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Future Demographic Change in Europe: The Contribution of Migration

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Abstract

This paper quantitatively assesses the effects of possible alternative future migration trends in the European Union (EU-15) on population growth and ageing until 2050. In particular, it views the uncertainty about future migration trends in the context of the range of possible future fertility and mortality trends. This is first done by comparing two sets of probabilistic population projections, a “regular” one including immigration, and a hypothetical “no migration” case assuming a closed population. In the second part we consider the question to what extent immigration can compensate for the low birth rates in Europe by combining seven alternative fertility-level scenarios with four migration scenarios. The results show a distinct compensatory effect for both total population size and the old-age dependency ratio: 100,000 additional immigrants per year have the same effect as an increase in the total fertility rate by 0.1 children per woman on average.

Future Demographic Change in Europe: The Contribution of Migration

Wolfgang Lutz and Sergei Scherbov

Europe is frequently called the old continent and it truly deserves this name in a demographic sense. Europe's population currently has the highest median age of any world region, 37.7 years, according to UN (2003). By the middle of the century the median age is likely to be as high as 48 years in Europe, while the "new world," i.e., North America, will be around 40 years and the rest of the world still younger.

Europe has been spearheading global demographic trends in the 19th and 20th centuries and it is likely to spearhead population ageing in the 21st century. The population above age 60 increases rapidly, and that below age 20 diminishes. Because of the very low levels of reproduction that prevailed in large parts of Europe over the past decades the age structure of the population has already been altered to such a degree that there will be fewer and fewer women of reproductive age in the years to come; continued population ageing and even shrinking is quasi pre-programmed (Lutz et al. 2003). The total population size of Europe is expected to decline in the long run, even when assuming sizeable immigration and continued increases in life expectancy. Without migration gains, Europe's population would age even more rapidly and population size would start to decline in the near future.

Although significant future population ageing in Europe is a near certainty, the exact degree of ageing will depend on future trends in fertility, mortality and migration that cannot yet be fully anticipated. There is significant uncertainty around the three key questions: Will the birth rates in Europe recover, stay around the current level, or even continue to fall? Are we already close to a maximum life expectancy beyond which there will be no further decline in mortality rates? And how many migrations will enter Europe in the coming decades? All three factors matter for the future population size and structure of Europe, but in this paper we will primarily focus on the role of migration in future population dynamics. We will do this by looking at different possible future migration regimes against the background of realistic ranges of future fertility and mortality changes. After a short summary of the principles of population dynamics we will look at probabilistic population projections for the European Union and try to quantify the importance of future migration for this outlook. In the final part of the paper we will explicitly and systematically address the frequently asked question: To what degree can immigration compensate for the low birth rate in Europe?

Population Dynamics

As compared to other social and economic factors, demographic trends are very stable and have a great momentum. For this reason population dynamics can be projected with greater accuracy over a longer time span. Of course, such projections are not absolutely certain because human behaviour is not purely deterministic and there can be unforeseen trends and disasters. But since most of the people that will live in 2020 are already alive today, we know with a high probability what the age structure of the labour force is likely to be in that year.

Future population size and age structures are determined by the present age structure and the future trends in the three basic demographic components fertility (birth rate), mortality (death rate) and migration. Any change in the population must operate through one of these three factors. But even rather rapid changes in one of the factors may take quite long to impact on the total population due to the great inertia of population dynamics. If, for instance, smaller and smaller cohorts of women are entering the childbearing ages, even a possible increase in the mean number of children per woman may not lead to an increase in the total number of births. Similarly, the "baby boom" of the 1960s (and not a discontinuity in life expectancy gains) is the main reason why we expect the proportion above age 60 to increase sharply after 2020.

The fact that there are only three factors to be considered in population projection does not necessarily make the task easier, because the projection of each of the factors is difficult and associated with significant uncertainties. Even the future of **mortality,** which traditionally has been considered the most stable demographic trend with steady improvements over the years, has recently become more uncertain. Over the last 50 years, life expectancy in Western Europe has increased by about 10 years, implying an average gain of two years per decade. Despite this significant gain that has surpassed all expectations expressed in earlier years, most statistical offices producing projections assume a slowing of improvements over the coming years, in some cases even constant life expectancy. Eurostat assumes, in the medium projection, a gain in life expectancy at birth of about three years over a period of 20 years (European Commission 1998). But there is increasing scientific uncertainty about limits to human longevity and consequently about the future gains still to be expected (Vaupel and Lundström 1996). In contrast to the traditionally dominating view that we are already very close to such a limit (actually, the assumed limits are being constantly moved upward by projectors as real gains surpass their expectations (Bucht 1996)) alternative views suggest that such limits (if they even exist at all) might be well above 100 years. This scientific uncertainty about the future trends in old-age mortality also needs to be reflected in the population projections.

Fertility is the most influential of the three demographic components under a longer time horizon. Changes in fertility not only impact on the number of children, but also on the number of the grandchildren, etc. For this reason relatively small changes in fertility may have very significant consequences on future population size and age structure in the longer run. Despite its significance we know rather little about the future trends of fertility in Europe. The history since World War II does not help us anticipate the future trend. During the so-called baby boom of the early 1960s most Western European countries had period fertility rates of above 2.5 children per woman. This was followed by a rapid fertility decline during the 1970s, bringing the European average down to about 1.5. Since then we have seen diverging trends, typically at levels well below replacement fertility. The most significant fertility declines were found in the Mediterranean countries, with Italy and Spain having around 1.2 children per woman. Some of the Central and Eastern European countries reached even lower levels, while France and the Northern European countries show somewhat higher levels. There are also significant regional differentials within countries, e.g., between Northern and Southern Italy. A further uncertainty is due to the fact that part of these trends are caused by the depressing effect of “tempo” changes, i.e., a postponement of births, and it is unclear for how long this will continue (Bongaarts and Feeney 1998). There is no clear scientific paradigm to adequately anticipate future reproductive behaviour. The notion of a “second demographic transition” has been suggested to capture these trends, but it does not say where and when the endpoint of this transition should be reached (Van de Kaa 1987; Cliquet 1991). For this reason, again, population projections need to reflect the uncertainty through a range of fertility assumptions.

Migration is the most volatile of the three demographic components. The number of people entering or leaving a country can change from one year to the next due to political events or the enforcement of new legislation. The past 10 years have witnessed great ups and downs in European migration levels. The problem with projecting migration trends is not only the intrinsic difficulty of foreseeing such political events, but also the fact that net migration is the result of two partly independent streams (in-migration and out-migration) and that they depend on the conditions in both the sending and receiving countries. In this respect projections can do little more than demonstrate the impacts of alternative net-migration assumptions (Lutz 1993).

Policies to manage the future and meet the demographic challenges require the best available information about future demographic trends. The standard way to project the future population path, which is considered most likely by experts, is a well-established methodology, the so-called cohort component method. The more difficult issue is how to deal with uncertainty in future demographic trends. As indicated above there are significant uncertainties associated with all three components, fertility, mortality and migration. The conventional way is to produce different scenarios or variants, which combine alternative fertility assumptions with single mortality and migration paths. The current practice of providing “high” and “low” variants to communicate uncertainty around the medium projection suffer from several drawbacks. The most important are: (a) In many cases, variants only address fertility uncertainty, ignoring mortality and migration uncertainty; (b) The variants approach is unspecific about the probability range covered by the “high” and “low” variants; (c) The variants are probabilistically inconsistent when aggregating over countries or regions because the chances of extreme outcomes in many countries or regions at once are portrayed as being the same as an extreme outcome in a single country or region; and (d) The variants typically do not allow for temporal fluctuations such as baby booms and busts that can produce bulges in the age structure. These problems can only be solved by turning to fully probabilistic projections when it comes to covering the uncertainty.

Probabilistic (or stochastic) population projections are a rather recent methodological development, but there has been a large body of literature recently (for summaries of the state of the art, see Lutz et al. 1999; Lutz and Goldstein 2004). The specific methodology applied in this paper has been extensively described elsewhere and cannot be described here. The model specifications are following those of the 13 world regions in Lutz et al. (2001).

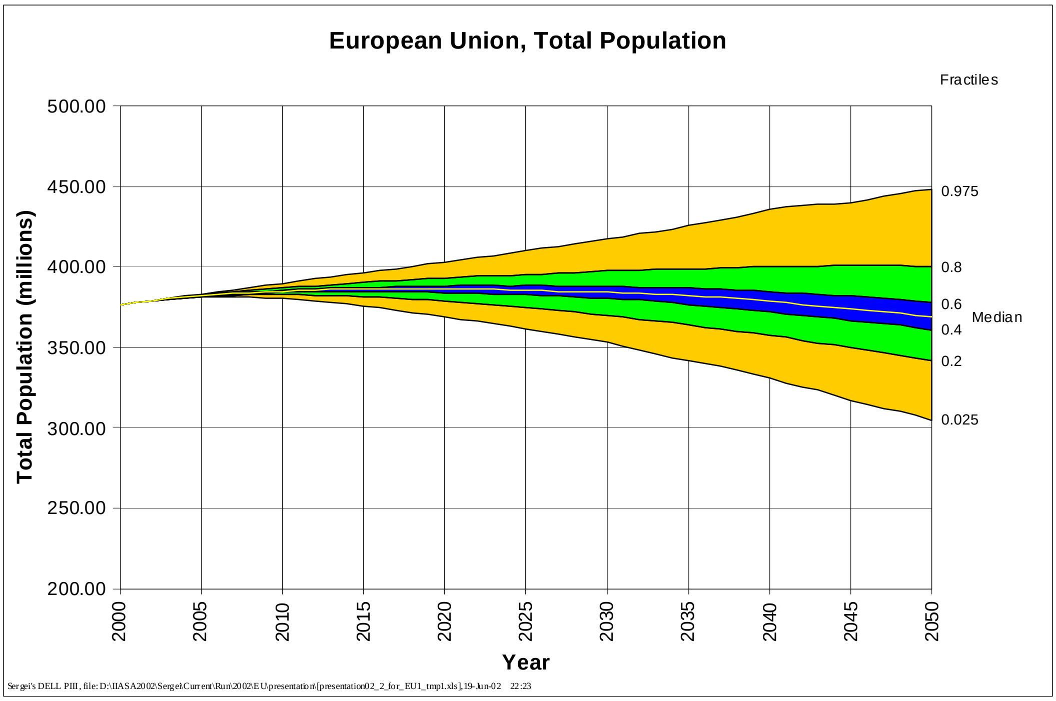
Comparing Population Outlooks with and without Migration

In this section we will present two different sets of population projections for the European Union (with its 15 member states as of 2003). Both are based on identical assumptions about the future range of fertility and mortality, but have different migration assumptions. In the case labelled "regular" we consider the full range of uncertainty in future migration as it looks plausible from today's perspective. In the second case labelled "no migration" we consider the purely hypothetical unrealistic case of Europe being entirely closed to migration. The comparison between the two projections will allow us to evaluate the contribution of migration to Europe's demographic future.

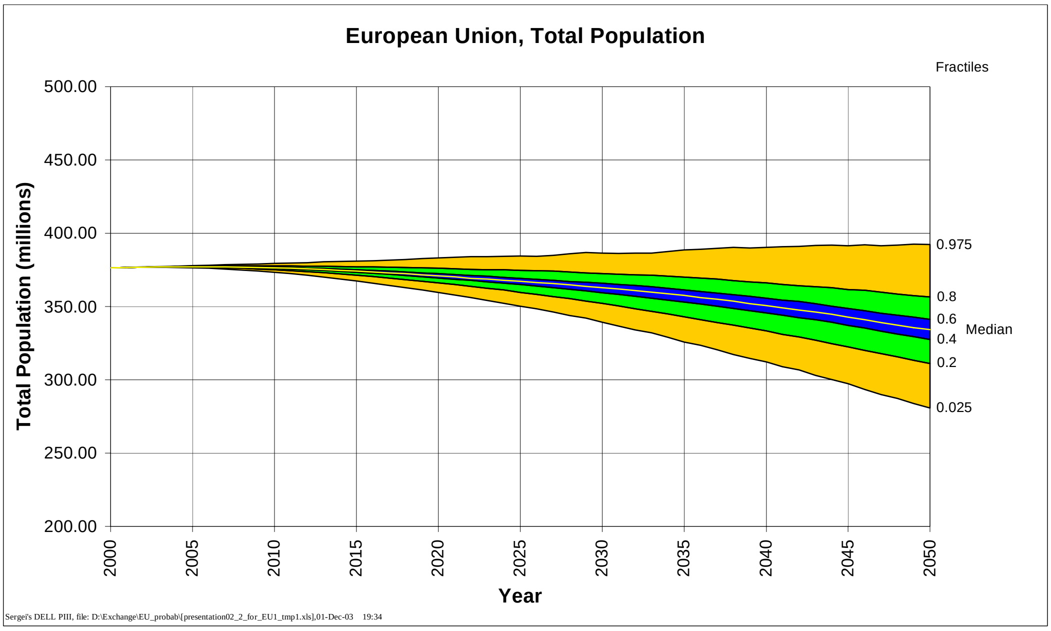
In numerical terms we make the following assumptions about future trends: For fertility we assume that by 2030 there is likely to be some recovery with the total fertility rate (TFR) increasing from currently 1.5 children per woman to 1.7. The 80 percent uncertainty range is half a child up and down from this median. In other words we assume that in 80 percent of all simulated cases in 2030, the TFR in the EU-15 will lie between 1.2 and 2.2. This range is kept constant till 2050. For female life expectancy, which currently stands at 81.5 years we assumed that the 80 percent range will be 82.9-88.9 years in 2030 and 84.9-94.9 years in 2050. For male life expectancy, which presently is 75.5 years, the assumed 80 percent ranges are 77.0-83.0 years for 2030 and 78.3-88.7 years for 2050. Each uncertainty distribution is modelled in terms of a normal distribution with tails of 10 percent of the cases above and below the stated values. An extensive substantive justification of these assumptions for Europe is given in Lutz et al. (2004).

For future migration into the EU-15 the following assumptions were made. In the "regular" case the annual net migration gain for the EU was considered to lie within zero and one million in 80 percent of the cases for every year. This means that an average annual migration gain of half a million was assumed. But the assumed uncertainty distribution also implies that in10 percent of the cases, Europe actually loses migrants and in another 10 percent will gain more than 1 million. In the "no migration" case a closed population was assumed, i.e., the EU is neither winning nor losing people by migration. For each of the cases 1,000 independent population projections by age and sex were performed drawing each year from the above-defined fertility, mortality and migration distributions with stochastic annual fluctuations (see Lutz et al. 2004).

Figures 1a and 1b show the resulting uncertainty distribution for the future total population size of the current 15 member countries of the European Union. It shows that, as can be expected, the uncertainty range expands over time. For the coming decade the range is very narrow, while in 2050 the 95 percent range goes almost from 300 million to 450 million inhabitants. In the "regular" case (Figure 1a) the total population of the EU-15 is still likely (in more than half of the simulations) to increase somewhat until around 2020 and then start to decline. The median of the projection shows a small increase from currently 376 million to 385 million in 2025 followed by a decline to 376 million in 2050 (see Table 1). In other words even in the case of significant immigration (in the order of half a million per year) the population size in the EU-15 is likely to be smaller in 2050 than it is today.



a) regular



b) no migration

Figure 1. Probabilistic projections for the total population size of the European Union (EU-15) including migration (a) and assuming a closed population (b). Fractiles of the resulting uncertainty distributions.

Table 1. Total population and proportion above age 65 in the EU-15 (medians with 80% uncertainty ranges), "regular" and "no migration" cases.

Year	Total Population (in millions)	Proportion 65+
2000	376	0.163
2025 "regular"	385 (369-401)	0.226 (0.214-0.238)
"no migration"	367 (355-378)	0.235 (0.222-0.246)
2050 "regular"	369 (325-418)	0.308 (0.268-0.355)
"no migration"	334 (300-372)	0.325 (0.282-0.368

In the case of a hypothetically closed population ("no migration" case shown in Figure 1b) the median starts to fall immediately. An initially moderate decline will then gain momentum over time and result in a rather steep decline after 2030. In this case the median would decline by around 10 million over the coming 25 years, but by more than 30 million over the second quarter century. A comparison of the two "trumpets" of uncertainty in Figure 1 shows that the uncertainty range for the "regular" case is much broader than for the "no migration" case because of the added migration uncertainty, which makes a significant difference to the total uncertainty. The comparison of the two graphs shows that in the case of "no migration" the uncertainty is essentially downwards, i.e., the open question would not be whether the population declines, but by how much the population declines, depending on future fertility and mortality trends?

In 2050 the median of the "no migration" projection is 35 million lower than that of the "regular" projection. This is in the order of 10 percent of the total population of the EU-15. In other words, this shows that over a 50-year horizon, migration gains in the EU-15 are likely to make a difference of 10 percent in total population size.

But migration not only matters for population size, also the speed and the degree of population ageing are sensitive to migration. Table 1 shows that the proportion of the population that is aged 65 or above is almost certain to increase from its current level of 16.3 percent under practically all conditions, with and without migration. Any meaningfully assumed level of immigration, even when combined with high fertility and low gains in life expectancy, cannot stop a very significant increase in the proportion elderly. In terms of the medians, it would increase to 30.8 percent in the "regular" case and to 32.5 percent in the "no migration" case by 2050 (see Table 1). This difference looks relatively minor when compared to the huge change from the current 16.3 percent. The difference is in the order of 10 percent of the expected increase. Ninety percent of the increase is already embedded in the current age structure due to continued low fertility and increasing life expectancy.

A look to the full age pyramids is very illuminating. Figure 2 shows the current age pyramid of the EU-15. There the picture is clearly dominated by the so-called baby boom generation, those large cohorts born during the 1960s. Never before and never after that time have birth cohorts been that large. The pyramid is narrow at the bottom as a consequence of the decline in birth rates since the 1970s. This age structure has future population ageing and even shrinking pre-programmed. At the moment the sizes of younger cohorts are still a bit inflated by the fact that the large baby boom cohorts have just moved through their prime reproductive ages increasing the number of potential mothers. Over the coming years the number of potential mothers in Europe will significantly decline and therefore the number of births will go down, even in the unlikely case that fertility would fully recover to the replacement level of two surviving children.

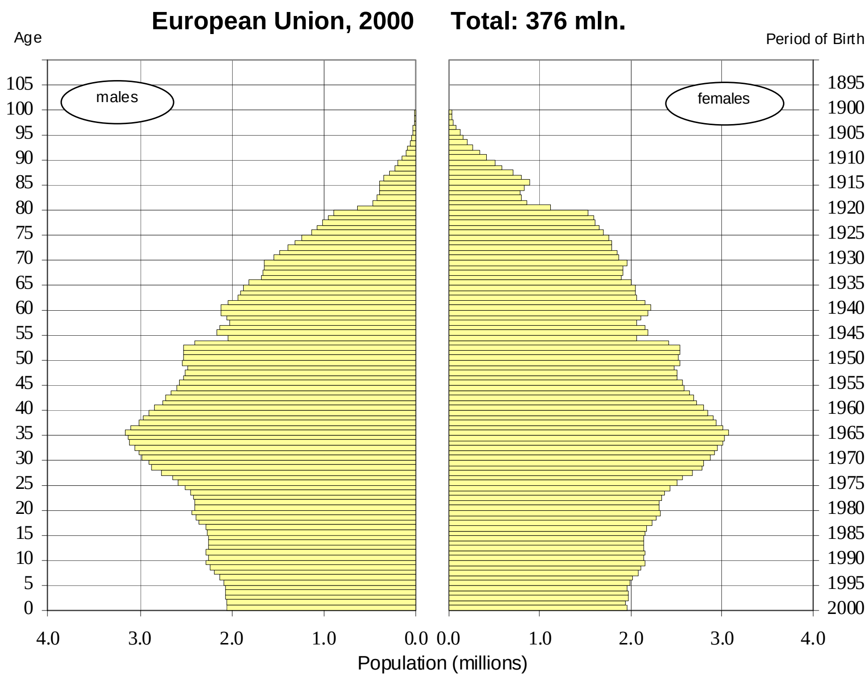


Figure 2. Age pyramid of the population of the European Union (EU-15) in 2000.

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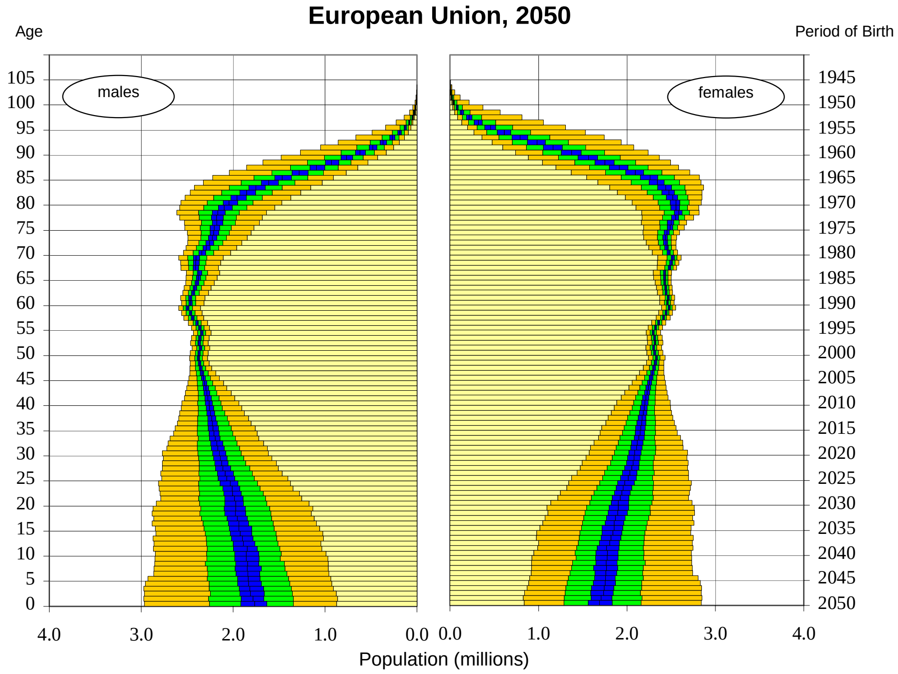
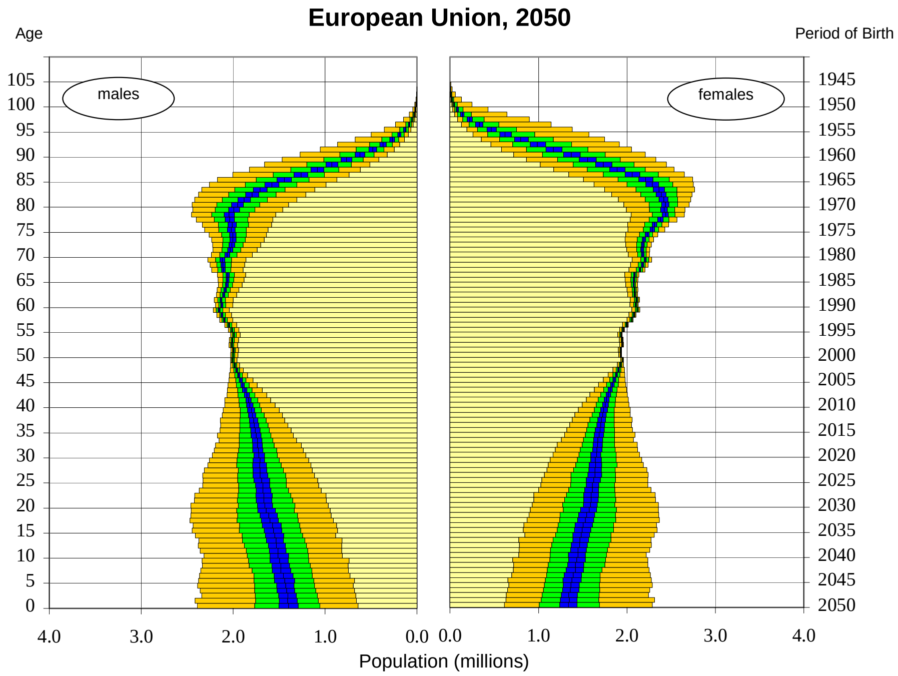
Figure 3 gives probabilistic age pyramids for the population of the current EU-15 for the year 2050. These pictures are still dominated by the baby boom generation, which in 2050 will be above age 80. On the female side of the pyramids it shows that this cohort of women aged 80-85 is still likely to be the biggest cohort alive. This is difficult to imagine today, but especially in the "no migration case," Figure 1b clearly shows that in 2050 no other age group of women will be as numerous as those aged 80-85. This incredible pattern is somewhat less pronounced for men because of the lower life expectancy of men. By 2050 a higher proportion of male members of the baby boom generation will have died.

Figure 3 also shows how important fertility uncertainty is in the longer run. Under the "regular" projections the 95 percent uncertainty range for children aged 0 to 1 goes from less than one million children to about three million children, i.e., it differs by a factor of three. No other age group has such huge uncertainties. Uncertainty at the highest ages is also quite sizable due to the uncertainty about the future increase in life expectancy. The range is smallest for ages 50-70, which are the cohorts born between 1980 and 2000. These cohorts are only affected by migration uncertainty, because they are already alive today (we know the actual cohort size; there is no fertility uncertainty) and they have not yet entered the high mortality ages in which the mortality uncertainty matters a lot. This is also evident in the "no migration" case (Figure 3b), where for the cohorts born shortly before 2000, there is no uncertainty because in this projection there is zero migration and therefore no migration uncertainty.



a) regular



b) no migration

Figure 3. Probabilistic population pyramids for the EU-15 for 2050. The different shadings refer to the fractiles of the uncertainty distributions (see Figure 1); (a) gives the "regular" projection and (b) the "no migration" case.

In Figure 3 a comparison between the two age pyramids also illustrates visually what has been discussed about the contribution of migration to population size and ageing above. In the “no migration” case the pyramid is narrower at the base because of fewer young people in Europe, and smaller in total area because of smaller total population size. The “regular” pyramid has a broader base because migrants tend to come at a younger age and because migrants also have children. In these projections we assumed for simplicity that immigrants have the same average birth rates as the general population. If it is assumed that immigrants have on average more children, the difference between the two cases becomes even more pronounced.

Can Immigration Compensate for Low Fertility?

In the second part of this contribution we choose another demographic approach to study the quantitative contribution of migration. Without considering the full uncertainty of future demographic trends we focus on the specific question of what are the implications for Europe’s population size and structure of alternative future fertility levels combined with alternative levels of immigration? We will present the results of 28 scenarios that combine seven different fertility levels with four different migration levels for the current 15 member countries.

Figures 4 and 5 present selected findings from a large number of different simulations that were calculated at the level of the EU-15 with a population of 376 million in 2000. Since the discussion of this question mainly concerns the long-term impacts, the figures only show the results for 2050. They are based on alternative population projections in which fertility and net migration are kept constant over time at the level indicated, while mortality – the third component of population change – is improving slowly as assumed in the regular projections (the median of the above discussed uncertainty distribution). The figures group the projection results by the assumed total fertility rate ranging from 1.0 to 2.2. For 1999 Eurostat gives a TFR of 1.45 for the EU-15, which covers a range from Spain (1.19), Italy (1.21), Greece (1.30), and Austria (1.30) at the low end, to Denmark (1.74), Finland (1.74), France (1.77), and Ireland (1.89) at the high end (European Commission 2001). The different bars under each fertility assumption refer to different assumed levels of net migration gain. For 1999 Eurostat estimates a positive net migration rate of 1.9 (per 1,000 population) for the EU-15, which in absolute terms implies a migration gain of 714,000 persons (European Commission 2001). Over the past decade, however, migration flows have shown strong annual fluctuations and great differences between the 15 member states. The figures show the results for four different levels of annual net migration, ranging from zero (no migration gains) at the low end to a constant annual gain of 1.2 million, which over the 50-year period would accumulate to a 60 million immigration surplus.

Figure 4 presents the results with respect to the total population size of today’s EU-15. Not surprisingly, the lowest population size in 2050 (271 million or a 28 percent decline from today) results from the combination of a TFR of 1.0 with the assumption of zero net migration gains. At the high end, the combination of a TFR of 2.2 with a 1.2 million annual migration gain results in a population size of 431 million in 2050, which is an increase of 15 percent as compared to today. Of all the alternative scenarios included in the figure, the overwhelming majority points toward population decline, but the impacts and the differences among the scenarios are not too dramatic considering that it reflects the change over half a century. This shows that total population size is a rather inert variable, and even rather extreme combinations of assumptions affect it only very slowly.

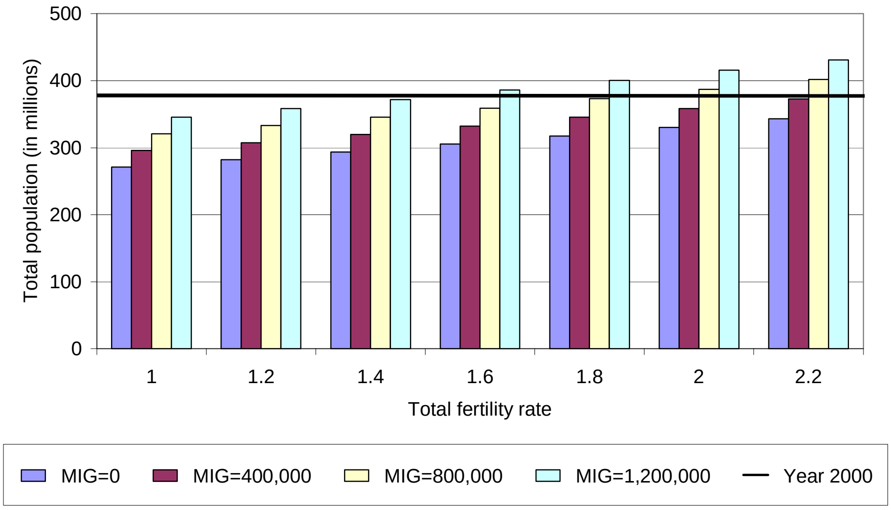


Figure 4. Total population of the EU-15 in 2050, according to alternative projections assuming a wide range of fertility and annual net migration levels. The level of 2000 is marked as a black line.

Figure 5 shows that the population age structure is expected to change more rapidly and more profoundly than population size. The graph plots the so-called old-age dependency ratio, which is defined here as the proportion of the population above age 65 divided by the population aged 15-64. At the level of the EU-15 this ratio is presently 0.24. Due to the inevitable changes that are mostly pre-programmed in the current age structure of the population, this ratio is bound to increase significantly under all scenarios. Up to 2050 this dependency ratio will increase by a factor of roughly two to three depending on the future fertility and migration levels assumed. It is interesting to see that even massive immigration to Europe makes little difference for the old-age dependency ratio. This difference is somewhat more pronounced in the case of very low assumed fertility and less pronounced for the higher fertility scenarios. Even in the extreme case of 60 million young immigrants added to the EU labour force, over the next five decades the expected increase in the old-age dependency ratio would be only slightly more moderate than under current migration rates and even not very significantly different from the other extreme case of no migration gains.

The above-described analysis shows that there is a clear compensatory relationship between fertility and migration: A TFR of 1.0 combined with a migration gain of 1.2 million per year yields the same old-age dependency ratio in 2050 as a TFR of 2.2 and a migration gain of zero. There even is a pretty clear general linear relationship that holds for both population size and the old-age dependency ratio: 1 million immigrants per year have the same effect as a TFR difference of 1.0. On a more realistic scale, the effect of 100,000 additional immigrants per year corresponds to that of an increase in the TFR of 0.1.

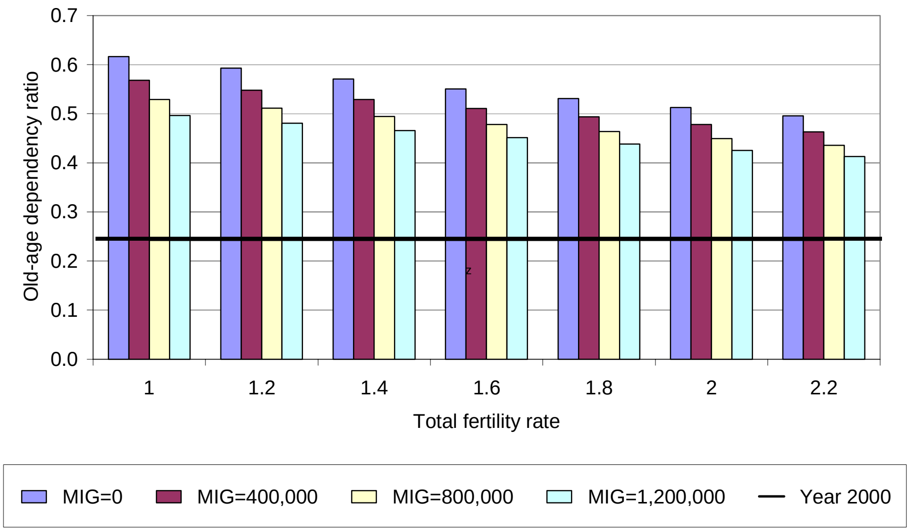


Figure 5. Old-age dependency ratio for the EU-15 in 2050, according to alternative projections assuming a wide range of fertility and annual net migration levels. The level of 2000 is marked as a black line.

Discussion

The question discussed in this paper has gained wide public prominence following the publication of a UN study entitled "Replacement Migration: Is it a solution to declining and ageing populations?" (UN 2000). This study presents several scenarios for a set of eight countries as well as Europe and the EU as aggregates. One scenario computes and assumes the migration required to maintain the size of total population; another keeps the working-age population constant; and finally, one maintains the current support ratio, i.e., the proportion of the population aged 15-64 over the population 65 or older. For the individual countries, the results show that significant immigration can result in constant population sizes and even constant sizes of the working age population, whereas the support ratio can only be maintained with implausibly high immigration levels. The absurd number of 5.1 billion immigrants necessary to maintain a constant support ratio until 2050 in the Republic of Korea has received a lot of attention in this context. For the European Union (EU-15) these calculations show that a total of 47.5 million (or 0.95 million per year) migrants would be required to keep the population size constant; 79.4 million (or 1.6 million per year) would be needed to maintain the working-age population; and an impossible 674 million (13.5 million per year) would be needed to keep the support ratio constant. It was interesting to see that in terms of public reactions to these calculations, one could find opposing conclusions ranging from "immigration can never solve the ageing problem" to "immigration is urgently needed to solve the ageing problem."

This UN study chose an approach that works top down or more precisely “back from the future.” A certain demographic target (such as keeping the working age population constant) is set and then one calculates what immigration would be needed to achieve this goal, assuming invariant paths of future fertility and mortality. In this study we are not setting a target but rather calculate the outcomes of possible variations in the future paths of all three demographic components fertility, mortality and migration. Since policy considerations typically are not based on a certain target in the distant future that is difficult to establish and defend substantively, but rather work in terms of processes evolving over time, the approach presented in this paper may be more relevant for policy discussions about migration in the context of an ageing European population.

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Note: Figures 4 and 5 and parts of the Discussion section are taken from IR-02-052, "Can Immigration Compensate for Europe's Low Fertility?" by Wolfgang Lutz and Sergei Scherbov.