



Has fertility declined in recent decades?

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Purpose of review

Over the last decade, a number of studies have been published on whether fertility has declined. The purpose of this article is to review the trends in fertility rates and assess how biological, behavioural, social and environmental factors affect fertility rates.

Recent findings

The average total fertility rate (TFR) in Europe is down to 1.5 children per woman, and the perceived ideal family size is also declining. Factors impacting on lower fertility include the instability of modern partnerships and value changes. Fertility depends on natural fecundity but also on a number of behavioural determinants, such as culture, society, economic conditions, living standards and other similar background determinants on individual reproductive behaviour.

Summary

Increasing use of infertility treatment and a decline in demographic fertility in some countries have raised concern whether human fecundity is declining or has declined over time. The downward trend in fecundity articulated on numerous occasions over the last decade, seems unsubstantiated as the forecasting agencies such as the United Nations and Eurostat are likely to be right in their medium variant assumption that TFR levels in most countries will rise to 1.5 or above in the decades ahead.

Keywords

demography, fertility, fertility decline, pregnancy, total fertility rate

INTRODUCTION

During the 19th century, there was steady state of high mortality and fertility rates in Europe. The change began with declining mortality rates resulting in a rapid increase of the population, followed by a reduction in birth rates during the 20th century, as the population continued to increase. All European countries have reached the demographic stage characterized by low fertility and high life-expectancy [1].

Fertility rates have been declining since the 1970s in Europe, despite a small increasing trend in some countries [2]. More couples are having either fewer children or no children, or couples are delaying childbirth at a later period until the woman is beyond her most fertile years [3]. The factors which influence these decisions vary from country to country. Marriage is no longer essential to family life, fewer people want large families, higher education is more available for men and women and women are now more likely to work for their living in western countries [4,5]. Governments have different health policies, such as support for having children, paid parental leave and easily accessible treatment for infertility [6,7]. The existing literature studying why fertility has declined includes surveys of individuals and families,

European and world surveys of changing attitudes and values, and studies of economic, employment and demographic statistics within and across countries.

WHAT IS FERTILITY RATE?

The fertility rate is measured in a variety of ways, which can be broken into 'period' measures and 'cohort' measures. 'Period' measures refer to a cross-section of the population in 1 year. 'Cohort' data, on the other hand, follows the same people over a period of decades. Both period and cohort measures are widely used.

Period measures

Crude birth rate (CBR) – the number of live births in a given year per 1000 people alive at the middle of

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KEY POINTS

- So far, despite extensive research, it seems clear that at a population level, the causes of male infertility are poorly defined. Risk factors need to be clearly identified and the interactions between genetic and environmental factors examined. In-utero and paternal exposures are particularly difficult to study in relation to male infertility without a longitudinal (cohort) study design.
- The relationship between economic conditions and fertility rates has to be better understood. A relevant topic is whether fertility policies such as generous paid parental leave for employed mothers may strengthen the procyclical nature of fertility, depending on the ease or difficulty of obtaining full-benefit employment.
- More demographic modelling is needed to address the issues of differential cohort postponement and the measurement of tempo effects. More research should be conducted on alternative period fertility indicators that can complement and even substitute for the total fertility rate, which is so strongly affected by tempo distortion and therefore can give very misleading signals about fertility levels, trends and cross-country differences.
- The consequences of the period of lowest-low fertility need to be confirmed. The prominent forecasting agencies such as the United Nations and Eurostat are likely to be right in their medium variant assumption that TFR levels in most countries will rise to 1.5 or above in the decades ahead.
- The fear of an accelerated downward spiral of fertility, articulated on numerous occasions over the last decade, seems unsubstantiated.

that year. One disadvantage of this indicator is that it is influenced by the age structure of the population.

General fertility rate (GFR) – the number of births in a year divided by the number of women aged 15–44, times 1000. It focusses on the potential mothers only and takes the age distribution into account.

Cohort measures

Age-specific fertility rate (ASFR) – The number of births in a year to women in a 5-year age group, divided by the number of all women in that age group, times 1000. The usual age groups are 10–14, 15–19, 20–24, etc. The pattern of age-specific fertility rate takes the form of a normal curve rising from near zero at 15 years to peak at around 0.10–0.15 births per woman per year in the early 30s, and falls to near zero around 47 years.

Total fertility rate (TFR) – the total number of children a woman would bear during her lifetime if she were to experience the prevailing age-specific fertility rates of women. TFR equals the sum for all age groups of 5 times each ASFR rate. The TFR (or TPF – total period fertility rate) is a better index of fertility than the CBR (annual number of births per thousand population) because it is independent of the age structure of the population, but it is a poorer estimate of actual completed family size than the total cohort fertility rate, which is obtained by summing the age-specific fertility rates that actually applied to each cohort as they aged through time. In particular, the TFR does not necessarily predict how many children young women now will eventually have, as their fertility rates in years to come may change from those of older women now. However, the TFR is a reasonable summary of current fertility levels. The TPF is affected by a tempo effect – if age of childbearing increases (and life cycle fertility is unchanged) then while the age of childbearing is increasing, TPF will be lower (because the births are occurring later), and when the age of childbearing stops increasing, the TPF will increase (because of the deferred births occurring in the later period) even though the life-cycle fertility has been unchanged. In other words, the TPF is a misleading measure of life-cycle fertility when childbearing age is changing, because of this statistical artefact.

Cohort fertility rate is the sum of the age-specific fertility rates that actually apply to each birth cohort (e.g. 1970–1974) as they age through time. The changes in the mean age of childbearing make the TFR a problematic measure of fertility. The TFR is lower than the corresponding cohort fertility during times of postponement of childbearing. Additionally, the average fertility level needed to maintain population size in the absence of migration is slightly below 2.1 children per woman.

WHAT IS FERTILITY DECLINE?

Changes in fertility rates could be the reflections of changes in the availability of contraception and new legislation about abortion [8], or economic factors affecting education, employment and family life [4], or changes in the attitudes and cultural values of men and women [9]. Taking the political and social differences among the European countries into consideration, legislative events seem unlikely to account for fertility changes across Europe. Likewise, economic factors and sociocultural trends may not be likely to be sufficient explanations of the change in fertility during the last part of the 20th century [6].

Economic theories about declining fertility postulates that the opportunity cost for childrearing would rise and women would prefer employed labour to childcare as women's educational attainment has increased, more employment opportunities and higher wage levels were available [10]. Thus, fertility depends on the level of income which shapes the economic cost and benefits of children [4]. In the economic model, the demand for children would increase as the government policies reduce the cost of children [6,11]. Policies might include child and family cash allowances, tax relief for the number of children in a family, subsidized childcare and parental leave benefits.

In short, fertility is increased either by the reduction of the cost of having children or by the increment of family income [4,12]. Nevertheless, the economic model has the assumption that potential parents have sufficient knowledge of the economics of having a child and that they make economical decisions about childbearing [4,10].

Changing individual values rather than economic factors have been postulated as primary determinants of the decline in fertility rates. In this view, a process of value change regarding personal goals, relationships, family formation and adherence to religion have been proposed [1]. In this sociocultural setting, lifestyle preferences and values could possibly determine women's fertility choices and outcomes.

Cultural factors have also been suggested as the influence on changes in family and fertility seen in modern industrialized societies [9]. Attitudes play a stronger role among women because women are more directly affected by the balance between employment and home-making [13]. In this regard, three different types of women are present: family oriented women (10–30%), adaptive women (40–80%) and career-oriented women (10–30%) [9]. An association between preferences and actual fertility has been confirmed, although the association with intended fertility was not consistent [13].

The ideal family size has been declining in many countries [14–18] and fertility rates are falling because couples are choosing to remain childless or to have fewer children [3]. In the UK, the state of not having a child has doubled from the birth cohorts of 1940–1960: 1 in 10 women born in 1940 reached the end of their reproductive life without a child compared with 1 in 5 women born in 1960 [19]. In pre-1950 European birth cohorts, the predominant reason for remaining childless was not being married, whereas in later birth cohorts many women remained childless although they had partners [20]. In the UK, the percentage of childless women who intended to have no children was 5%

among those who were aged 18–20 in 1980 and rose to 9% in women of the same age in 2000 [21] and even rose to 50% at age 34 [22]. The desire for no children among female Finnish university students increased from 10% in less than 30 years of age to 17.5% in the minority who were 30–34 years of age [23]. The family size preferences of men have also changed over time. It was very important for a couple to have children among 50% of young Austrian men and women aged 16–24 in 1990; but the percentage had fallen to 27% in 2000 [24]. In contrast to women, higher education in men reduces the likelihood of childlessness [25]. Educational attainment and a stable career among Dutch women aged 40–79 years increased the likelihood of remaining childless [20]. This condition can be reversed if women can have children earlier without being socially prejudiced [26]. Couples wanting fewer children is another factor for the falling fertility rates. Although the number of families with one child has not changed in the UK, fewer families have four or more children [27]. Personal choices related to education, income, political stability, the (im)possibility of combining paid work with a family and whether or not a woman meets an appropriate partner in time all restrict size of the family [28]. Although the average desired family size is steadily decreasing in Europe [14], a majority of women and men still desire two children [23]. Two children has been reported as the ideal family size by more than 50% of men and more than 40% of women Finnish students. A higher proportion of men and women wanted three or more children than the numbers wanting zero or one combined [23]. As a result, there is a difference between ideal and real-life wishes about family size [29].

Delaying childbirth means that more couples reach the end of the woman's reproductive career without having attained their desired family size and is another obvious factor contributing to falling fertility rates [30]. Beginning in the early 1980s, couples have been marrying at later ages at completion of education because tertiary education was more available [31]. Average age at birth was also delayed, beginning in the early 1980s in European countries. By 2000, the age at first birth in most European countries was 28–29 years, compared with 24–25 years in the early 1970s. Even in Central and Eastern Europe, where women used to have children at an earlier age, the trend to postpone was strong. Still delayed childbirth alone is not enough to reduce fertility rates. In France, despite the average high age at first birth, fertility rate remained close to the 2.1 replacement value [32]. The factors in delayed reproduction include the instability of modern partnerships, declining ideal family size,

higher population density and pressure from globalization of business to relocate without regard to partnerships [1]. Of women older than 33 years of age who planned to conceive, 74% gave reasons to do with their relationship(s) as the most common reason for delay, 52% had other distractions in life and only 34% delayed because of work or training issues [22]. More available education [33], the rise in women's employment and insufficient institutional support for families [20] were reported as additional factors. The individual decisions appear to reflect complex cultural, demographic and economic trends leading couples to delay childbirth to a later age when the woman's fertility will be lower.

FERTILITY DECLINE AROUND THE WORLD

The debate on a possible decline in semen quality raised the question of whether couple fertility has declined. A cross-sectional survey in Britain included participants aged 16–59 years who were asked about their first pregnancy [34]. They were asked how long it took to conceive – time to pregnancy (TTP) – using the question, 'How many months or years did it take you to become pregnant?' for women, and substituting 'your partner' for 'you' in the case of men. Even though the individual values are often inaccurate by a month or two, the TTP distribution obtained gives a good estimate of the true distribution [35,36]. This was true even with a recall period of up to at least 20 years [37,38].

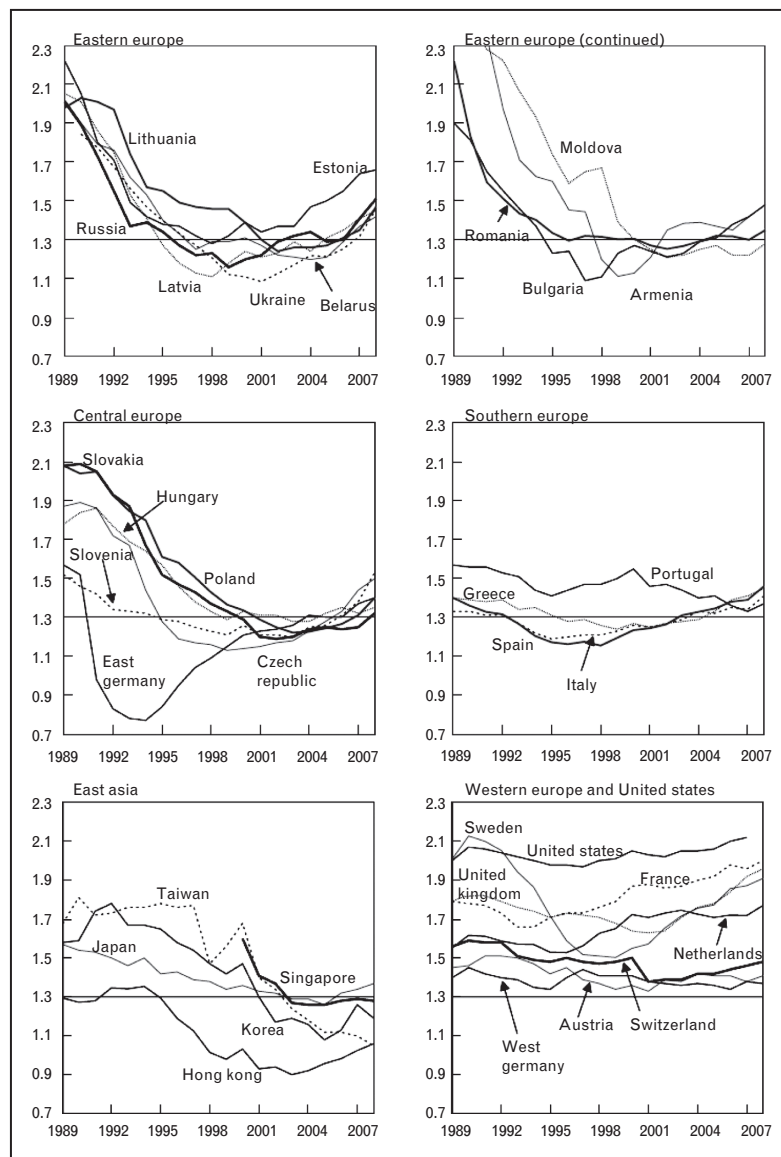


FIGURE 1. Total fertility rates in countries that have experienced lowest-low fertility and in selected other developed countries, 1989–2008 (reproduced with permission [41]).

The British study [34] had contradicting findings to expectations: fertility had increased rather than decreased during the period 1961–1993. Couples had taken less time to conceive in the later period than earlier on, especially after about 1980. Similar results were obtained from the groups of female and male participants. A study done in Denmark covering the period 1948–1997 also found no evidence for a decline in fertility [38]. From the reports of the female participants, fertility appeared to have increased slightly and in the male group, severe infertility (defined as not having any children despite having tried to conceive) appeared to have decreased over time.

A study from the USA found a 30% decline in subfertility defined as TTP greater than 12 months during the period 1982–2002 [39]. This study was based on a nationally representative sample and included couples who remained unable to conceive despite unprotected intercourse. The design was superior to pregnancy-based samples [37]. A study in Sweden examined trends in subfertility, defined as TTP greater than 12 months [40]. A decline was observed from 1983 to 2002, which was more apparent when analysed as a birth cohort effect than as a period effect: a decrease of about 35% from year of birth 1945–1975.

It appears that the widespread decline of TFRs to very low levels that began in many parts of Europe and East Asia in the early 1990s is nearly over, at least in Europe (Fig. 1) [41]. In East Asia, Hong Kong, Korea and Taiwan, fertility rates were below 1.2 in 2008, but Japan's TFR has risen above the 1.3 threshold. Many provinces of China, most of them well above the population size of an average

European country, probably experience sustained lowest-low fertility, and in lowest-low fertility there may be the sequel of strict government policies promoting one-child families. The average TFR in formerly lowest-low-fertility countries is now slightly above 1.4. This is still a very low level, however, and it does not imply an end of subreplacement fertility across most of the developed world. As many of the higher fertility developed countries have had increases in TFR since the late 1990s, the cross-country differences have broadened. This is a new and rather unexpected situation. A few industrialized countries, including the United States, have achieved TFR levels around the replacement threshold, levels not previously recorded since the 1970s. Myrskylä *et al.* [42] proposed that in these countries further economic development and prosperity may stimulate a modest increase in fertility rates. For most of the formerly lowest-low-fertility countries, the period of TFRs below 1.3 has passed because the postponement transition has begun to run its course. Therefore, the fear of an accelerated downward spiral of fertility is not confirmed. Fertility postponement continues in most developed countries but at a decelerating pace.

The importance of the tempo effect for explaining lowest-low fertility has three implications. First, although lowest-low-fertility countries have many characteristics contributing to their low fertility, none of them would have experienced extended periods of lowest-low fertility without a downward pressure exerted by tempo effects. Second, lowest-low-fertility countries still have room for the TFR to increase as postponement continues to slow and eventually to stop. Completed cohort fertility rates

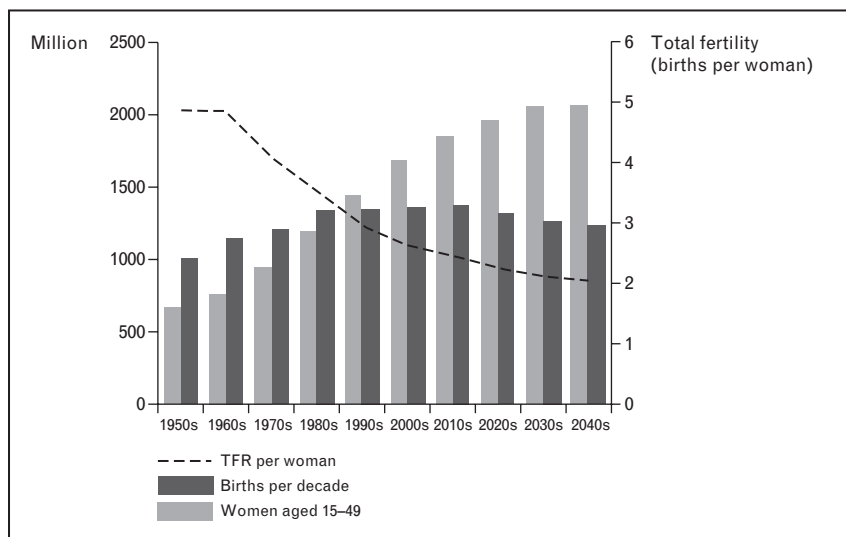


FIGURE 2. Estimates and projections for the world of total fertility, the number of women of reproductive age, and the number of births, 1950–2050 (reproduced with permission [43]).

of younger women in lowest-low-fertility countries will not be known for some time, but the fertility of cohorts born around 1970 tends to exceed 1.5 in nearly every case. Nearly all lowest-low-fertility countries are expected to have completed cohort fertility rates in the range of 1.5–1.8. Third, an extended re-emergence of lowest-low fertility is likely to require a new acceleration, not just a continuation, of postponement [41[■]].

The period of lowest-low fertility in Europe typically lasted less than a dozen years. The rather short-lived nature of lowest-low fertility is consistent with what is expected from a postponement transition from early to late childbearing and the accompanying depression in TFRs attributable to tempo effects. Moreover, the postponement transition appears to consist of an acceleration and

deceleration of postponement over its course. Although postponement can last for three or four decades, the period of rapid postponement, usually concentrated halfway through this course, is much shorter. Because the end of lowest-low fertility corresponds not to an end in postponement but rather to a reduction in its pace, almost all of the formerly lowest-low-fertility countries continue to have tempo-adjusted TFRs that are higher than observed TFRs. Unless these are due to artefacts in the measurement of tempo-adjusted TFRs, considerable room remains for TFRs to rise in most of these countries even after they exceed the level of 1.3 [41[■]].

Figure 2 shows the United Nations estimates and projections for the world of total fertility [41[■]]. The TFR falls in the projection to 2.0 births per woman

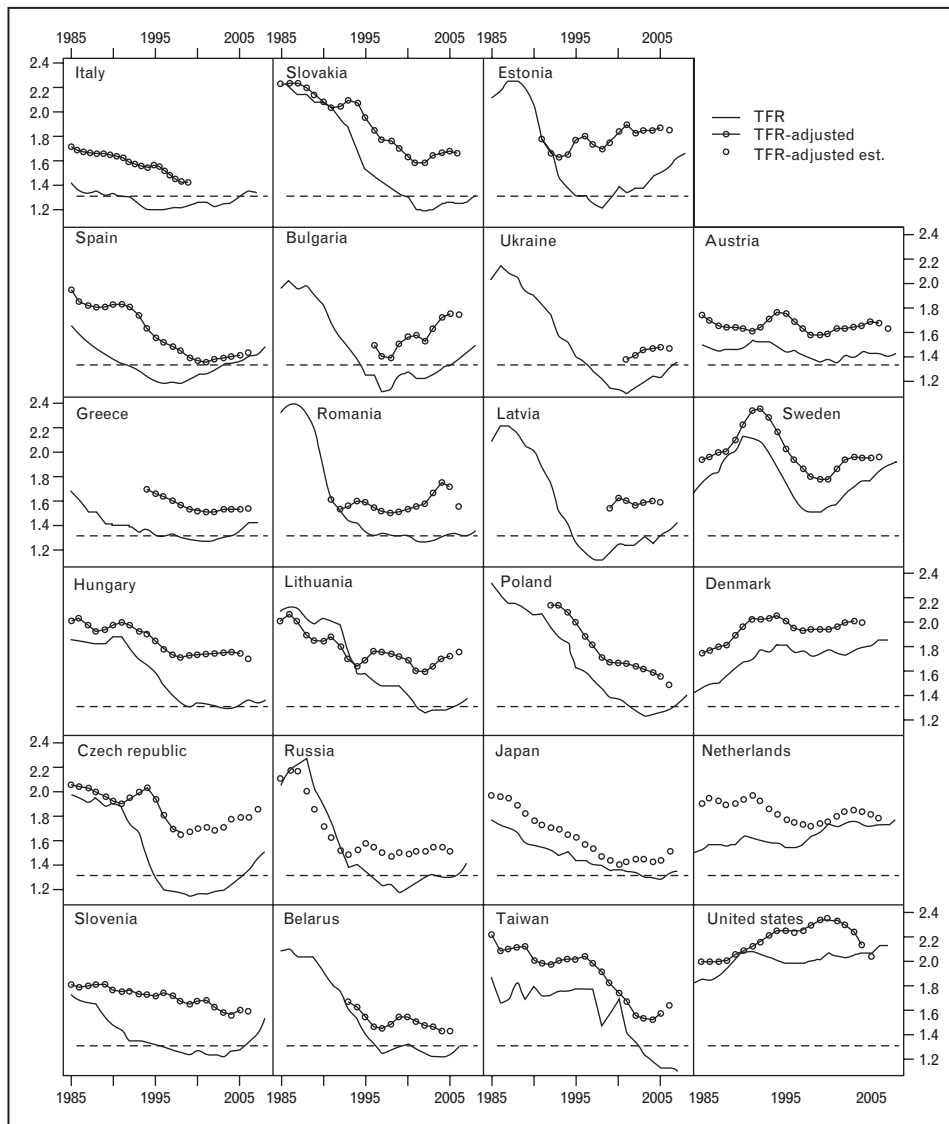


FIGURE 3. Total fertility rate and adjusted total fertility rate in lowest-low-fertility countries and selected other developed countries, 1985–2008 (reproduced with permission [41[■]]).

by 2050. But the number of women in the reproductive ages (i.e. those aged 15–49 years) increases throughout the period to 2050. This increase is essentially inevitable, because it arises largely from the world's current – still fairly young – age structure (i.e. that holding around 2010). As a result of these offsetting influences, the number of births occurring in the projection falls only slowly from decade to decade. In short, the rising number of women of childbearing age will act to slow the rate at which the world's birth rate falls [43^{***}].

FERTILITY DECLINE IN EUROPE

In 2005, the European TFR was only 1.31–1.50 in 15 countries and less than 1.30 in 10 countries [32]. Afterwards, the TFRs have slightly increased in some of these countries. There is a distinct contrast between the highest rates (over 2.0) in Denmark, France, Iceland, Ireland, Norway and Turkey, which are mainly in western and northern Europe, and the lowest rates less than 1.54 mainly in southern and eastern Europe (Belarus, Greece, Italy, Russia, Spain and the Ukraine, Fig. 3). Trends show a small increase from 1998 to 2008. Eurostat data on TFRs in 32 countries show that there has been an overall increase in the TFR during that period of time (http://epp.eurostat.ec.europa.eu/portal/page/portal/population/data/main_tables). Weighted by 2005 population, the average TFR in these 32 countries was 1.46 in 1998 and 1.59 in 2008. Only nine countries had lower TFRs in 2008 than 1998 of which the largest were Germany, Poland, Portugal and Slovakia. Countries showing the largest increases in TFR were those that began with TFRs below 1.3. These countries were Bulgaria (1.11–1.48), Czech Republic (1.16–1.50), Estonia (1.28–1.65), Slovenia (1.25–1.53) and Spain (1.16–1.46). One exception was Sweden, where the TFRs were 1.50 and 1.91 in 1998 and 2008, respectively (Fig. 3).

The rising TFRs may reflect different influences which are difficult to interpret. Previously postponed births, improved family living conditions in former eastern bloc countries and, in Sweden, possibly directed social policies could have been the causes [41^{***}].

CONCLUSION

The decrease in TFRs is the consequence of individual decisions arising from the instability of modern partnerships and the higher cost of maintaining a family together, given the widespread use of contraception and abortion to reduce the incidence of unplanned pregnancy. Whether the governments transfer cash to families for pregnancy

and child support or provide payments for assisted human reproduction has small effects on fertility rates. On the contrary, support of education and compatibility of work and family life are the most likely strategies in the long term to improve prosperity and allow couples to have the family size they prefer.

Acknowledgements

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Conflicts of interest

There are no conflicts of interest.

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- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 194–195).

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