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

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Background

In 2018 TFR was below ($\text{NRR} = 1$) 'replacement level' in throughout Europe.

In combination with zero migration long run implication of (continued) below replacement (i.e. NRR below 1) fertility is eventual population decrease.

However, for most European countries **net migration is positive**.

What are the long run population growth implications of constant fertility, mortality and net migration (amounts) at levels observed in selected European countries over 2009-18?

Under hypothetical stability of net migration (amounts) and mortality rates, which TFRs would be consistent with long run zero population growth?

Stationary Populations with NRR below 1 and Positive Immigration

“As long as fertility is below replacement, a constant number and age distribution of immigrants (with fixed fertility and mortality schedules) leads to a stationary population”. (Espenshade, Bouvier, and Arthur 1982)
(Previously documented by J.H. Pollard 1973).

I refer to this as the **Terminal Stationary Population** (TSP).

A person's (A) '**Generational Index**' is defined by the most recent overseas birth from the set consisting of the person and his/her all female line of ancestry (A (Gen. Index =1), A's mother (2), A's mother's mother (3) etc.).

Terminal Stationary Populations can be partitioned into components defined by generational index.

Formula for Terminal Stationary Population Size



$$P_{TSP} = \sum_i P_i$$

Where i = generational index

$$P_1 = (\sum_x M_{x,m} e_{x,m}) + (\sum_x M_{x,f} e_{x,f})$$

$M_{x, m/f}$ = Net migration for age x and sex m/f

$e_{x, m/f}$ = remaining (complete) life expectancy for x and sex m/f

$$P_2 = (e_{0, F} (\sum_x M_{x,f} B_{x, f})) + (SRB e_{0, M} (\sum_x M_{x,f} B_{x, f}))$$

Where

$B_{x, f}$ = remaining lifetime births for a female aged x (considering fertility and survival)

SRB = sex ratio at birth (males per female)

$$P_{i+1} = NRR P_i \quad \text{for all } i \geq 2$$

$$P_{TSP} = P_1 + (P_2 / (1 - NRR))$$

Migration-Adjusted Replacement Fertility (Parr 2021)

The 'With Current Migration Replacement TFR' (or 'Migration-Adjusted Replacement TFR') (MAR_TFR_t) for population A and year t is such that the size of Terminal Stationary Population generated by;

- constant fertility with $TFR = MAR_TFR_t$
 - constant net migration (amounts) by age and sex as per population A and year t,
 - constant age-sex specific mortality rates as per population A and year t
- = the (real) population size of A in year t (POP_t),

i.e. all ASFRs for population A and year t are scaled by the same number to equate Terminal Stationary Population size with real population size

Reference: 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



Formula for Migration-Adjusted Replacement Level (Parr 2021)

$$MAR_TFR_t = \frac{TFR_t}{NRR_t} \times \frac{POP_t - P_{1,t}}{POP_t - P_{1,t} + \frac{P_{2,t}}{NRR_t}}$$

Where:

TFR_A and NRR_A denote the TFR and NRR respectively for population A in year t.

$\frac{TFR_t}{NRR_t}$ = (NRR =1) replacement level

POP_t - the (real) population size of A in year t,

$P_{1,t}$ - “1st generation component” of TSP (generated using data for A and t)

$P_{2,t}$ - “2nd generation component” of TSP (generated using data for A and t)

Reference: 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

Data and Method

Data - For individual years from 2009-2018 for 9 European countries for which all the requisite data inputs could be identified for all years from Eurostat website.

Method – Simple line graphs compare real TFR for year t to MAR_TFR_t

TFR_t above MAR_TFR_t implies long run population growth under constant fertility, mortality and net migration i.e. fertility is ‘above migration adjusted replacement’.

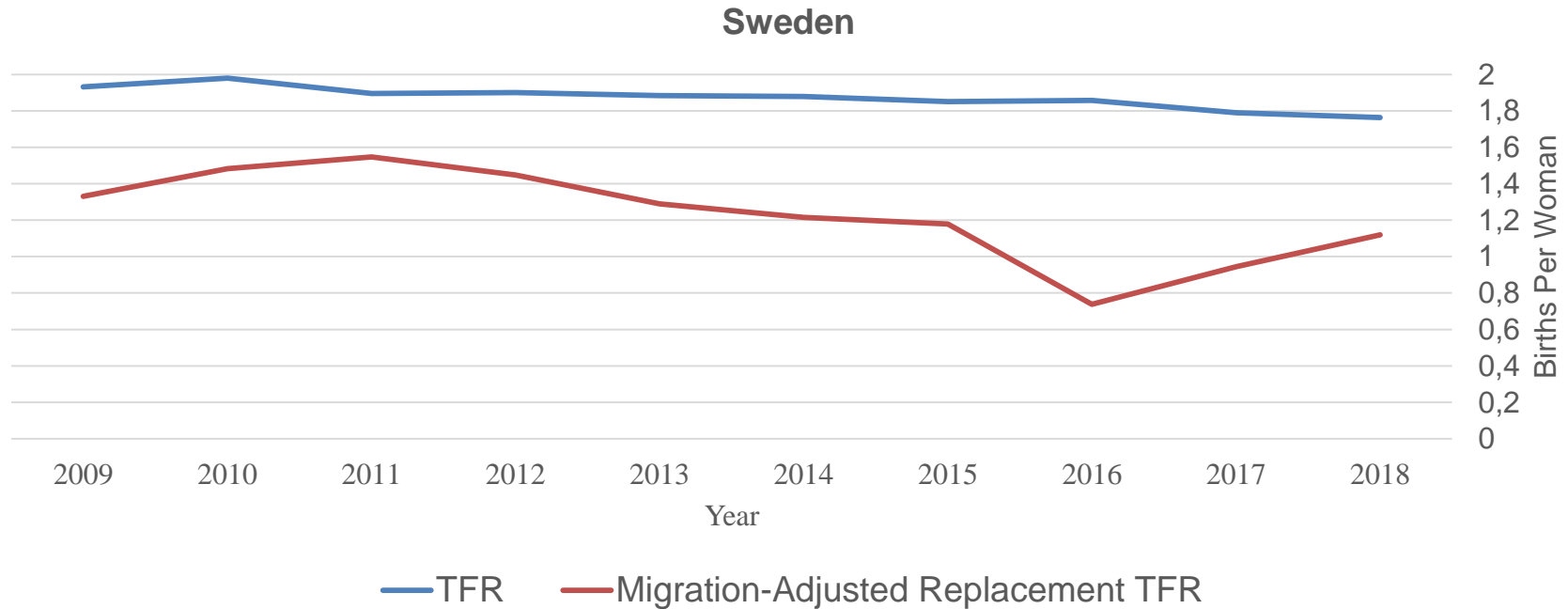
TFR_t below MAR_TFR_t implies long run population decrease under constant fertility, mortality and net migration i.e. fertility is ‘below migration adjusted replacement’.

Above Replacement Throughout 2009-18

Sweden



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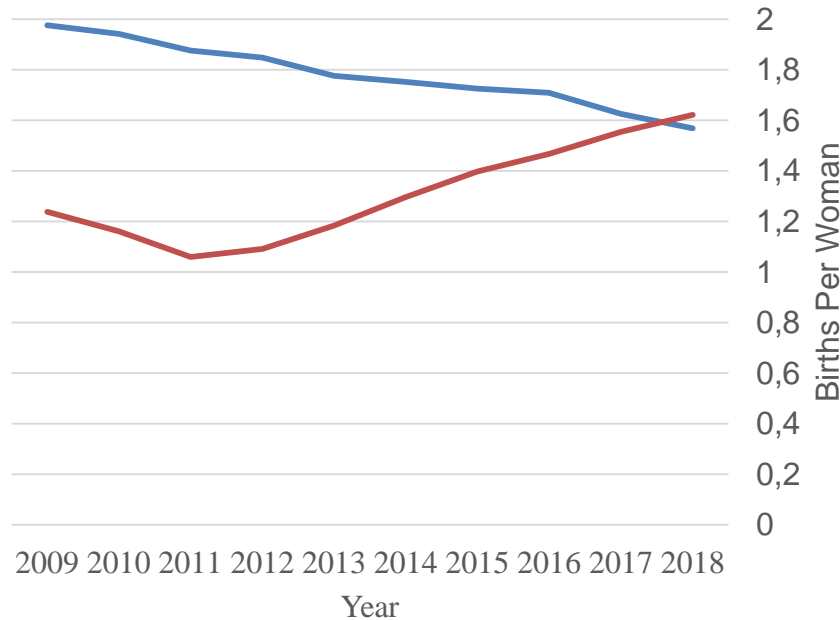


Above Migration-Adjusted Replacement No Longer Norway and Switzerland

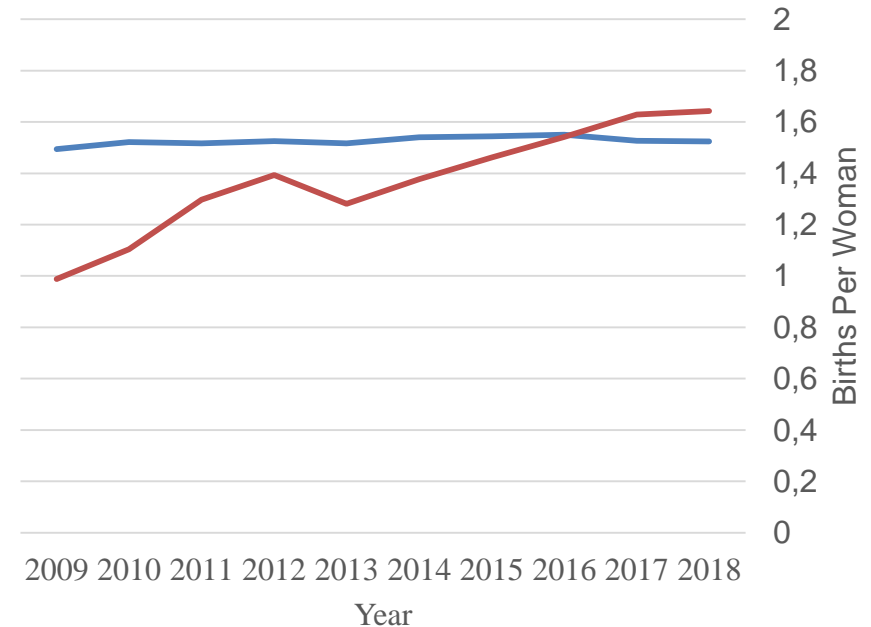


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Norway



Switzerland



— TFR

— Migration-Adjusted Replacement TFR

— TFR

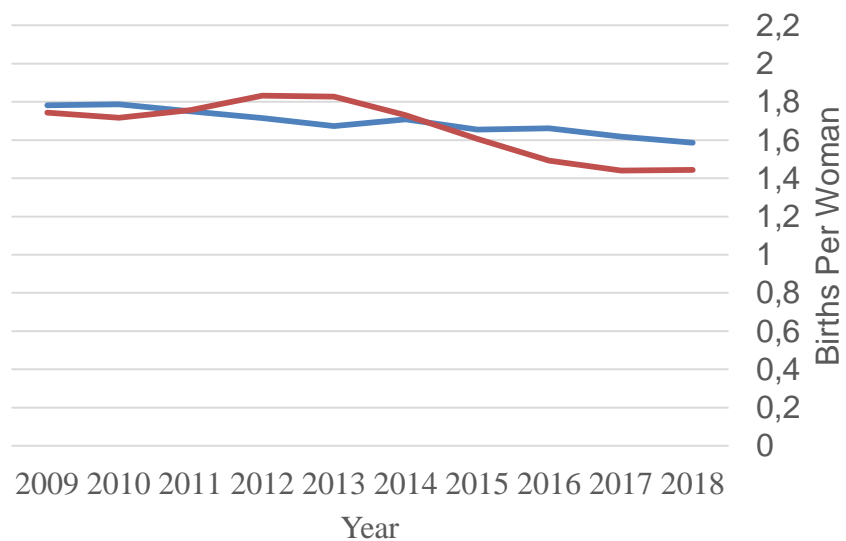
— Migration-Adjusted Replacement TFR

Replacement Fluctuating Above and Below TFR

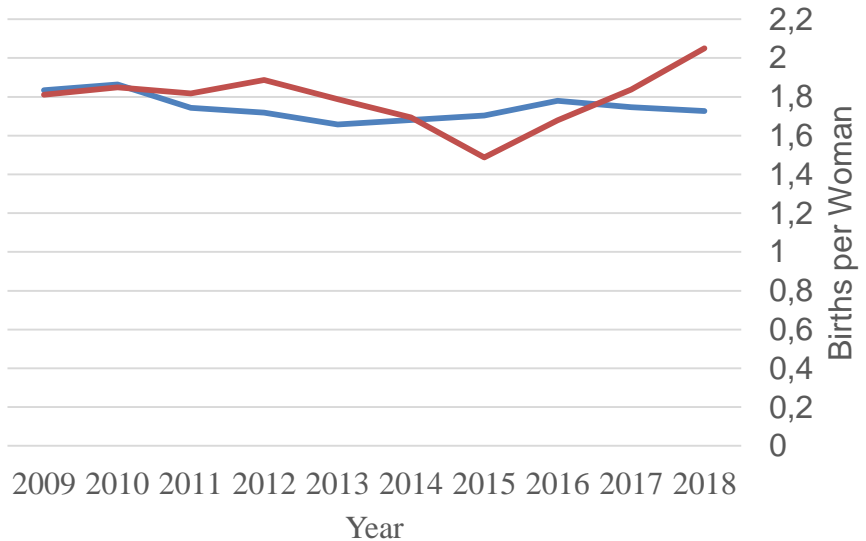


Netherlands and Denmark

Netherlands



Denmark

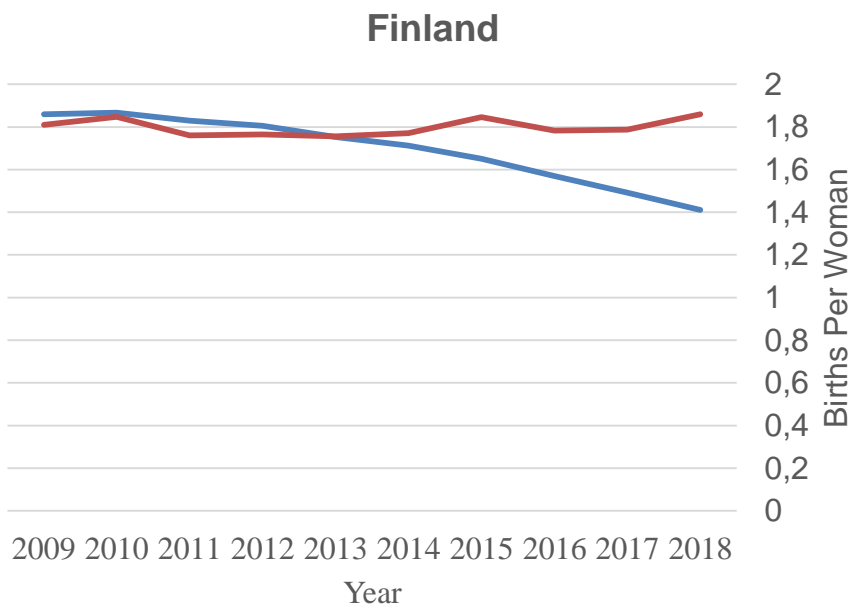
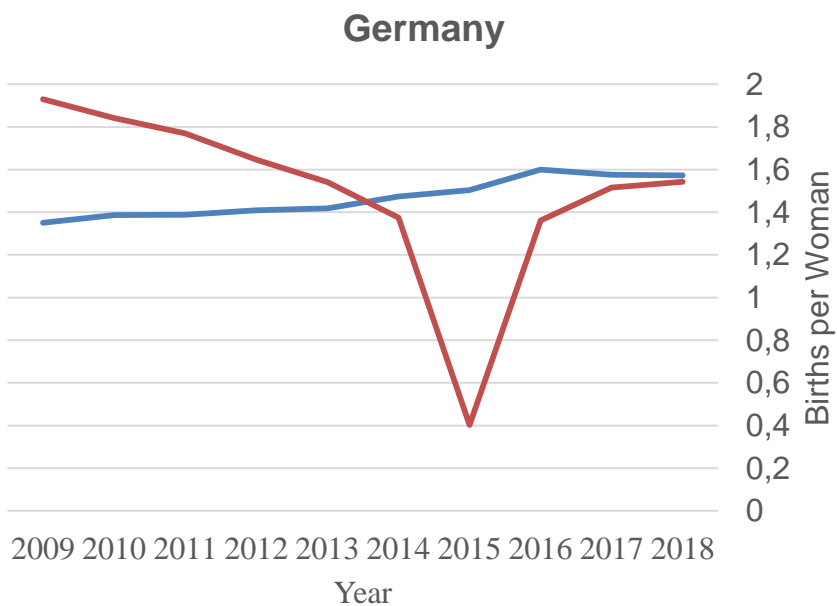


— TFR
— Migration-Adjusted Replacement TFR

— TFR
— Migration-Adjusted Replacement TFR

Change to TFR and Its Relationship to Migration-Adjusted Replacement

Germany and Finland



— TFR

— Migration-Adjusted Replacement TFR

— TFR

— Migration-Adjusted Replacement TFR

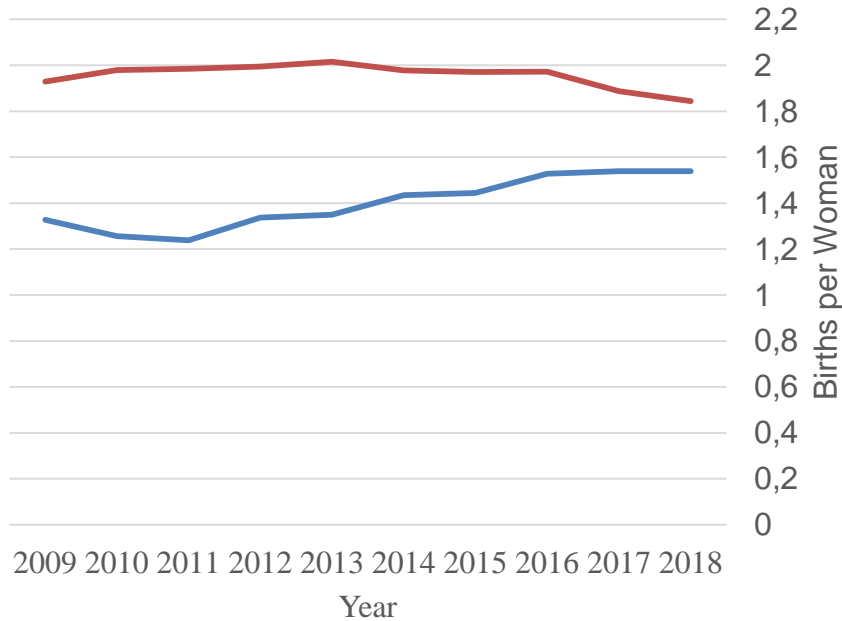
Below Migration-Adjusted Replacement



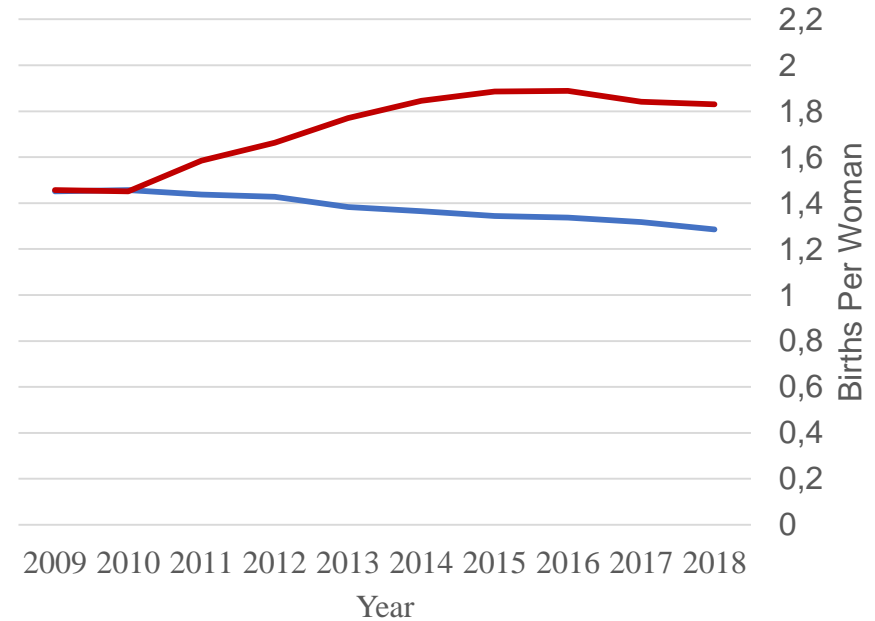
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Hungary and Italy

Hungary



Italy



— TFR

— Migration-Adjusted Replacement TFR

— TFR

— Migration-Adjusted Replacement TFR ¹²

Summary and Key Takeout Messages



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1. Constant TFR below ($NRR=1$) replacement does not necessarily mean long run population decrease. Rather the long run population growth implication is interdependent with net migration (and mortality) levels.
2. This paper presents TFRs which are coherent with long run zero population growth *if migration (and mortality) remain constant* for a range of European countries and recent years.
3. For some countries and years (e.g. Sweden 2009-18, Norway and Switzerland 2009-16) constant TFR (+ constant migration and mortality) would generate considerable long run population INCREASE.
4. Even very low (below 1.5) TFR is not coherent with population decrease if combined with migration and mortality of Sweden 2009-10 & 2012-18, Norway 2009-16, Switzerland 2009-15, Netherlands 2016-18, Denmark 2015, Germany 2014-16, Italy 2009-10.
5. Policy to prevent long run population decrease may be guided either by raising TFR to migration-adjusted replacement or by lowering migration-adjusted replacement to TFR (by increasing net migration (or survivorship)).

References

Espenshade, T.J., Bouvier, L.F. and Arthur, W. B. (1982) Immigration and the Stable Population Model. *Demography*. 19(1): 125-133.

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

Pollard, J.H. (1973) Mathematical Models for the Growth of Human Populations. London: Cambridge University Press.

(Generic) spreadsheet available via Researchgate.

https://www.researchgate.net/profile/Nick_Parr2 or by request from Nick.Parr@mq.edu.au

Motivation - Misguided (?) Pronatalism in Australia

“this trend of declining fertility, in the absence of a massive increase in immigration, will result in our population declining in absolute terms and, over time, we will simply die out” (Malcolm Turnbull 2002)

Australia 2002

Migration-Adjusted Replacement TFR = 1.52

Actual TFR = 1.74.

“If you can have children it's a good thing to do – you should have one for the father, one for the mother and one for the country”

former Australian Treasurer Peter Costello
(pictured opposite) as quoted in SMH 12/5/2004
(Source of picture opposite: Sun Herald)

