

Which of Europe's Migration-Receiving Countries Face Long Run Population Decline?

Nick Parr, Macquarie University

Abstract

This paper examines the differing long run population growth prospects of countries with below (conventional) replacement level fertility and positive net migration. For individual years between 2009 and 2018 for nine European countries, it compares the TFR to a replacement level which is adjusted to consider current migration, developed by Parr (2021). Results show in all or almost all years for Sweden, Norway and Switzerland the TFR is above the migration-adjusted replacement level, whilst for Hungary and Italy the TFR is below it. Germany's TFR rose from below migration-adjusted replacement to above it, whilst Finland's TFR fell from above migration-adjusted replacement to below it. The results show the population growth implication growth implication of an NRR below 1.0, when considered in combination with concurrent net migration and mortality, varies between countries and over time.

Introduction

Throughout Europe the Total Fertility Rate (TFR) is below the (approximately 2.1) replacement level, which in the absence of sustained immigration would prevent a long run population decline (Espenshade et al. 2004; Rindfuss 2016; Sobotka 2017; Gietel-Basten and Scherbov 2020). During and following the ‘Great Recession’ the TFR fell in most European countries (Matysiak et al. 2021). However, over the same time period, net migration was positive in a majority of European countries, with most of the exceptions being Eastern European countries. Population growth remains positive in most European countries (De Haas et al. 2019; UN 2019). If sustained, would the recent levels of fertility in Europe’s immigrant-receiving countries propel them towards long-run population decrease? Or would sustained immigration and its flow-on effects on births build larger future populations? How do the answers to the preceding questions vary from country-to-country? This paper aims to illustrate the heterogeneity of the long run population growth prospects of a range of European countries in which the Total Fertility Rate (TFR) is below the (approximately 2.1) replacement level and net migration is positive.

Long Run Zero Population Growth, Migration and Fertility

A population which experiences constant fertility below exact replacement level, constant mortality and constant net immigration amount with a fixed age composition will converge to a stationary state with non-zero size, zero growth and constant numbers by age (Cerone 1987; Espenshade et al. 1982; Pollard 1973). In Parr (2021) I formulated a critical level for fertility (which I termed the *Current Migration Replacement TFR*) which is coherent with zero long run population growth: with constant fertility at this level, constant net migration (measured in absolute terms) and constant mortality rates at the levels for a specified population and year the size of stationary population generated equals the actual population size for that year. If the TFR for a particular country and year exceeds this critical level then, with constant fertility, constant mortality and constant net migration at the levels for that country and year, the country’s population will eventually become larger in size than it currently is. Conversely, if the TFR is below this critical level it will eventually become smaller in size than it currently is.

Method, Data and Presentation

The size of the stationary population (P) which corresponds to sustained constant below-replacement fertility with a constant proportionate age distribution, in combination with constant absolute net immigration by age and sex, age-sex specific mortality rates, and sex ratio at birth at the levels observed for a specified population and time period can be expressed as the sum of components corresponding to generations of migrants (Espenshade et al. 1982; Schmertmann 1992):

$$P = \sum_{i=1}^{\infty} P_i \quad (1)$$

Where P denotes the total size of the stationary population, i is the migrant generation index, and P_i the size of the i th migrant generation. The size of the ‘first generation’ component in Equation (1) (P_1) is calculated by:

$$P_1 = M \sum_{j=1}^2 \sum_{x=0}^{\omega} m_{x,j} e_{x,j} \quad (2)$$

Where M denotes the constant annual total net migration, $m_{x,j}$ denotes the proportion of total net migration contributed by persons of age x (last birthday) and sex j (1 for female and 2 for male), $e_{x,j}$ is the (remaining) life expectancy for x and j , and ω is the maximum age of people in the population.

The ‘second generation’ component (P_2) is calculated by:

$$P_2 = M \text{ TFR} \sum_{j=1}^2 s_j e_{0,j} \sum_{x=0}^k m_{x,1} \sum_{t=0}^{k-x} f_{x+t} {}_t p_{x,1} \quad (3)$$

Where TFR denotes the Total Fertility Rate, f_{x+t} is the proportionate contribution to TFR from the age-specific fertility for age $x+t$, ${}_t p_{x,1}$ is the probability of a female surviving from x to $x+t$, k the upper limit of the female reproductive age range, s_j is the proportion of births of sex j , and $e_{0,j}$ is life expectancy at birth for sex j .

For all $i \geq 2$

$$P_{i+1} = \text{NRR} P_i \quad (4)$$

where NRR denotes the conventional (zero migration) net reproduction rate.

In Parr (2021) I show the value of the TFR which equates the stationary population size (P) to the current population size (POP) can be calculated by:

$$\text{Migration – Adjusted Replacement TFR} = \frac{\text{TFR}}{\text{NRR}} \times \frac{POP - P_1}{POP - P_1 + \frac{P_2}{\text{NRR}}} \quad (5)$$

Thus the migration-adjusted replacement level is the product of the (conventional) exact replacement level ($\frac{\text{TFR}}{\text{NRR}}$) and a ‘migration adjustment’ index derived from the sizes the first generation (P_1) and second generation (P_2) components of the stationary population and the NRR (Adjustment Index = $\frac{POP - P_1}{POP - P_1 + \frac{P_2}{\text{NRR}}}$). Due to this structure, I prefer here to refer to it as the

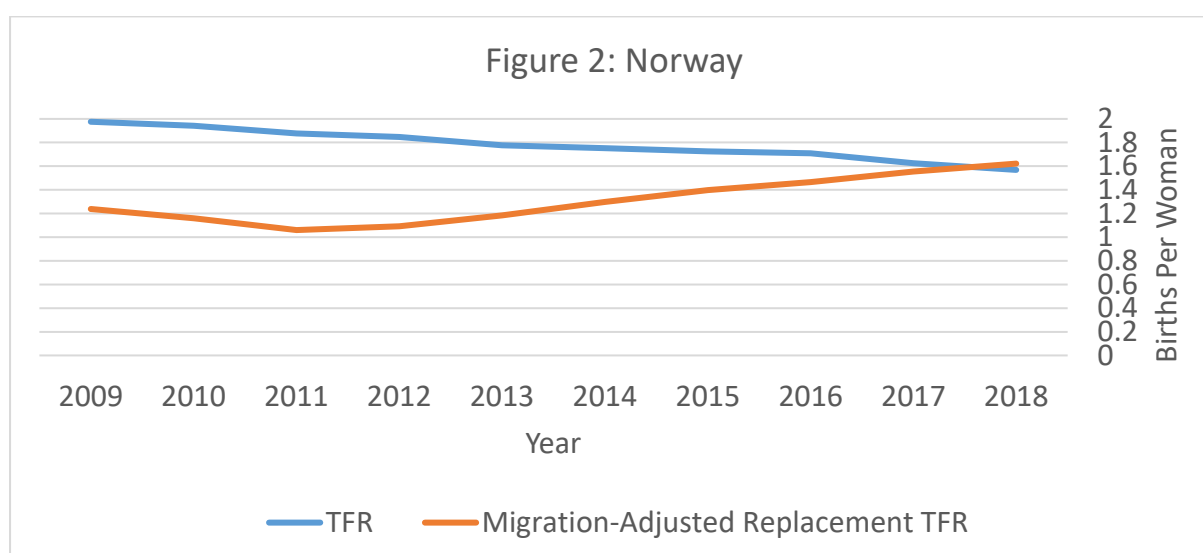
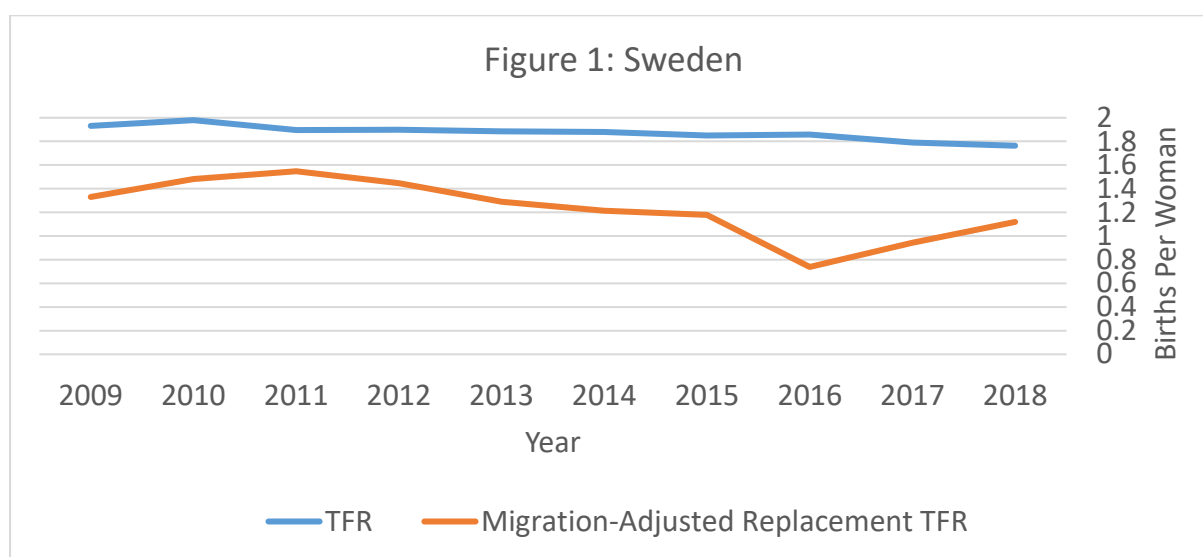
‘Migration-Adjusted Replacement level’ (MAR_TFR in the slides) rather than the term ‘Current Migration Replacement’ used in Parr (2021). The Migration-Adjusted Replacement level is strictly less than $\frac{TFR}{NRR}$ when P_2 is positive. Moreover, as net migration approaches zero, migration-adjusted replacement level approaches $\frac{TFR}{NRR}$ i.e. the (approximately 2.1) TFR which corresponds to an NRR of 1.0. Migration-adjusted replacement is not applicable to for some populations with very high net migration rates, specifically when the size of the current population (POP) is less than the size of the first-generation component of the TSP (P_1) or to populations with generally negative net migration for females of or below reproductive age, specifically those for which the value of P_2 is negative.

The analysis was restricted to the following countries for individual years between 2009 and 2018; Denmark, Finland, Germany, Hungary, Italy, Netherlands, Norway, Sweden, and Switzerland. The criteria for inclusion were; 1) that the country had a 2018 population in excess of 1.0 million; 2) that for all years between 2009 and 2018 all the requisite data for calculating migration-adjusted replacement level were available from the Eurostat website. 3) that for all years the estimated values of birth rates are within the admissible range i.e. non-negative and below (zero migration) replacement. The lack of data on immigration and emigration by age and sex from the Eurostat website for some or all of the years covered precluded coverage of a range of countries. For a substantial number of countries, particularly those with largely negative net migration at or below the female reproductive ages, were also excluded due to negative births being undefined.

The comparison of TFR to migration-adjusted replacement level is presented visually using line graphs. Thus whether the TFR for a particular country and year, in combination with the concurrent net migration and mortality for that country, is coherent with long run population increase or with long run population decrease is simple and immediately conveyed by whether the TFR (shown by the blue line) is higher than or lower than Parr’s (2021) migration-adjusted replacement level (shown by the orange line).

Results

In 2009 the TFR exceeded migration-adjusted replacement in six of the nine countries considered (Denmark, Finland, Netherlands, Norway, Sweden and Switzerland). The number of countries in which the TFR was ‘above replacement’ fell to three (Norway, Sweden and Switzerland) in 2013-14, rose to six (Norway, Sweden, Switzerland, Denmark, Germany, Netherlands) in 2015-16, before falling to three (Germany, Netherlands and Sweden) in 2018.

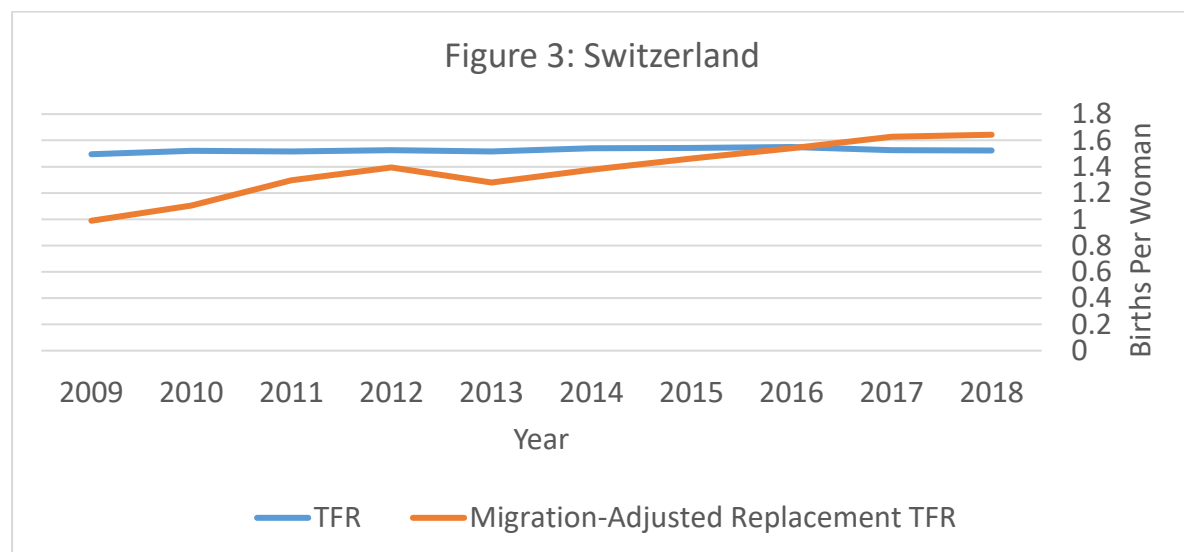


For Sweden the TFR was above migration-adjusted replacement level throughout 2009-18, and by considerable margins (Figure 1). The implication is that over the long run the population would increase were fertility, mortality and net migration to remain constant at the levels for any year. There was little change in the *TFR* over the period considered (a slight decrease is evident post-2010). The extent to which the TFR is above migration-adjusted replacement level generally increased, due to increases in the rate of net migration and, less importantly, to increases in life expectancy at birth and ages at birth (and hence, to a higher proportion of TFR accruing after (net) migration). The latter two trends are common across the countries considered. For Sweden migration-adjusted replacement level is in the ‘very low’ fertility range (below 1.5) for most of the period considered, and as low as 0.74 for 2016, a year in which the rate of net migration was particularly high. If sustained over the

long run, the fertility-mortality-net migration combination for 2018 would propel Sweden's population towards roughly triple its 2018 size.

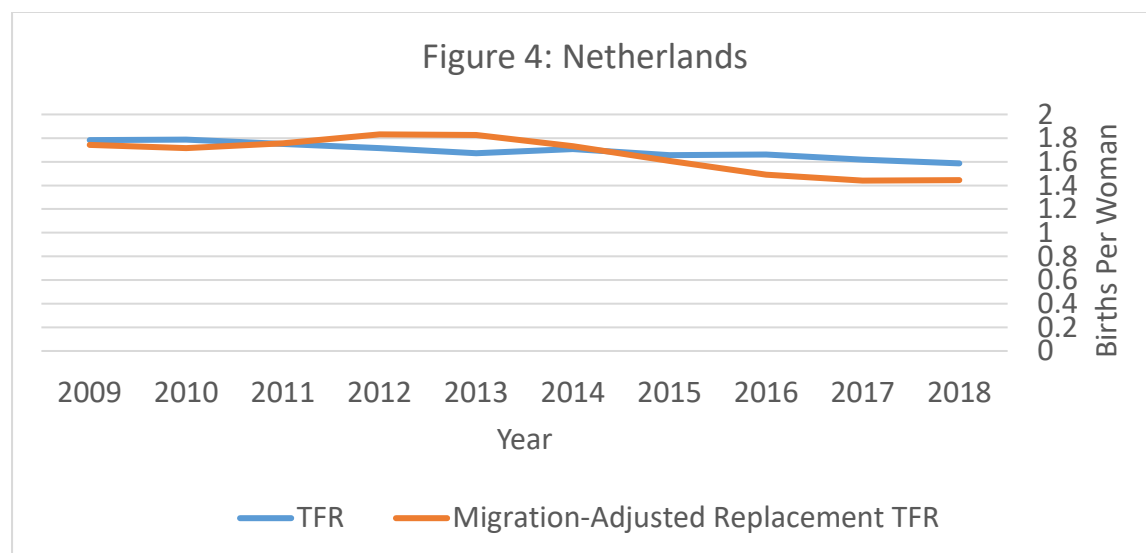
Similar to Sweden, between 2008 and 2011 the TFR for Norway considerably exceeded migration-adjusted replacement (Figure 2). However, a combination of a significant reduction in the TFR and an even larger increase in the migration-adjusted replacement level, primarily due to reduced net migration, progressively narrowed the gap between the two measures, and so much so that for 2018 Norway's TFR was marginally below migration-adjusted replacement.

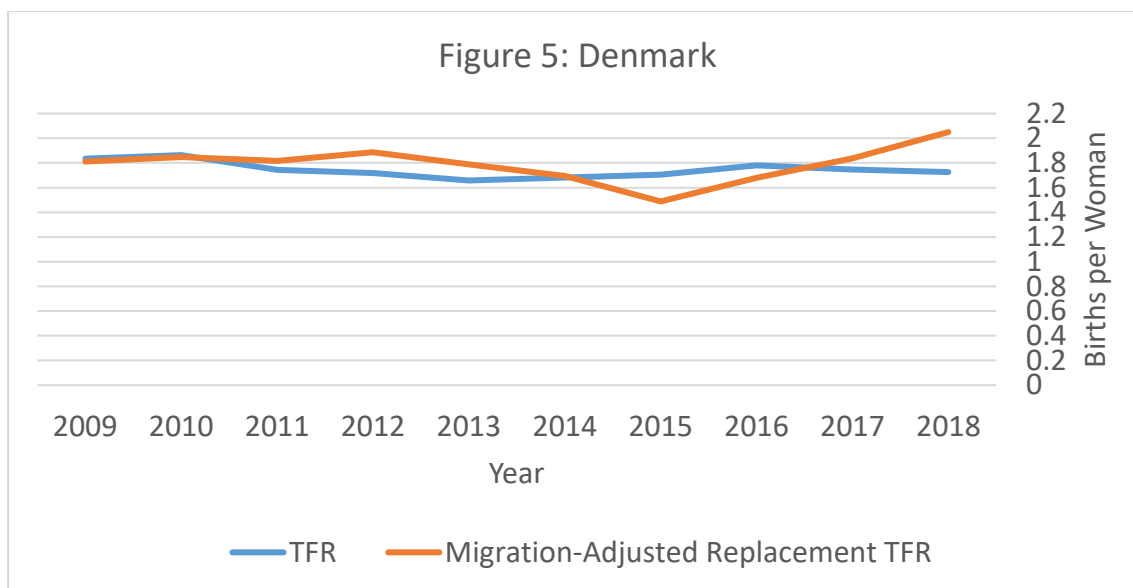
The TFR For Switzerland also exceeded migration-adjusted replacement for most of the period considered (Figure 3). The TFR for Switzerland remained more-or-less constant at around 1.5 births per woman throughout the 2009-18 period, considerably lower than the TFRs for Sweden and Norway. Despite this, except in 2017 and 2018, Switzerland's TFR was above migration-adjusted replacement. This outcome was primarily because of its very high rate of net immigration, one of the highest worldwide (UN 2019). The net migration rate fell considerably from 5.3 per 1000 population in 2009 to 4.2 in 2014, the year in which a referendum proposing to limit immigration from the European Union was narrowly approved, and further to 2.2 per 1000 population in 2018 (Randall 2016). Whereas for 2010, when the rate of net migration was 4.8 per 1000 population, the TFR of 1.52 is coherent with considerable long run population growth, in 2018 an identical TFR is coherent with a long run reduction in population.



For Netherlands, Denmark, Germany and Finland the TFR exceeded migration-adjusted replacement for between four and six of the 10 years considered. Between 2009 and 2011 the TFR for the Netherlands exceeded was above migration-adjusted replacement (Figure 4). The TFR decreased slightly between 2010 and 2018. The migration-adjusted replacement level fluctuated. Fertility was below migration-adjusted replacement between 2011 and 2014. Post-2015 a steeper decrease for migration-adjusted replacement than for the TFR, primarily due to a considerable increase in net migration and an increase in the mean age of net migration, resulted in an above migration-adjusted replacement fertility pattern.

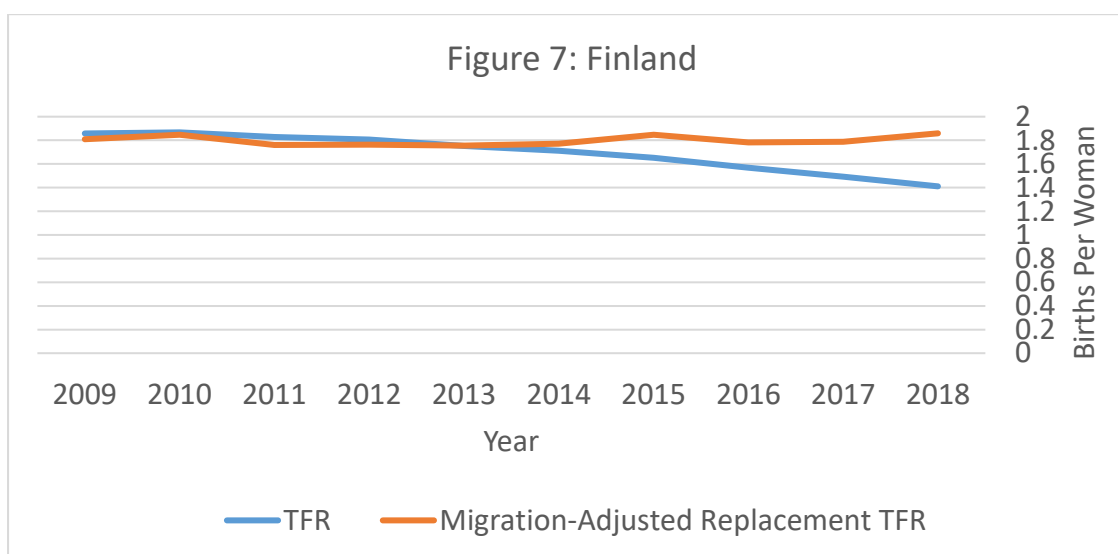
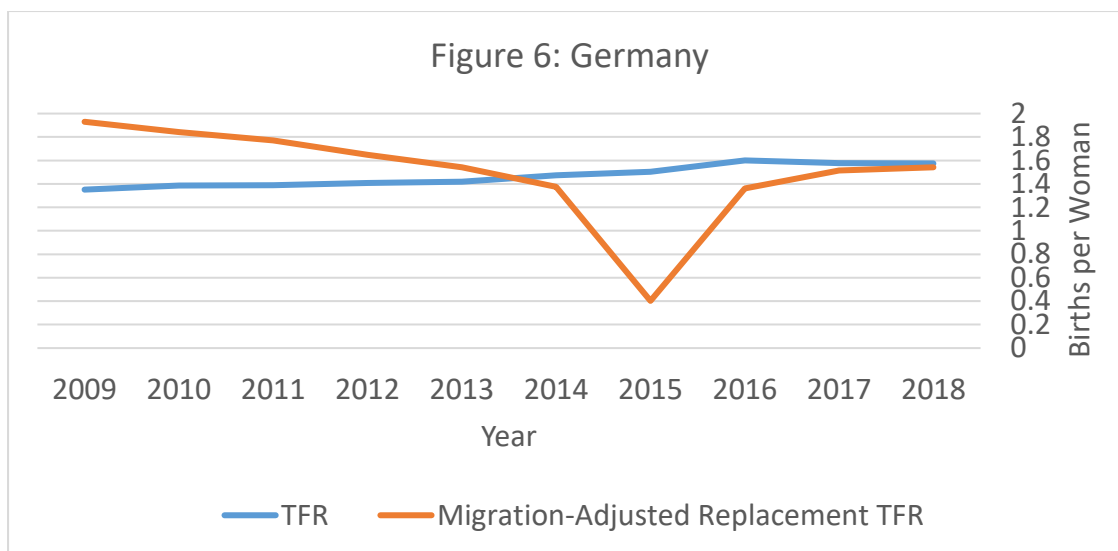
Whilst only slightly lower than those for Norway and Sweden, the TFR for Denmark for 2009 was only marginally above migration-adjusted replacement level, because of its more restrictive policies on, and hence significantly lower rate of, immigration (Figure 5; Hagelund 2020). Over 2011-13 Denmark's TFR generally fell slightly and was below migration-adjusted replacement. In 2015 a large increase in net immigration substantially reduced migration-adjusted replacement to below the TFR (Hagelund 2020). Post-2016 net migration fell sharply to very low levels, and migration-adjusted replacement level rose above the TFR. With net migration close to zero, migration-adjusted replacement level for 2018 exceeded 2.0 births per woman.





Between 2009 and 2013 the TFR for Germany was very low and considerably below migration-adjusted replacement (Figure 6). Over 2009-15 the TFR increased, whilst migration-adjusted replacement fell. Consequently, post-2014 the TFR exceeded migration-adjusted replacement. The particularly low migration-adjusted replacement level for 2015 (just 0.40 births per woman) is due to very high net migration which included very large inflows of refugees, most notably from Syria (Pew Research Centre 2016).

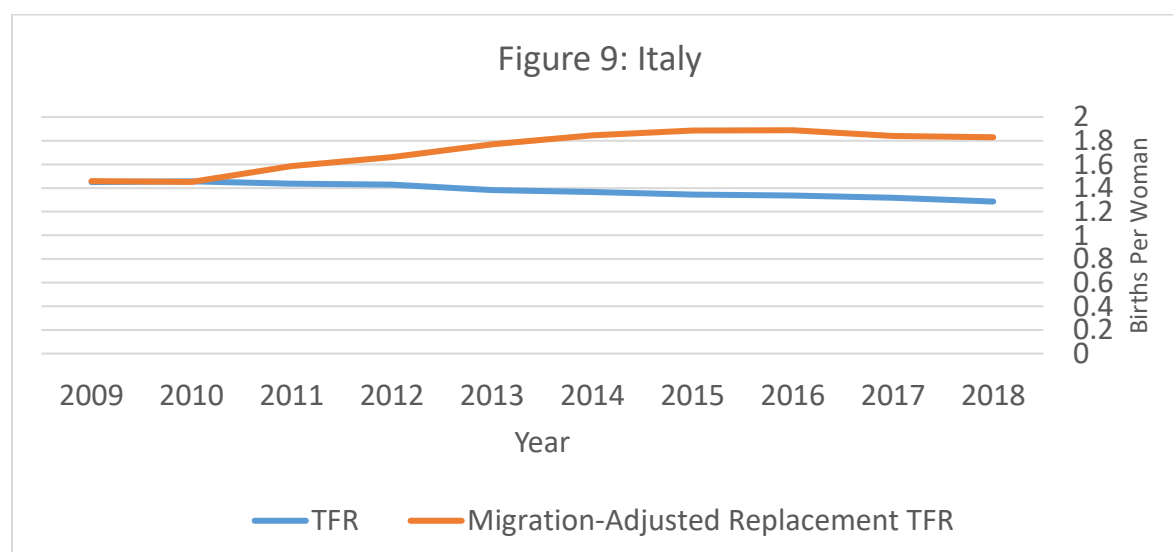
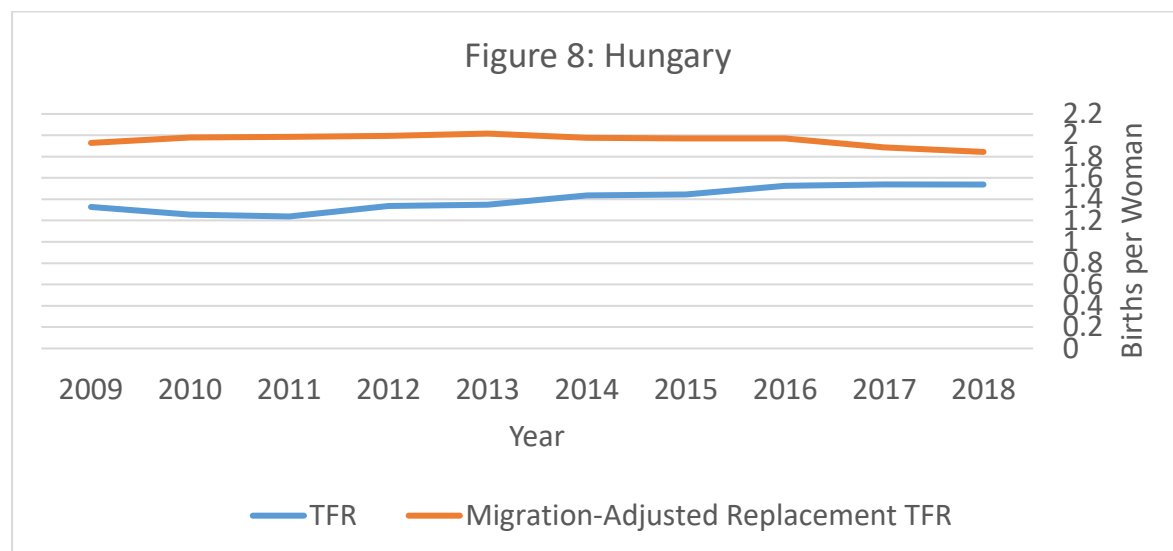
The reduction in TFR for Finland between 2009 and 2018 was the second largest for a European country (exceeded only by that for Iceland) (Eurostat 2021; Hellstrand et al. 2020). Over the same time period, the migration-adjusted replacement level changed little (Figure 7). Whereas between 2009 and 2011 the TFR was marginally above the migration-adjusted replacement level, post-2014 Finland's TFR fell far below it. If sustained over time, the fertility-mortality-net migration combination for 2018 would propel Finland's population towards 35 per cent of its 2018 size.



Between 2009 and 2018 the increase in TFR for Hungary was the largest for a European country (Eurostat 2021; Stone 2018). Despite this, the TFR remained below the migration-adjusted replacement level (Figure 8). A reduction in migration-adjusted replacement between 2014 and 2018, primarily due to an increase in net immigration, also narrowed the gap between the TFR and migration-adjusted replacement level. As well increased net migration, an increase in life expectancy, the largest over this period for any of the countries considered, also contributed to the reduction of migration-adjusted replacement level (Parr et al. 2016, Parr 2021). Despite the narrowed gap between fertility and migration-adjusted replacement, the implication of long run continuation of the 2018 fertility-mortality-net migration combination is that Hungary's population size would more than halve. The migration-adjusted replacement level shows that, in combination with its 2018 net migration

and mortality levels, a constant TFR of 1.84 would generate a population equal in size to Hungary's mid-2018 population.

Although very low by international standards (just 1.45 births per woman), for Italy for 2009 and 2010 the TFR was almost identical to the migration-adjusted replacement level (Figure 9; Vitali and Billari 2017). The low value of the latter is primarily due to the prevailing rate of net migration, then among the highest worldwide (UN 2019). After 2011 Italy's TFR fell progressively lower, whilst large reductions in net migration propelled the migration-adjusted replacement level further and further above the TFR. In combination with its 2018 net migration and mortality levels, a constant TFR of 1.83 would generate a stationary population equal in size to Italy's mid-2018 population of 60.5 million people.



Conclusion

This paper's results show the heterogeneity of the long run population growth implications of fertility levels combined with the concurrent migration and mortality between a selection of European countries and over time. Despite having a Net Reproduction Rate consistently below the 1.0 replacement level, for Sweden, and, for all but one or two of the years considered here, Norway and Switzerland, the implication of constant fertility, migration and mortality is long run population growth. This pattern appears at odds with the generalized characterisation of the implication of such a fertility level as 'incipient decline': rather they imply a long run increase in population to multiple times the current population (Notestein 1945). For Hungary and for all except one of the years considered for Italy the implication of continued fertility, migration and mortality is long run population decrease. For the remaining countries, the results show the direction of the the long run population growth implication of fertility, combined with the concurrent migration and mortality, varies between years. In view of the divergence of the population prospects of populations with 'post transitional' levels of fertility, it is critically important that models of the demographic transition incorporate migration patterns, as well as fertility and mortality.

The results provide examples of countries with very similar fertility levels which face very different long run population growth prospects, primarily because of differences in their net migration levels. For example, whilst the implication of a TFR below 1.6 in the context of the net migration (and mortality) patterns for Hungary is long run population decrease, the same TFR would have the implication of population increase when combined with the much higher net migration levels of Sweden or Norway. In view of such differences, rather than universal generalization, a migration context specific view of the implications of very low fertility rates is appropriate (Lutz 2014).

For some of the countries considered, annual net migration levels are so volatile that the population growth implication of the prevailing fertility is changed considerably or even reversed within a short span of time. For example, for Switzerland a broadly-speaking unchanged TFR is coherent with significant population growth in combination with the very high net migration levels over 2009-15 and with a modest population decrease under the much lower net migration of 2017-18. In view of past volatility and future unpredictability of migration, a circumspect view of the prospective future direction of population change is warranted for a number of the low fertility countries in this study, including Denmark, Germany, Netherlands, Norway and Switzerland.

The results of this study show that for eight of the nine countries considered, a fertility-migration-mortality combination which could prevent long run population growth was observed for at least one year (for Sweden for all ten years) within the 2009-18 period. Thus, migration-based prevention of population decline would appear at least technically feasible in the light of recent experience (although whether sustaining such levels of net migration over the long run would be politically feasible may be another matter) (Coleman 2002; Saczuk 2013; United Nations 2000).

This paper's method aims to make the complex appear simple. Rather than using the complex arithmetic and algebra involved in deriving migration-adjusted replacement level, the population growth implication of the TFR for a country and year being sustained, in combination with sustained migration and mortality at the levels for the same country and year, and the value of the TFR which would correspond to long run zero population growth are conveyed simply and immediately using basic graphs. The hope is to allow the population growth implication of below replacement fertility and positive net migration readily apparent to policymakers, journalists and members of the public (perhaps even some demographers!) who lack a higher level background in mathematics and thereby to dispel a popular misconception which equates a TFR below 2.1 with long-run population decrease.

References

- Cerone, P. 1987. On stable population theory with immigration. *Demography* 24(3): 431–438.
- Coleman, D. A. (2002). Replacement migration, or why everyone is going to have to live in Korea: A fable for our times from the United Nations. *Philosophical Transactions of the Royal Society B*, 357(1420), 583–598.
- De Haas, H., Czaika, M., Flahaux, M.L, Mahendra, E., Natter, K., Vezzoli, S., and Villares-Varela, M. 2019. International Migration: Trends, Determinants, and Policy Effects. *Population and Development Review*. 45(4): 885-992.
- Espenshade, T.J., Bouvier, L.F. and Arthur, W. B. 1982. Immigration and the Stable Population Model. *Demography*. 19(1): 125-133.
- Espenshade, T.J., Guzman, J.C., and Westoff, C.E. 2004. The surprising global variation in replacement fertility. *Population Research and Policy Review*. 22:575-583.
- Gietel-Basten, S. and Scherbov, S. 2020. Exploring the ‘true value’ of replacement rate fertility. *Population Research and Policy Review*. 39(Winter): 763-772

- Hagelund, A. 2020 After the refugee crisis: public discourse and policy change in Denmark, Norway and Sweden. *Comparative Migration Studies*. 8: 13.
- Hellstrand, J., Nisen, J. and Myrskylä, M. 2020. All-time low period fertility in Finland: Demographic drivers, tempo effects, and cohort implications. *Population Studies*. 74(3): 315-329.
- Lutz, W. 2014. A Population Policy Rationale for the Twenty-First Century. *Population and Development Review*. 40(3): 527-544.
- Matysiak, A., Sobotka, T. and Vignoli, D. 2021. The Great Recession and Fertility in Europe: A Sub-national Analysis. 37(1): 29-64
- Notestein, F. 1945. Population: the long view. In T. Schulz (ed.) *Food for the World* (pp36-57. Chicago: Chicago University Press.
- Parr, N. 2021. A New Measure of Fertility Replacement Level in the Presence of Positive Net Immigration. *European Journal of Population*. 37(1): 243-262.
- Parr, N., Li, J. and Tickle, L. .2016. A Cost of Living Longer: Projections of the Effects of Prospective Mortality Improvement on Economic Support Ratios for Fourteen More Advanced Economies. *Population Studies*. 70(2): 181-200.
- Pew Research Centre 2016. Number of Refugees to Europe Surges to Record 1.3 Million in 2015. Online at: <https://www.pewresearch.org/> Accessed 12 April 2021.
- Pollard, J.H. 1973. *Mathematical Models for the Growth of Human Populations*. London: Cambridge University Press.
- Randall, M.H. 2016. Direct Democracy in Switzerland: Trends, Challenges and the Quest for Solutions. In: Chommeloux A., Gibson-Morgan E. (eds) *Contemporary Voting in Europe*. Palgrave Macmillan, London. https://doi.org/10.1057/978-1-137-50964-2_7.
- Rindfuss, R., Choe, M.K. and Brauner-Otto, S.R. 2016. The Emergence of Two Distinct Fertility Regimes in Economically Advanced Countries. *Population Research and Policy Review*. 35(3): 287-384.
- Saczuk, K. 2013. Development and Critique of the Concept of Replacement Migration. In: Kupiszewski M. (ed.) *International Migration and the Future of Populations and Labour in Europe*. Springer, Dordrecht.
- Schmertmann, C.P. 1992. Immigrants' ages and the structure of stationary populations with below-replacement fertility. *Demography* 29(4): 595–612.
- Schmertmann, C.P. 2012. Stationary populations with below-replacement fertility. *Demographic Research* 26(14): 319–330.

- Sobotka, T. 2017. Post-transitional fertility: the role of childbearing postponement in fuelling the shift to low and unstable fertility levels. *Journal of Biosocial Science*, 49(S1): S20-S45.
- Stone, L. (2018) Is Hungary Experiencing a Policy-Induced Baby Boom? Institute of Family Studies. <https://ifstudies.org/blog/is-hungary-experiencing-a-policy-induced-baby-boom>. Last accessed 2 July 2021.
- United Nations. 2000. *Replacement Migration: Is It a Solution to Declining and Ageing Populations?* New York, Population Division, United Nations.
- United Nations. 2019 *World Population Prospects 2019*.
<https://population.un.org/wpp/Download/Standard/Population/> Accessed 16 March 2021.
- Vitali, A. and Billari, F. (2017) Changing Determinants of Low Fertility and Diffusion: a Spatial Analysis for Italy. *Population, Space and Place*. 23(2): e1998.