THEMATIC SECTION
Population Projections

Introduction

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While Insee is set to prepare new population projections for France, the thematic section featured in this issue is an opportunity to take stock of both the results of previous projections and the methods used in France and elsewhere.

Why do we make projections? Given that they present not only the current or past situation, but also the future, projections are a very specific category of scientific product. It is not until the future has become the present and then the past that we can assess their "accuracy" or their "errors", treating projections as forecasts. Indeed, they are rarely forecasts; projections are not all carried out with a view to coming true. For example, some projections present an undesirable future, in the aim of highlighting actions that could be taken to avoid it (anti-fulfilling prophecy) while others set an objective and explore ways to achieve it (pro-active projections). The projections presented in this section all start from a central scenario presented as the most likely future on the basis of current knowledge, and propose variants based on that scenario. When carrying out a projection, users take the central scenario as a forecast to shed light on present actions or suggest others.

How do we develop scenarios? The scenarios are most often developed by analysing past trends, over a longer or shorter period. Experts examine them and propose the best way to continue them. Sometimes, hypotheses can be excluded *a priori*, and in fact lead to limiting the range of possible evolutions. Given what has been observed in the past in France for example, it would be difficult to imagine considering scenarios of negative net migration (involving a greater number of people leaving the country than entering), or a fertility rate above the replacement level of 2.1 children per woman. Refining the hypotheses may be taken further, such as in the case of the mortality scenarios used in Insee's projections for France. As **Nathalie Blanpain** explains, these now take into account, for the first time, generational effects – the decrease in mortality rate stops for the generations born between 1940 and 1955, before resuming at a steady pace for those born afterwards, as observed over the last few decades.

How do we manage the uncertainty? Working from the central scenario, the projections offer alternative scenarios which allow us to take the uncertainty associated with the hypotheses into account. Since the end of the baby boom, all of Insee's projections have shown that population ageing, understood as being the increase in the proportion of elderly people, is unavoidable. This is a happy consequence of living longer, accelerated in France as the large generations of baby-boomers (born between 1946 and 1974) reach more advanced ages. The projections are therefore useful to forecast adaptations to the health system or retirement schemes. Comparing these with projections from neighbouring European countries also sheds light on France's future. By conducting a comparison with Eurostat projections for France and for the other EU Member States, we can learn a great deal. With the public dissemination of expert opinions, details on the methods and results,

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Insee's projections for France form a tool that has taken on a central importance in the public debate in the country.

What is the benefit of probabilistic projections? The high and low scenarios proposed by Insee for France allow us to set the limits of the uncertainty, while the probabilistic projections incorporate the risk in different ways: there are no variants but rather a set of scenarios built on the basis of probability densities. The main advantage of these projections is being able to offer not only a central estimate but also a confidence interval for any derived indicator (for example, the proportion of women among the over 65s in 2070). **Vianney Costemalle** engages in this exercise for France. In addition to proving the feasibility of these projections by actually carrying them out, he shows some differences compared to the usual Insee projections. The central value of projected fertility for 2070 is the same (1.95 children per woman), but the uncertainty is higher: the 95% confidence interval, assimilated here to the gap between the high and low hypotheses, is [1.63; 2.26] compared with [1.8; 2.1] for the high and low scenarios. Conversely, the mortality scenarios are both more pessimistic and narrower: 88.4 years and 92.0 years for life expectancy at birth for men and women in 2070, plus or minus a year, compared with 90 and 93 years, plus or minus three years, in the high and low scenarios.

How do we evaluate the projections? One way of evaluating past projections consists in comparing them with actual developments. **Nico Keilman** has shown in previous research that, for 40 years, the projections have not come close to reality, concluding that we need to make probabilistic projections (Keilman, 2008). Here, he proposes a method for evaluating this type of projection, and applies it to those of three countries, France, Norway and the Netherlands. This allows him to revisit the projections he participated in 10 years ago and to show that they turned out to be more accurate than official projections, except in the case of France where the adjustments made in 1999 and 2006 were not correctly taken into account in the estimation of the parameters. He also shows that the errors are more marked for certain age groups, either because there is more uncertainty here or because the adjustments related specifically to those ages.

How do we build the projections? The components method used in the projections consists in estimating, for each year, net migration by sex and age, deaths by sex and age on the basis of the mortality rates, and the total number of births on the basis of the number of women of childbearing age and the fertility rates by age.

The method is very effective as the sex and age of the inhabitants are very easy to forecast: girls aged 10 in 2020 will become women aged 60 in 2070, if they are still alive. These very severe restrictions regarding sex and age enable us to develop population projections that are much more robust than other projections (for example, economic projections) and to propose long time horizons of at least 50 years. Yet other dimensions can also be taken into consideration: residential lifestyle for household projections (Jacquot, 2012), professional situation for labour force projections (Koubi & Marrakchi, 2017), health status for dependent population projections (Lecroart, 2013; Larbi & Roy, 2019); these are traditionally conducted by Insee or DREES by projecting the proportions and applying them to the results of the population projections. The projections can be more complex and dynamic, for example projections by area of residence for sub-national projections (Desrivierre, 2017), in which the rates of internal migration are used to determine the number of internal migrants, with overall consistency guaranteed as each exit from a region becomes an entry into another.

Calculating projections by taking into account dimensions other than sex and age? We could also include other dimensions in the projections. This is what **Anne Goujon** presents in her discussion of the difficulties involved in the exercise using projections based on level of education. She reviews the methods used for multi-state population projections and shows their potential added value (measure of human capital, feedback from education on fertility components, migrations, mortality). By way of example, she addresses other possible additional dimensions: diet, language spoken, political or religious opinions, and

family network, and discusses the increased difficulty involved in the exercise when these different dimensions are included.

The UN World Population Prospects. The section begins with a presentation, by **Thomas Buettner**, of the most notable projection exercise to date: the United Nations World Population Prospects (WPP). First published just after the Second World War, in 1951, these projections are based on current population estimates and the desire to take a long-term view; the projections have been revised at regular intervals (currently every two years), with those published in 2019 comprising the 26th edition. The description of the components and their development at a continental level gives an idea of the work undertaken and progress made. The results and methods are now easily accessible and can be used as a reference by all other efforts in this field. The series of projections is very extensive, which allows us to compare the projections both with the actual developments in different countries or continents, or the entire world, and amongst themselves, with their developments resulting both from the revision, in each edition, of some of the past figures and modifications of future scenarios. Moving to probabilistic projections has, to some extent, allowed us to do away with high and low scenarios (± 0.5 children per woman in all countries) and the confidence intervals used in probabilistic projections give rise to significant work in presenting the uncertainty and its limits when publishing the results.

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