

Low, but not too low, fertility can represent a positive development

Vegard Skirbekk^{1,2,3,4,*} 

Abstract

The public discourse about the ongoing fertility decline and the spread of low fertility, and the consequences thereof, is often unscientific and emotionally charged. As I argue in my book, *Decline and Prosper!* (Skirbekk, 2022), low fertility *per se* does not pose a major societal threat – and it is also accompanied by a number of benefits. In this article, I summarize my main points: namely, that i) the negative consequences of low fertility are often exaggerated and based on false assumptions; ii) low fertility is driven by many different, interacting factors, and is the byproduct or the cause of many positive societal developments; iii) low fertility is here to stay; and iv) societies urgently need to adapt to a world with fewer children. Fertility decline is self-perpetuating: once low fertility has become the norm in one generation, the fertility level is much less likely to increase in subsequent generations. At the same time, no plausible level of migration would be enough to meaningfully alter population aging in the long term. If, however, societies make the right choices, low fertility can enable humans to live more sustainably well into the future, and can stimulate further positive developments in the human condition.

Keywords: global demographic change; low fertility; ageing; population concern

1 Introduction

More and more countries around the world already have or are steadily approaching having fertility rates below the replacement level (which is currently slightly over two

¹Centre for Fertility and Health, Norwegian Institute of Public Health, Oslo, Norway

²Norwegian National Centre for Ageing and Health, Tønsberg, Norway

³PROMENTA Research Center, Department of Psychology, University of Oslo, Oslo, Norway

⁴Columbia University, USA

*Correspondence to: Vegard Skirbekk, Veski@fhi.no

children per woman, and is falling over time due to reductions in mortality). As of 2020, around 100 countries had a total fertility rate lower than the replacement level (United Nations, 2022). There is little evidence that this downward trend in fertility is coming to an end or will be reversed in the foreseeable future (Skirbekk, 2022; United Nations, 2022; Vollset et al., 2020). In middle- and high-income countries – including in much of East Asia, Europe, North America, the Caribbean, parts of Latin America and, more recently, China and India – low fertility rates have sparked concerns about population aging and decline. Some observers have warned that fewer births will lead to economic stagnation, ballooning social security costs and imploding welfare systems due to shrinking workforces and high shares of older persons (aged 65+ years) in the population. Indeed, some have predicted that whole societies or even mankind in its entirety will be driven to extinction, or be “over run” by (sub)populations with higher fertility. In other world regions, including in parts of West Asia and Sub-Saharan Africa, low fertility is sometimes perceived as an invasive Western, secular phenomenon that threatens to erode traditional culture (Goldman, 2011). Nonetheless, fertility is gradually declining in these regions as well.

The public discourse about low fertility and its consequences is often unscientific and emotionally charged. As I argue in my book, *Decline and Prosper!* (Skirbekk, 2022), low fertility *per se* does not pose a major societal threat – and it also provides a number of benefits. In this article, I summarize my main points: namely, that i) the negative consequences of low fertility are often exaggerated and based on false assumptions; ii) low fertility is driven by many different, interacting factors, and is the byproduct or the cause of many positive societal developments; iii) low fertility is here to stay; and iv) societies urgently need to adapt to a world with fewer children.

2 Low fertility is not a harbinger of doom

Many common assumptions about the negative consequences of low fertility – and of population aging in particular – are not or are only partially supported by evidence. The countries with the lowest fertility and the chronologically oldest populations tend to be economically better off (Götmark and Andersson, 2020; Lee et al., 2014; Vandenbroucke, 2016) and to have better age-specific health than countries with higher fertility and younger populations (Chang et al., 2019; Skirbekk et al., 2022). Notably, all of the world’s 10 largest economies in terms of absolute gross domestic product – including India and China – now have below-replacement fertility (Skirbekk, 2022). Some of these countries, such as Germany and Italy, have had low fertility for several decades. Thus, there is little reason to conclude that low fertility is at odds with economic strength. Moreover, cataclysmic prophesies about the impact of population aging on society tend to be guided by an inaccurate understanding of the malleability of the aging process and/or the needs and abilities of the older population. More recent cohorts of people aged 65+ have higher education, improved cognitive function and better health; and they also hear better than previous

generations (Engdahl et al., 2021; GBD 2019 Ageing Collaborators, 2022; Skirbekk et al., 2013; Strand et al., 2019). The vast majority of people aged 65+ in the 27 European Union member countries – one of the oldest world regions – are able to perform all instrumental (e.g., shopping) and basic (e.g., preparing food) activities of daily living without any major difficulty (75% and 91%, respectively) (Gaertner et al., 2019). In fact, the ratio of people in good health to people in poor health is actually about the same in the chronologically younger South Asian and African populations as in the chronologically older Western European and East Asian populations (Skirbekk et al., 2022). While there is no denying that health and functional impairments and the need for care tend to increase as people get older, the relationship between chronological age and functioning is weaker than is often presumed, and depends to a great extent on people's health, which is, in turn, influenced by the health care, education, lifestyles and living conditions they experienced throughout their lives.

Negative prophecies about the consequences of low fertility also need to be counterbalanced by adequate recognition of its benefits. While low fertility brings with it new challenges, such as the increasing prevalence of unwanted childlessness and a need to restructure social security systems; it can also contribute to better maternal and child health, as mothers have more time and resources to care for themselves and their families. Having fewer children also means that young and middle-aged adults – and women in particular – can invest more time and energy in continuing education, enabling them to fulfil their potential on the labour market and contribute to the community outside of their immediate families. Moreover, having fewer children may help humanity to reduce its ecological footprint, and could ease crowding and congestion in places where population density is already high (Sherbinin et al., 2007). Slowing population growth and low fertility can reduce pressure on infrastructure, and may improve access to quality educational and work opportunities if there is less competition among young people. By contrast, fast population growth could reduce opportunities to invest in youth (Asheim et al., 2023; Bashir et al., 2018; Packer, 2008). Finally, population aging might contribute to decreases in crime, physical and sexual interpersonal violence and war (Farrington, 1986; Haas, 2017; Kanazawa, 2003).

It is also often overlooked that today's low fertility actually represents a return to historically normal levels of net fertility (i.e., the number of surviving offspring per person) (see Skirbekk, 2022, pp. 39–65). For most of human history, women have had an average of two or slightly more children who lived long enough to reproduce themselves. From the early 19th to the early 21st century, infant and child mortality declined dramatically. More children survived to reproductive age, while the total number of babies born declined only slowly. From a historical perspective, it was this period of high net fertility and enormous population growth that was the anomaly. The world's current net reproduction rate of just over one surviving daughter per woman (Keilman et al., 2014) is probably about the same as it had been for most of the pre-demographic transition era, during which the global population grew only slowly (Johansen, 2002; Maddison, 2010; UN, 1973). Current net fertility

in Europe and North America is around a quarter below the net replacement level, and is slightly increasing in several countries (Eurostat, 2022) – which is a far less dramatic trend than claims about the impending collapse of the human population or the erosion of the “traditional family” due to low fertility would imply. The primary difference between nuclear families of the present and those of the more distant past is that fewer of their children are dying – which most observers would consider a good thing. One might argue that human fertility behavior has finally “caught up” to the condition of low mortality.

3 Why are people having fewer children?

In addition to lower infant and child mortality, today’s low fertility has been deeply intertwined with many other positive developments in the human condition (Santelli et al., 2017): e.g., the proliferation of education; the spread of safe and effective contraception; improvements in women’s rights and opportunities; decreases in child and adolescent marriages; economic progress; and more freedom to live as one desires. It is important to consider how attempts to reverse fertility decline may infringe upon societal advancements in these important spheres of life. Other drivers of today’s low fertility include a reduced need to have children in order to secure one’s own welfare; new conceptions of young adulthood as a time of exploration; secularization; the high financial costs of having children; (lack of) job opportunities for young adults; increases in the cognitive demands of work; changes in partnership dynamics; and biological constraints (e.g., semen quality, age at menarche and menopause). Geopolitical and economic instability, economic downturns and environmental disasters or climate change may further depress the desire for (more) offspring (Sobotka et al., 2011; Tong et al., 2011), see also Skirbekk (2022, pp. 265–284). All of these factors continuously interact with each other and evolve over time.

In the world’s richer countries, most people still want to marry and have children – but later, and not at any cost (see Skirbekk, 2022, pp. 159–176). People now see their twenties as a time for studying, travelling, establishing a career, forming an identity and searching for a suitable partner. Childbearing and childrearing remain closely linked to partnerships (Bergsvik et al., 2019), see also Skirbekk (2022, pp. 217–245). Today, people spend a much lower proportion of their reproductive life in a partnership than was previously the case. New processes of dating and partnership formation allow people to “test” potential partners for extended periods of time before having children. Unrealistic expectations about finding the “perfect partner” may contribute to later family formation. As women’s educational and labour market outcomes improve, continuing preferences for a “male breadwinner” and the expectation that mothers should perform the majority of household labour might likewise prevent many people from finding or keeping a partnership. Thus, large shares of people remain single, and those who marry often do so later in life. Moreover, many marriages dissolve, which contributes to lower fertility.

Fertility delay is a major driver of fertility decline. In higher-income countries, many people do not have their first child until their mid-thirties, and may end up – voluntarily or not – having just one child. In addition, many women and men forego having children altogether. Approximately one in five women in their late forties are childless in the UK, Germany, the Netherlands and the United States; and one in four women in their late forties are childless in Italy, Switzerland and Singapore (Sobotka and Beaujouan, 2018). The proportion of people who do not have children is increasing. In several industrialized countries, childlessness is now more common among men than it is among women (Kneale and Joshi, 2008). Childlessness is particularly high among men with low education and/or low financial resources.

4 Low fertility is here to stay

Fertility decline is self-perpetuating: once low fertility has become the norm in one generation, the fertility level is much less likely to increase in subsequent generations. This can be described as a “low fertility trap” (Lutz and Skirbekk, 2005; Lutz et al., 2006; Skirbekk and KC, 2012). Fewer births in one generation mean fewer potential parents in the next. Moreover, people who have internalized the idea that smaller families are “normal” tend to have smaller families themselves. Finally, aspirations tend to increase across generations, even as it becomes more difficult for people to attain what many see as the pre-conditions for having children: e.g., a stable job; a committed partner; adequate housing; and a sense of having sufficiently explored the opportunities of a child-free life. All of these mechanisms make it unlikely that fertility will rebound once it drops below 1.5 children per woman.

Globally, more and more governments are implementing policies designed to encourage higher fertility (e.g., one-time baby bonus, expansion of day care), see Skirbekk (2022, pp. 357–386) as well as United Nations (2021). From a human rights perspective, it is an admirable policy aim to help people to have the number of children they ideally want to have. From an economic perspective, it is also advantageous to prevent generations from shrinking too quickly, so that individuals and cultural systems have more time to adapt. While the policies implemented so far may have improved family life somewhat, they have, at best, had only temporary and modest effects on birth rates. This is because most policies only superficially reduce the burden of childbearing. Many of the barriers to having as many children as one would like to have would be difficult to address via policy measures (e.g., difficulties establishing and maintaining a partnership; preferences for a lifestyle at odds with childbearing), and some interventions would be controversial in some countries (e.g., expanding access to assisted reproductive technologies). In sum, policies are unlikely to reverse fertility decline.

Migration has sometimes been proposed as a way to counteract negative population growth and/or population ageing. However, no plausible level of migration would be enough to meaningfully alter population ageing in the long term. Between 1990 and 2020 Africa’s population rose from 638 to 1,361 million – and the share who

emigrated out of this world region was around 1.1% to 1.2% (Africa Centre for Strategic Studies, 2023). If the share of emigrants remains stable, emigration would increase to 20–30 million persons as Africa’s population grows toward 2.5 billion by mid-century. This would not be enough to alter age structures in major receiving world regions. Moreover, education tends to be low across much of South America, Africa, the Middle East and South Asia – and thus in all regions of the world with relatively young populations (Barro and Lee, 2013; Gust et al., 2022). About nine out of 10 adolescents in South Asia and Sub-Saharan Africa and seven out of 10 adolescents in Latin America and the Middle East and North Africa (MENA) region lack basic skills: i.e., they are not able to perform at the PISA level 1 (the most basic level, which entails being able to answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined) (Gust, Hanushek et al. 2022). These conditions limit the relevance of migration for alleviating labor shortages. Migrants can also generate substantial fiscal and social costs (Brochmann and Grødem, 2013; National Research Council, 1997, ch. 7; Wadensjö, 2000), especially if working-age migrants have problems establishing themselves on the labour market.

5 Adapting to a world with fewer children

Given that neither low fertility nor population aging will be reversed in the long term, the most relevant question is how societies can best prepare for and adapt to a world with fewer children and more older people. There are clear challenges that need to be addressed. Some physical and cognitive abilities decline with age, and some work skills may become redundant over time. While population aging will likely put a strain on welfare and pension systems, there is enormous room to optimize how people’s health and abilities change with age. Greater investments in education, preventive care, health service provision (physical and mental) and the promotion of healthy lifestyles across the entire life course are key to enabling longer working lives and reducing the strain on health care and welfare systems as populations get older. It is also necessary to address inaccurate beliefs about the aging process and old age, as well as outdated ideas about what constitutes age-appropriate behavior, which can influence how people behave and function across the life course (Bowen, 2011). Due to demographic changes, increasing numbers of people may lack familial support in old age, making universal social security systems important sources of assistance. It is, however, crucial to ensure that these systems are sustainable over time by balancing the generosity of benefits and the age of eligibility. Doing so would reduce the risk of insolvency and prevent some generations from supporting a system that may not provide them with adequate benefits.

To maintain economic stability, people will need to spend a greater number of years of their life as “contributors” (performing paid and unpaid work), rather than as “dependents” (recipients of financial support and/or care). This might entail

delaying retirement, as well as encouraging earlier labour market entry (Loichinger and Skirbekk, 2016) and the participation of women in the labour market.¹ However, extending the “contributing” period of life will also require much deeper adjustments to how individuals and societies approach working life. The focus should be on designing working contexts that make working more attractive, and on making sure that people have the tools to perform the jobs they like doing. Investments in employees’ health, skills and motivation across the entire life span will be necessary to ensure that people work sustainably. Improving options for (re)training and education; providing support for people changing jobs and careers, including later in life; creating more opportunities for quality part-time work and intermittent sabbaticals; improving rehabilitation and (re-)integration programs; and addressing the perception of retirement as a reward are just some of the measures that could encourage people to remain in the workforce longer.

Alongside investments in human capital and working conditions, investments in labor-saving technologies would help to replace human labour where it is scarce, and to free up human labour in sectors where it is unnecessary. Automation has already contributed to the displacement of the vast majority of European primary industry workers, and has lowered the number of workers in secondary industries. Some studies have suggested that automation is actually driven by low fertility and population aging (Abeliansky and Prettnner, 2023; Acemoglu and Restrepo, 2022; Stähler, 2021). It has been estimated that if currently available technologies were implemented everywhere, just 2% of the world’s current agricultural workforce (and around 0.5% of the world’s total workforce) would be needed to produce all the food consumed in the world today (Vittis et al., 2022). By making more efficient – as well as more sustainable – use of human labour, societies will be able to sustain economic development, while also improving working conditions. It will, of course, be necessary to support people who are displaced by technology by helping them to integrate into other sectors.

Another, less discussed challenge of low fertility is the increase in childlessness, particularly among men with low education and low economic resources. Increasing proportions of men in many countries will not only lack financial and educational resources, but will also have less family support as they grow older. Societies need to pay attention to this growing risk group. Evidence suggests that much of the increase in childlessness is “coincidental;” that is, more people are ending up childless without explicitly wanting to do so (see Skirbekk, 2022, pp. 105–140). Many people who postpone having children until they are older overestimate their ability to conceive later in life, naturally or with the support of assisted reproductive technologies. To

¹ Notably, policies that improve young people’s employment opportunities and help more women combine work and family life are apt to be met with more enthusiasm than policies that delay retirement. Furthermore, retirement policies that allow for more flexible work schedules at higher ages and provide older people with work opportunities more suited to their interests and skills could prove popular.

help prevent unwanted childlessness in future generations, young men and women need to be better informed about their biological chances of reproducing in later life, and more cognizant of how their life choices may impact their chances of having children. Policies that address younger peoples' housing and the labor market opportunities may also be effective.

If societies fail to seize the benefits of the demographic dividend, or “get old before getting rich,” they will face greater challenges related to population aging. These challenges can be exacerbated if countries do not accumulate sufficient capital or invest in crucial areas, like preventive health care, education, infrastructure and technology. As social mobility tends to be lower at older ages, countries should seek to increase social equity at younger ages by implementing policy measures aimed at reducing economic inequality earlier in the life course.


6 Breathe in, breathe out – low fertility can enable humans to live more sustainably

Low fertility, together with population ageing and, eventually, a declining population, represent the demographic hallmarks of the 21st century for countries all over the world. More balanced, evidence-based discussions of the causes and consequences of low fertility are urgently needed. Societies, communities and individuals will have to adapt: i.e., individuals will need to spend more years contributing to society, and societies will need to invest much more in the education and health of all their members. Some of these changes will be painful, but the dividends from these investments will likely far outweigh their costs. If societies make the right choices, low fertility can enable humans to live more sustainably well into the future, and can stimulate further positive developments in the human condition.

Acknowledgements

I am grateful for editing assistance from Dr. Catherine Bowen, as well as from the editors of the Vienna Yearbook of Population Research. I appreciate the financial support I received from the National Institutes of Health (NIH), R01 grant no. R01AG069109-01. DIMJOB NRC number 296297. PROMENTA 288083.

ORCID iD

Vegard Skirbekk  <https://orcid.org/0000-0002-1647-3246>

References

- Abeliansky, A. L., and Prettnner, K. (2023). Automation and population growth: Theory and cross-country evidence. *Journal of Economic Behavior & Organization*, 208, 345–358. <https://doi.org/10.1016/j.jebo.2023.02.006>
- Acemoglu, D., and Restrepo, P. (2022). Demographics and automation. *The Review of Economic Studies*, 89(1), 1–44. <https://doi.org/10.1093/restud/rdab031>
- Africa Centre for Strategic Studies. (2023). *African migration trends to watch in 2023*, 9 January 2023. <https://africacenter.org/spotlight/african-migration-trends-to-watch-in-2023/>
- Asheim, G. B., Hartwick, J. M., and Yamaguchi, R. (2023). Sustainable per capita consumption under population growth. *Resource and Energy Economics*, 73, 101363. <https://doi.org/10.1016/j.reseneeco.2023.101363>
- Barro, R. and Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, 104, 184–198.
- Bashir, S., Lockheed, M., Ninan, E., and Tan, J.-P. (2018). *Facing forward: Schooling for learning in Africa*. World Bank Publications. <https://doi.org/10.1596/978-1-4648-1260-6>
- Bergsvik, J., Kitterød, R. H., and Wiik, K. A. (2019). Parenthood and couples' relative earnings in Norway. *European Sociological Review*. <https://doi.org/10.1093/esr/jcz062>
- Bowen, C. E. (2011). *Images of aging are related to the plasticity of adult development*. Ph.D. thesis, Jacobs University Bremen. <http://nbn-resolving.org/urn:nbn:de:101:1-201305157781>
- Brochmann, G., and Grødem, A. S. (2013). Migration and welfare sustainability: The case of Norway. *Europe's immigration challenge: Reconciling work, welfare and mobility*, 59–76. <https://doi.org/10.5040/9780755619931.ch-003>
- Chang, A. Y., Skirbekk, V. F., Tyrovolas, S., Kassebaum, N. J., and Dieleman, J. L. (2019). Measuring population ageing: An analysis of the Global Burden of Disease Study 2017. *The Lancet Public Health*, 4(3), e159–e167. [https://doi.org/10.1016/S2468-2667\(19\)30019-2](https://doi.org/10.1016/S2468-2667(19)30019-2)
- Engdahl, B., Strand, B. H., and Aarhus, L. (2021). Better hearing in Norway: A comparison of two HUNT cohorts 20 years apart. *Ear and Hearing*, 42(1), 42. <https://doi.org/10.1097/AUD.0000000000000898>
- Eurostat. (2022). Fertility statistics. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Fertility_statistics
- Farrington, D. P. (1986). Age and crime. *Crime and justice*, 7, 189–250. <https://doi.org/10.1086/449114>
- Gaertner, B., Busch, M. A., Scheidt-Nave, C., and Fuchs, J. (2019). Limitations in activities of daily living in old age in Germany and the EU—Results from the European Health Interview Survey (EHIS) 2. *Journal of Health Monitoring*, 4(4), 48. <https://doi.org/10.25646/6226.2>
- GBD 2019 Ageing Collaborators. (2022). Global, regional, and national burden of diseases and injuries for adults 70 years and older: Systematic analysis for the Global Burden of Disease 2019 Study. *BMJ*, 376, e068208. <https://doi.org/10.1136/bmj-2021-068208>
- Goldman, D. (2011). *How civilizations die: (And why Islam is dying too)*. Regnery Publishing.

- Götmark, F., and Andersson, M. (2020). Human fertility in relation to education, economy, religion, contraception, and family planning programs. *BMC Public Health*, 20(1), 1–17. <https://doi.org/10.1186/s12889-020-8331-7>
- Gust, S., Hanushek, E. A., and Woessmann, L. (2022). *Global universal basic skills: Current deficits and implications for world development* (NBER Working Paper 30566). National Bureau of Economic Research. <http://www.nber.org/papers/w30566>
- Haas, M. L. (2017). Population aging and international conflict. In *Oxford Research Encyclopedia of Politics*. <https://doi.org/10.1093/acrefore/9780190228637.013.589>
- Johansen, H. C. (2002). *Danish population history: 1600–1939*. University Press of Southern Denmark.
- Kanazawa, S. (2003). Why productivity fades with age: The crime–genius connection. *Journal of Research in Personality*, 37(4), 257–272. [https://doi.org/10.1016/S0092-6566\(02\)00538-X](https://doi.org/10.1016/S0092-6566(02)00538-X)
- Keilman, N., Tymicki, K., and Skirbekk, V. (2014). Measures for human reproduction should be linked to both Men and Women. *International Journal of Population Research*, 2014. <https://doi.org/10.1155/2014/908385>
- Kneale, D., and Joshi, H. (2008). Postponement and childlessness: Evidence from two British cohorts. *Demographic Research*, 19, 1935–1968. <https://doi.org/10.4054/DemRes.2008.19.58>
- Lee, R., Mason, A., Amporf, E., An, C.-B., Bixby, L. R., Bravo, J., Bucheli, M., Chen, Q., Comelatto, P., and Coy, D. (2014). Is low fertility really a problem? Population aging, dependency, and consumption. *Science*, 346(6206), 229–234. <https://doi.org/10.1126/science.1250542>
- National Research Council. (1997). *The new Americans: Economic, demographic, and fiscal effects of immigration*. The National Academies Press. <https://doi.org/10.17226/5779>
- Loichinger, E., and Skirbekk, V. (2016). International variation in ageing and economic dependency: A cohort perspective. *Comparative Population Studies*, 40(5). <https://doi.org/10.12765/CPoS-2016-04>
- Lutz, W., and Skirbekk, V. (2005). Policies addressing the tempo effect in low-fertility countries. *Population and Development Review*, 31(4), 699–720. <https://doi.org/10.1111/j.1728-4457.2005.00094.x>
- Lutz, W., Skirbekk, V., and Testa, M. R. (2006). The low-fertility trap hypothesis: Forces that may lead to further postponement and fewer births in Europe. *Vienna Yearbook of Population Research* 2006, 167–192. <https://doi.org/10.1553/populationyearbook2006s167>
- Maddison, A. (2010). *Statistics on world population: GDP and per capita GDP, 1–2008 AD*. Groningen Growth and Development Centre, University of Groningen.
- Packer, S. (2008). The education for all global monitoring report: A mid-term assessment. *Prospects*, 38(3), 287–293. <https://doi.org/10.1007/s11125-009-9084-3>
- Santelli, J. S., Song, X., Garbers, S., Sharma, V., and Viner, R. M. (2017). Global trends in adolescent fertility, 1990–2012, in relation to national wealth, income inequalities, and educational expenditures. *Journal of Adolescent Health*, 60(2), 161–168. <https://doi.org/10.1016/j.jadohealth.2016.08.026>

- Sherbinin, A. d., Carr, D., Cassels, S., and Jiang, L. (2007). Population and environment. *Annual Review of Environment Resources*, 32, 345–373. <https://doi.org/10.1146/annurev.energy.32.041306.100243>
- Skirbekk, V. (2022). *Decline and prosper. Changing global birth rates and the advantages of fewer children*. Palgrave Macmillan. <https://doi.org/10.1007/978-3-030-91611-4>
- Skirbekk, V., Dieleman, J. L., Stonawski, M., Fejkiel, K., Tyrovolas, S., and Chang, A. Y. (2022). The health-adjusted dependency ratio as a new global measure of the burden of ageing: A population-based study. *The Lancet Healthy Longevity*, 3(5), e332–e338. [https://doi.org/10.1016/S2666-7568\(22\)00075-7](https://doi.org/10.1016/S2666-7568(22)00075-7)
- Skirbekk, V., and KC, S. (2012). Fertility-reducing dynamics of women’s social status and educational attainment. *Asian Population Studies*, 8(3), 251–264. <https://doi.org/10.1080/17441730.2012.714667>
- Skirbekk, V., Stonawski, M., Bonsang, E., and Staudinger, U. M. (2013). The Flynn effect and population aging. *Intelligence*, 41(3), 169–177. <https://doi.org/10.1016/j.intell.2013.02.001>
- Sobotka, T., and Beaujouan, É. (2018). Late motherhood in low-fertility countries: Reproductive intentions, trends and consequences. In D. Stoop (Ed.), *Preventing age related fertility loss* (pp. 11–29). Springer. https://doi.org/10.1007/978-3-319-14857-1_2
- Sobotka, T., Skirbekk, V., and Philipov, D. (2011). Economic recession and fertility in the developed world. *Population and Development Review*, 37(2), 267–306. <https://doi.org/10.1111/j.1728-4457.2011.00411.x>
- Strand, B. H., Bergland, A., Jørgensen, L., Schirmer, H., Emaus, N., and Cooper, R. (2019). Do more recent born generations of older adults have stronger grip? A comparison of three cohorts of 66-to 84-year-olds in the Tromsø study. *The Journals of Gerontology: Series A*, 74(4), 528–533. <https://doi.org/10.1093/gerona/gly234>
- Stähler, N. (2021). The impact of aging and automation on the macroeconomy and inequality. *Journal of Macroeconomics*, 67, 103278. <https://doi.org/10.1016/j.jmacro.2020.103278>
- Tong, V. T., Zotti, M. E., and Hsia, J. (2011). Impact of the red river catastrophic flood on women giving birth in North Dakota, 1994–2000. *Maternal and Child Health Journal*, 15(3), 281–288. <https://doi.org/10.1007/s10995-010-0576-9>
- United Nations. (1973). *The determinants and consequences of population trends: New summary of findings on interaction of demographic, economic and social factors. Volume 1*. Department of Economic and Social Affairs, United Nations.
- United Nations (2021). *World population policies 2021: Policies related to fertility*. UN DESA/POP/2021/TR/NO. 1. Population Division, Department of Economic and Social Affairs, United Nations.
- United Nations (2022). *World Population Prospects 2022: Summary of Results*. UN DESA/POP/2022/TR/NO. 3. Population Division, Department of Economic and Social Affairs, United Nations.
- Vandenbroucke, G. (2016). The link between fertility and income. *On The Economy Blog*, 13 December 2016. <https://www.stlouisfed.org/on-the-economy/2016/december/link-fertility-income>
- Vittis, Y., Godfray, C., and Obersteiner, M. (2022). Agricultural mechanisation could reduce global labour requirements by hundreds of millions of agri-food workers. Research Square. <https://doi.org/10.21203/rs.3.rs-1344105/v1>

- Vollset, S. E., Goren, E., Yuan, C.-W., Cao, J., Smith, A. E., Hsiao, T., Bisignano, C., Azhar, G. S., Castro, E., Chalek, J., Dolgert, A. J., Frank, T., Fukutaki, K., Hay, S. I., Lozano, R., Mokdad, A. H., Nandakumar, V., Pierce, M., Pletcher, M., . . . and Murray, C. J. L. (2020). Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: A forecasting analysis for the Global Burden of Disease Study. *The Lancet*. [https://doi.org/10.1016/S0140-6736\(20\)30677-2](https://doi.org/10.1016/S0140-6736(20)30677-2)
- Wadensjo, E. (2000). Immigration, the labour market, and public finances in Denmark. *Swedish Economic Policy Review*, 7(2), 59–84.

Open Access This article is published under the terms of the Creative Commons Attribution 4.0 International License (<https://creativecommons.org/licenses/by/4.0/>) that allows the sharing, use and adaptation in any medium, provided that the user gives appropriate credit, provides a link to the license, and indicates if changes were made.