REVUE Quetelet JOURNAL

Vol. 5, n° 2, octobre 2017, pp. 7-35
DOI : 10.14428/rqj2017.05.02.01
ISSN: 20349378

The critical role of assumptions in population projections: The case of Belgium

Marie Vandresse

Centre de recherche en démographie (DEMO)
Institut d'analyse du changement dans l'histoire et les sociétés contemporaines (IACCHOS)

REVUE QUETELET/QUETELET JOURNAL
Vol. 5, n° 2, octobre 2017, pp. 7-35
DOI : 10.14428/rqj2017.05.02.01

The critical role of assumptions in population projections: The case of Belgium

MARIE VANDRESSE[1]

Résumé
Les perspectives de population constituent un outil d'aide à la décision ou encore un instrument permettant d'alimenter les débats sur l'avenir de nos sociétés. Ces perspectives sont basées sur un ensemble de choix pris par le modélisateur quant à la méthodologie de projection et à l'évolution future des composantes de le croissance démographique (fécondité, mortalité, migration). Afin d'utiliser ces projections à bon escient, les utilisateurs doivent être conscient de l'impact de ces choix sur les résultats d'une projection démographique. À l'aide de perspectives démographiques publiées pour la Belgique par des institutions nationales et internationales, cet article met en évidence le rôle crucial joué par les hypothèses retenues relatives à l'évolution future des composantes de la croissance de la population sur le résultat des projections.

Mots clefs
Projection de population, (rôle des) hypothèses, composantes de la croissance.

Abstract
Population projections serve as a decision-making tool or as a tool to help contribute to discussions on the future of our societies. These projections are based on a series of choices made by the modeller about the projection methodology and the future trends in the population growth components (fertility, mortality and migration). To use these projections wisely, users should be aware of the impact of these choices on the results of a population projection. This article highlights the crucial role of the assumptions made on the future trends of the population growth components on the projection results, using population projections for Belgium published by national and international institutions.

Keywords
Population projections, (role of) assumptions, growth components.

1. Bureau fédéral du Plan, Bruxelles, Belgique.

Introduction

A population projection is the result of a set of choices on both the projection method and the assumptions about the future evolution of the different population components (mortality, fertility and migration). In this paper, we study the effect of changes in these assumptions on the results of the population projections for Belgium until 2060. We also examine how the assumptions are influenced by the year or time when the projection is carried out. In particular, it shows the interest of a regular revision (every year in this case) of the assumptions to take the most recent trends into account, without losing sight of the longer-term trends. This article tries to show that, more than the population projection itself, the assumptions used for the projection are themselves important results.

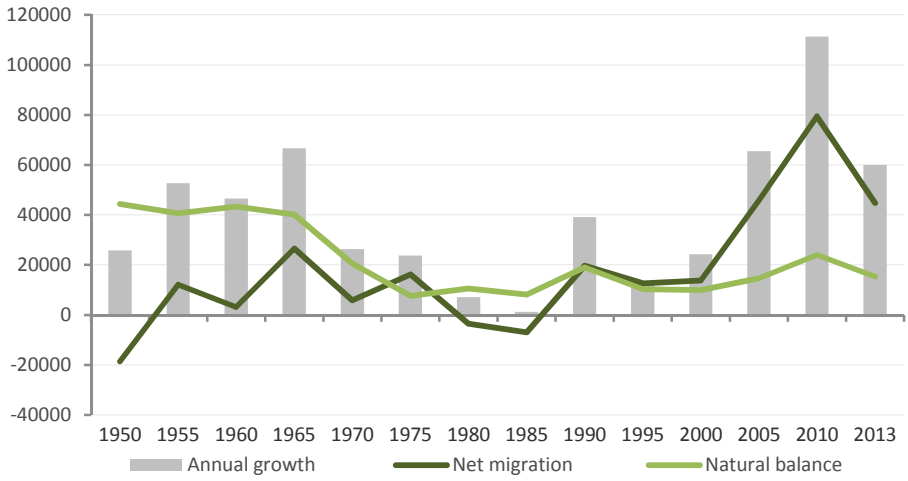
First, we focus on the historical components of population growth in Belgium to highlight which of these components currently influence this growth and, consequently, are more likely to impact future growth. Next, there is a short description of the projection method used in the national population projections for Belgium. The assumptions on fertility, mortality or migration are subsequently presented and the importance of the time horizon when making these assumptions highlighted. The national population projection for Belgium published in 2016 is then presented at country level and for the three regions (the Flemish Region, the Walloon Region and the Brussels-Capital Region). This projection is compared with previous national population projections (published since 2000) and with population projections for Belgium published by international organisations (Eurostat and the United Nations Population Division). These comparisons will once again highlight the impact of the assumptions concerning the future evolution of the demographic components on the future population growth and its age structure. The comparisons show also the need to update the assumptions regularly, at least for short-term purposes. The last section discusses and summarises some of the points explained in the paper.

Determinants of growth – historical overview

The yearly population growth in Belgium (Figure 1) should be analysed from the point of view of the population growth determinants. At the national level, population growth is the result of the natural balance (births

minus deaths) and net international migration (immigration minus emigration). Up to the 1980s, population growth was largely explained by the natural balance, which dominated net international migration for almost the whole period. During the 1990s, both determinants contributed equally to population growth. During the 2000s, international net migration contribution went up and became significantly higher than the natural balance. In the 2010s, international net migration explains around 70% of the population growth.

FIGURE 1 Historical yearly population growth and its components for Belgium



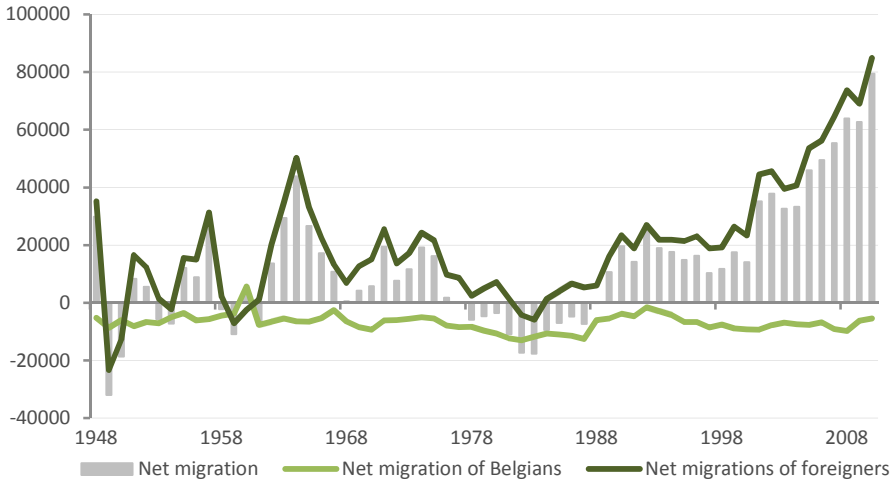
Sources: National Register, FPB calculations.

In Figure 2, a distinction is made between net migration from individuals with Belgian nationality and other individuals («foreigners»)[2]. Net migration of individuals with Belgian nationality has been relatively constant and negative[3] since 1948. Since the 2000s, population growth in Belgium has been mainly due to an increase in net migration of foreigners.

2. It corresponds to the current nationality of the individual, but not to the nationality of origin or the country of departure.

3. The independence of Congo in 1960 led to a massive return of Belgian people, which explains the positive value of the net migration of Belgians for this year.

FIGURE 2 Net international migration of Belgians and foreigners

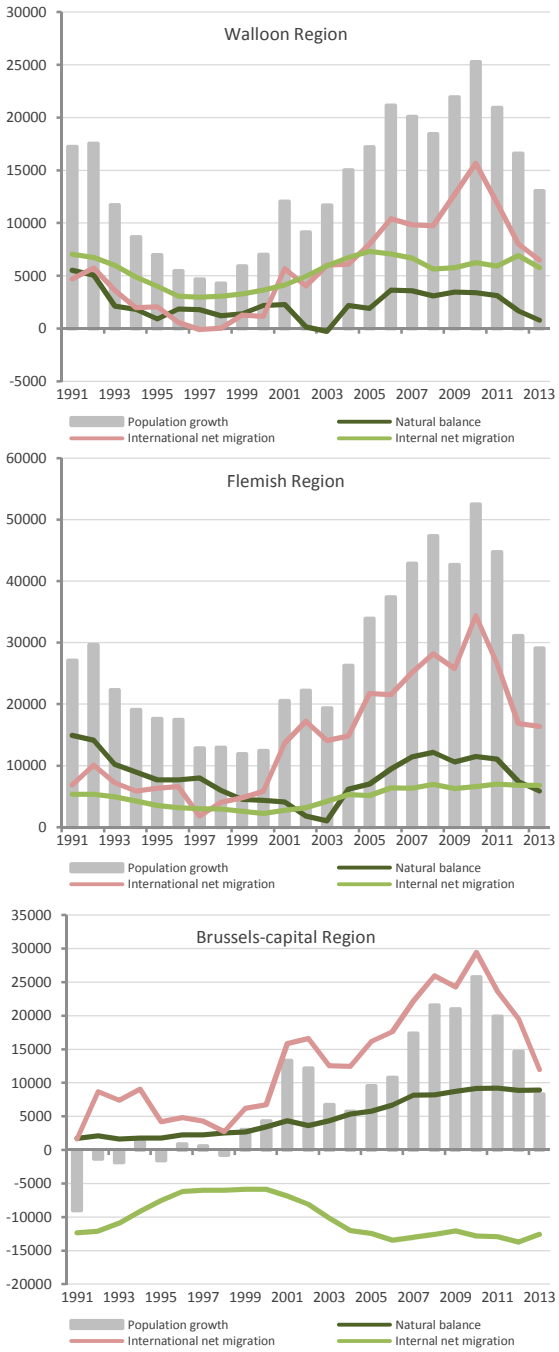


Sources: National Register and Statistics Belgium, FPB calculations.

International migration mainly impacts the working-age population: 80% of immigrants are aged between 15 and 64 (compared to 63% for the native population), which also has an impact on the number of women of childbearing age and, consequently, the number of births.

Internal migration constitutes the third determinant of population growth for the three regions (Figure 3). Unlike the other two regions, the Brussels-Capital Region is experiencing negative internal net migration: the number of individuals leaving this region (going to either the Walloon Region or the Flemish Region) is higher than the number of individuals moving into this region (and coming from either the Walloon Region or the Flemish Region). This phenomenon is explained by suburbanisation. As a result, while internal migration is currently slowing down population growth in the Brussels-Capital Region, it contributes to the growth of the other two regions. Internal migration is even more important for smaller geographical unit, e.g. municipalities (Eggerickx *et al.*, 2010). At the subnational level, internal migration thus constitutes an important determinant of population projection.

FIGURE 3 Components of the annual growth for the three regions



Sources: National Register, FPB calculations.

Projection method: importance of the assumptions

General overview

Since 2008, population projections for Belgium have been prepared jointly by Statistics Belgium and the Federal Planning Bureau (FPB). They are updated annually. Twenty population projections for Belgium have been published between 1940 and the 1990s (Schoumaker *et al*., 2010). All of them are based on the «cohort component projection method», which is based on the components of demographic change. Starting from the latest observation of the population at the beginning of the year t (Pop^t), the births during year t (B^t) are added and the deaths (D^t) subtracted (including the deaths related to the births occurring in the same year). Then internal immigration (InI^t) is added and internal emigration (InE^t) is subtracted. Finally, the model addresses international migration (adds immigration (I^t) and subtracts emigration (E^t)).The resulting population is the *final population* at the end of year t, which becomes the population at the start of year t+1:

$$Pop^{t+1} = Pop^t + (B^t - D^t) + (InI^t - InE^t) + (I^t - E^t) \quad (4)$$

Splitting the total population by age *x*:

$$Pop_{x+1}^{t+1} = Pop_x^t - D_x^t + (InI_x^t - InE_x^t) + (I_x^t - E_x^t) \quad (5)$$

for x from 1 to last projected age

$$Pop_0^{t+1} = Birth^t - D_{birth}^t + (InI_{birth}^t - InE_{birth}^t) + (I_{birth}^t - E_{birth}^t) \quad (6)$$

Where D_{birth}^t represents the deaths of children born in year t (and the same applies to the other components of the equation (6)).

It is an iterative, deterministic process which runs until the last projection year. The projection model goes to 2060 and makes projections for Belgium by age, sex and district[4] (NUTS 3 level). Although the component method is straightforward, its complexity lies in the assumptions on future demographic changes (the expected number of births, deaths and migrations).

The official population projections are not only carried out at national level but also at subnational level for regions and also for districts. Consequently, the projection model is based on a bottom-up approach, which allows assumptions to be made on mortality, fertility and migration at

4. Belgium has 43 district subdivisions smaller than the provinces.

district level, whenever possible[5], so as to integrate specific local features. The projection of the population at regional level thus corresponds to the sum of the projected populations at district level, while the projection of the population for Belgium corresponds to the sum of the population in all the districts.

In-depth analysis of the assumptions

This section gives an overview of the assumptions applied by the FPB and Statistics Belgium in the official population projections (a detailed description is available in different Working Papers[6] and in the organisations' annual publications[7]). It is important to specify that official projections – excluding the implementation of specific scenarios – are established assuming unchanged policy and unchanged societal organisation. They are also based on the scientific knowledge available at the time of the projection.

Presenting several scenarios would be a way to highlight the uncertainty surrounding projections. However, The FPB with Statistics Belgium decided against publishing multiple scenarios because the official population projection for Belgium serves as input for different projection exercises carried out by the FPB (among others, the economic outlook and projections related to the cost of ageing). Multiple demographic scenarios could make decision-making even more difficult. Nevertheless, while the «pedagogical» weakness of publishing only one scenario is recognised, the assumptions are described in complete transparency.

With regard to mortality, the projections for Belgium have been relying for many years on a continued downward trend in death probabilities by age and sex (Paul, 2009). The most recent projections apply this trend at the regional level (by sex and age) and use a standardised mortality ratio[8] to obtain projections of death probabilities at district level.

5. It greatly depends on the number of observations required to obtain statistically representative results at district level by sex, age and (groups of) nationality.

6. See Paul, 2009, for the mortality model; Vandresse, 2014, for the household projections; Vandresse, 2015 for the modelling of international migration and Vandresse 2016 for the modelling of internal migration.

7. Available on www.plan.be.

8. Ratio between the observed number of deaths in a district and the expected number of deaths based on the mortality rates – by age and sex – observed in the region to which this district belongs.

The assumptions on fertility, used to make birth projections, are based on age-specific fertility rates. It should be noted that in the past, at least before the 1990s, fertility was assumed to follow a decreasing or an increasing trend based on the linear extrapolation of the past trend. Before the 1990s', fertility was higher and fluctuated. Given the significant impact of this component on population growth at this time (see Section 2), the projection of births was a significant component of expected growth. Since fertility has been low and relatively stable for several years, the latest projections are based on constant age-specific fertility rates in the long term. These expected rates are based on the average of the last observed years and incorporate a distinction between Belgian women and women with a foreign nationality. These rates are also calculated by district to specify local features. Since the projections are currently based on constant age-fertility rates, the fertility assumption does not account for delayed motherhood, a phenomenon which is characteristic of modern society. There is room for improvement here.

In most population projections (especially in those made by national institutions), the future evolution of international migration is assumed to be based on either constant immigration and emigration flows (based on the latest observations) or on a scenario of convergence to zero net migration in the long run. These two approaches (constant migration flows or convergence scenario) lead to different population trends. As explained above, net migration currently explains more than 70% of the population growth in Belgium, which leads to the assumption that migration flows have a significant impact on the population projection. Consequently, special care must be taken in considering this assumption.

As part of a continuous process of improving its models, the Federal Planning Bureau has done background work to develop further the methodology for the projection of international migration (Vandresse, 2015). In particular, it has assessed the relevance of economic variables as determinants of international migration and taken into account the expected population increase in the origin countries, which should increase international migration flows in the long run. Furthermore, assumptions on the future international immigration of foreign-born individuals have been made for three groups of countries: the old Member States of the European Union, the new Member States of the European Union since 2004 and non-EU countries. This makes it possible to make migration depend, among other factors, on nationality.

As far as possible, this methodology tries to reconcile – in the Belgian context – the different arguments described in the migration theories and the

rather mechanical approaches (convergence scenario or constant migration flows) generally applied in most population projections.

Time horizon

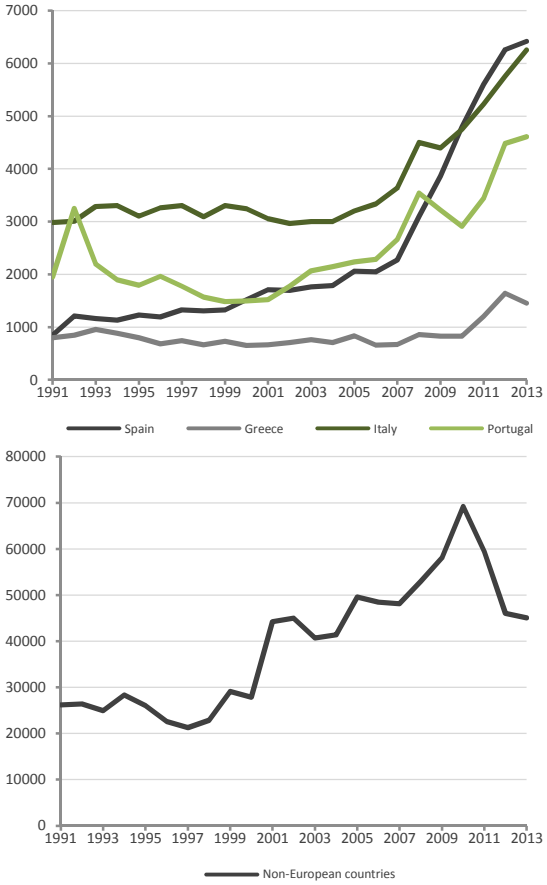
Population projections are usually made over the long term, between 20-year and 50-year time horizon. The World Population Prospects published by the United Nations (2015) even go up to 2100. The longer the projection horizon, the more uncertainties there are (National Academies Press, 2000, chapter 7). For a 50-year time horizon, the fertility and mortality behaviours of individuals who are not yet born have to be projected. There are not only uncertainties about the projection of the number of individuals but also about their demographic behaviours. Therefore, the long-term assumptions should be completely transparent to interpret projection correctly.

In the short term, without unexpected events, uncertainty is less important (a significant share of the future population is already born and present on the territory). Modellers have better knowledge (or a better feeling) of what could happen in the coming few years, taking the recent past into account. Schoumaker *et al*. (2010) estimate the error of projection at time t+15 to 1.5% in the projection for Belgium published in 1992. They also found that the projection error decreased progressively over the successive projections (from 6.1% in 1940 to 1.5% in 1992).

Note that the short-term evolution has, of course, an impact on the population growth in the long term. The new-borns of the 2020s will become the adults of the 2040s-2050s, while the new migrants arriving in the 2020s will immediately integrate into the working age population, then leave the working-age population after some decades.

Unexpected shocks have played an important role in the recent evolution of the Belgian population. First, immigration to Belgium from Italy, Spain, Greece and Portugal has sharply increased since 2009 (Figure 4). For these countries hit by the economic crisis, there is a link in the short term between immigration and some economic variables, especially the unemployment rate. In the 2014-2060 population projections published by the Federal Planning Bureau and Statistics Belgium (Federal Planning Bureau and Statistics Belgium, 2015), this link has been estimated through an econometric approach and is used for short-term immigration projections only.

FIGURE 4 International immigration in Belgium from Spain, Italy, Greece and Portugal (top) and from non-EU countries (botton)



Sources: National Register and Statistics Belgium.

Second, for immigration from non-EU countries, a reverse trend was observed between 2010 and 2013 (Figure 4) that can be explained by a change in the law concerning family reunification (more restrictive conditions[9]) under which most of the immigration from these countries occur. The population projections for Belgium published in 2015 are based

9. The Law of 15 December 1980 on entry to Belgian territory, residence, establishment and removal of foreign nationals was amended on 8 July 2011. The new law introduces additional requirements and restricts the right to family reunification, notably the introduction (except for EU citizens) of a condition of stable, regular and sufficient income.

on the assumption that the effect of the new law on family reunification will persist until the end of the current legislative term in 2019. In the long run, however, population growth in non-EU countries (i.e. of population at risk of migration) should lead to increased immigration.

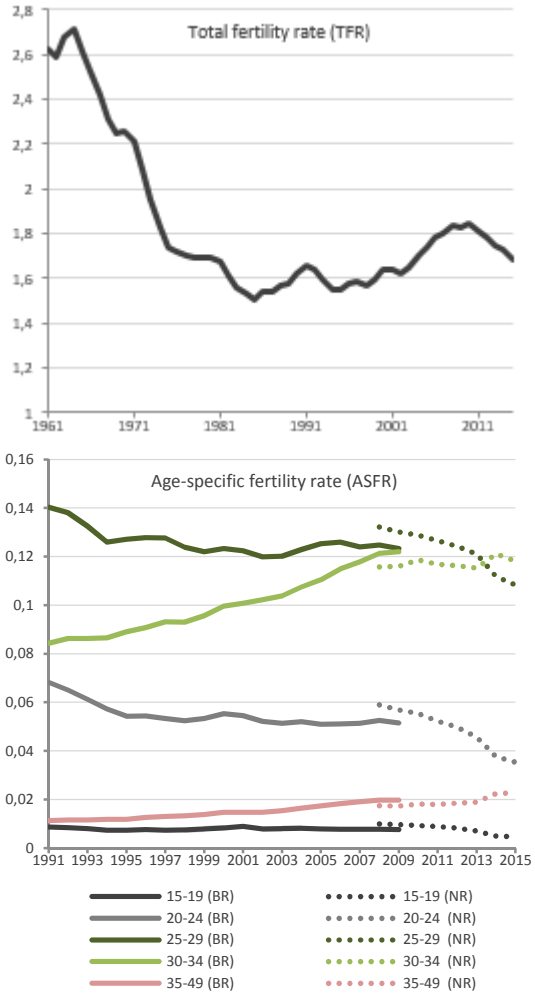
Third, the economic crisis and high unemployment rate seem to have an impact on fertility, especially at younger ages (Goldstein *et al*., 2013). After several years of catching up succeeding a postponement period (changes in childbearing age patterns), the total fertility rate in Belgium has been declining again since 2010 (Figure 5), in the wake of the economic crisis. The decline in fertility rates particularly concerns women under 30 years (Figure 5). This downward trend can be explained by a desire of young households, who are most affected by the crisis, to postpone parenthood. The economic and financial crisis does not seem to impact the fertility behaviour of women aged 30 years and more. There is even evidence to suggest that the fertility rate of women aged between 35 and 49 years continues to rise.

In the short term, the latest population projections assume that the total fertility rate will have decreased until 2015 (included) and then will progressively reach its pre-crisis level (assuming a progressive economic recovery in the coming years).

Finally, the recent and unexpected asylum crisis (observed in 2015), which led to a substantial flow of asylum seekers into Belgium (and into Europe in general), should push population growth upwards in the short term (this will be discussed in the next section).

Given these few elements, it seems that, when possible and relevant, assumptions should be differentiated by the time horizon (short- and long-term). Furthermore, integrating specific short-term assumptions (related in the present case to a change in a specific migration policy or to economic and humanitarian crises) in the population projection shows the importance of regularly updating the projection to take the latest observations and events into account. These have an impact on the population growth components, in particular in the short/medium term. This is important, keeping in mind that population projections are used not only for long-term planning, but also for the short-term economic forecasts used by the federal government to draw up its budget.

FIGURE 5 Total fertility rate and (group of) age-specific fertility rate



Sources: National Register and Statistics Belgium.

Overview of the population projection for Belgium

National population projection (2015-2060) for Belgium and the three regions

The population of Belgium is projected to grow by 16% (1.8 million inhabitants) between 2015 and 2060, in accordance with the assumptions

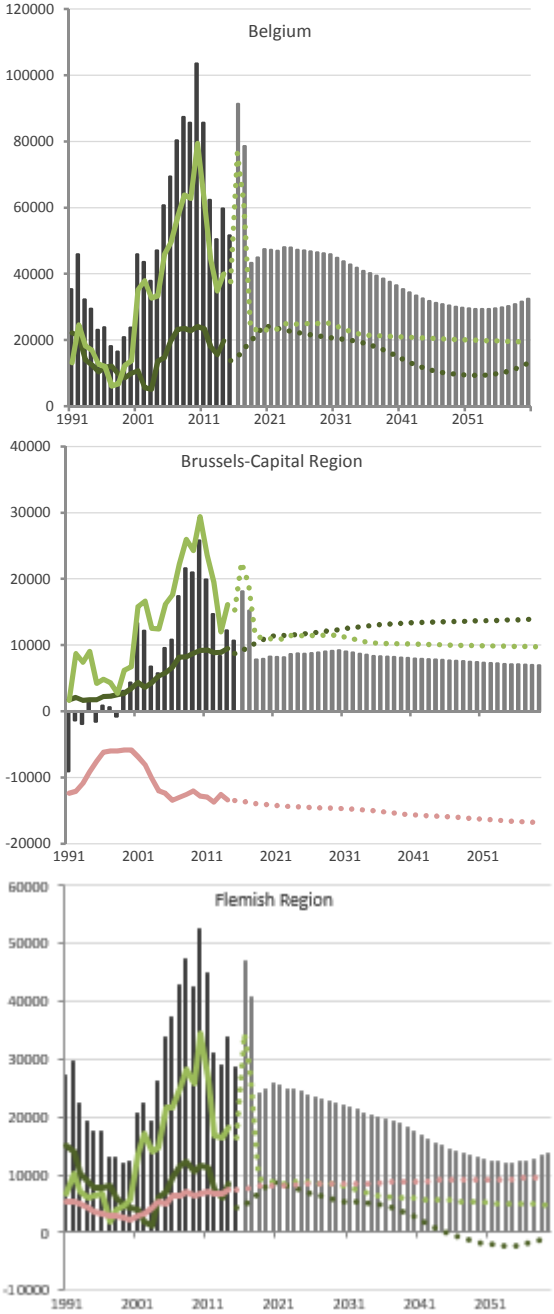
described in the 2014-2060 population projection of the FPB (Federal Planning Bureau and Statistics Belgium, 2016).

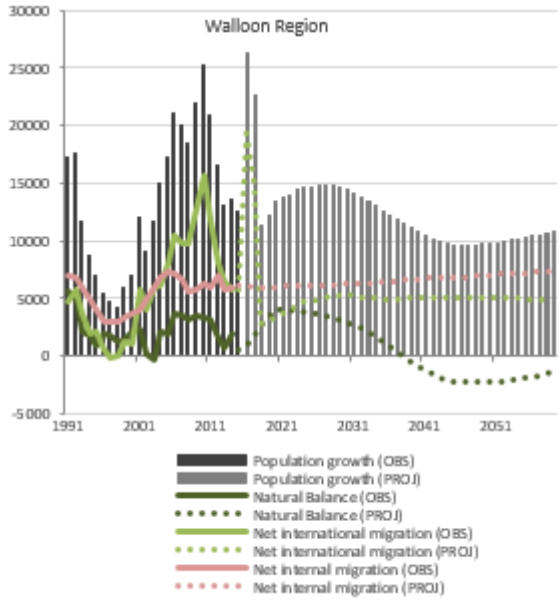
In the *long term*, the natural balance decreases. The decline is caused, in particular, by a rise in the number of deaths as the baby-boom generations gradually reach higher ages (85 years as from 2030). However, the natural balance remains positive over the whole projection period as does net international migration. *In the short to medium term* (2016-2020), the natural balance increases owing to an upturn in fertility (see Section 3.3), which had been on the decline during the economic and financial crisis. Fertility (particularly among women under 30 years) is assumed to decrease until 2015, as a result of the crisis, and thereafter gradually return to its pre-crisis average.

During the preparation of this projection, Belgium, and Europe in general, were facing a large inflow of asylum seekers. In the short term, the asylum crisis is expected to generate an increase in migration flows. Indeed, this projection assumes that the inflow of asylum seekers in 2016 will remain unchanged compared to the last quarter of 2015 and then decline gradually to reach, by mid-2017, the levels observed before the asylum crisis. However, in accordance with the national definition of the official population figure (art. 4 of the Act of 24 May 1994 creating the waiting register), the population projection does not include the asylum seekers whose application is pending and who are recorded in the waiting register, but only those who are recognised as refugees. As a result, additional assumptions on the rate of recognition and the duration of the asylum procedure have been made (see Federal Planning Bureau and Statistics Belgium, 2016, for more details). Obviously, all these assumptions on the asylum crisis are surrounded by a high level of uncertainty owing to the unpredictability of many factors[10].

10. Since then, countries at the borders of Europe and the European Union have taken measures (closing borders and the agreement with Turkey concluded in March 2016) which have led to a drastic decrease in the flow of asylum seekers into Belgium (and into other European countries).

FIGURE 6 Population Projections 2015-2060, Belgium and the three Regions





Sources: 1991-2014: National Register, Statistics Belgium and FPB calculations, 2015-2060: Perspectives demographiques 2015-2060, BFP-DGS.

A population increase is also expected in all three regions (see Figure 6), but at different rates: growth is higher in the Brussels-Capital Region (+32% in 2060 compared to 2015, i.e. 380'000 additional inhabitants) and in the Walloon Region (+16%, 882'000) than in the Flemish Region (+14%, 907'000). The relatively stronger increase expected in the long term in the Brussels-Capital Region, is due to the relatively higher number of immigrants settling in this region. The projected international migrations at the national level is distributed by age, sex and district (and consequently by regions) according to the average of the last three observed years (35% for the Brussels-Capital Region, 47% for the Flemish Region and 33% for the Walloon Region).

The natural balance in both the Flemish Region and the Walloon Region becomes slightly negative as of the 2040s but tends to become positive at the end of the projection period. In contrast, the natural balance remains positive in the Brussels-Capital Region. These contrasting evolutions are due to different age structures in the regions. Immigration affects age structure more in the Brussels-Capital Region as well as its share of population in childbearing age.

The population evolution in the regions depends not only on the evolutions of the natural balance and net international migration, but also on

the evolution of net internal migration (between regions). In this regard, the Brussels-Capital Region stands out from the other two regions, with a negative balance for the whole projection period due to suburbanisation.

Comparison between successive national projections

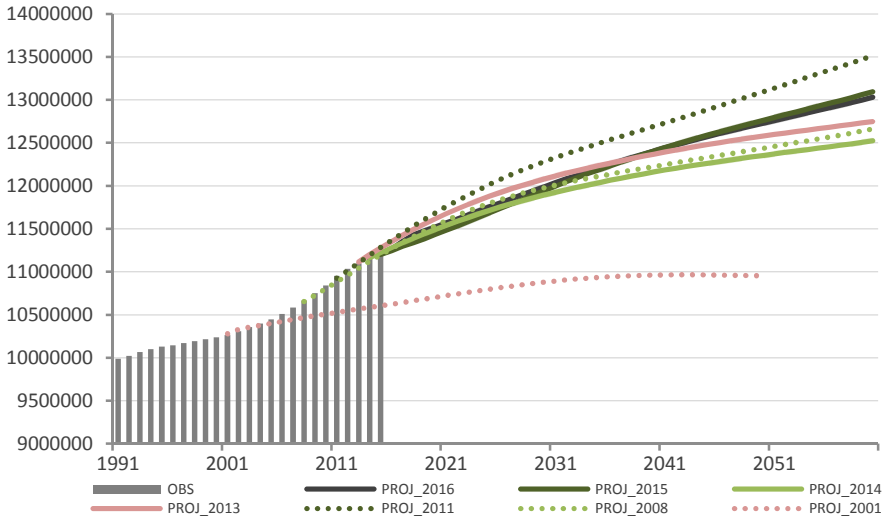
The aim of this section is not to compare the successive national population projections with reality. A post-mortem analysis of the population projections for Belgium has already been done in Schoumaker *et al*. (2010) for projections produced between the 1940s and the 1990s. More recent projections are too recent to do such an exercise. The aim of this section is rather to explain how and why the most recent BEPOP until 2060 have evolved from year to year, thereby highlighting the importance of the assumptions in a projection.

The successive projections are summarised in Figure 7. The oldest projection discussed in this paper, which is the projection from 2001 to 2050 (PROJ_2001, see Figure 7), shows a significantly lower population count compared to all the others. In this projection, the number of inhabitants in Belgium in 2050 was expected to be around 11.1 million, a lower level than currently observed (less than 15 years after its publication). Given that the number of inhabitants amounted to 11.2 million in 2014 and that the 2000 projection result for 2014 was around 10.6 million inhabitants, the projection error (at t+15) reaches 10%, which is notably higher than the errors of the projections published before 2000, e.g. 1.5% in 1992. The increase in immigration observed from the 2000s was largely unexpected. Total immigration was projected at 70'000 immigrants per year until 2050 (net migration around 17'000 per year) while the actual statistics show an increase ranging from 89'000 in 2000 to 166'000 immigrants in 2010 (35'000 net migration in 2001 up to 62'000 in 2010).

The next projection was published in 2008 (PROJ_2008). The increase in international immigration was partially observed then, and consequently taken into account. Experts estimated that this trend would persist in the medium term but that such a high level of immigration would not be sustainable in the long term. They consequently assumed that the immigration level would progressively slow down in line with the decrease in the relative economic attractiveness of Belgium. Net migration was assumed to decrease from 52'000 immigrants in 2008 to 29'000 immigrants in 2060 (26'000 in 2050). Given this assumption, the population projection

for Belgium reached 12.5 million inhabitants in 2060 (12.4 million inhabitants in 2050), which was noticeably higher than the previous official national projection.

FIGURE 7 Population Projections for Belgium
Comparison between successive national projections



Sources: Statistics Belgium and the Federal Planning Bureau.

It was also the first time that a link was made between immigration and economic determinants in these projections jointly developed by the Federal Planning Bureau and Statistics Belgium. In this methodology, the long-term evolution of immigration from the new EU Member States and non-EU countries (third countries) was based on the relative economic attractiveness of Belgium. The reasoning underpinning this approach was based on the immigration surge from the new EU Member States during the 2000s, which could be largely attributable to the relative economic attractiveness of Belgium (standard of living, salaries and employment opportunities), since the EU enlargement process had progressively led to free movement of people and workers. It did not exclude the possibility that the immigration surge would continue or even increase in the short term. Nevertheless, looking further ahead, it was reasonable to project a trend reversal should the economic attractiveness of Belgium relative to these countries deteriorate in the long term. The same logic of comparing living standards was applied to the expected evolution of immigration from third countries. For immigration from the old EU Member States, the expected evolution relied more on a logic of proximity with

Belgium rather than on a logic of attractiveness based on the gap between standards of living.

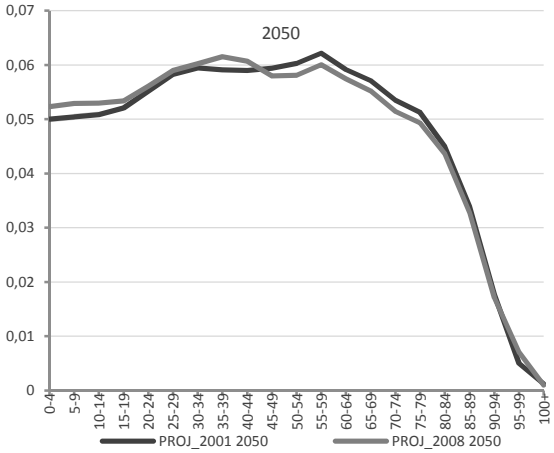
The projection published in 2011 (PROJ_2011)[11] was updated upwards (13.5 million inhabitants in 2060), mainly because the last available immigration statistics, which determine the starting point of the projection of international immigration, had seen a continuous increase. From 2011 to 2013, immigration in Belgium faced a decreasing trend (mainly explained by the modification in the law concerning family reunification). In the following two editions, this drop led to successive downward revisions of the future evolution of immigration, which entailed a downward revision of the population projections down to 12.5 million for 2060(PROJ_2014). In hindsight, the projection methodology developed at that time especially for the long term appeared over-dependent on the last observed level of immigration.

The revised methodology made the population long-term projections less dependent on the last observed trend in international migration. This methodology has been applied since the 2015 population projection and has led to an upward revision of the population projection in the long term (13.0 million inhabitants in 2060 for PROJ_2016).

PROJ_2016 clearly shows the benefit of this new methodology. Indeed, the asylum inflow which has been taken into account in PROJ_2016 has a substantial impact on population growth in the short term (Figure 7), without impacting the long-term population growth, which is a reasonable assumption. Actually, the recent asylum flows into Belgium for 2016 have shown a strong decrease. The closure of the European Union's external borders and the Agreement between the European Union and Turkey concluded in March 2016 certainly explain a significant part of this evolution. The short-term growth as projected in PROJ_2016 was too high. Those elements once again show the benefit of a flexible methodology based on sound assumptions which allows projections to be easily and annually updated (in particular for short-term shocks) without substantially affecting long-term trends.

11. Between 2008 and 2011, no updated population projection was published, notably due to a delay in the publication of the population statistics.

FIGURE 8 Population projections for Belgium
Comparison between two national projections. Age structure



Sources: Statistics Belgium and the Federal Planning Bureau.

For purposes such as planning for housing and schools, users of population projections are interested in knowing the growth rate of the population or its absolute increase. For other purposes, such as forecasting the cost of ageing, the age structure is more relevant. Differences in the assumptions not only lead to differences in the growth rate of the population but also to differences in its age structure. This is illustrated in Figure 8 with two different projections. The age structure projected for 2050 by PROJ_2008 is younger than that projected by PROJ_2001. The main reason for this difference is the assumption on net migration: in PROJ_2008, net migration has been revised upwards and migrants are more likely to be aged between 18 and 45 years. The higher share of the population aged between 0 and 20 years in PROJ_2008 is not only explained by the slightly upward adjustment of the total fertility rate, but also by the indirect impact of migration on the number of births. Migrants are more likely to be of childbearing age.

These elements lead us to conclude that each update of the population projections should be viewed as an ongoing improvement process integrating new observations, new demographic changes (which were not expected) and new methodological aspects (generated by new socio-demographic trends, new issues, etc.) which could influence the growth rate of the population as well as its age structure.

Comparison with projections made by international institutions

Besides the BEPOP published by the Federal Planning Bureau and Statistics Belgium, projections are also produced by international institutions, including Eurostat and the United Nations. This section briefly compares the projections published by these institutions (EUROPOP2013 and UNPOP2015)[12] with the population projections published by the Federal Planning Bureau and Statistics Belgium in 2016 (BEPOP_PROJ2016). These projections are summarised in Figure 9 (total population, net migration, total fertility rate and life expectancy at birth).

The projected total population for Belgium in 2060 is much higher in the Eurostat projections (15.4 million inhabitants in EUROPOP2013) than in the national population projection (13.0 million in BEPOP_PROJ2016). This difference is mainly due to the migration component[13]. The medium-term dynamic of migration is much greater in the Eurostat approach (Figure 9). The future evolution of net migration as assumed in EUROPOP2013 is a combination of three elements: a nowcasting component for the first projected year (2013), a trend component for the following five years (ARIMA model) and a convergence model[14] for the long term (from 2050 onward). For the medium term (2020-2050), the assumption is based on a combination of the trend component and the convergence model (Eurostat, 2014).

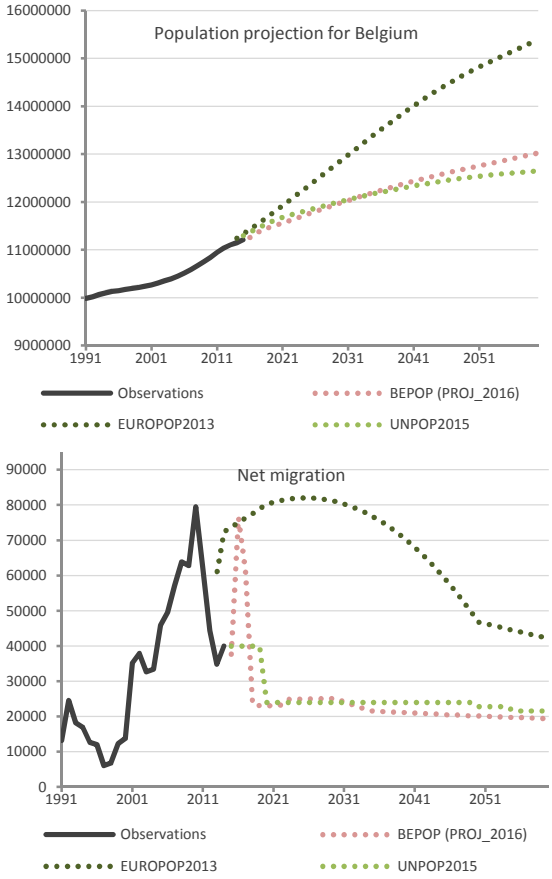
In particular, the trend component did not take into account the restrictive policy measures introduced in 2011, which curbed the growth (at least in the short term) of immigration. Nor did it consider that the growth observed in 2000 was due to specific factors (regularisation, accession of additional countries to the European Union), which should have been controlled for in the trend estimation.

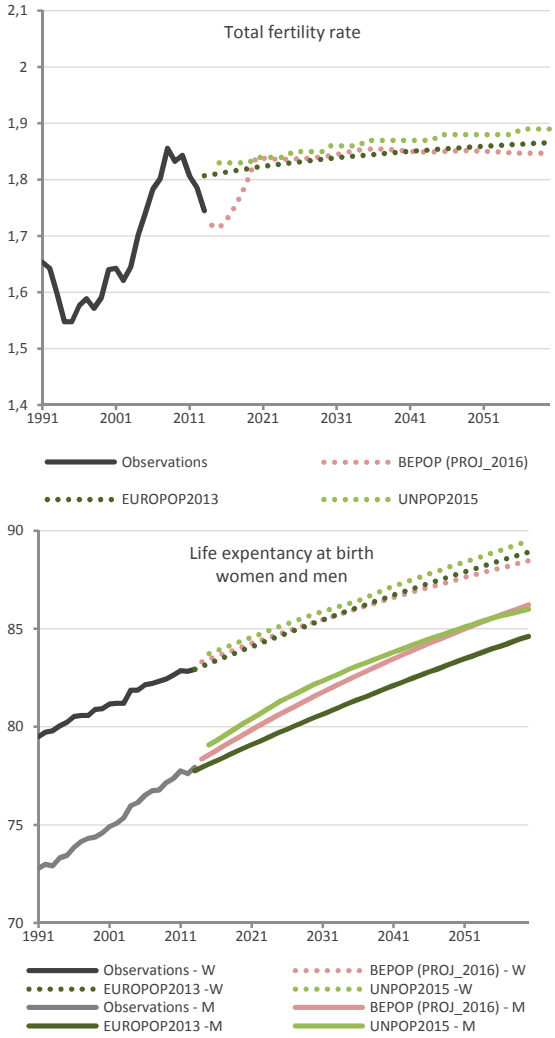
12. EUROPOP2103 and UNPOP2015 were published before the asylum crisis, as opposed to the latest population projection published by the Federal Planning Bureau and Statistics Belgium.

13. For a summary of the most recent Eurostat population projection (EUROPOP 2013), see European Commission, 2015.

14. Eurostat assumes that all countries converge at a different pace to zero net migration in the very long run (2150 in EUROPOP2013).

FIGURE 9 Population projections for Belgium comparison with projections made by national and international institutions





Sources: Statistics Belgium (Observations), Federal Planning Bureau (BEPOP), Eurostat (EUROPOP2013) and United Nations (UNPOP2015).

In the BEPOP, assumptions on international migration are not based on net migration but on immigration and emigration flows. The future evolution of international migration flows is the result of different elements: a detailed analysis of the reasons for migrating; the use of econometric approaches for estimating, when relevant, the impact of relative economic attractiveness on international immigration; the integration of world population growth; and the integration of specific events/shocks (the asylum crisis, the economic crisis, new legislation) which influence

immigration, at least in the short term. The emigration flows are projected using emigration rates in line with the immigration trend (Vandresse, 2015).

The long-term trends of the determinants of the natural balance (total fertility rate and life expectancy at birth) are similar[15] in both projections. However, it should be noted that the higher level of immigration in the Eurostat projection also leads to a higher number of births, as migrant women are generally of childbearing age (Eurostat applies the same fertility rate for both native and foreign women).

With regard to the population outlook by the United Nations (UNPOP, 2015), the projection population for Belgium is slightly lower in the long term (12.7 million in 2060 in the medium-term scenario[16]) than the national projections and slightly higher in the short/medium run. The projected populations are rather close to each other although quite different methodologies are used for the projection of the growth's components. For fertility the United Nations[17] uses a first autoregressive model with a long-term mean equal to 2.1 (replacement fertility level), while the BEPOP are based on a constant fertility level. Belgium is one of the countries that is characterised by a low fertility level (third demographic transition), with a current fertility rate of around 1.8 (before the economic crisis).

Regarding international migration, it is assumed in the United Nations population projection that if the recent net migration is stable, it should continue up to 2050 and then progressively decrease to reach 50% of the projected 2050 level in 2100. For Belgium, the United Nations consider that the recent net migration is not stable and apply a higher net migration in the short term (2015-2019). The long-term net migration level is computed using the average over the 1950-2010 period. Note that the United Nations does not take the latest available official statistics into account.

The age structures (in %) in 2060 for Belgium resulting from the projections published by the national institutions (POPBE), the Eurostat population projection (EUROPOP2013) and the United Nations population projections (UNPOP2015) are compared in Figure 10. The population ageing shows a slower pace in the Eurostat population projection: the population aged 75 years or more represents a smaller share compared

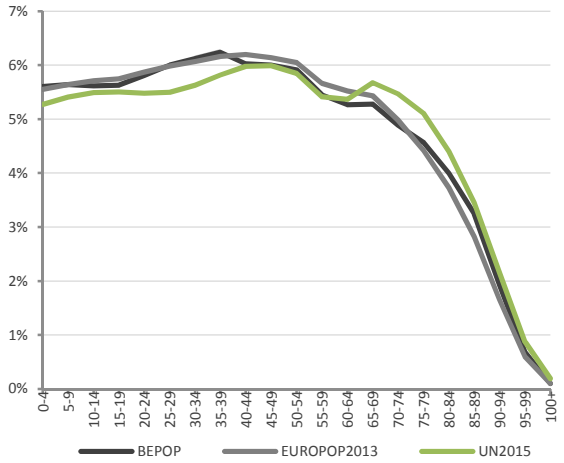
15. The life expectancy at birth for women seems, however, slightly higher in the national projections.

16. This is considered as the most likely scenario.

17. See United Nations (2015) for a detailed description of the methodology.

to the national population projection. The opposite is true for the population under 75 years, in particular between 40 and 65 years. Two factors explain this phenomenon. First, the higher projected level of immigration in the Eurostat population projection (see Figure 9) leads to a relatively higher share of new residents in the working age population and in the population of childbearing age. Second, the life expectancy at birth for men is considerably lower in the EUROPOP2013 exercise (Figure 9), which reduces the number of older individuals. In the United Nations population projections (UNPOP2015), the ageing process plays a stronger role, notably due to the more optimistic evolution of life expectancy for women.

FIGURE 10 Age structure of Belgium in 2060
National projection (BEPOP) compared to te Eurostat projection (EUROPOP2013) and to the United Nations projection (UN2015)



Sources: Federal Planning Bureau (BEPOP), Eurostat (EUROPOP 2013) and United Nations (UNPOP2015).

Users of population projections may ask which of these three projections should be used or is more reliable. The answer is not straightforward. We could carry out an ex-post analysis to determine which of the institutions performs best. For such an analysis, different elements make the comparison between projections difficult (see for example, Keilman, 2008). First, a sufficiently long historical perspective is necessary to compare a projection with observations. Second, projections are published at times when socio-economic and demographic conditions could be different. Let

us take the example of the last two national population projections. For these projections, the projection methodologies for international migration are identical but the worldwide environment changed, in that we had to face the asylum crisis. Finally, a projection is not a forecast. «Projections are aimed to describe what will happen in the future if current trends continue» while «forecasts are aimed to describe the most likely future» (de Beer, 2011, Section 7.4). Literally, «an analysis of the accuracy is useless in the [case of a projection] because [it is] always 100 percent correct» (Keilman, 2008). Still, projections are based on a set of assumptions which are subject to considerable uncertainties. To show these uncertainties, some projection-makers (see for example Keilman *et al*., 2002) call for the use of probabilistic population projections. In addition to a baseline scenario, these give a range of possible deviations from this path, a probability attached to that range. The United Nations opted for a probabilistic approach in their 2015 release but does this approach lead to more reliable projections? Uncertainties still exist on the parameters of the distribution (for fertility, mortality and migration) and the resulting confidence intervals. Distribution parameters are obtained from model-based estimations (times series) or from expert judgment. The parameters based on time series vary according to the quality of the data or the selected period of estimation. When they are based on expert judgment, the element of subjectivity is all the more present in attributing a probability of 95% to a future trend or level.

National population projections can be regularly updated and thus take into account the most recent observations, reflecting the latest demographic evolution (influenced by policy, the economic environment, the socio-cultural context, etc.). This is important, in particular when an unexpected break in the trend appears. National population projections also allow countries' specificities to be taken into account. Therefore, national population projections could be promoted when projections are used in a national or subnational context. For international studies or comparisons between countries, the use of projections published by international institutions ensures a certain consistency in assumptions between countries particularly with regard to international migration in developed countries.

Discussion

Statistics Belgium and the Federal Planning Bureau have been publishing for many years official population projections for Belgium at the district

level. These are used by official Belgian institutions in several short-, medium-, and long-term projection models (such as economic, poverty, long-term healthcare expenditure, energy and transport projections) and for specific external projects or requests.

A projection is always based on a set of assumptions. The choice of the assumptions has a greater impact than the method itself on the projection results. For a long-term horizon (2060), it seems difficult to set up a scenario which could be considered as the most likely projection. Each of the successive BEPOP projections presented in this paper is based on the current knowledge and assumes there will be no change in policy or in societal organisation.

The assumption of «unchanged societal organisation» does not entail freezing the value of various key parameters but rather assumes that the current trend will continue in the future, excluding breaks and major changes. For example, the downward trend observed in the mortality rates is expected to continue. The latest publication by the Federal Planning Bureau and Statistics Belgium that takes world population growth into account shows a long-term sustained level of international migration. In the case of a significant change or a break in these trends, the reality may deviate from the assumptions made in these projections.

Forecasting a break in the trend (for example as recently observed with the inflow of asylum-seekers) is not easy, notably because it can be influenced by «unexpected» events such as changes in policy, in the international environment (in particular for migration) or in economic activity. The asylum inflow and the economic crisis in Europe have influenced migration and fertility, which consequently impacts the population projection in the short term and confirms the need for a regular update of projections in Belgium.

As for the general usefulness of a population projection, a population projection is not intended to provide the «right» number of inhabitants in a specific region for a specific time horizon but a trend. This trend should be as reliable as possible to be used as a guideline to analyse the impact of population growth on the different fields of potential interest (economics, politics, mobility, energy, urbanisation, health, ageing, environment, etc.). In other words, the aim of a population projection is to serve as a tool to support political decisions or feed debates on the future of our societies. For example, a given population projection might be used by policy makers to modify transport infrastructure or create new cities, which could impact on the future evolution of the local populations. The projection used to make such policies will consequently not be confirmed in the future when policy-makers succeeded in changing the trend.

To analyse and interpret projections in a relevant way, producers of population projections should pay special attention to the description and the publication of the methodology. Users should be made aware of the assumptions underlying the population projection. A good knowledge of statistics is also necessary. For example, it is important to know whether the projected population includes only the registered population or the *usually resident population* (which also includes non-registered individuals), in particular for smaller entities. For example, the BEPOP only include the registered population, which certainly leads to an underestimation of the population of localities (and more particularly of cities) where asylum seekers[18], homeless or irregular migrants are more likely to settle. For example, in 2013, Belgium had 11'099'554 inhabitants according to the national concept[19] and 11'161'642 inhabitants according to the Eurostat concept[20], a difference of 62'088 inhabitants (0.5%). This difference stems from the asylum seekers, who are included in the Eurostat population statistics. Assuming that this population has specific behaviours with respect to migration (emigration in particular) or fertility and mortality, the long-term growth of the population could be affected.

As a final remark, it should be borne in mind that each update of the population projections has to be viewed as part of a continuous process of integrating new observations, new demographic changes and methodological improvements. In other words, previous projections should not be considered as «unreliable» or «bad», but rather as being established on the basis of the current knowledge at the time. Since knowledge is a continuous process regular updates of projections are necessary. The update should notably take into account new demographic trends observed in the short term, while keeping the projection consistent (or relatively stable from one projection to another) in the long term.

18. The official national definition of the population of the Kingdom of Belgium (Act of 24 May 1994, article 4) does not allow asylum seekers (registered in the so-called «waiting register») to be taken into account. They are included in the population statistics once they are recognised as refugees.

19. Art. 4 of the Act of 24 May 1994 creating the waiting register: the statistics on population does not include asylum seekers whose application is pending and who are recorded in the waiting register, but only those who are recognised as refugees.

20. For the population figures compiled by Eurostat from the data provided by European Union (EU) Member States, that time is *1st January* and the resulting figure is called *population on 1 January*. The recommended definition is the *usual resident population*, representing the number of inhabitants of a given area on 1st January of the year in question. To meet this notion of usual resident population, Statistics Belgium provides Eurostat with the population including asylum seekers.

References

Federal Planning Bureau and Statistics Belgium (2016), *Perspectives démographiques, population, ménages et quotients de mortalité prospectifs*, March.

De Beer J. (2011), *Transparancy in Population Forecasting, Methods for Fitting and Projecting Fertility, Mortality and Migration*, Amsterdam University Press.

Eggerickx T., **Hermia J.-P.**, **Surkijn J.**, **Willaert D.** (2010), *Les migrations internes en Belgique,* Monographie de l'enquête socio-économique 2001, DGSIE, Brussels.

Eurostat (2014), *Comparison between Eurostat Population Projections 2010-Based (EUROPOP2010) and 2013-Based (EUROPOP2013)*, Eurostat technical note, ESTAT/F2/GL, 18 April.

European Commission (2015), *The 2015 Ageing Report, Underlying Assumptions and Projection Methodology*, European Economy 8/214.

Goldstein J. R. ***et al.*** (2013), «Fertility Reactions to the 'Great Recession' in Europe: Recent Evidence from Order-Specific Data», *Demographic Research*, 29 (4), pp. 85-104, https://doi.org/10.4054/DemRes.2013.29.4.

Keilman K., **Dinh Quang Pham D. Q.**, **Hetland A.** (2002), «Why Population Forecast Should be Probabilistic. Illustrated by the Case of Norway», *Demographic Research*, Rostock, Germany, 16 (15), pp. 407-454, https://doi.org/10.4054/DemRes.2002.6.15.

Keilman N. (2008), «European Demographic Forecasts Have not Become More Accurate over the Past 25 Years», *Population and Development Review*, March, 34 (1), pp. 137-153.

National Academies Press (2000), «Beyond Six Billion; Forecasting the World's Population», J. Bongaarts, R. D. Bulatao (eds), National Academy of Sciences, 258 p.

Paul J.-M. (2009), *Quotients de mortalité prospectifs par sexe et unisexes*, Federal Planning Bureau, Working Paper 18-09.

Schoumaker B. ***et al.*** (2010), «Perspectives démographiques en Belgique depuis 1940. Confrontation à la réalité», *Histoire de la population de la Belgique et ses territoires, Chaire Quetelet 2005*, Centre de Recherche en Démographie et Sociétés, Université catholique de Louvain, pp. 251-290.

United Nations (2015), *World Population Prospects, The 2015 Revision Methodology of the United Nations Population Estimates and Projections*, Department of Economic and Social Affairs, Population Division.

Vandresse M. (2014), *Une méthodologie de projection des ménages : le modèle HPROM*, Working Paper 09-14, Federal Planning Bureau.

Vandresse M. (2015), *Modelling the Future Evolution of International Migration for Belgium*, Working Paper 02-15, Federal Planning Bureau.

VANDRESSE M. (2016), *Projection of Internal Migration Based on Migration Intensity and Preferential Flows*, Working Paper 10-16, Federal Planning Bureau.