) and can be summarized as "…socio-economic differentials among EU Member States are expected to be fading out in the very long term" (Eurostat, 2017, p. 3). Thus, it is assumed that the countries are following a similar pattern of demographic development and the model combines this assumption with an extrapolation of four parameters using Schmertmann's (2003) model for age specific fertility rates. The trend extrapolation has full weight for the years before and including 2020 (Eurostat, 2019b). After 2020 "…the convergence assumption starts operating, with linearly increasing weight towards the end of the projections period. Country-specific trend extrapolations are obtained from a constrained ARIMA(1,0,1) applied to the time series 1950-2017. Missing Eurostat TFR data have been replaced with data extracted from the Human Fertility Database. Convergence is modelled by assuming a tendency of fertility in all countries towards an ultimate value never reached during the horizon of the projections, namely equal to 1.83. This value represents the maximum TFR that UN's World Population Prospects 20194 project for 2100 for the countries included in EUROPOP2018" (Eurostat, 2019b). Despite using a statistical model for the extrapolation, Eurostat defines their method for projecting TFR as determinist because the specification of the ARIMA is such to "force" the long-term extrapolation towards a target value defined a-priori. The model serves the purpose of having values of the TFR, but the distribution across ages is obtained using the Schmertmann (2003) model.

(c) Denmark

17. Denmark published their first population projection in 1963 and has produced projections annually since 1978. From 2010, Statistics Denmark has made their projections in cooperation with DREAM (The Danish Research Institute for Economic Analysis and Modeling), an independent semi-governmental Danish research institution. Each February, Statistics Denmark update DREAM with the most recent data on immigration, emigration, births, deaths, and change in citizenship. DREAM utilize this data to run "the actual projection model for the whole of Denmark" (Statistics Denmark, 2019, p. 2) and provides Statistics Denmark with the data used to publish the national population projections (Statistics Denmark, 2019). Statistics Denmark used to have an expert panel for fertility projections, but that was terminated in 2019. The fertility assumptions are now calculated using two formal methods; the Richards Curve for the convergence for the short-term towards the long-term development and the Cubic Spline Smoothing to calculate the trend in the age-related fertility. Denmark's population projections are deterministic (based on historical experience) and creates only one scenario utilizing one set of assumptions (Statistics Denmark, 2019).

(d) Finland

18. Statistics Finland published the first population projection in 1934 and are currently publishing projections biennially. Statistics Finland utilizes a demographic component method and "…future population number and structure are calculated by means of age-specific birth rate, mortality and migration coefficients" (Statistics Finland, 2019). The coefficients for fertility are calculated "on the basis of demographic statistics for the last few years" (OSF, 2019). To predict fertility, both number of births as well as age-specific fertility rates are calculated. For the latest fertility productions (published in 2019), the number of births were calculated by grouping municipalities "into 74 fertility areas on the basis of the total fertility rate in the years 2014 to 2018." (OSF, 2019). Age-specific fertility rates are calculated for the aforementioned fertility areas and each area have identical fertility coefficients. When projecting fertility, the rates are kept "constant throughout the projection period" (OSF, 2019). In their latest fertility projection (2019), Finland made national projections up to 2070 and provide only one alternative, in which the TFR is constant.

(e) Iceland

19. Iceland publishes population projections on an annual basis, utilizing a combination of the cohort model and "certain expert assumptions on some components" (Calian & Harðarson, 2015, p. 3). For the expert assumptions on fertility, they have three variants (Calian & Harðarson, 2015, p. 9). Because of its small population size, Iceland faces certain challenges when calculating fertility rates and is therefore utilizing a functional data approach based on Hyndman et al. (2007). The fertility projections are created "using functional models with time series coefficients according to [the] functional data method" (Calian & Harðarson, 2015, p. 3). The long-term fertility projections "are constrained to converge to fixed values given by

expert assumptions… the (independent) assumptions are very close to the estimated confidence interval bounds given by the model" (Calian & Harðarson, 2015, p. 4). Statistics Iceland obtain both short- and long-term projections, and for the long-term fertility projections a total of three alternatives are created; low, medium (main), and high. The low and high represents prediction intervals, resulting from probabilistic methods.

(f) Poland

20. Poland publishes an overview of the population, including demographic developments, projections, and methods in a demographic yearbook. The first yearbook was published in 1968, accompanied by an English version from 1993. From 2004 the yearbooks have been published electronically. Trends in vital statistics are described using demographic dynamics, total fertility rate, and gross reproduction rate. For their fertility projections, they also publish age-specific fertility rates which are "calculated as the ratios of the number of live births from women and the number of these women in the same groups of age" (Statistics Poland, 2019, p. 178). Poland also publishes a household projection booklet every four years, the most recent (2016) include projections up to 2050.
21. Statistics Poland describe that they have developed four coefficients based on " the census data for the years 2002 and 2011, for all voivodships in a breakdown by urban and rural areas. Their values for the subsequent years of the projection were calculated in such a way so that they are compatible with the projected changes in the structure of households" (2016, p. 29). For their fertility projections, Poland utilizes a constant value of the coefficient for the whole period of the projection (latest projection 2016-2050). Their projections are based on extrapolation of trends of the last 25 years, as well as on assumption on convergence to countries in Europe with higher fertility. Future TFR schedules are also based on those countries which currently have higher MAC than Poland.

(g) Sweden

22. Statistics Sweden is responsible for the population projections in Sweden and publishes population projections on an annual basis. Sweden has a long history of producing population projections. Sweden does not utilize a formal model for projecting fertility. Instead, fertility is projected using a cohort model with a parity component for the Swedish-born women. No parity-specific assumptions are made for foreign born women, instead, foreign-born women are divided into six groups based on country of birth (Nordic countries, non-Nordic countries of the EU27, non-EU27 countries in Europe, or a non-European country grouped by the UN Human Development Index; high, medium or low). When making fertility projections for foreign-born women, Statistics Sweden uses annual age specific fertility rates that have been projected for each country in the birth group. Several deterministic alternatives are provided, as well as stochastic prediction intervals. The fertility assumptions are revised every third year based on advice and viewpoints from an expert reference group.

2. Survey

23. Below is a preliminary comparison of twelve European countries, included are the Nordic countries participating in the pilot study (Sweden, Denmark, Iceland, and the Faroe Islands), as well as the European countries that had completed the survey by November 11th (Bulgaria, Luxembourg, Netherlands, Poland, Serbia, Spain, Switzerland, and Ukraine). The survey has been distributed to the countries that partake in the Eurostat collaboration in November this year and is currently open for the remaining countries to participate. Four countries (Belarus, Latvia, Lithuania, and North Macedonia) have so far reported that they do not produce fertility projections. The results will be analyzed and included in the final article which we hope to present at the EPC2020 in June 2020.

24. In this study, the Faroe Island is viewed as being distinct from Denmark as they make their own population projections. It should be noted that the population composition and size vary between the four pilot countries, ranging from the Faroe Islands with around 49,000 people (2017) to 46,6 million people in Spain (2018), which impacts the type of methods they utilize for their population projections, as well as the resources available.

(a) Use of formal statistical methods

25. Seven of the twelve countries that had responded by November 11th, reported that they are currently using formal statistical models to project fertility (Denmark, Faroe Islands, Iceland, the Netherlands, Poland, Spain, and Switzerland) . While Switzerland do not use a formal model for the evolution of fertility, they use a model for the age structure of fertility. The Netherlands look at cohort- and period-patterns (by age and number of children) and use extrapolation by setting future fertility rate and age of motherhood. While Iceland is utilizing a functional modelling approach, stochastic population forecasts using functional data models for fertility, as well as integrated long-term expert assumptions, Denmark is using Cubic Spline Smoothing and the Richards Curve for the convergence from the short- to the long-term development. As in Iceland, the Faroe Islands are also utilizing a stochastic fertility model. Poland's fertility projections are based on extrapolation of trends of the last 25 years, as well as on assumptions on convergence to countries of Europe with higher fertility rates than Poland. Future TFR rates are also based on European countries that currently have higher TFR than Poland. Spain adjusts future fertility rates to a known beta function, establishing hypothesis about evolution of TFR at 15 and 50 years from an expert panel and hypothesis about the average age at maternity at 15 and 50 years (also from an expert panel). The five remaining countries (Bulgaria, Luxembourg, Serbia, Sweden, and Ukraine) do not rely on a formal model and base their fertility assumptions on deterministic methods.

26. All countries, except Denmark and Luxembourg, provide several alternatives. The Faroe Islands updates their fertility projections most often (monthly), Sweden, Denmark, and Iceland make updates annually, Spain updates biennially, Bulgaria and the Netherlands updates triennially, while Luxembourg, Switzerland, and Poland make their updates every 5th year. Ukraine is currently working on plans to update projections annually or biennially and Serbia updates on a ten-year basis. Seven of the twelve countries (Sweden, Iceland, Spain, Switzerland, Ukraine, the Netherlands,

and Poland) rely on a panel of expert assumptions, while others have done so in the past, such as Denmark which eliminated this as of 2019.

(b) Evaluation of most recent population projections

27. When asked to evaluate the most recent population projections, eleven of the twelve countries answered that the information available for making the fertility projections were adequate, while Denmark are currently exploring whether they can elaborate on the input used in the fertility calculations and part of this exploration involves testing whether their current method is adequate or not. The majority of the countries felt that enough time is spent on fertility projections and that the frequency of updates is adequate. Only Luxembourg reported that they felt the time spent is insufficient, while both Poland and Serbia indicated that the fertility projections were not updated frequent enough.

28. Sweden explained that the number of scenarios/levels provided are not detailed enough, Denmark is currently testing this, and Poland reported that probabilistic projection would be better, but as for the determinist the number is adequate. Denmark is also currently evaluating whether their fertility projections are adequate, while the three other countries answered that they view the fertility projections as adequate as of now. Iceland mentioned that they are currently experimenting with Bayesian methods, with the goal of improving small population estimates of rates and to incorporate expert assumptions into the models in a more nuanced way. Ukraine reported that after the next population census, they have plans to revise the projections for the country, as well as for the administrative regions, and to introduce probabilistic methods. The Netherlands do not have any specific changes planned, but they would like to review how other countries are currently projecting fertility.

(c) Discrepancies between projected and observed fertility

29. For discrepancies in trends between projected and observed fertility, Denmark reported that because fertility varies, it is challenging to grasp these variations in their calculations and thus the projected fertility is currently a little higher than the observed fertility. While the Faroe Islands, Serbia, Switzerland, and Ukraine do not report marked discrepancies between projected and observed fertility, Iceland and Luxembourg reported projecting a higher level than what was actually observed. The Netherlands explained that fertility was projected at a higher level than what was observed in their latest fertility projections and that the number of childless women stayed at 20 percent, while they had projected this number to decrease to 18 percent. Sweden has seen a decline in fertility since 2010, resulting in an overestimate of the projected fertility. However, for some groups of foreign-born, they have underestimated the fertility because fertility is higher during the first years in Sweden, i.e. immigrants with short lengths of stay. Only two of the twelve countries, Poland and Spain, had seen an unexpected increase in fertility since their last projection. In both countries, this resulted in higher numbers for the observed rates than what was projected.

V. A preliminary categorization of different methods

30. Table 1 summarizes the statistical methods used for the countries and organizations included in this working paper. We strongly encourage countries to correct us if we have misunderstood or misinterpreted responses. Only Iceland reported the use of a stochastic model. The majority of countries relies on some expert input, often in combination with other methods. None of the countries included so far reported the use of "Other methods", but Eurostat relying on UNs long-term trend as a "target" is classified in this category.

Table 1. A summary of ways fertility assumptions and/ or projections are made for individual countries, Eurostat and the United Nations[a]

Type of fertility projection	Classification of countries/organizations
1) Model-based, deterministic	Denmark, Poland, Eurostat, United Nations
2) Model-based stochastic[b]	Iceland, United Nations
3) Expert-opinion/research based[c]	Finland, Iceland, Norway, Sweden
4) Other methods	Eurostat
5) No projection	Belarus, Latvia, Lithuania, North Macedonia

[a]Only including countries and organizations included in this preliminary analysis, listed in alphabetical order. Some countries use both models and expert opinions, and are thus categorized twice. [b]Both frequentist and Bayesian approaches are included here. [b]Most countries rely not only on experts, but rely in addition on analyses of historical trends as well as the research of others.

VI. Preliminary conclusion

31. Based on the pilot study, as well as the current response of the survey, the majority of the countries seem to view their methods for fertility projections as adequate, but with certain challenges. Although the challenges differ, the countries are experimenting and testing whether certain changes can improve their models and thus the projected fertility estimates. A common trend seems to be a slight overestimation of predicted fertility levels over the past years in all countries except the Faroe Islands, Serbia, Switzerland, and Ukraine. This might be a result of the observed decline in fertility in the Nordic countries during the past decade, perhaps stronger than foreseen, in line with the conclusions for Norway in the review by Rogne (2016).

32. If we consider the document review, readily available documentation in English of the fertility assumptions and projections is limited to some degree, in various manners, for most countries, Norway included. Iceland, the Netherlands, and Luxembourg are exceptions, with available information online as well as in published articles. While Bulgaria, Denmark, Finland, Poland, Spain, and Ukraine provide information readily available in English, the Swedish documentation is thorough, but primarily available in Swedish. Serbia has some information available in English, but detailed information about projection methodology is only available in Serbian. In a similar manner, Switzerland has most of their detailed documentation in German and French and only a limited volume available in English. Faroe Islands is a small area, and limited information was publicly available in English.

33. To conclude, countries are likely to benefit from increased interaction and exchange of ideas and views regarding fertility projections, and efforts to increase such collaboration in the Nordic countries have been initiated by the ONS of Denmark.

Furthermore, the meetings and seminars organized by Eurostat are welcome, as further exchange of information outside the Nordic area appears warranted to improve fertility projections and learn from countries and organizations that do well in this area. It is our hope that this paper, once finished, can be a helpful resource to increase learning and the exchange of ideas across European countries to a greater extent than what is the case today. The analyses and conclusions will be finalized in January 2020.

VII. References

Alkema, L., Raftery, A. E., Gerland, P., Clark, S. J., Pelletier, F., Buetttner, T, & Heilig, G. K. (2011). Probabilistic Projections of the Total Fertility Rate for All Countries. *Demography 48(3),* p. 815-839.

Bohk-Ewald, C., Li, P., & Myrskalä, M. (2018). Forecast accuracy hardly improves with method complexity when completing cohort fertility. *PNAS 115(37),* p. 9187-9192.

de Beer, J. (2011). *Transparency in population forecasting: Methods for fitting and projecting fertility, mortality and migration.* Amsterdam, Nederland: Amsterdam University Press.

Eurostat. (2017). Technical note: summary methodology of the 2015-based population projections. *European Commission, Eurostat.* ESTAT/F-2/GL. Luxembourg: Eurostat.

Eurostat. (2018). Joint note on the meaning of projections and forecasts. Working paper for the' Working Group on Population Projections. *European Commission, Eurostat.* ESTAT/F2/PRO/2018/WG1/02/DI. Luxembourg: Eurostat.

Eurostat. (2018). *The EU in the world introduction*. Statistics Explained 2018 edition. From: https://ec.europa.eu/eurostat/statistics-explained/index.php/The_EU_in_the_world_introduction

Eurostat. (2019a). *Population (demography, migration and projections): Overview*. Eurostat. From https://ec.europa.eu/eurostat/web/population-demography-migrationprojections/background

Eurostat. (2019b). Technical note: Summary methodology of the 2018-based population projections (EUROPOP2018). *European Commission Eurostat.* ESTAT/F-2/PRO/2019. From: https://ec.europa.eu/eurostat/cache/metadata/Annexes/proj_esms_an2.pdf

Eurostat. (2019c). Population (demography, migration and projections): Population projections. *European Commission Eurostat*. From https://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-data#

Insee. (2019). Population projection: Definition. *Institut national de la statistique et des études économiques*. From: https://www.insee.fr/en/metadonnees/definition/c1235

Keilman, N. (2008). Using determinist and probabilistic population forecasts. In W. Østreng (ed.), *Complexity: Interdisciplinary Communications 2006/2007.* ISBN: 978-82-996367-5-9.

Keilman, N. (2018). Probabilistic demographic forecasts. *Vienna Yearbook Population Research* 16, p. 1-11.

Lanzieri, G. (2009). EUROPOP2008: a set of population projections for the European Union. Paper for the XXVI IUSSP International Population Conference, Marrakech (Morocco), 27 September – 2 October 2009.

Official Statistics of Finland (OSF). (2019). *Population projection* [e-publication]. ISSN=1798-5153. 2019, Quality description: Population projection 2019–2070. Helsinki: Statistics Finland [referred: 30.10.2019]. From: http://www.stat.fi/til/vaenn/2019/vaenn_2019_2019-09-30_laa_001_en.html

Peltier, F. (16/17 May, 2018). Analysing the performance of national projections issues in the period 1930-2000, from both a descriptive and a modelling perspective (Bulatao method). STATEC – population projections WG – Malta – 19/17 May, 2018.

Rafterty, A. E., Alkema, L., & Gerland, P. (2014). Bayesian Population Projections for the United Nations. Statistical Science 29(1), p. 58-68.

Rogne, A. F. (2016). Hvor godt treffer befolkningsframskrivingene? *Økonomiske analyser* 3, 63-74.

Rowland, D. T. (2003). *Demographic methods and concepts.* New York, NY: Oxford University Press.

Schmertmann, C. (2003). A system of model fertility schedules with graphically intuitive parameters. *Demographic Research* 9(5), p. 81-110.

Statistiska Centralbyrån. (2019). Kvalitetsdeklaration: Befolkningsframskrivingar. *Statistiska Centralbyrån.* From:
www.scb.se/contentassets/77d1f12a07214b528b2141df9bb818cf/be0401_kd_2019_ll_190319.pdf

Statistics Poland. (2019). *Demographic Yearbook of Poland.* Retrieved from https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/demographic-yearbook-of-poland-2019,3,13.html

Statistics Poland. (2016). *Household projection for the years 2016-2050.* Retrieved from https://stat.gov.pl/en/topics/population/population-projection/household-projection-for-the-years-2016-2050,3,4.html

United Nations, Department of Economic and Social Affairs. (2013). Explaining differences in the projected populations between 2012 and 2010 Revisions of World Population Prospects: The role of fertility in Africa. *Population Facts*. Retrieved from: https://www.un.org/en/development/desa/population/publications/pdf/popfacts/popfacts_2013-10.pdf

United Nations, Department of Economic and Social Affairs, Population Division (2017). *World Population Prospects: The 2017 Revision, Methodology of the United Nations Population Estimates and Projections,* Working Paper No. ESA/P/WP.250. New York: United Nations.

United Nations, Department of Economic and Social Affairs, Population Division. (2019a). *World Population Prospects 2019: Methodological updates.* Retrieved from https://population.un.org/wpp/Publications/Files/WPP2019_Methodological-updates.pdf

United Nations, Department of Economic and Social Affairs. (2019b). Definition of projection variants. *World Population Prospects 2019.* Retrieved from: https://population.un.org/wpp/DefinitionOfProjectionVariants/

United Nations, Department of Economic and Social Affairs. (2019c). Methodology of the United Nations Population Estimates and Projections. *World Population Prospects 2019.* Retrieved from: https://population.un.org/wpp/Methodology/

United Nations, Department of Economic and Social Affairs. (2017). Methodology of the United Nations Population Estimates and Projections. *World Population Prospects 2017*. Retrieved from: https://population.un.org/wpp/Publications/Files/WPP2017_Methodology.pdf

VIII. Appendix.

Survey for current fertility projection practices

Please provide the following identification information:

1. Country:

2. Responsible agency:

3. Responsible person and email for population projections:

4. Reference to webpage(s) in English or other documentation in English:

Please send a copy of any English documentation to ecc@ssb.no

5. Do you currently use a formal statistical model(s) to project fertility?
   ☐ No ☐ Yes (please explain below):

6. How many fertility scenarios and/or levels do you provide?
   ☐ One scenario only
   ☐ One scenario with surrounding confidence interval based on probabilistic/stochastic methods
   ☐ Several scenarios/variants based on determinist methods (please specify the number of scenarios/variants below):

7. Please provide a short description of how fertility is projected in your country (e.g., how are future fertility trends determined, do you have an expert panel, etc.):

8. What year was your last projection published?
   ☐ 2019 ☐ 2018 ☐ 2017 ☐ 2016 ☐ 2015
   ☐ 2014 ☐ 2013 ☐ 2012 ☐ 2011 ☐ 2010 or earlier

9. How often are the fertility projections updated?
   ☐ Quarterly ☐ Annually ☐ Biennially ☐ Triennially ☐ Other (please explain):

10. What were the input years in formal models (e.g., historical time series)?

11. What time periods did you emphasize the most if you did not use a formal model?

12. Have your agency used other methods to project fertility previously?
    ☐ No ☐ I don't know ☐ Yes (please explain below):

13. How do you assess your projections when information on the actual fertility becomes available – e.g., do you measure if your projections are on the right track short-term? What about long-term?

14. Please give a short description of any discrepancies in trends between projected and actual fertility:

15. Do you use different methods for short (1-4 years), medium (5-10) and long-term (11+ years) projections?
    ☐ No ☐ Yes (please describe or list the web page where we can read about this):

16. How many people work with the fertility projections in your country (including yourself)?
    ☐ 1☐ 2 ☐ 3 ☐ 4 ☐ 5+

17. What is the highest level of education the person(s) that is responsible for fertility projections have?
    ☐ Bachelor's degree ☐ Master's degree ☐ Doctoral degree

18. What type of background does the person(s) responsible for fertility projections have?
    ☐ Demography ☐ Economics ☐ Social Sciences
    ☐ Statistics ☐ Health sciences ☐ Other

19. About how many months per year is spent on fertility projections in your country? Please include both time spent on the actual projections, as well as background studies. (If you publish projections biennially, please average the time spent per year):

20. In the data you rely on, what type of information do you actually use? Please mark all that applies:
    ☐ Births, yearly ☐ Births, multiple yrs. ☐ Mother's age ☐ Mothers' education
    ☐ Marital Status ☐ Citizenship ☐ Country of origin ☐ Sub-national geography
    ☐ Parity ☐ Household type ☐ Ethnicity ☐ Length of stay (immigrants)

21. For information about mother's age, what level of detail is projected?
    ☐ Single years ☐ 5-year age groups ☐ Other (please specify below):

22. For which sub-groups do you project fertility?
    ☐ Immigrants ☐ Country of origin ☐ Length of stay ☐ Ethnicity
    ☐ Citizenship ☐ Parity ☐ Other (please specify below):

23. Does your country also project regional fertility?
    ☐ No ☐ Yes (please explain below):

24. Are you satisfied with your method of projecting fertility?
    ☐ Yes ☐ No (please explain below):

25. Please list at least 3 strengths of your current fertility projection method:

26. Please list at least 3 weaknesses of your current fertility projection method:

27. Do you know of any future plans to make changes to the way your country projects fertility?
    ☐ No ☐ Yes (please explain below):

28. If you could choose freely, do you have any suggestions of changes to the way your country projects fertility?
    ☐ No ☐ Yes (please explain below):

29. For what purpose do you use projections?
    ☐ Publish national projections
    ☐ Research
    ☐ Publications (journals, etc.)
    ☐ Other, please specify below:

30. Do you have some measures of the usage of the projections? Indicate all that apply.
    ☐ No
    ☐ Yes, electronic web hits/page views views/downloads
    ☐ Yes, other (please explain below):

Please respond with reference to the most recent edition of your country's population projection:

31. In your opinion, the information available for making the fertility projections are:
    ☐ Not detailed enough
    ☐ Adequate
    ☐ Too detailed
    ☐ No opinion/not applicable
    Comments (optional):

32. In your opinion, the number of scenarios/levels your country provides is:
    ☐ Not detailed enough
    ☐ Adequate
    ☐ Too detailed
    ☐ No opinion/not applicable
    Comments (optional):

33. In your opinion, the time spent on fertility projections in your country is:
    ☐ Insufficient
    ☐ Adequate
    ☐ Too much time is allowed
    ☐ No opinion/not applicable
    Comments (optional):

34. In your opinion, the fertility projections are:
    ☐ Not detailed enough
    ☐ Adequate
    ☐ Too detailed
    ☐ No opinion/not applicable
    Comments (optional):

35. In your opinion, the frequency of the fertility projection updates is:
    ☐ Not frequent enough
    ☐ Adequate
    ☐ More frequent than necessary
    ☐ No opinion/not applicable
    Comments (optional):

36. Can we contact you if we have any follow-up questions? If yes, please provide your contact information (name, email address, phone number):

END OF THE SURVEY

Thank you for taking the time to complete this survey/questionnaire. If you have any additional comments (regarding method of fertility projections or the survey itself), please send them to ecc@ssb.no or provide them below.