Comparative Population Studies
Vol. 40, 2 (2015): 165-190 (Date of release: 17.04.2015)

Could Immigration Prevent Population Decline?

The Demographic Prospects of Germany Revisited

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Abstract: Germany has a record of more than 40 years of below-replacement fertility and annual death surplus. Hence, it is commonly accepted that Germany's population will decline considerably in the coming decades. Recent increases in immigration may, however, challenge the official long-term demographic projections for Germany. This paper assesses the impact of a permanent higher-than-expected level of net immigration to Germany as in the past three years on the projections for population, age structure and ethnic makeup by mid-century.

The paper adds a higher immigration variant to the Federal Statistical Office's latest Coordinated Population Projection and two variants of a (a) constant or (b) decreasing fertility rate among migrant women. It can be shown that with permanent net migration as high as in recent years (around 300,000 per annum), Germany's population would not significantly decrease in the coming decades but would rather remain at 80 million until 2050. On the other hand, the sharp rise in the old-age dependency ratio is only mildly weakened by increased immigration rates. This issue is therefore probably best addressed by other (or additional) means. The increase in retirees will level off after 2035 in any case. The ethnic makeup of society would be affected to a greater degree than its age composition: The share of first- and second-generation immigrants among the total population is projected to rise to about 35 percent in this scenario (and to above 40 percent if the third generation is also counted).

Keywords: Immigration · Germany · Population decline · Ethnic minorities

DOI: 10.12765/CPoS-2015-05en
URL: www.comparativepopulationstudies.de
URN: urn:nbn:de:bib-cpos-2015-05en6

1 Introduction

Every year since 1972, deaths have outnumbered births in Germany.[1] Since then, the total fertility rate (TFR) has remained constant at around 1.4 children per woman. While fertility decline is witnessed by all societies in the course of demographic transition (*Dyson* 2010), the case of Germany is exceptional with respect to the length and consistency of this period of below-replacement fertility and excess of deaths over births. In most other developed countries, the onset of natural population decline has occurred significantly later, if at all. The first post-war year in which natural population growth was negative in Russia was 1992, in Italy 1993, and in Japan 2007. Some countries, such as Sweden or Denmark, have returned to birth surplus after brief episodes of negative natural population growth while others, such as France or the United Kingdom, have not had notable periods of post-war death surplus years. In a European comparison, most northern and western European countries have significantly higher birth rates than Germany, while many central-eastern and southern European countries are characterised by comparatively low fertility rates, but have witnessed the onset of fertility decline much more recently (see e.g. *Goldstein et al*. 2009). Moreover, some of the latter countries are currently experiencing a recovering fertility rate after a period of "lowest-low" fertility as a result of birth postponements, an effect that appears to have slowed down since the late 1990s (*Goldstein et al.* 2009; *Sobotka et al.* 2011; *Bongaarts/Sobotka* 2012). Thus, in an international comparison, Germany stands out as the country with a history of more than 40 years of negative natural population growth and a total fertility rate that is consistently below 1.5 children per woman. It is beyond the scope of this article to investigate the reasons for this exceptional process and the apparent futility of all pronatalist governmental policies. Rather, the purpose of this study is to investigate whether a permanently high level of net immigration, as in the past three years, may prevent population decline until mid-century despite this quite spectacular record of a continuous birth deficit.

So far, the impact of fertility decline on society and the economy has arguably been rather low. In 2012, both the absolute and relative sizes of the workforce were at record highs in Germany (*Statistisches Bundesamt* 2013c: 115). This indicates that Germany is still at a point in demographic transition where the economic benefits arising from the decline in the young dependent population are not yet fully cancelled out by the growing retirement-age population (the so-called "demographic dividend", see *Bloom et al.* 2003): The dependency ratio (aged 0-14 and 65 or older relative to the working age population aged 15-64) is currently (0.51) still lower than in 1970 (0.57), before the onset of negative natural population growth. However, this will dramatically change in the coming two decades, when the baby boomer

[1] This and the following statement refer to West Germany before and unified Germany after 1990. The fertility rate in East Germany was higher prior to 1990 (*Kreyenfeld* 2004), but in total, East and West Germany still displayed a consistent death surplus since 1972. Data sources for this and the following statements are *Statistisches Bundesamt* (2013d) and United Nations (yearly).

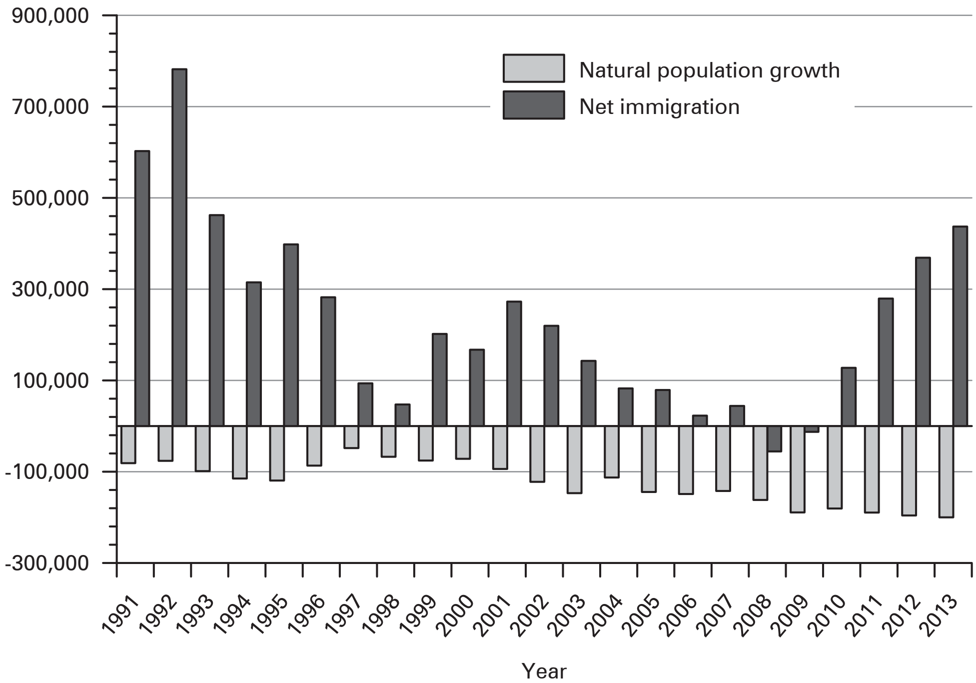
cohorts born in the 1950s and 1960s retire. Between 2025 and 2035, 13.4 million people now aged 45 to 55 will drop out of the labour force (assuming a retirement age of 67 and ignoring future migration and pre-retirement age mortality), while only 6.9 million – about half that number – of currently 0 to 10 year olds will enter the workforce. This obviously poses a great challenge to the pay-as-you-go pension system and Germany's export-oriented economy. The number of taxpayers will shrink disproportionately compared to a sharp increase in retirees, and companies may struggle to replace their retiring employees. Furthermore, population decline will affect some geographical regions and branches of the economy more than others. The number of college graduates in the fields of social sciences, law and economics, for instance, has more than doubled between 1995 and 2011 (from 50,400 to 114,200) in Germany, while the number of engineering graduates has risen only mildly during that same period (from 50,600 to 65,100; see *Statistisches Bundesamt* 2012a: 44-45). It can thus be assumed that a shortage of labour will more likely hit sectors recruiting from the latter group as opposed to the former (which is already the case to some extent, see *Bundesagentur für Arbeit* 2013).[2]

It should be noted, however, that population and labour force decline do not necessarily have only negative consequences in the eyes of public opinion (see, e.g., *Coleman/Rowthorn* 2011). All other things being equal, population decline may lead to, among others, a decrease in housing prices, less traffic, and less pollution. Moreover, if the demand for labour does not decrease in equal proportions, a decline in the labour force may lead to an increase in wages or a falling unemployment rate. While we cannot elaborate in greater detail on the likelihood or the desirability of such outcomes here, it should be emphasized that not every aspect of population decline and aging needs to be perceived as negative by a majority of the population.

Official projections estimate the population will drop from currently more than 80 million to between 65 and 70 million by 2060 (medium variant, lower and upper limit, see *Statistisches Bundesamt* 2009). The prospects of a declining German population are widely considered to be beyond question and are communicated as such in the media (see, e.g., *Spiegel* 2008; *FAZ* 2010; *New York Times* 2013). In recent years, however, immigration to Germany has risen to a considerably higher level than the official projections had assumed. In 2013, deaths outnumbered births in Germany by around 200,000; yet in the same year, immigrants outnumbered emigrants by 437,000, constituting the largest net immigration rate since the early 1990s and a remarkable increase since the year 2009, which had seen more emigrants from than immigrants to Germany (see Fig. 1). That year, the Federal Statistical Office (*Statistisches Bundesamt* 2009) estimated the latest Coordinated Population Projection. The models included two assumptions with regard to external migration: one variant assumed a net immigration of 100,000 from 2014 on, while

2 A shortage of skilled labour may be even more severe in branches that traditionally recruit from the German dual system of vocational education (as already reported in *Bundesagentur für Arbeit* 2013), given the recent sharp increase in tertiary education: The share of college entrants within each cohort rose from 29 percent to 43 percent between 2000 and 2011 (*Statistisches Bundesamt* 2012a: 15).

Fig. 1: Net immigration and natural population growth in Germany, 1991-2013



Source: data Federal Statistical Office, own illustration

the other variant calculated 200,000 from 2020 on. Probably unforeseeable in 2009, the actual annual net immigration to Germany in the years 2011 to 2013 by far surpassed the rate assumed in the higher immigration variant of the official projection.

It is uncertain whether migration inflows will continue at this level. On the one hand, improving economic conditions in southern Europe may lead to less labour migrants especially from Greece, Spain, and Italy as compared to the recent years since the onset of the financial crisis. Moreover, the countries in central-eastern and southeastern Europe – from where Germany currently receives the most migrants – are themselves characterised by aging populations and their future emigration potential may therefore decrease drastically. On the other hand, unrestricted access to the German labour market for Romanians and Bulgarians since 2014 may at least in the near future give rise to labour migration from these countries, as has been the case with Poland and other EU-10 countries since 2011, when labour market restrictions for these citizens were dropped.[3] Furthermore, the repeated refugee ship tragedies off the Italian coastlines and the civil war in Syria, among other events, have led to debates about less restrictive asylum regulations. Finally, while the migration potential may decrease in central-eastern Europe, the opposite is likely to be true for Africa and the Middle East in the coming decades, given the prospects for population growth – especially in the age group 20 to 35 – in these regions, which has been shown to influence migration rates (*Cohen et al.* 2008; *Mayda* 2010). In any case, we should consider the possibility that the official projections underestimate the long-term immigration rates to Germany. Therefore, this paper aims to investigate how ongoing higher net immigration rates would affect the demographic prospects of Germany and its ethnic makeup.

2 Research design and methodology

The purpose of this study is to show how the official population forecasts for Germany would change were there permanent higher-than-expected future immigration rates of a magnitude as in recent years (2011 to 2013). It therefore follows the Federal Statistical Office's (*Statistisches Bundesamt* 2009) 12th Coordinated Population Projection, adopting all its major assumptions but adding a higher immigration variant and two variants with regard to fertility among migrant women.

2.1 Defining ethnic minorities

Apart from the consequences for the total population size, these projections also seek to assess the impact of immigration on the ethnic makeup of Germany's population. One of the biggest difficulties of this task is defining ethnic groups and the rules for assigning them to individuals. There are different approaches to this topic based on differences in underlying concepts of national or ethnic identity as well as on national laws and customs of data collection. In Germany, at least two historical factors have influenced the definition of racial and ethnic minorities. On the one hand, there was a long tradition of an *ius sanguinis* nationality law, such that children born to foreigners in Germany were not granted German citizenship by birth unless they had some ethnic German ancestry (see, e.g., *Brubaker* 1992). On the other hand, after the racially motivated persecution in the Nazi era, German authorities usually refrain from using concepts such as race or ethnic ancestry in official censuses or surveys. As a result, until recently ethnic minorities in post-

3 Yearly inflows from Poland had been quite constant in the years before the 2004 enlargement, when they increased to 125,000, up from 88,000 in 2003. 2011 saw another significant increase, when 163,000 people entered the country from Poland, as compared to 115,000 in 2010. The most recent value (189,000 in 2013) is twice the figure of 2003 (cf. *Statistisches Bundesamt* 2014b). Needless to say, there is no guarantee that this trend will be lasting, nor that a similar increase will occur with regard to Romanian and Bulgarian migrants from 2014 on, especially since a large number of Romanians had already migrated to Spain and Italy in the previous decade.

war Germany have been almost exclusively analysed by looking at residents with foreign citizenship. This worked well for a long time, given the fact that even most second- or third-generation native-born residents of foreign origin did not hold German passports. This has changed, however, since the introduction of *ius soli*-type elements, i.e. German citizenship by birth to children of foreign parents under some conditions, to German nationality law in the year 2000. Among 25-35-year-old German-born residents with at least one foreign parent, for example, only a minority (41 percent) were German citizens in 2012. However, this figure rises to 88 percent among the age group of 0 to 10 years (*Statistisches Bundesamt* 2013a). The Federal Statistical Office introduced the concept of "migration backgrounds" in 2005, which covers both foreign- as well as native-born residents of Germany with at least one foreign or foreign-born parent (excluding all persons who themselves or whose parents came to Germany before 1950, e.g., as expellees from central-eastern Europe in the aftermath of World War II or in previous migration waves, which were apparently not assumed to be relevant for analysing the current ethnic diversity in Germany). Data on residents with "migration backgrounds" come from the micro-census, a household survey with a sample size of around 1 percent of the total population. Survey questions on "migration backgrounds" were first included in 2005.

Since official statistics on ethnic affiliation based on self-ascription as used in the U.S. census do not exist in Germany, this study works with the concept of "migration backgrounds" and uses this definition as a proxy variable for "ethnic minority status." Obviously, no assertions can be made regarding subjective ethnic identity or cultural assimilation among people of migrant or mixed origin in the future, or the possible changes in future public discourse with regard to those labelled "minority members." This paper addresses the quantitative question of how many future residents will be first- or second-generation immigrants, depending on future levels of immigration and fertility among migrant women, but we do not intend to speculate here whether this will be of any sociological significance in the future. The study thus looks at:

- first-generation immigrants, defined as future newcomers to Germany in addition to foreign-born residents already living in the country,
- second-generation immigrants, defined as native-born residents with at least one foreign or foreign-born parent, and
- persons with migration backgrounds, defined as being either of the above.

The migration background concept as used by the Federal Statistical Office also applies to the third generation in cases where at least one of the parents, despite being native-born, is a foreign (or naturalised) citizen. As the percentage of second-generation immigrants with (exclusively) foreign nationality is rapidly declining (from 59 percent to 12 percent among children aged 0 to 10 in the past 20 years), the proportion of third-generation immigrants covered by the official definition will diminish as well. For the sake of simplicity, all children born to second-generation immigrants in the future are therefore treated as natives in this projection. Moreover, the impact of future unions between natives and immigrants is neglected. Mixed unions may lead to a numerically higher proportion of migrant-origin residents.

2.2 Data and methods

The official population projections are based on traditional point forecast models which vary several key parameters and designate the resulting variants as "high," "medium," "low," etc. It has long been argued that a stochastic approach, indicating confidence intervals and probability estimates, is preferable for long-term population forecasts (e.g., *Lutz et al.* 1998; *Keilman et al.* 2002). However, estimating long-term prediction intervals for future immigration rates – which are the main scope of this article – is more difficult than projecting parameters such as the number of births or the old-age dependency ratio, as these are path-dependent factors that in most cases do not change abruptly, while immigration rates are highly sensitive to unpredictable changes in push- and pull factors such as economic growth, political violence and war, or migration-related policies in various countries.

Projections for future immigration rates can be based on expert estimates or surveys among potential migrants, or they can use empirical data on past migration flows to develop forecasting models based on demographic, geographic, economic (such as wage and employment differences) and other factors (e.g., linguistic similarities, past colonial ties, civil war or human rights violations, stock of migrants already living in the country as an indicator of migration networks; see, e.g., *Pedersen et al.* 2008; *Brücker/Siliverstovs* 2006; *Cohen et al.* 2008). These factors themselves must be projected into the future by certain routines or expert judgments that are associated with some degree of uncertainty, whether quantifiable or not. For instance, *Brücker/Siliverstovs* (2006: 49) assume constant unemployment and GDP growth rates for sending and receiving countries in their projection of future migration flows to Germany. Future empirical deviations from such assumptions add to the amount of unexplained variance in the various econometric models (39-50 percent in the case of the aforementioned study) due to unobserved factors, which inevitably exist despite the vast number of variables and model specifications that the authors consider.

It is therefore not surprising that the recent substantial increase in immigration to Germany has not been predicted by these models. For instance, *Brücker/Siliverstovs* (2006: 50) projected a sharply declining net migration potential from the ten central-eastern EU accession countries (i.e., the new member states of 2004/2007 except Malta and Cyprus) to Germany from 98,000 in 2010 to 29,000 in 2015. The actual figure for 2010 was even below the projected number (80,000), but the recent increase to 189,000 in net inflows from these countries in 2013 (*Statistisches Bundesamt* 2014b) stands in marked contrast to the projections. Obviously, among other factors, the financial and fiscal crisis starting in 2008, which affected Germany less than other EU member states, could not have been taken into account in these projections (but this and other factors may well change in the near future). Studies that quantify the degree of uncertainty with regard to projected migration flows include *Alders et al.* (2007). Their projections of international migration rely on expert judgments, the extrapolation of past trends, and ad-hoc assumptions about which countries are likely to receive below- or above-average levels of net migration (*Alders et al.* 2007: 60). The limits of their 80 percent prediction interval for yearly net migration to Germany until mid-century are –80,000 and 640,000, respectively. This illustrates why *Brunborg* and *Cappelen* (2010: 323) write that "with rapidly changing migration flows, the confidence intervals easily become so large that they are of little or no value for users of the projections." Given the difficulties in predicting migration flows with a quantifiable degree of uncertainty, we consider it appropriate to make a point forecast based on fixed parameters of immigration as a "what-if" scenario to complement the existing official scenarios.

The starting point of the projection is the actual age pyramid of Germany as of December 31, 2012. Data from the 2011 census, as projected in *Statistisches Bundesamt* (2014a), have been combined with estimates on "migration backgrounds" among 5-year age groups from 2012 (*Statistisches Bundesamt* 2013a). The data on age cohort size for the total population were multiplied by two vectors containing the percentage values for foreign- and native-born residents of migration background, respectively, by age cohort. Missing values due to age cohort grouping were linearly interpolated. Hence, three separate matrices were obtained containing data for residents without "migration backgrounds", foreign-born residents, and second-generation immigrants, respectively. Newcomers are added to the foreign-born group; their children are members of the second-generation group, while *their* offspring in turn count as native (see 2.3). It should be noted that the population estimates based on the census of 2011 are significantly (around 1.5 million) lower than the projections based on the census of 1987, which prevailed in official publications and projections until mid-2013. As described above, the model differentiates between residents without "migration backgrounds," immigrants (i.e. foreign-born residents) and second-generation immigrants (i.e. native-born residents with at least one foreign-born parent). Distinguishing between the two sexes within each of these groups resulted in six separate matrices. For reasons of space, the projection algorithms are given for females only in the following. The size of a future age cohort from the first group is estimated as

$$N_{a,t} = N_{a,t-1} * S_{a,t}, \text{ for } a > 0, \tag{1}$$

where $N_{a,t}$ is the number of native females without "migration backgrounds" of age a in year t, $S_{a,t}$ is the age-specific survival rate for females (from *Statistisches Bundesamt* 2013e), varying by year as it has been linearly extrapolated to account for a rising life expectancy (see 2.2). The number of female newborns without "migration backgrounds" in a given year is estimated as

$$N_{0,t} = 0.49 \sum_{a=13}^{53}(F_a * N_{a,t}) + 0.49 \sum_{a=13}^{53}(F_a * M_{a,t}), \tag{2}$$

where F_a is the age-specific fertility rate and $M_{a,t}$ is the number of second-generation migrant women in a respective age group in year t, as their children (i.e. the third generation) are classified as natives. This group, in turn, is equallyforward-projected by

$$M_{a,t} = M_{a,t-1} * S_{a,t}, \text{ for } a > 0, \tag{3}$$

while

$$M_{0,t} = 0.49 \sum_{a=13}^{53}(G_a * I_{a,t}) \tag{4}$$

is the number of births to foreign-born women $I_{a,t}$ who count as second-generation migrants, given the differing age-specific fertility rate G_a for immigrant women. Finally, the foreign-born group grows by a yearly constant number of newcomers $C_{a,v}$, dependent on variant v and distributed across age groups:

$$I_{a,t} = I_{a,t-1} * S_{a,t} + C_{a,v}, \text{ for } a > 0, \tag{5}$$

$$I_{0,t} = C_{0,v}. \tag{6}$$

2.2 Underlying assumptions of the model

The parameters of the model have been mainly adjusted according to the medium or basic variants of the official projections:

The total fertility rate is assumed to remain constant at the present level of roughly 1.4 children per woman, following the Federal Statistical Office's medium variant. Certainly, a TFR of 1.4 is not considered an inevitable fate and no policy recommendation is being made here to conceive it as such. Yet, existing (point) forecasts expect Germany's TFR to remain at 1.4 until mid-century (*Alders et al.* 2007) or increase only marginally (to 1.47 by 2050 according to Eurostat, see *Scherbov et al.* 2008).[4] Given the fact that the TFR "seems to have stalled at a level of 1.4 children since the 1970s" (*Goldstein/Kreyenfeld* 2011: 454), it appears reasonable to fix this parameter for the present analysis. Age group-specific fertility rates are taken from the *Human Fertility Database* (2013) and are assumed to be distributed as in 2010. Further fertility postponement may occur as a result of, for example, the continuing growth of participation in higher education (*Ní Brolchaín/Beaujouan* 2012). On the other hand, the pace of fertility postponement is declining and tempo effects are projected to disappear in the near future (*Bongaarts/Sobotka* 2012). The official projections (*Statistisches Bundesamt* 2009) assume that the number of births to women aged 30 and over will rise, while the age-specific fertility rate for younger women is either assumed to decrease proportionately or over-proportionately or remain constant (which would result in a higher period TFR). As there is currently no coherent theory for the prediction of the future development of fertility, with (sociological, economic, or biological) arguments available in favor of both a rise as well as further decline (for an overview see *Lutz* 2006), for the sake of simplicity both period and cohort TFR are held constant in the present study.

4 Exceptions include the *United Nations* (2013: 75) who assume a rise in Germany's TFR to 1.64 by 2050, similar to the Federal Statistical Office's "higher variant."

Fertility patterns among native and migrant women are assumed to either remain constant (variant A), or fertility among foreign-born women will decline to 1.4 children per woman (variant B). According to *Statistisches Bundesamt* (2012b: 39), the total number of births to foreign-born women until the age of 39 was 1.9 children on average. As the difference between native and foreign-born women has remained quite constant over the past decades (*Statistisches Bundesamt* 2012b), Variant A of the model assumes that this trend will continue. However, there are some reasons to expect immigrant women's fertility rates to decline (see *Schmid/Kohls* 2009 for an overview of the determinants of migrants' reproductive behavior in Germany). Apart from a general fertility decline in most countries of origin and an expectable approximation of immigrant women to host country family customs, the growing share of central-eastern and south-eastern European immigrants, whose fertility rates are comparable to those among Germans, might lead to a convergence of birth rates among natives and immigrants (*Statistisches Bundesamt* 2012b: 23). For example, the completed fertility rate among migrant women aged 40 or older was 3.47 children for Turkish women compared to 1.53 children for Polish women (*Schmid/Kohls* 2009: 49). While Turks make up the largest group of foreign residents in Germany, Poland has been the number one country of origin for new arrivers in the past years. Fertility among migrants is thus likely to decline through this composition effect, in addition to other effects (e.g. socialisation). Therefore, the second variant assumes a fertility rate among the foreign-born of 1.4 children per woman, as for the current total population, with age-specific fertility rates equaling those of native women. It should be noted that the TFR for native women without "migrant backgrounds" might be below the threshold of 1.4, but no reliable data are available to distinguish native women with and without migration backgrounds. Second-generation immigrant women (whose children count as natives without "migration backgrounds") are assumed not to differ from native women with regard to period and cohort TFR due to a lack of reliable data on fertility among native-born women with "migration backgrounds."

Life expectancy is assumed to rise to about 87 years (85 for males and 89 for females) by 2050 according to the Federal Statistical Office's base assumption (*Alders et al.* 2007 as well as *Bijak et al.* 2007, among others, project similar values). In the past, reality has disproved projections of a decreasing slope in the rise of life expectancy and the trend has instead been rather linear (*Oeppen/Vaupel* 2002). For the lack of a more plausible alternative assumption, the model specifies a continuously linear trend. The probability of surviving from birth to age 85 is thus assumed to be 50 percent in 2050 (up from 30.1 percent in 2011) for males and rises linearly until then. The same is true for females until the age of 89. Age-specific survival rates have therefore been multiplied by an interpolated factor such that survival rates linearly increase within each age group until reaching the target value for 2050. Obviously, a rise in life expectancy will affect the age-specific survival rates of older age groups more than those of younger cohorts, which are already close to 1. Therefore, the inflating factor has been weighted by an exponential weight variable to affect older age groups more than younger ones. As a result, for instance, the probability of surviving the next year for a 30-year-old male rises from 99.94 percent to 99.96 percent, whereas the same probability for an 85-year-old male rises from 89.1 percent to 92.1 percent.

Four different variants are calculated for external migration rates. Two of them correspond to the variants included in the Federal Statistical Office's official projection, assuming annual net migration inflows of 100,000 and 200,000, respectively. A high-migration variant assumes an annual net immigration of 300,000, based on recent trends in migration to Germany, whereas a zero variant assumes balanced external migration and is included for comparison. The 10th Coordinated Population Projection, published in 2003 (*Statistisches Bundesamt* 2003), still included a variant assuming 300,000 immigrants per year, in light of an average annual net migration of 335,000 in the period of 1991 to 2000. The follow-up projections have dropped this variant given low immigration rates in the 2000s. Recent increases in net migration (see fig. 1) suggest reconsidering the 300,000 variant. Changes in cohort size and age structure as a result of net immigration are supposed to be limited to foreign nationals, while external migration of native Germans is assumed to be balanced and without impact on the age structure. Note, however, that net migration of German nationals has been negative since 2005, but the data do not show a coherent trend. Migrants are assumed to continuously have the same age and sex distribution as the new arrivers in 2012 did (as reported in *Statistisches Bundesamt* 2014c). Most migrants are males aged 20 to 24 (16 percent of all male immigrants), the modal value being 22 years. In total, 60.3 percent of all newcomers in 2012 were reported to be male.

Tab. 1: Overview of variants included in the projection model

	TFR among migrant women	
	remains at 1.9 children	declines to 1.4 children
External migration		
zero net migration	Variant 1A	1B
100,000 per year	2A	2B
200,000 per year	3A	3B
300,000 per year	4A	4B

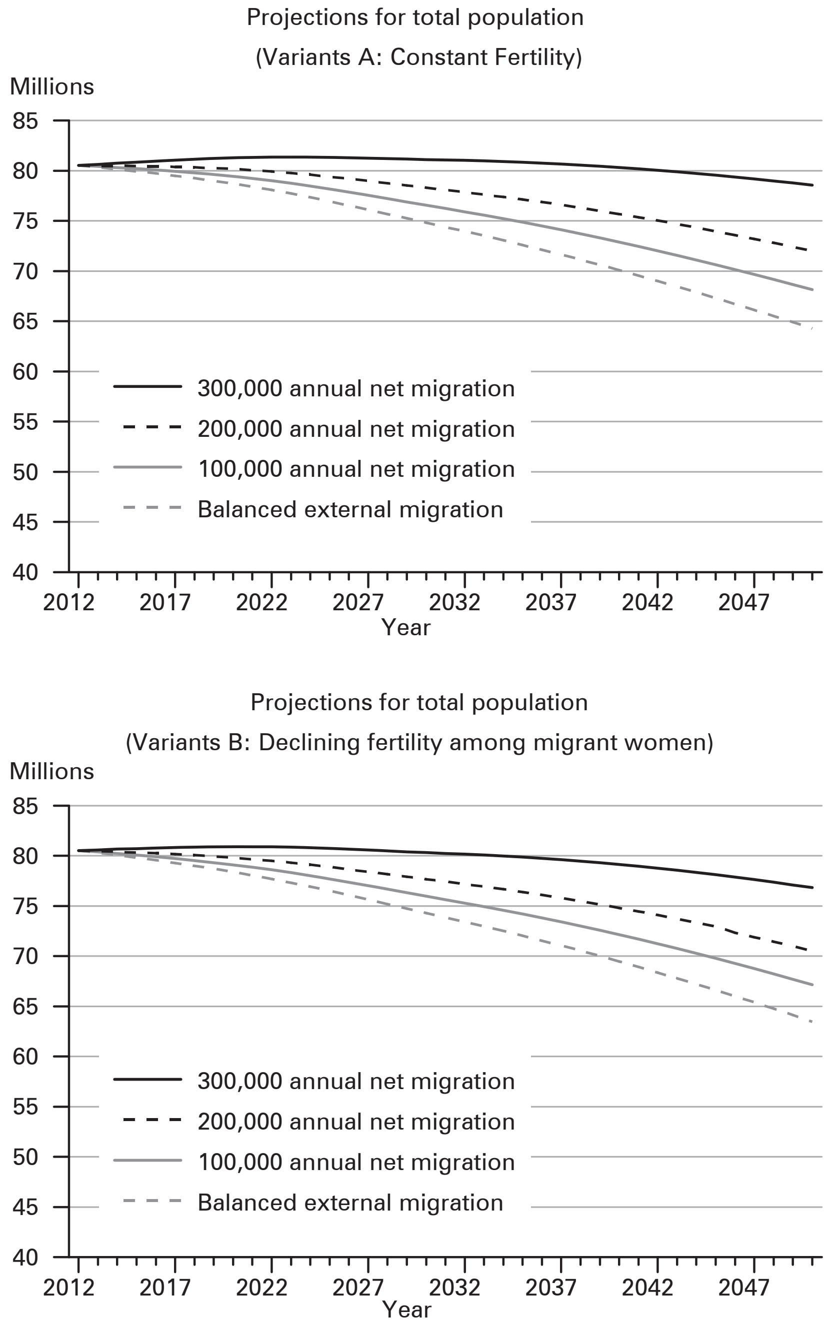
Source: own design

3 Results

3.1 Total population size

Figure 2 shows the results of the projections, with the upper graph displaying the constant fertility variants (1A to 4A) while in the lower graph migrant women's birth rates are assumed to decline to the present TFR among the total population in the future (variants 1B to 4B). As the graphs show, the model reproduces the Federal Statistical Office's forecasts for the annual net immigration assumptions of 100.000 and 200.000, respectively (variants 2 and 3). Similar to the official projections, a de-

Fig. 2: Projections for Germany's population (in millions) by mid-century



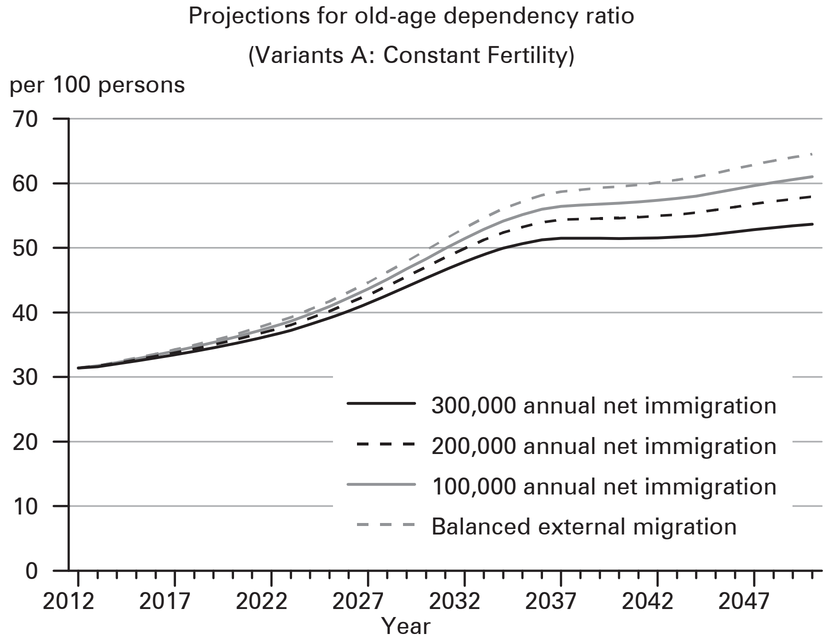
Source: own calculations

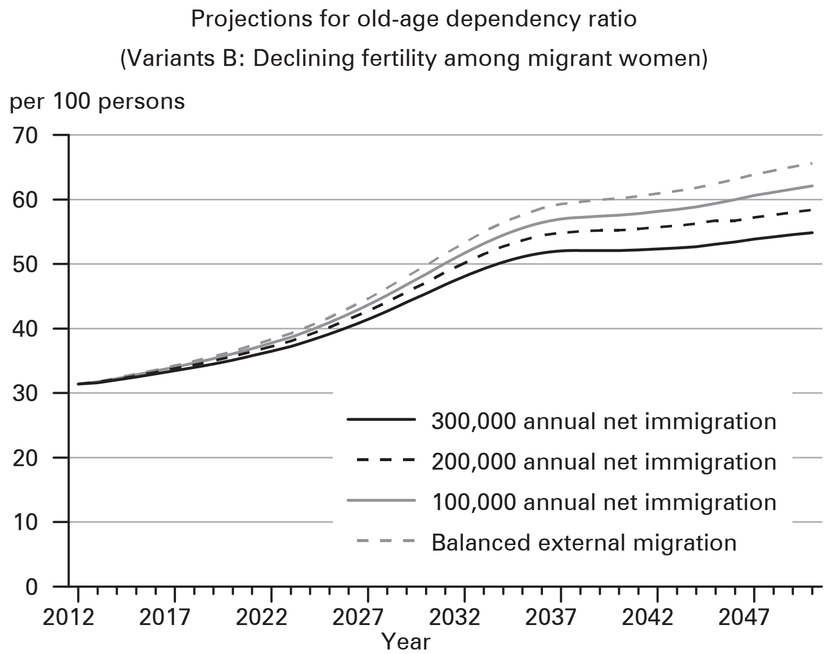
clining population to between 67 and 72 million in 2050 is forecasted for these two scenarios. If Germany were to experience permanently higher immigration rates of around 300,000 per year, however, according to the projections the population would not significantly decline by mid-century and would continue to be around 80 million until 2050. After 2050, population decline is probably inevitable if fertility rates do not rise. Until then, Germany may achieve stationarity through immigration (cf. *Schmertmann* 1992), despite a then 80-year pattern of birth deficit and death surplus. The lower graph in Figure 2 shows that the mid-century population can be expected to be slightly lower if fertility among native and migrant women converges as opposed to the constant fertility variants. In the scenario where fertility among migrant women declines and external emigration is balanced, Germany's population drops by more than 17 million to around 63 million by 2050.

3.2 Old-age dependency ratio

With or without immigration, the percentage of retirees among the total population will greatly increase in the coming decades. As Figure 3 shows, the old-age dependency ratio (the number of people aged 65 or older relative to the working age population of 15-64 years) is projected to rise from currently 0.31 to between 0.54 (Variant 4A) and 0.66 (Variant 1B) by 2050. We can thus conclude that while high immigration rates could prevent population decline until around 2050, they would only mitigate the challenge of population ageing to a relatively small extent, even though new immigrants are significantly younger than the resident population. This finding is consistent with the *United Nations Population Division's* (2000) report about "replacement migration," which in the year 2000 estimated that Germany needed 344,000 immigrants per year to keep the population at a constant level until 2050, while an absurdly high annual inflow of 3.6 million (or 181 million in total until 2050) would be needed to maintain the old-age dependency ratio at the 2000 level (for the development and public reception of this study, see *Teitelbaum* 2004; similar results have been obtained by *Bijak et al.* 2008). An annual net immigration rate of 300,000 instead of 200,000 would result in six million additional people living in Germany, yet would lower the old-age dependency ratio by only 3-4 percent (see Appendix for details). From around 2035 on, the slope will be less steep in any case, as the cohorts reaching retirement age from then on are already post-baby boom. Starting in the late 2030s, all retirees will already have been born in the low-fertility period, so that the gap between the number of retirees and the number of young people entering the workforce each year will be much smaller than in the period from 2025 to 2035. The most challenging period of the demographic transition therefore certainly lies ahead for Germany, specifically in the next two decades.

Fig. 3: Projected number of people aged 65 or older per resident in age group 15 to 64





Source: own calculations

3.3 Share of ethnic minorities

Figure 4 displays the projected impact of different scenarios of immigration and fertility rates on the ethnic makeup of Germany. While immigration can only moderately affect Germany's future age structure, the influence on the percentage of ethnic minorities is significantly greater. In the high immigration and constant fertility scenario, first- and second-generation migrants will make up 35 percent of the total population in 2050. With zero immigration and migrants' fertility as low as natives', the share of residents with "migration backgrounds" would stagnate at around 20 percent until mid-century. With future immigration rates as assumed in the official projections (100,000 or 200,000), the share of first- and second-generation migrants is projected to rise to 24 percent in the lowest (2B) and 29 percent in the highest variant (3A).[5] Whether birth rates among migrant women remain at 1.9 or decline to 1.4 children per woman has only a marginal impact on the projection results with regard to this indicator. If the third generation of migrants is included in the definition of "migration background" as well, then the share of the latter group rises above 40 percent in the high immigration scenario.

We must emphasize again that it is difficult to define who belongs to an ethnic minority group and that patterns of subjective ethnic identification may develop differently. In case of ongoing net migration of a magnitude as in recent years, however, we can project that the share of the population with a foreign background will rise significantly in the future, even if the third and later generations of immigrants or minorities are defined as natives. Moreover, the distribution of immigrants and ethnic minorities will probably continue to be uneven across the country. The percentage of residents with "migration backgrounds" currently ranges from only around 1 percent in some east German districts to more than 50 percent in the city of Offenbach near Frankfurt am Main. In many west and south German urban agglomerations such as Frankfurt am Main, Munich or Stuttgart, the majority of children today are already being born into migrant families.[6] The possible economic (e.g., *Rowthorn* 2008; *Glitz* 2012) or social (e.g., *Schlueter/Wagner* 2008; *Eger* 2012) implications of this trend are beyond the scope of this study. Yet from a demographic point of view, we can project that variance in future immigration rates will have a greater impact on the ethnic composition of society (as visualised by the diverging curves in Fig. 4) than on its age structure (and thus the dependency ratio).

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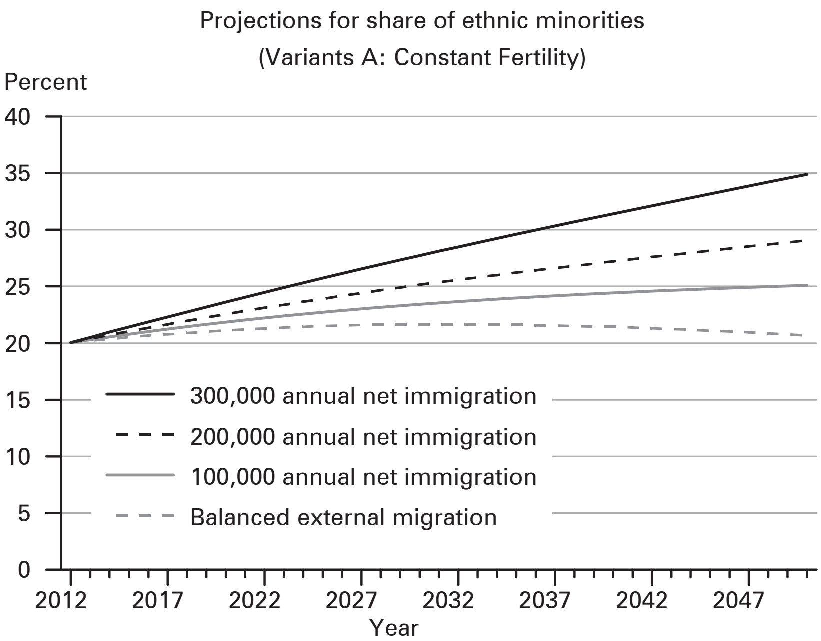
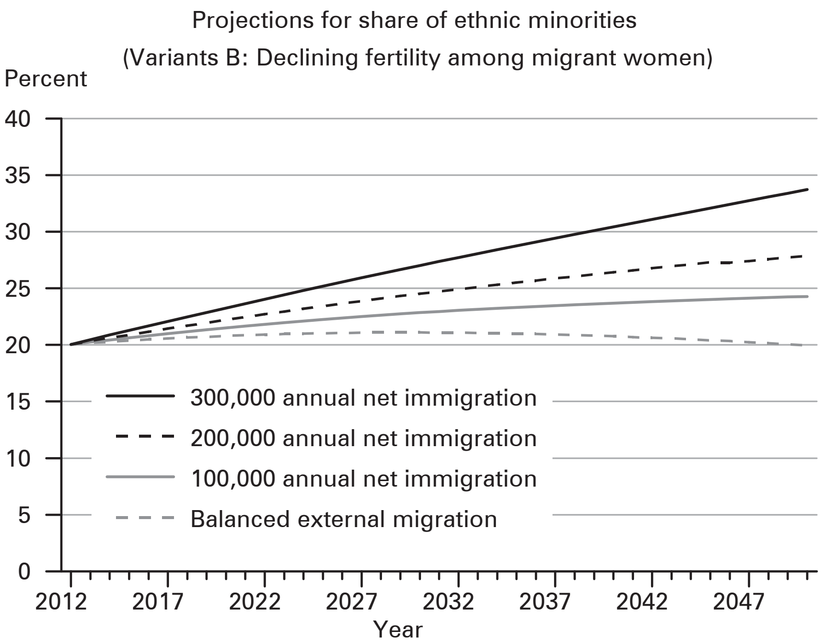
5 *Lanzieri* (2011) has somewhat higher results (32-39 percent residents of foreign origin in Germany by 2051) with a number of yearly net inflows fixed at around 155,000 on average per year. The differences can probably be attributed to the divergent definitions of "foreign origin." In the present study, around 4-6 percent of the projected population in 2050 is made up of third-generation immigrants who are not included in the definition of "migration background" in Figure 4.

6 For the share of foreign nationals on local (NUTS-3) level, see S*tatistische Ämter des Bundes und der Länder* (2013b). For the share of people and children with "migration backgrounds" in selected cities and regions, see *Statistische Ämter des Bundes und der Länder* (2013a). The latter source is based on the micro-census survey, but several cities also use special software such as "MigraPro" to determine the number of residents with "migration backgrounds" from their register data.

Fig. 4: Projections for the share of people with "migration backgrounds"





Source: own calculations

4 Conclusions

Contrary to the widely held assumption, Germany's population may not decline significantly by mid-century. Ceteris paribus, an annual net immigration of 300,000 per year could prevent population decline until 2050 and cause the number of inhabitants in Germany to stay roughly around 80 million. This would be the case if annual inflows would be as high as in 2011-2013 (and during the 1990s). The share of first- and second-generation immigrants would rise to around 35 percent by mid-century (or above 40 percent including the third generation). The economic and social consequences of such an increase are disputed and cannot be assessed here, nor can we discuss the question whether it is ethically justifiable to draw on working-age immigrants to mitigate one's own demographic problems, thereby potentially causing difficulties in the countries of origin where these people may be needed as well. It is furthermore impossible to estimate the numerical likelihood of this higher net-inflows scenario; but given the recent increase in net immigration to more than 400.000 in 2013, the possibility should be considered. With less immigration, Germany's population would indeed decline.

In any case, increased immigration rates could only slightly ease the problem of the sharp increase in the old-age dependent population in the coming decades. This increase is an obvious result of the baby boomer cohorts retiring between 2025 and 2035. After this period, the gap between the annual number of retirees and the number of young people entering the workforce will abruptly decrease due to the fact that the retirees will themselves have been born in the era of below-replacement fertility. Increasing the annual number of immigrants from 200.000 (as in the Federal Statistical Office's high assumption) to 300.000 would result in a mere 3-4 percent decrease in the old-age dependency ratio by 2050, despite adding six million people to the total population.

If a stationary total population by mid-century is considered desirable, immigration rates as high as in the 2011-2013 period are probably the only practicable means of achieving this goal. However, the main challenge arising from the demographic transition is arguably the rise in pensioners alongside the decline in the working-age population rather than a reduction in the total population (which may, after all, involve some desirable effects as well in the eyes of the public). This challenge is probably best met by means other than (or in addition to) immigration, as the latter only affects the old-age dependency ratio to a limited degree. Such means may include increasing the labour market participation of older workers, as only about one in two men aged 55 to 64 in Germany is active in the labour force – a sharp decline since the 1970s and a considerably lower value than in other developed countries (*Cooke* 2006). Policy changes to reverse this trend have already been implemented, but with disputable effects so far (*Buchholz et al.* 2013). In total, the *Federal Statistical Office* (*Statistisches Bundesamt* 2013c: 117) estimates an unused potential of almost seven million unemployed, underemployed and other non-active members of the labour force seeking work. This number is larger than the gap in the labour force that will occur when the baby boomer cohorts retire between 2025 and 2035. And since many of them are women, better opportunities to combine career and children are an obvious measure that policymakers may want to pursue. Germany is still enjoying the "demographic dividend," the concurrence of few children and a so far moderate number of old-age dependent persons. This will naturally change in the coming decades, but the major challenge will diminish after 2035. Until then, there appear to be sufficient options to address the issues associated with a shrinking and aging population, including, but not limited to, a higher future net immigration.

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Date of submission: 13.01.2014 *Date of acceptance: 12.09.2014*

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Appendix

Tab. A1: Projections for total population size of Germany (Variants 1A to 4B)

	2012	2015	2020	2025	2030	2035	2040	2045	2050
1A	80,523,746	79,943,606	78,712,754	76,956,442	74,820,431	72,604,367	70,093,612	67,313,747	64,275,910
2A	80,523,746	80,206,238	79,439,687	78,179,468	76,560,786	74,870,562	72,888,291	70,639,514	68,136,344
3A	80,523,746	80,468,871	80,166,620	79,402,493	78,301,141	77,136,756	75,682,970	73,965,280	71,996,779
4A	80,523,746	80,861,381	81,285,443	81,335,207	81,109,840	80,852,897	80,325,585	79,556,807	78,566,364
1B	80,523,746	79,806,494	78,387,196	76,503,374	74,292,641	72,029,325	69,469,563	66,616,612	63,483,340
2B	80,523,746	80,067,989	79,103,054	77,695,508	75,974,939	74,205,982	72,139,954	69,779,349	67,136,866
3B	80,523,746	80,329,875	79,819,828	78,889,240	77,659,576	76,385,483	74,814,067	72,946,983	70,522,116
4B	80,523,746	80,719,074	80,909,327	80,741,110	80,317,003	79,869,092	79,134,127	78,115,400	76,829,202

Tab. A2: Projections for the share of residents with "migration background" in %

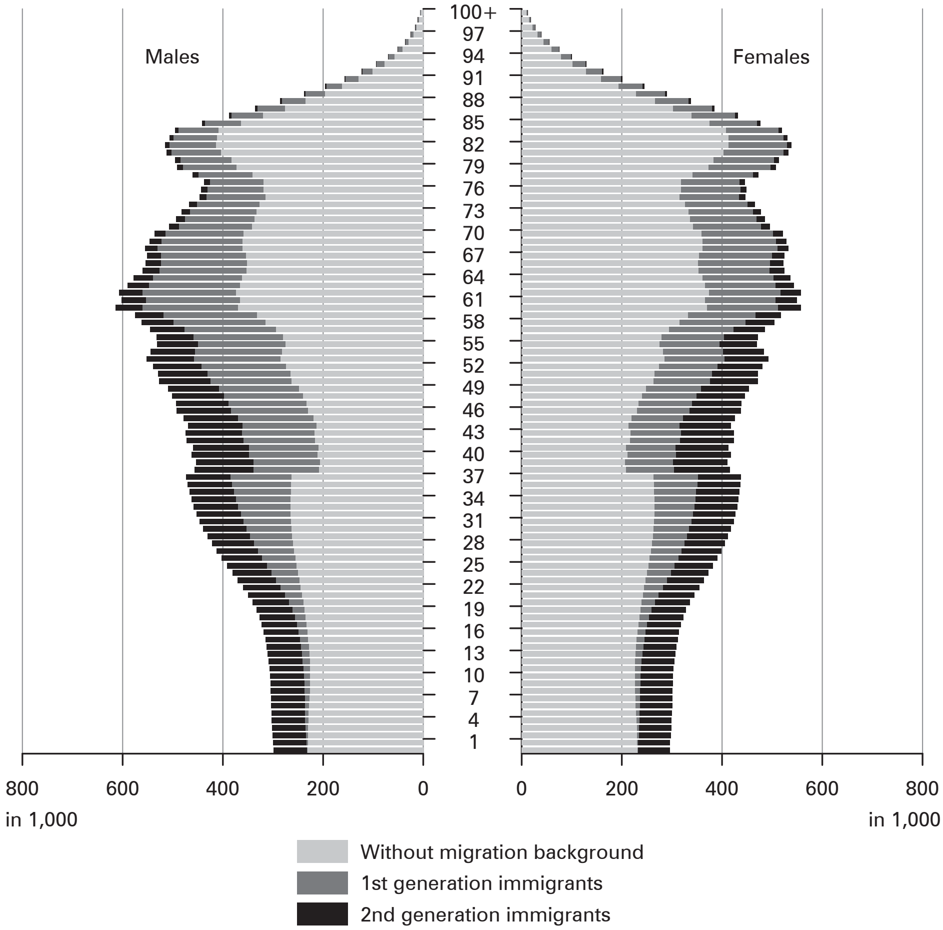
	2012	2015	2020	2025	2030	2035	2040	2045	2050
1A	20.05	20.51	21.12	21.50	21.66	21.61	21.42	21.10	20.66
2A	20.05	20.77	21.84	22.73	23.44	23.98	24.43	24.80	25.10
3A	20.05	21.03	22.55	23.92	25.14	26.22	27.22	28.16	29.07
4A	20.05	21.42	23.62	25.73	27.73	29.61	31.41	33.17	34.88
1B	20.05	20.38	20.79	21.04	21.10	20.99	20.76	20.42	19.96
2B	20.05	20.64	21.51	22.25	22.85	23.31	23.69	24.01	24.28
3B	20.05	20.90	22.21	23.42	24.52	25.50	26.41	27.30	27.88
4B	20.05	21.28	23.26	25.18	27.02	28.75	30.43	32.08	33.71

Tab. A3: Projections for old-age dependency ratio (people aged 65 or older/ people aged 15-64, per 100 persons)

Variante	2012	2015	2020	2025	2030	2035	2040	2045	2050
1A	31,18	34,95	39,53	45,89	54,11	60,33	61,20	62,49	63,88
2A	31,18	34,68	38,90	44,73	52,15	57,53	57,84	58,54	59,30
3A	31,18	34,42	38,31	43,68	50,43	55,15	55,13	55,50	55,98
4A	31,18	34,16	37,73	42,67	48,83	53,00	52,72	52,87	53,16
1B	31,18	34,95	39,52	45,85	54,09	60,51	61,74	63,55	65,56
2B	31,18	34,68	38,90	44,73	52,22	57,85	58,62	59,94	61,46
3B	31,18	34,42	38,31	43,68	50,50	55,46	55,87	56,85	58,04
4B	31,18	34,16	37,73	42,67	48,89	53,29	53,43	54,16	55,14

Source: own projections

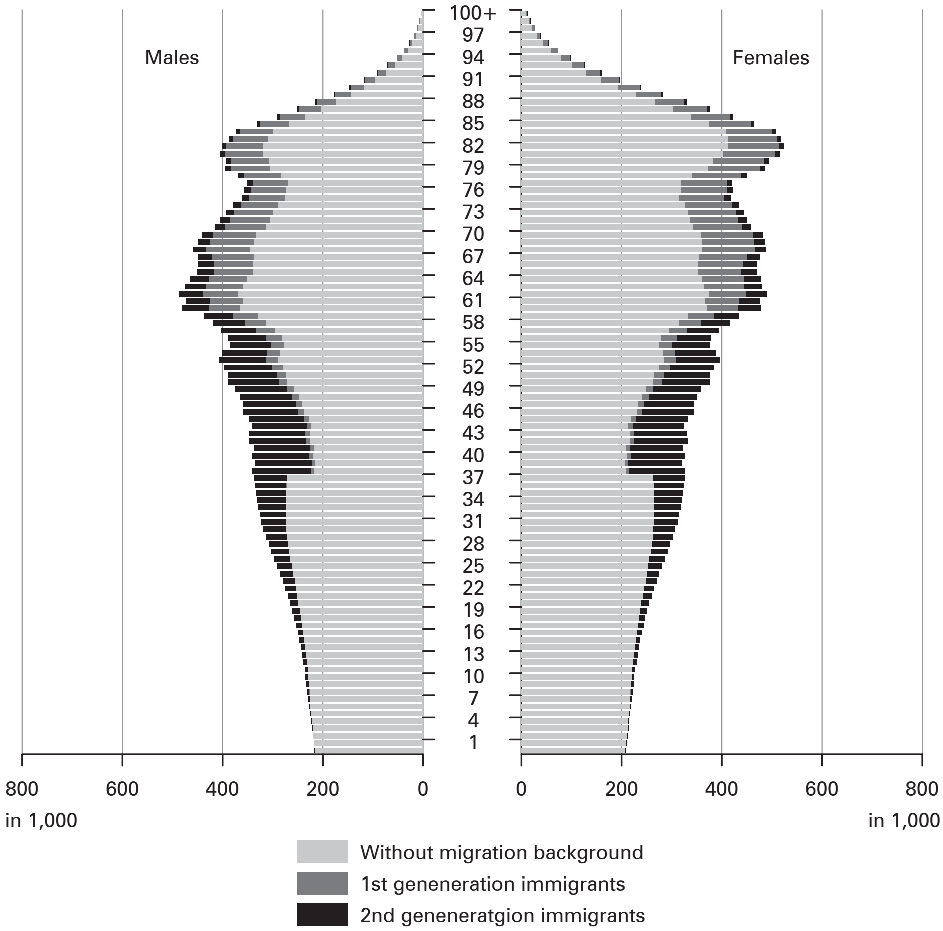
Fig. A1: Population pyramid of Germany in 2050 (High immigration variant 4A)



Note: The sudden increase in natives below the age of 38 is due to the projection defining second-generation migrants' children as natives. See text for details.

Source: own projections

Fig. A2: Population pyramid of Germany in 2050 (No immigration variant 1B)



Source: own projections

Comparative Population Studies

www.comparativepopulationstudies.de

ISSN: 1869-8980 (Print) – 1869-8999 (Internet)

Published by / Herausgegeben von
Prof. Dr. Norbert F. Schneider

Federal Institute for Population Research
D-65180 Wiesbaden / Germany

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