

ESTIMATING TEMPO EFFECT AND ALTERNATIVE FERTILITY INDICATORS

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The period level of fertility is commonly measured by the *Total Fertility Rate* (TFR). However, the TFR is sensitive to changes in the age at childbearing, which has been rising in most European countries for several decades. In Italy, Luxembourg, Spain and Switzerland women now have their first child on average after age 30. As births are shifted to later ages, they are both postponed into the future and spread over a longer period of time. This “stretching” of reproduction in turn depresses the period TFR even if the number of children women ultimately have over their life course does not change.

Alternative indicators were proposed to obtain a more accurate measure of the mean number of children per woman in a calendar year. The European Demographic Datasheet 2016 features two such indicators, *Tempo-adjusted TFR* (TFR*), proposed by Bongaarts and Feeney (1998, 2000) which is based on birth order-specific total fertility rates and mean ages at birth, and *Tempo and Parity-adjusted Total Fertility* (TFRp*), elaborated by Bongaarts and Sobotka (2012). The TFRp* offers several improvements over the TFR*. It takes into account the parity composition of women of reproductive age, and thus controls for an additional source of distortion in the conventional TFR. Moreover, it yields considerably more stable results than the TFR*, which is clearly illustrated in the three country graphs (see box on *Tempo effect*). However, the limited availability of detailed data is an obstacle to its use. Wherever possible, we present the results for the TFRp* for 2012, which were computed for 17 European countries¹, the United States and Japan.

For the countries lacking the required data, the data sheet features the TFR* for 17 countries² (computed from birth order-specific data) or its estimate for 11 countries³ (based on period TFR and changes in the mean age at childbearing for all birth orders combined). The computations and estimates of the TFR* show data averaged over the three-year period of 2011–2013 to increase the robustness of this indicator. No data were available for 4 countries⁴.

¹ Austria, Belarus, Czech Republic, Estonia, Finland, Hungary, Latvia, Lithuania, Netherlands, Norway, Portugal, Russia, Slovakia, Slovenia, Spain, Sweden and Ukraine. The main source of the data used in the TFRp* computations is the Human Fertility Database 2016 (www.humanfertility.org), except for Austria (Geburtenbarometer 2016, www.oeaw.ac.at/vid/data/geburtenbarometer-austria-and-vienna), Hungary (data provided by Hungarian Central Statistical Office) and Slovakia (data provided by Infostat).

² Belgium, Bulgaria, Croatia, Cyprus, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Macedonia, Malta, Romania, Poland, Serbia, Switzerland and United Kingdom. The main source of the data used in the TFR* computations is Eurostat 2016 (epp.eurostat.ec.europa.eu), except for Italy (data provided by ISTAT, also available at Human Fertility Collection 2016).

³ Albania, Andorra, Armenia, Azerbaijan, Bosnia and Herzegovina, Denmark, Georgia, France, Moldova, Montenegro and Turkey. The data source is Human Fertility Collection 2016 (www.fertilitydata.org), except of Albania, Andorra and Georgia, where the data are based on publications by the national statistical organisations.

⁴ Kosovo, Liechtenstein, San Marino and Monaco.

Conventional Total Fertility Rate and Mean Age at Birth

The conventional period *Total Fertility Rate* (TFR) is computed as the sum of age-specific fertility rates observed in a given period among women across all childbearing years. These rates can be defined as $f(a, t, i)$ for year t , women's age a and birth order i . Age a typically ranges from 14 to 50 (Eurostat, HFC), but other age ranges are used as well (e.g. 12 to 55 in HFD). These rates are computed as a share of number of births and population exposure.

$$f(a, t, i) = \frac{B(a, t, i)}{P(a, t)}$$

The denominator of the rates equals all women aged a at time t , regardless of their parity (i.e. number of children they have had until year t). Because these rates do not control for parity distribution of the female population, they are called rates of the second type, incidence rates or type-II rates. TFR of birth order i is computed as follows:

$$TFR(t, i) = \sum_a f(a, t, i)$$

The TFR for all birth orders is a sum of non-order-specific fertility rates or a sum of order-specific TFRs for all birth orders:

$$TFR(t) = \sum_a f(a, t)$$

$$TFR(t) = \sum_i TFR(t, i)$$

The mean age at birth, MAB, is computed from the age-specific fertility rates across the entire range of reproductive ages. It can be computed separately for each birth order i :

$$MAB(t, i) = \frac{\sum_a a * f(a, t, i)}{\sum_a f(a, t, i)}$$

$$MAB(t) = \frac{\sum_a a * f(a, t)}{\sum_a f(a, t)}$$

Tempo and Parity-adjusted Total Fertility Rate TFRp*

The index of total fertility, controlling for parity and adjusted for the distortions caused by changes in the timing of childbearing, TFRp, was elaborated by Bongaarts and Sobotka (2012: 113-114, Appendix 1). It is computed from conditional fertility rates (hazard rates) $p(a, t, i)$, with births of each birth order treated as separate non-repeatable events. At each age a , the exposure population for computing the hazard of having a birth of order i equals all women aged a who have not yet reached parity i , i.e., those with $i-1$ and fewer children.

$$p(a, t, i) = \frac{B(a, t, i)}{\sum_{i=0}^{i-1} P(a, t, i)}$$

$$TFRp(t, i) = 1 - \exp \left[- \sum_a p(a, t, i) \right]$$

The TFRp is then adjusted for tempo distortion caused by the changes in age at childbearing, using Bongaarts and Feeney's (1998) formula:

$$TFRp^*(t, i) = \frac{TFRp(t, i)}{1 - \frac{MAB(t+1, i) - MAB(t-1, i)}{2}}$$

Tempo-adjusted Total Fertility Rate TFR*

Tempo-adjusted TFR (TFR*) is computed for countries where detailed data needed for calculating *Tempo and Parity-adjusted Total Fertility* (TFRp*) are not available. The TFR*, is computed using the formula developed by Bongaarts and Feeney (1998) which uses fertility data specified by age of mother and birth order of child. The TFR* for a year t for birth order i is computed as follows:

$$TFR^*(t, i) = \frac{TFR(t, i)}{1 - \frac{MAB(t+1, i) - MAB(t-1, i)}{2}}$$

The formula takes into account the change in the mean age at childbearing of birth order i between the beginning and the end of year t (see Bongaarts and Feeney 2000: 563, fn. 1). To reduce instability in the estimated adjusted TFR, the European Demographic Datasheet gives the mean of the adjusted TFRs for the three-year period, 2011–2013. The overall tempo-adjusted total fertility rate for all birth orders is computed as the sum of the adjusted order-specific total fertility rates. The adjustment was performed for birth orders 1, 2 and 3, whereas the conventional TFR was applied for birth orders 4+.

Estimating Tempo Effect in the Absence of Order-specific Data on Fertility Rates

The application of the Bongaarts-Feeney formula (TFR*) requires the TFR and the mean age at childbearing (MAB) to be specified by birth order. These data are not available for 11 countries (see Footnote 3 above), for which the TFR and the MAB are therefore reported for total births only. For these countries, the estimates of the tempo effect were derived from data on the conventional TFR and the mean age at childbearing (MAB), using the simplified formula:

$$TFR^*(t) = \frac{TFR(t)}{1 - \frac{MAB(t+1) - MAB(t-1)}{2}}$$

In times when the period TFR falls or increases fast, or when the birth order distribution changes, e.g. as a result of the drop in higher-order births, this approximation can yield distorted estimates of TFR*. In this case, its use should be avoided or the results should be interpreted with great caution. However, this simplified estimation of tempo-adjusted fertility should provide a good approximation of TFR* during the periods when fertility changes are relatively small and the distribution of births by birth order is stable. These assumptions are likely to hold in most European countries analysed here.

References

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